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Preface

This document was prepared by the EMC Management Development Group, overseen by the RISSB Train Control Systems Standing Committee.

Objective

The objective of this document is to define requirements for the management of electromagnetic emissions and susceptibility of devices used in the railway so that all systems used in the railway are electromagnetically compatible.

These requirements define the minimum effort required to manage the risk associated with EMC and to ensure compliance with legal and regulatory, safety and reliability requirement. Particular situations could require more detailed assessment.

Advisory information is also provided to support mandatory requirements.

Rail Transport Operators (RTOs) remain responsible for ensuring that any EMC risks introduced by new or altered systems and products are controlled so far as is reasonably practicable (SFAIRP).

Compliance

There are four types of provisions contained within Australian Standards developed by RISSB:

(a) Requirements.

(b) Recommendations.

(c) Permissions.

(d) Constraints.

Requirements – it is mandatory to follow all requirements to claim full compliance with the Standard. Requirements are identified within the text by the term ‘shall’.

Recommendations – do not mention or exclude other possibilities but do offer the one that is preferred. Recommendations are identified within the text by the term ‘should’.

Recommendations recognize that there could be limitations to the universal application of the control, i.e. the identified control is not able to be applied, or other controls are more appropriate or better.

Permissions – conveys consent by providing an allowable option. Permissions are identified within the text by the term ‘may’.

Constraints – provided by an external source such as legislation. Constraints are identified within the text by the term ‘must’.

For compliance purposes, where a recommended control is not applied as written in the standard it could be incumbent on the adopter of the standard to demonstrate their actual method of controlling the risk as part of their WHS or Rail Safety National Law obligations. Similarly, it could also be incumbent on an adopter of the standard to demonstrate their method of controlling the risk to contracting entities or interfacing organisations where the risk may be shared.

RISSB Standards address known hazards within the railway industry. Hazards, and clauses within this Standard that address those hazards, are listed in Appendix F.

Appendices in RISSB Standards may be designated either “normative” or “informative”. A "normative" appendix is an integral part of a Standard and compliance with it is a requirement, whereas an "informative" appendix is only for information and guidance.

Commentary

Commentary *C Preface*

This document includes a commentary on some of the clauses. The commentary directly follows the relevant clause, is designated by 'C' preceding the clause number and is printed in italics in a box. The commentary is for information and guidance and does not form part of the Standard.

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Figures

Section 1 Scope and general

1.1 Scope

The scope of this document covers requirements for the management of EMC as applicable to:

(a) planning EMC management;

(b) introduction of new rail assets (new products or integrated systems);

(c) alterations to existing rail assets (existing products or integrated systems);

(d) novel alterations to existing rail system configurations or layouts;

(e) maintenance of operational rail systems; and

(f) decommissioning of rail systems.

The scope of this document is limited to rail systems and assets under the scope and control of Australian railway networks. This scope includes potential EMC risks existing or introduced between the Australian railway network and any third parties, as a result of action by Australian railway network assets, for example as discussed in AS 2344.

This document will assist RTOs to apply harmonized management of EMC risks to meet their legal and regulatory obligations.

Heritage railways are excluded from this document, unless there is a physical and operational interface that could affect EMC.

1.2 Normative references

The following documents are referred to in the text in such a way that *some* or all of their content constitutes requirements of this document:

- AS 2067:2008, *Substations and High Voltage Installations Exceeding 1 kV AC*
- AS 2344, *Limits of electromagnetic interference from overhead a.c. powerlines and high voltage equipment installations in the frequency range 0.15 MHz to 3000 MHz*
- AS 7000, *Overhead line design*
- AS 7472, *Railway Operations – Management of Change*
- AS 7501:2019, *Rolling stock compliance certification*
- AS 7505, *Signalling detection interface*
- AS 7655, *Wayside electrical charging interfaces for battery electric rolling stock*
- AS 7663, *Railway signal cables*
- AS 7702, *Type approval*
- AS/CA S009, *Installation requirements for customer cabling (Wiring Rules)*
- HB 100-2000, *Coordination of Power and Telecommunications*
- AS/NZS 1768, *Lightning protection*
- AS/NZS 3000, *Electrical installations – Wiring Rules*
- AS/NZS 60255.26, *Measuring Relays and Protection Equipment. Part 26: EMC*
- AS/NZS 61000, *Electromagnetic compatibility – Parts 1 to 4*
- IEC 55103-1, *EMC – Product Family Standard for Audio, Video, AV and Entertainment Lighting Control Apparatus. Part 1 – Emissions*

