Master Specification
Part PC-RW30

Design

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Government of South Australia
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Contents

PC-RW30 Design

1 General

a) This Master Specification Part sets out the requirements for the design management of Rail Infrastructure including:

i) the documentation requirements, as set out in section 2;

ii) the design coordination requirements, as set out in section 3;

iii) the requirements for design verification, validation and requirements management, as set out in section 4;

iv) the ICT and software systems management requirements, as set out in section 5;

v) the human factors requirements, as set out in section 6;

vi) the construction specification requirements, as set out in section 7; and

vii) the Hold Point requirements, as set out in section 8.

b) The Contractor must ensure that the management of design complies with PC-EMD1 “Design Management” and PC-RW20 “System Safety and Assurance”.

c) The design of Rail Infrastructure must comply with the Reference Documents, including:

i) AM4-DOC-000466 Type Approval for Railway Products;

ii) AM4-DOC-001217 Systems engineering standard;

iii) AS 7470 Human factors integration in engineering design - General requirements;

iv) AS 15288 Systems and software engineering - System life cycle processes;

v) AS 61508 Functional safety of electrical / electronic / programmable electronic safety-related systems;

vi) CLC/TS50701 Railway applications - Cyber Security;

vii) ISO/IEC/IEEE 12207 Systems and software engineering - Software life cycle processes;

viii) NATSPEC - DPTI Amendments (227) (available at http://www.bpims.sa.gov.au/);

ix) PR-AM-GE-807 Development and Approval of Engineering Waivers;

x) PTS-MU-10-EG-PRC-00000016 Design Decisions Records Procedure;

xi) PTS-MU-10-EG-PRC-00000023 Design lifecycle management procedure; and

xii) South Australian Cyber Security Framework (available at https://www.security.sa.gov.au/cyber-security/sacsf).

d) The gates referenced in this Master Specification Part are references to gates contemplated by PC-RW10 “Railway Management Planning”.

2 Documentation

2.1 Design Management Plan

a) In addition to the requirements of in PC-EDM1 “Design Management”, the Contractor must develop, implement, and comply with the Design Management Plan for the management of the engineering and design activities for Rail Infrastructure in accordance with AM4-DOC-001217 Systems engineering standard.

b) The Design Management Plan must, as a minimum, include:

i) the proposed engineering lifecycle;

ii) the engineering competency management system and approach to assessing and maintaining competency within the project team;

iii) a procedure for the application of value management activities through each design stage;

iv) details to manage all design activities, including:

A. management and organisation of design personnel;

B. design stage review requirements, deliverables and meetings;

C. processes to generate innovation; and

D. coordination and integration between different design disciplines as detailed in section 3;

v) the approach to ensuring alignment with Principal's personnel and any external rail operators;

vi) application of both technical and construction integration and interface management activities to engineering and design management;

vii) processes for capture and recording of design decision records;

viii) methodology for the development and update of a technical deliverables register in accordance with PC-RW60 "Asset Management Handover";

ix) procedures for reliability, availability, maintainability and safety in accordance with RW-RAMS-D1 "Reliability, Availability, Maintainability and Supportability";

x) procedures for EMC hazard identification and control (where applicable);

xi) roles, skills and competencies of the personnel undertaking design work;

xii) roles, skills and competencies of the personnel preparing the construction specification as required in section 7;

xiii) interfaces with the Contract Program and work breakdown structure;

xiv) management of Design Documentation;

xv) identifying and managing Hold Points during design activities;

xvi) verification and validation;

xvii) operational concept, including:

A. operations concept definition (**OCD**) development;

B. operational performance capability;

C. operational constraints;

D. operational service levels;

E. operational assets and facilitates;

F. operational process scenarios;

G. operational users;

H. operations migration;

I. operational interfaces; and

J. operating modes; and

xviii) maintenance concept, including:

A. OCD and OCD relationship;

B. system lifecycle description;

C. levels of maintenance;

D. maintenance and operational interfaces;

E. information and information management systems;

F. tools, equipment, instruments and facilitates;

G. documentation and training;

H. logistics;

I. spare parts strategy;

J. maintenance personal; and

K. access arrangements.

c) The Design Management Plan must be prepared, submitted and updated in accordance with the requirements of PC-PM1 “Project Management and Reporting”.