- IEC 55103-2, *EMC – Product Family Standard for Audio, Video, AV and Entertainment Lighting Control Apparatus. Part 2 – Immunity*
- IEC 60050-161 Amend.3 Ed 1.0, *International Electrotechnical Vocabulary – Chapter 161: Electromagnetic Compatibility*
- IEC 60364-4-44, *Low-Voltage Electrical Installations - Protection for Safety - Protection Against Voltage Disturbances and Electromagnetic Disturbances*
- IEC 60364-5-53, *Electrical Installations of Buildings - Selection and Erection of Electrical Equipment - Isolation, Switching and Control*
- IEC 60571 Ed.3.0, *Railway Applications – Electronic Equipment Used on Rolling Stock*
- IEC 61000-6-7, *Electromagnetic Compatibility (EMC) - Generic Standards - Immunity Requirements for Equipment Intended to Perform Functions in a Safety-Related System (Functional Safety) in Industrial Locations*
- IEC 61133 Ed.2.0, *Railway Applications – Rolling Stock – Testing of Rolling Stock on Completion of Construction and Before Entry into Service*
- IEC 62040-2, *Uninterruptible Power Systems (UPS) – Part 2: EMC requirements*
- IEC 62236, *Railway Applications - Electromagnetic Compatibility - Parts 1 to 5*
- IEC 62271-1, *High-voltage switchgear and controlgear – Part 1: Common specifications for alternating current switchgear and controlgear*
- IEC 62305-4, *Protection Against Lightning - Electrical & Electronic Systems Within Structures*
- IEC/TR 61000-5-1, *Electromagnetic Compatibility (EMC) - Installation and Mitigation Guidelines*
- IEC/TS 61000-1-2, *Electromagnetic Compatibility (EMC) - General - Methodology for the Achievement of Functional Safety of Electrical and Electronic Systems Including Equipment with Regard to Electromagnetic Phenomena*
- EN 50121, *Railway Applications Electromagnetic Compatibility Parts 1 to 5*
- EN 50126, *Railway applications - The Specification and Demonstration of Reliability, Availability, Maintainability and Safety (RAMS) Generic RAMS Process*
- EN 50155:2021, *Railway applications – Rolling stock -Electronic equipment*
- EN 50343:2025, *Railway applications – Rolling stock – Rules for installation of cabling*
- EN 50500:2008/A1 Edition, - *Measurement procedures of magnetic field levels generated by electronic and electrical apparatus in the railway environment with respect to human exposure*
- EN 50152-1, *Railway applications. Fixed installations. Particular requirements for alternating current switchgear. Single-phase circuit-breakers with Un above 1 kV*
- *ACMA-mandated Electromagnetic Compatibility (EMC) standards, Parts 1 and 2*
- RPS3, *ARPANSA Radiation Protection Standard for Maximum Exposure Levels to Radio Frequency Fields – 3 kHz to 300 GHz (Radiation Protection Series 3)*
- HB 101-1997 (CJC5), *Coordination of Power and Telecommunications – Low frequency Induction – Code of Practice for the mitigation of hazardous voltages induced into telecommunication lines*
- HB 102-1997 (CJC6), *Coordination of Power and Telecommunications – Low frequency induction (LFI) – Application guide to the LFI code*

NOTE:

Documents for informative purposes are listed in a Bibliography at the back of the Document.

1.3 Defined terms and abbreviations

For the purposes of this document, the following terms and definitions apply:

1.3.1
ACMA
Australian Communications and Media Authority

1.3.2
ARPANSA
Australian Radiation Protection and Nuclear Safety Agency

1.3.3
assurance
positive declaration intended to give confidence

1.3.4
condemning limit
permissible EMI susceptibility limits at which point the degradation of the performance of equipment/system is deemed unacceptable

1.3.5
electromagnetic compatibility - EMC
ability of an equipment or system to function satisfactorily in its electromagnetic environment without introducing intolerable electromagnetic disturbances to anything in that environment [IEC 60050-161]

1.3.6
electromagnetic interference
degradation of the performance of an equipment, transmission channel or system caused by an electromagnetic disturbance [IEC 60050-161]

1.3.7
EMI
electromagnetic interference

1.3.8
EMI risk
when referring to the impact of electromagnetic interference from an EMI source

1.3.9
EMI victim
element within the system affected by electromagnetic interference, also known as receiver

1.3.10
FAT
factory acceptance testing

1.3.11
FTN
fixed telecommunications network

1.3.12
ICNIRP
International Commission on Non-Ionizing Radiation Protection

1.3.13
OEM
original equipment manufacturer

1.3.14
ONRSR

Office of the National Rail Safety Regulator

1.3.15
RTO
rail transport operator as defined in the RSNL

1.3.16
railway network
railway system within Australia owned or managed by a RTO

railway operation
as defined in the RSNL

1.3.17
RAMS
reliability, availability, maintainability and safety

1.3.18
RSNL
Rail Safety National Law

1.3.19
safety case
formal presentation of evidence, arguments and assumptions aimed at providing assurance that a system, product or other change to the railway has met its safety requirements and that the safety requirements are adequate

1.3.20
standards compliance register
list of compliance and controls against the requirements contained in the AS 7500 and AS 7600 series of Australian standards, and other standards and specifications forming the basis of the type of approval evaluation

1.3.21
type approval
approval of a specific item of railway equipment for a defined application

1.3.22
verification/verify
testing and evaluation of a product to assure compliance with its specification or other requirements.

General rail industry terms and definitions are maintained in the RISSB Glossary. Refer to: https://www.rissb.com.au/glossary/

Section 2 EMC management requirements

2.1 General

EMC management activities shall be planned at the beginning of the system life cycle for a new or altered system. The activities should be recorded in an EMC management plan or equivalent.

EMC management activities should be scaled and tailored to the level of novelty, complexity and risk associated with the system of interest and the associated EMI interfaces to be managed.

See Appendix C for EMC management plan contents.

2.2 Responsibilities and competence

EMC management activities shall be carried out by qualified and competent persons.

EMC specialists are responsible for the following:

(a) The identification of EMC risks and advise on mitigations in relation to human exposure to electromagnetic energy.

(b) Ensuring that EMC threats are identified and mitigated between interfacing equipment and systems, and third-party infrastructure.

(c) Advising on the safe design, installation and operational practices in relation to EMC.

The overall responsibility for EMC management shall be determined and assigned over the relevant life cycle stage of the system of interest, to comply with relevant legislation and standards.

2.3 Policy, procedures and plans

RTOs shall implement policies, procedures and plans for the safe management of EMC within their operating environment.

EMC management shall include planning, analysis, execution, assurance and reporting of all EMC management activities on the new or altered system-of-interest.

Engineering standards in force for design, construction, testing, operation and maintenance of rail systems and protection against EMI, whether as a threat or victim, shall be complied with.

The RTO should have specific implementation guidance for EMC to support this document.

See Appendix B for an EMC lifecycle flow chart.

Section 3 EMC compliance

3.1 Legislative requirements

Management of EMC is subject to legislated requirements within Australia. RTOs must comply with any legislative requirements applicable to their railway operations.

Commentary C2.2

In each state jurisdiction, Work Health and Safety legislation outlines general duties for employers, workers and others in managing risks related to human exposure to electromagnetic radiation in workplaces. Other authorities that regulate EMC requirements include state based Electrical Safety Regulators.

The *Radiocommunications Act 1992* governs the management, regulation, and licensing of radiocommunication services in Australia, ensuring efficient use of the radiofrequency spectrum,

minimizing interference, and promoting public and industry access to safe and reliable communication technologies.

Supported by the *Radiocommunications Act 1992*, the *Radiocommunications (Electromagnetic Radiation – Human Exposure) Standard 2014* is the Australian regulation established to ensure electromagnetic emissions from radiocommunications transmitters are managed to ensure safe limits of human exposure are not exceeded.

The *Australian Radiation Protection and Nuclear Safety Act 1998* (ARPANS Act) oversee the regulation and promotion of uniform radiation protection across Australia. This is supported by the ARPANSA Radiation Protection Series Standards that specifically deal with exposure to radiofrequency electromagnetic radiation.

This aligns with the International Commission on Non-Ionizing Radiation Protection (ICNIRP) to protect people and the environment from the potential health impacts of non-ionising radiation.

For informative guidance in interpreting this document, see Appendix E.

3.2 Standards compliance

3.2.1 General

Applicable specifications or standards associated with relevant systems shall be identified and selected as required by the work tasks. All specifications and Standards shall be confirmed for their currency and adequacy.

ACMA is the independent Commonwealth statutory authority that regulates communications and media services in Australia. EMC legislative requirements are primarily governed by the *Radiocommunications Act 1992* and managed by the ACMA. ACMA regulations mandate that electrical and electronic equipment shall comply with relevant EMC standards to minimize electromagnetic interference and ensure safe and reliable operation. ACMA publishes a list of mandated standards, covering various equipment categories and their associated EMC requirements.

Railway engineering activities and products that require management of EMC shall comply with the standards listed in this document, as applicable to the new or altered system of interest.

In the context of this document, engineering activities should include;

(a) specification and analysis;
(b) design and manufacturing;
(c) installation and integration;
(d) testing and commissioning;
(e) maintenance; and
(f) modification and disposal.

EMC interface management shall comply with the safety interface coordination requirements of the RSNL.

The *National Construction Code* (NCC) Classification of Buildings or Structures should be used to inform the selection of the appropriate immunity and emissions standard.

3.2.2 Immunity

Products compliant with EMC immunity standards shall be assessed to confirm that appropriate immunity from interference will be achieved in the target environment and integrated system solution.

Products within the scope of the ACMA EMC regulatory arrangements shall comply with the applicable standards or the generic standards for emissions. For products outside the scope of those standards, compliance with the product standard or generic standards for emissions is desirable.