2.2 ICT and Software Systems Management Plan

a) The Contractor must develop, implement and maintain an ICT and Software Systems Management Plan which identifies the procedures, processes and management systems for all ICT and software for Rail Infrastructure.

b) The ICT and Software Systems Management Plan must:

i) document the software engineering processes adopted as part of the Contractor’s systems engineering framework for Rail Infrastructure with specific treatment of the software implementation process in accordance with ISO/IEC/IEEE 12207 Systems and software engineering - Software life cycle processes;

ii) include a detailed description of the processes to identify and manage all safety critical items and reliability critical items for ICT and software;

iii) include a detailed description of the SIL derivation process for ICT and software and hardware, with reference to AS 61508 Functional safety of electrical / electronic / programmable electronic safety-related systems, together with the Contractor’s method of internal approval of the derived SILs;

iv) clearly describe the Contractor's strategy for actively managing all ICT and software systems including equipment and components over the term;

v) identify key ICT and software design personnel responsible for implementing the ICT and Software Systems Management Plan. Key ICT and software design personnel must be tertiary educated and experienced in the use of structured, analytical software engineering methods; and

vi) address the processes, methods, and standards, which are applied to ICT and software systems including:

A. requirement analysis, functional allocation, architecting and design;

B. testing and acceptance strategies including test cases and pass or fail criteria;

C. software quality assurance;

D. software security, including user access policies;

E. procurement and development;

F. integration and testing including hardware unit testing, software unit testing and hardware and software integration testing;

G. deployment to operation and acceptance;

H. ongoing operational support, including support subsystems;

I. change and defect management;

J. maintenance, scheduled, reactive and preventative;

K. enhancement; and

L. transition:

I. to a major new version;

II. to a new infrastructure base; and

III. through replacement by a different software system.

c) The ICT and Software Systems Management Plan must be prepared, submitted and updated in accordance with the requirements of PC-PM1 “Project Management and Reporting”.

2.3 Human Factors Integration Plan

a) The Contractor must develop, implement and maintain a Human Factors Integration Plan in accordance with the Rail Commissioner’s safety management requirements, which identifies how the Contractor will comply with human factors requirements for the Rail Infrastructure Works.

b) The Human Factors Integration Plan must cover all phases of the Rail Infrastructure life cycle and set the design requirements for:

i) integration with safety requirements;

ii) human reliability analysis;

iii) human-system interface assessment;

iv) risk based training needs assessment;

v) consideration of normal and degraded operations;

vi) cognitive ergonomics; and

vii) normal and degraded operations.

c) The Human Factors Integration Plan must:

i) include a human factors risk register required by section 6c); and

ii) be prepared, submitted and updated in accordance with the requirements of PC-PM1 “Project Management and Reporting”.

2.4 Cyber Security Management Plan

a) The Contractor must develop, implement and maintain a Cyber Security Management Plan for Rail Infrastructure.

b) The Cyber Security Management Plan must be developed in accordance with:

i) the South Australian Cyber Security Framework; and

ii) CLC/TS50701 Railway applications - Cyber Security.

c) The Cyber Security Management Plan must be prepared, submitted and updated in accordance with the requirements of PC-PM1 “Project Management and Reporting”.

2.5 Human Factors Summary Report

The Contractor must prepare and submit a human factors summary report in accordance with PC-RW60 " Asset Handover".

2.6 Design Documentation

2.6.1 General

In addition to the requirements of PC-EDM1 "Design Management", the Design Documentation must include:

a) all software documentation as required in section 5b); and

b) the construction specification as required in section 7.

2.6.2 Design Report

In addition to the requirements of PC-EDM1 "Design Management", the Design Report must include:

a) design decisions, consistent with the requirements of PTS-MU-10-EG-PRC-00000016 Design Decisions Records Procedure;

b) proposed maintenance regime;

c) an outline of the documentation that must be prepared for the operation and maintenance of the Works;

d) any processes or procedures for commissioning of the Works; and

e) details regarding compatibility of the design with future expansion of the infrastructure.

2.6.3 Type Approval for Rail Infrastructure

The Contractor must obtain type approval for products to be incorporated into Rail Infrastructure in accordance with AM4-DOC-000466 - Type Approval for Railway Products.

2.6.4 Product technical files for individual items

In addition to the requirements of PC-EDM1 "Design Management", the Design Report must include Product Technical Files (PTF) as follows:

a) the Contractor must provide a PTF for each item of the Rail Infrastructure to be used in the construction and operation of the system;

b) the PTF must cover the design, manufacture, operation and maintenance of the item to the extent necessary to demonstrate compliance with the Contract Documents;

c) the PTF for each item of equipment must have been submitted, reviewed and approved by the Principal prior to that equipment being installed;

d) each PTF must follow a standard format which includes the requirements of section 2.6.4f);

e) each PTF must demonstrate the item complies with the requirements of the Contract Documents and the system safety requirements of PC-RW20 "System Safety and Assurance"; and

f) the PTF must include:

   i) a general description of the item and its purpose in the system;

   ii) general arrangement and control circuit drawings along with the pertinent descriptions and explanations necessary for understanding the operation of the item;

   iii) detailed drawings and descriptions, including any calculations, test results and certificates, required to demonstrate that the essential RAMS requirements set out in