Products that have a specific standard containing EMC requirements should have evidence of compliance with the applicable product standard.

Products that do not have a specific product standard should comply with the immunity requirements of the applicable railway equipment standard from the IEC 62236 series.

Application of the industrial generic immunity standard provides greater assurance of reliability in a railway environment for operational systems in or near the rail corridor than commercial and domestic limits.

3.2.3 Emissions

All products shall comply with the emissions requirements of AS 61000-6-3 or AS 61000-6-4 as a minimum.

Products compliant with EMC emissions standards should be assessed to confirm that acceptable reliability will be achieved in the target environment and integrated system solution.

EMC management activities shall identify electromagnetic emissions and immunity vulnerabilities outside the requirements defined in standards to ensure compatibility.

The electromagnetic emissions of a railway should comply with IEC 62236-2 to confirm that they are less than the defined limits and typical maximum field values as defined for the type of railway electrification.

3.2.4 Lightning protection

Lightning protection based on AS/NZS 1768 should be provided for installations.

Protection of products from the effects of lightning should be assessed in design and construction in accordance with IEC 62305-4.

3.2.5 Rolling stock

New and existing rolling stock should be tested in accordance with IEC 62236-3-1 or equivalent to confirm that electromagnetic emissions are less than the defined limits.

Appropriate segregation distances for any transmitting antenna should be incorporated into the design to ensure electromagnetic compatibility with other onboard train equipment.

Where compliance with IEC is not achievable trainbourne equipment shall comply with EN 50155

Trainborne cable installation shall minimize coupling of electromagnetic disturbances in accordance with EN 50343.

EMC aspects of rolling stock to signalling detection interface shall comply with AS 7505 and AS/NZS 62236-4.

Rolling stock and signalling product EMI emission levels shall not exceed those defined in AS 7505 or AS/NZS 63326-4.

Intentional emissions from radiating antennas and portable transceivers installed as part of the rolling stock communication systems shall be designed and managed to ensure they do not interfere with other equipment in the surrounding environment. This includes sensitive medical devices such as cardiac pacemakers, provided such equipment complies with relevant radiated immunity standards.

Commentary C3.2.5

Rolling stock in motion is a mobile source of EMI and can impact the performance of sensitive equipment located along the rail corridor.

This includes installations in hospitals, research facilities, and industrial sites.

All potential EMI victims along a train route within the rail corridor arising from onboard communication equipment shall be identified, and appropriate mitigation measures implemented to ensure electromagnetic compatibility. Onboard human exposure to electromagnetic fields should be assessed in accordance with the requirements outlined in Section 3.3.

3.2.6 Fixed power installations

EMC performance of traction power substations and high voltage connections should comply with AS 2067, AS 7000 and EN 50122 and the power quality requirements of the network service provider to control conducted emissions from the railway interfering with the public supply network.

EMC performance of fixed power supplies should comply with IEC 62236-5 to control radiated emissions from the railway causing interference both within and external to the railway environment.

Ancillary equipment directly related to the control and monitoring of traction power substations and high voltage connections should comply with standards suitable for use in heavy industrial environments.

Ancillary equipment not directly related to the control and monitoring such as heating, ventilation and air conditioning systems, lighting of traction substations and high voltage connections should be risk assessed for suitability.

3.2.7 Fixed telecommunications

All fixed telecommunications cabling should be in accordance with AS/CA S009 to minimize coupling of electromagnetic disturbances.

Good electricity industry practice and EMC design principles should be followed to achieve EMC compliance with fixed telecommunications networks (FTN) external to the railway network.

RTOs should set specific AC and DC power immunity requirements for product types being used in their environment as AC power supply quality can be affected by the electrical traction network, both with and without regenerative braking contributions.

3.2.8 Power interfaces

Alternating current (AC) power interfaces, and associated power quality criteria such as power dips, transients and harmonics should be assessed as part of EMC management.

3.2.9 Intra-system interfaces

Intra-system interfaces shall include all unintended EMI interference coupling between system elements within the system boundary of a new or altered system of interest.

Internal systems that have EMI interactions and adversely affect or could be affected by each other shall be identified in the new or altered system of interest in the internal EMI interface specifications.

3.2.10 Inter-system and external environment interfaces

Inter-system interfaces shall include all unintended EMI interference coupling across the system boundary of the new or altered system within external systems and the wider system environment.

External systems that adversely affect or could be affected by a new or altered system-of-interest shall be defined in the external EMI interface specifications.

EMC performance degradation mechanisms and effects that electromagnetic emissions from a new or altered system will have on other systems shall be determined.

3.2.11 EMC risk matrix

To ensure the reliable and safe operation of electronic products, an EMC risk matrix should be used to analyze and manage complex challenges of electromagnetic compatibility.

System developers should identify and analyze relevant system EMI interfaces and risk levels for that particular system application.

See Appendix A for an EMC risk matrix sample.

3.3 Human effects

The system electromagnetic emissions shall be analyzed for potential harmful effects across the electromagnetic frequency spectrum of interest. Exposure to the general public and rail safety workers to electromagnetic emissions shall be managed in accordance with the requirements of ARPANSA Radiation Protection Series S-1.

Equipment with integral antennas shall comply with *Radiocommunications Equipment (General) Rules* (2021).

EN 50500 should be used for testing frequencies below 3 kHz and for specification of measurement of fields that could affect humans. Technical measurements are necessary for frequencies up to 20 kHz and should be conducted in accordance with the requirements of the ICNIRP Guidelines, EN 50500 and any applicable RTO guidelines.

EMC requirements for active implantable medical devices shall be in accordance with EN 45502-2-1 and EN 45502-2-2 is when assessing human exposure levels for workers and the general public.

Exposure to radiofrequency fields above 3 kHz shall be assessed to ensure compliance with ICNIRP and ARPANSA standards.

The limits of exposure to non-ionising radiation for persons on rolling stock shall not exceed:

(a) the basic restrictions specified for general public in ARPANSA *Standard for Limiting Exposure to Radiofrequency Fields – 100 kHz to 300 GHz*, Radiation Protection Series S-1 (Rev. 1) (2021); and

(b) the *ICNIRP Guidelines for Limiting Exposure to Time-Varying Electric and Magnetic Fields (1 Hz -100 kHz)* (2010).

3.4 EMC and new product type approval

All EMC product certification and type approvals required by the RTO shall be obtained prior to introduction of the new product onto the operational rail network, in accordance with the RTO's safety management system.

AS 7702 should be used as an input for the assessment of EMC as part of the type approval process.

3.5 EMC and functional safety

EMC management activities shall identify and assess the functional safety and reliability of installed infrastructure, specifically relating to electrical and electronic systems.

Functional safety EMC management guidelines are provided in EN 50126.

Risk assessments shall identify hazards and risks related to EMC for:

(a) product and system design;

(b) system installation and application; and

(c) potential failure modes.

An EMC safety argument shall be developed as part of the integrated system safety argument.

EMC records should be collected and retained to support the safety assurance case.

The RTO should review EMC compliance of existing installations when legislative and safety requirements change.

Specific legislative and safety requirements for EMC and the electromagnetic environment must be addressed. These are in addition to those that apply under the RSNL.

IEC/TS 61000-1-2 provides a standardized methodology and should be used for functional safety relating to EMC.

Equipment performing safety functions should be compliant with the applicable sections of IEC 62236.

Railway equipment compliant with immunity requirements of standards with lower levels than IEC 62236:2018 shall be assessed to ensure safe operation in the target environment.

3.6 EMC in design and construction

3.6.1 Overview

EMC compliance and constraints should be confirmed during individual product type approval.

Design, construction, installation, integration, testing, commissioning and maintenance solutions should be defined to meet and manage all constraints, including EMC.

Design, construction, installation, integration, testing, commissioning and maintenance processes should apply engineering solutions within these pre-defined constraints.

3.6.2 Design

Design system installation and integration processes shall be planned to ensure that EMC system integrity is maintained.

The system shall be verified to comply with EMC standards used in the design prior to test verification.

The system shall comply with the declared OEM product, EMC requirements and product application limitations.

3.6.3 Construction

During construction, site activities shall not adversely affect the EMC integrity of existing operational rail systems and assets on or adjacent to the construction site.

Interface risks shall be managed within third party works for systems that could adversely affect, or be affected by, the new or altered system.

Existing rail construction standards shall include installation requirements to achieve and maintain EMC.

3.7 EMC in testing and commissioning

3.7.1 Test planning

EMC testing of system requirements shall be determined to ensure that system integrity is maintained in accordance with the design specification.

If required an EMC test plan shall be developed for testing a product, system or configuration on site.

The EMC test plan should identify as a minimum:

(a) EMC targets containing tolerable emission and susceptibility levels and design requirements;

(b) the EMC assurance and testing organisation and competent person details;

(c) EMC test and evaluation methodology; and

(d) details of any calibrated measurement instrumentation and its management.

EMC tests shall be conducted in accordance with an approved EMC test plan. See Appendix D for a list of EMC test plan elements.

Depending on the scope, novelty, complexity and risk of the system under test, EMC tests may be integrated with other tests plan if practicable to do so.

Testing and analysis of radio frequency fields shall be assessed by a competent person.

See Appendix C for EMC test plan guidance.

3.7.2 Test execution

EMC testing should include standard tests, FAT environment testing, or in-situ testing to the following:

(a) IEEE Std 1460:1998

(b) IEEE Std C95.3.1:2010

EMC test management shall address how to manage EMC test failures.