RW-RAMS-D1 “Reliability, Availability, Maintainability and Supportability” have been complied with;

iv) a risk assessment that identifies the essential safety requirements that apply to the equipment and a description of the protective measures incorporated to eliminate the identified risks;

v) the standards and other technical specifications used including the essential safety requirements covered by these standards;

vi) the testing regime to demonstrate compliance with the Contract Documents including frequency of Factory Acceptance Testing (FAT) and “Commercial Off the Shelf (COTS)” components including materials, plant and equipment;

vii) the operations and maintenance requirements for the item;

viii) identification where the product has been used in a similar function elsewhere as it relates to environmental conditions;

ix) spatial constraints (structure gauge, corridor width, on-board equipment locations);

x) non-functional safety requirements (manual handling, pinch points, ergonomics, etc.);

xi) electromagnetic compatibility;

xii) software safety (subject to application specific safety requirements);

xiii) hardware functional safety (subject to application specific safety requirements);

xiv) generic functionality and operation; and

xv) overall reliability, availability and maintainability in accordance with RW-RAMS-D1 “Reliability, Availability, Maintainability and Supportability”.

3 Design coordination

3.1 Design, engineering and test gated reviews

a) The Contractor must convene and host a design, engineering and test gated review with the Principal’s key personnel at gates 4A, 4B, 4C, 4D and 4E in accordance with:

i) PC-RW10 “Railway Management Planning”

ii) PC-RW20 “System Safety and Assurance”; and

iii) PTS-MU-10-EG-PRC-00000023 Design lifecycle management procedure,

as applicable

b) The Contractor must manage the design, engineering and test gated reviews to be formalised assessments during the development of the design to ensure that deficiencies regarding design principles and practices and project requirements are identified and corrected.

c) The Contractor must present the design at each design, engineering and test gated review in sufficient detail to demonstrate that it has achieved the design intent. Changes to the design from prior submission, with particular attention to the integration and interaction of the different design elements, must also be identified.

d) All documentation including the Design Documentation, engineering, inspection and test procedures and reports must be provided to the Principal at least 10 Business Days prior to the applicable gated review.

e) Without affecting the Contractor’s obligations, at each gated review, the Principal may:

i) permit work to proceed;

ii) permit work to proceed, provided that specified changes are implemented by the Contractor; or

iii) prohibit work from proceeding until the Design Documentation or related documentation is revised and resubmitted.

f) The completion of each gated review constitutes a **Hold Point**. The design or testing (as applicable) cannot proceed until the Hold Point is released.

g) The Contractor must plan and implement procedures to have ownership of, capture, process, and close out comments received from design, engineering and test gated reviews at each gate. These must be logged in evidence of the meeting in a design, engineering and test gated review register, and the Contractor must respond to each individual issue or comment at the next gate review.

h) The evidence of review register must be updated and submitted at the next gate review.

3.2 Contractor's proposed alternative approach

a) The Contractor may propose an alternative systems engineering based approach outside the requirements specified in this Master Specification Part, provided that it demonstrates that the proposed alternative approach aligns with the requirements of:

i) AS 15288 Systems and software engineering - System life cycle processes; and

ii) PTS-MU-10-EG-PRC-00000023 Design lifecycle management procedure.

b) Submission of a proposal for an alternative approach constitutes a **Hold Point**. The design cannot proceed until the Hold Point is released.

3.3 Engineering waivers

a) Where the Contractor is unable to comply with an rail engineering standard specified by the Rail Commissioner, the Contractor must obtain an engineering waiver in accordance with PR-AM-GE-807 Development and Approval of Engineering Waivers.

b) The Design Departure process in PC-EDM1 "Design Management" does not apply to departures of rail engineering standards specified by the Rail Commissioner, which are the subject of section 3.3a).

3.4 Design reviews

Design Documentation for Rail Infrastructure must be managed in accordance with PC-EMD1 "Design Management" except as follows:

a) the Contractor must issue the Design Documentation associated with each Design Package to the Principal and the Rail Commissioner at the same time as the Design Documentation is issued to the Independent Design Certifier;

b) the Contractor must review the finding of the Principal and Rail Commissioner review and resolve the comments; and

c) the Contractor must provide the Principal and the Rail Commissioner editable access to the review register.