3.7.3 Third party works

Management of third-party works shall be communicated and coordinated with the RTO.

Third-party works include high voltage electrical transmission and distribution feeders, copper communication cables and radio communications systems.

3.7.4 Test reporting

An EMC test report shall include the EMC test results, an analysis of these results and the conclusions of EMC suitability.

EMC test reports should clearly identify the product being tested including:

(a) the part number;

(b) current revision of the product;

(c) the configuration of the product;

(d) any applicable software and versions installed;

(e) the test environment configuration used; and

(f) the mode of operation tested.

Evidence of compliance to applicable standards for immunity testing of safety-related products shall be provided.

Reference shall be made to the specific immunity standard that meets the safety requirements.

3.8 EMC in maintenance

3.8.1 Maintenance planning

Maintenance of systems shall be planned and managed to ensure that system EMC integrity is maintained to design specification during maintenance work, and after the asset is returned to normal operational service.

3.8.2 Maintenance execution

EMC in maintenance applies to in-situ maintenance on an operating railway, or where a line replaceable unit is tested as compliant before return to service after repair.

Commentary C3.1.10

For example, if a maintainer disconnects a data cable to repair an axle counter on site, the screen and earthing will be reconnected in accordance with the design specification after completing the repair.

Typically, equipment will have initial performance limits that determine the need for corrective action.

Permissible EMI susceptibility limits can degrade from the initial design specification to a minimum condemning limit over the asset operational life. However, the original design specification can include these minimum permissible performance levels.

The EMC control plan should specify the level of the condemning limit where detailed by the RTO.

Components, connections and insulation shall be maintained in accordance with OEM requirements. The RTO shall include these factors in the management of assets.

If EMC integrity is compromised as a result of maintenance, suitable operational procedures shall be put in place to assure availability and safety of assets and services.

3.8.3 Configuration management during maintenance

Changes to asset configuration as a result of maintenance shall be controlled in accordance with the EMC management plan.

3.9 EMC in decommissioning

3.9.1 Decommissioning planning

Decommissioning of systems shall be planned and managed to ensure that the EMC integrity of retained operational systems is maintained in accordance with design specification, during and after decommissioning and removal of the system or product.

If EMC integrity is expected to be compromised as a result of decommissioning, then suitable operational procedures shall be put in place to assure availability and safety of running services.

3.9.2 Configuration management during decommissioning

Changes to asset configuration as a result of decommissioning and removal shall be controlled from an EMC perspective.

3.10 EMC management records

EMC records shall be available to all responsible parties at agreed points in the acquisition and implementation of a new or altered product or system.

EMC records should include:

(a) EMC safety plan which can form part of a wider system safety assurance plan;
(b) EMC risk matrix;
(c) EMC control plan;
(d) EMC risk log which can form part of a wider system hazard log;
(e) EMC requirements specification;
(f) EMC approvals issues log;
(g) EMC test plan and test specifications; and
(h) EMC test reports.

RTOs should maintain EMC records to support the following:

(a) System configuration changes during the maintenance phase of the asset lifecycle.
(b) Safety interface agreements between interfacing parties.
(c) Risk management documentation including risk assessments and risk registers.

Appendix A EMC Risk Matrix Sample (Informative)

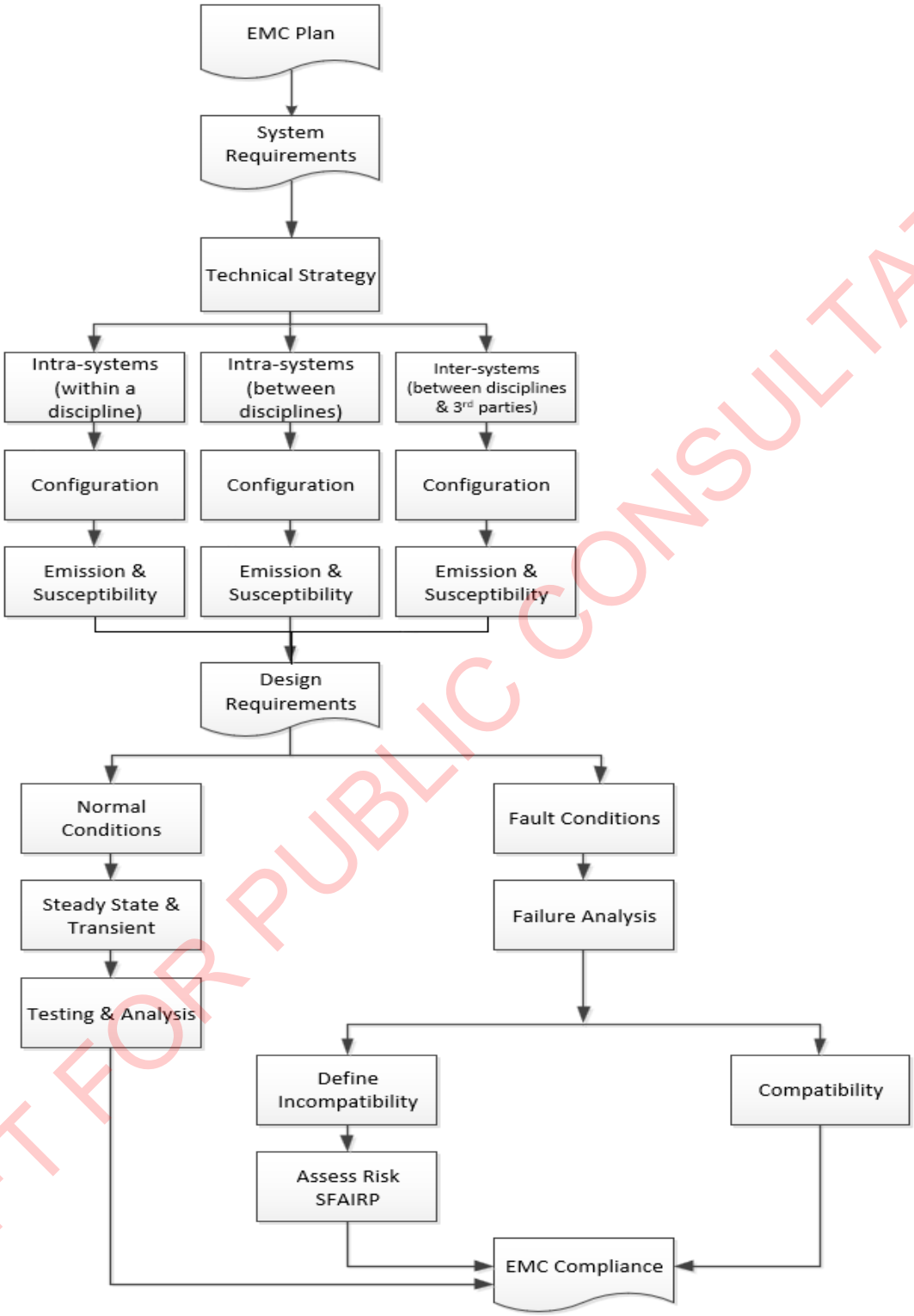
Appendix Table A-1 EMC Risk Matrix Sample

		Emitters						Emitters		
		Rolling Stock	Electrification	Signalling	Communications	Station Equipment	Depot Equipment	Other Railways	Human Beings	External Sources
Receivers	Rolling Stock	Intra	Intra	Intra	Intra	Intra	Intra	Inter	Inter	Inter
	Electrification	Intra	Intra	Intra	Intra	Intra	Intra	Inter	Inter	Inter
	Signalling	Intra	Intra	Intra	Intra	Intra	Intra	Inter	Inter	Inter
	Communications	Intra	Intra	Intra	Intra	Intra	Intra	Inter	Inter	Inter
	Station Equipment	Intra	Intra	Intra	Intra	Intra	Intra	Inter	Inter	Inter
	Depot Equipment	Intra	Intra	Intra	Intra	Intra	Intra	Inter	Inter	Inter
Receivers	Other Railways	Inter	Inter	Inter	Inter	Inter	Inter	Inter	Inter	Inter
	Human Beings	Inter	Inter	Inter	Inter	Inter	Inter	Inter	Inter	Inter
	Neighbours	Inter	Inter	Inter	Inter	Inter	Inter	Inter	Inter	Inter

Appendix Table A-2 EMC Risk Classification Table Sample

I	No risk rating	All EMC effects are internal to the system and are managed by EMC Standards and EMC testing of the equipment/sub-system in isolation from the railway system.
H	High	1. The source will produce a significant EMC disturbance through radiated and/or conducted means at one or more locations in the railway system or external to the railway system AND 2. The EMC disturbance from the source which could result in an unsafe condition and/or is very likely to cause interruption to normal operation of victim equipment at one or more locations in the railway system or external to the railway system
M	Medium	1. The source could produce a significant EMC disturbance through radiated and/or conducted paths at one or more locations in the railway system or external to the railway system AND 2. The EMC disturbance from the source is unlikely to create an unsafe condition and/or cause interruption to normal operation of victim equipment at one or more locations in the railway system.
L	Low	1. The source will not produce a significant EMC disturbance through radiated and/or conducted paths at one or more locations in the railway system AND/OR 2. The EMC disturbance from the source will not create an unsafe condition and/or cause interruption to normal operation of victim equipment at one or more locations in the railway system or external to the railway system.

Appendix B EMC Lifecycle Workflow (Informative)



Appendix Figure B-1 EMC Lifecycle Workflow

Appendix C EMC Management Plan Contents – Example (Informative)

The following list identifies topics to be included in an EMC Management Plan:

(a) Scope of system
(b) EMC Critical Components List
(c) EMI risk and victim identification
(d) Identifying EMI emission and susceptibility levels
(e) Frequency management
(f) EMC design
(g) Grounding & shielding
(h) Decoupling
(i) Filtering
(j) Separation
(k) Emissions suppression
(l) Susceptibility hardening
(m) Mechanical design
(n) EMC modelling and analysis
(o) Subsystem analysis
(p) EMC installation/integration controls
(q) EMC testing
(r) Susceptibility testing
(s) Emissions testing
(t) Product testing
(u) Site/integration testing

Appendix D EMC Test Plan Contents – Example (Informative)

The following list identifies possible elements of an EMC Test Plan:

(a) Scope of system for EMC testing
(b) System description
(c) Operating environment
(d) System modification
(e) System specifications
(f) EMC test objectives
(g) Third party certification
(h) Responsible parties
(i) Test facilities
(j) Test power requirements
(k) Test instrumentation & calibration certificates
(l) Test schedule
(m) Test methodology
(n) Developmental testing
(o) Final site testing
(p) Test failure management
(q) Test reporting
(r) Construction
(s) EMC maintenance

Appendix E Guidance for Integrators and Regulators (Informative)

The following informative guidance is provided for integrators and regulators in interpreting this document:

(a) APTA-PR-E-S-010-98 Standard for the Development of an EMC Plan is not mandated by this document but provided as additional useful guidance.

(b) IEC 62236 series is nominated as the preferred overarching standard as it is an international standard. However, compliance with the EN 50121 series as a legacy standard would be an acceptable alternative, where systems and products have been approved in Europe under the EN Standards.

(c) In those cases where additional requirements are necessary (for example, where equipment outside the scope of IEC 62236 standards requires a level of immunity in order to function correctly in the railway environment), then the use of other standards in the reference list (e.g., AS/NZS 61000.6.2 generic immunity for industrial environments) can be demonstrated.

(d) EN 50155 and IEC 62236-3-2 have some overlap in scope. In the event of overlap or conflict, IEC 62236-3-2 will take precedence.

(e) EN 50238-1 and IEC 62336-4 have some overlap in scope. In the event of overlap or conflict, IEC 62336-4 will take precedence.

(f) CLC/TR 50427:2004 Assessment of inadvertent ignition of flammable atmospheres by radio-frequency radiation is not mandated by this document but is provided as guidance.

Appendix F Hazard Register (Informative)

Hazard number	Hazard
5.2.1.12	Rolling stock electrical systems generating the same frequency as infrastructure system frequency, affecting the communication system and thereby causing EMI
5.2.1.13	Rolling stock electrical systems generating the same frequency as infrastructure system frequency, affecting the signalling system and thereby causing EMI
5.2.1.19	Harmonics affecting overhead wires causing rolling stock electrical systems to generate the same frequency as an infrastructure system frequency, affecting communication systems and thereby causing EMI
5.4.1.38	EMI
5.9.1.20	Signalling detection being affected by EMI from rolling stock electrical equipment so that trains are not detected (Signal failure)
5.10.1.30	EMI affecting brake signals causing a braking signal transmission system failure (Braking system failure)
5.41.1.1-19	Radiation exposure (various effects on humans)
6.23.1.1-27	Radiation exposure (various effects on humans)
6.25.1.7	Sparks and leaked fuel
9.2.1.4	Low frequency / mains induction
9.4.1.4	Noise interference into circuits
9.4.1.5	Low frequency / mains induction
9.5.1.17	Interlocking protocol not being safety certified for wireless communications
9.14.1.9	Low frequency / mains induction
9.16.1.3/4	Noise interference into circuits
9.16.1.5	Low frequency and mains induction
9.25.1.4	Shorting or electrical interference of train detection equipment in the location case
9.56.1.6	Interference with 3rd party services

Bibliography (Informative)

The following referenced documents are used by this document for information only:

- ISO/AS 31000, *Risk Management*
- EN 55011, *Limits and Methods of Measurement of Radio Disturbance Characteristics of Industrial, Scientific and Medical (ISM) Radio Frequency Equipment (CISPR 11)*
- EN 55022, *Information Technology Equipment – Radio Disturbance Characteristics – Limits and Methods of Measurement (CISPR 22, Modified)*
- *ACMA-mandated Electromagnetic Compatibility (EMC) Standards – August 2019*
- *ICNIRP Guidelines for Limiting Exposure to Time-Varying Electric and Magnetic Fields (up to 300 GHZ)*
- *Electrical Safety Act*
- *Radiocommunications Act 1992, Act No. 174 of 1992, Australian Government*
- *Rail Safety National Law*
- *Work Health and Safety Act*