4 Design verification, validation and requirements management

4.1 General

a) The Contractor must develop a Project requirements, analysis, allocation and traceability management (RAATM) register for Rail Infrastructure to:

i) capture, record, analyse and prioritise requirements;

ii) manage changes to requirements; and

iii) maintain traceability to any Contract Document, verification and validation results, and any modifications made during the Works.

b) The RAATM register required by section 4.1a) must:

i) be prepared in a best practice requirement management tool;

ii) be readily compatible with IBM® Rational® DOORS® (DOORS®);

iii) include the derived safety requirements from PC-RW20 “System Safety Assurance”; and

iv) be provided as part of documentation for the design, engineering and test gated reviews required by section 3.1.

c) The Contractor must:

i) prepare and maintain a system requirements specification (**SRS**) which incorporates the requirements of the business requirement specification (**BRS**), the Contract Documents, and addresses the system architecture;

ii) develop and maintain a system architecture;

iii) allocate requirements to subsystem elements as identified in the system architecture;

iv) prepare and maintain an interface requirements specification identifying interface requirements for all major subsystems and external interfaces;

v) maintain traceability between the BRS, the SRS, subsystem elements, safety requirements, design outputs, verification and validation activities, integration tests and operational readiness activities and outcomes, and functional responsibilities;

vi) maintain traceability between subsystem elements and work packages allocated to subcontractors; and

vii) provide ongoing reporting which measures the performance against the RAATM in a format agreed by the Principal.

d) The Contractor must produce, as a subset of the RAATM, an engineering assurance register for the design, construction and testing and commissioning stages.

e) The engineering assurance register required by section 4.1d) must include:

i) unique identifiers for each system and interface requirement;

ii) derived system requirements, including those requirements originating from safety controls identified by the Contractor in the project safety hazard log in accordance with PC-RW20 “System Safety and Assurance”;

iii) a reference to the source of the requirement;

iv) other references as appropriate including project safety hazard log references;

v) an attribute identifying the type of requirement including:

A. heading;

B. information;

C. technical;

D. process;

E. construction;

F. testing;

G. operations and maintenance;

H. safety requirements;

I. interface requirements including human factors and systems; and

J. RAMS requirements in accordance with RW-RAMS-D1 “Reliability, Availability, Maintainability and Supportability”;

vi) systems assumptions, dependencies and constraints (**ADCs**) for integration;

vii) obsolescence status as a requirement for software and equipment;

viii) subsystem elements that satisfy a particular system requirement, with a link to subsystem requirements or specification document reference, as appropriate;

ix) a description of how each requirement must be verified or validated;

x) work package reference;

xi) documentation reference;

xii) review by IDC and/or ISA;

xiii) the Principal’s, Rail Commissioner’s and Independent Design Certifier’s comments on Design Documentation;

xiv) the Contractor's response to Principal’s, Rail Commissioner’s and Independent Design Certifier’s comments on Design Documentation;

xv) inspection and test plan references; and

xvi) reference to verification and validation status.

f) The Contractor must maintain traceability between safety requirements in the RAATM register and the project safety hazard log.

g) The Contractor must ensure that system and interface requirements are known and implemented by all design, construction, testers, rail transport operators and other groups on the Project including Subcontractor’s systems and safety assurance of the Works.

4.2 Submission of Design Documentation

The Contractor must submit the Design Documentation for each Design Package for review progressively including:

a) Design Basis in accordance with PC-EDM1 “Design Management”;

b) Requirements Definition Design Documentation in accordance with section 4.3 (where applicable); and

c) design submissions in accordance with PC-EDM1 “Design Management” including:

i) Preliminary Design Documentation for Gate 4A in accordance with PC-RW10 “Railways Management Planning”;

ii) Detailed Design Documentation for Gate 4B in accordance with PC-RW10 “Railways Management Planning”;

iii) Final Design Documentation;

iv) Issued for Acceptance Design Documentation; and

v) Issued for Construction Design Documentation for Gate 4C in accordance with PC-RW10 “Railways Management Planning”.

4.3 Requirements Definition Design Documentation

a) If required in the Contract Documents, the Requirements Definition Design Documentation must demonstrate that the specified operational outcome and key project technical requirements and must include:

i) design which has been developed to demonstrate the concept of the relevant Design Packages to a level of sufficient detail to demonstrate:

A. the extent of Works;

B. impacts to land acquisition requirements;

C. impacts to Utility Services, including protection and re-location requirements; and

D. key features, risks and constraints;

ii) the Design Report;

iii) the Design Drawings;

iv) evidence of the Contractor's review of the design to consider constructability and integration of the design with construction staging and any Temporary Works; and

v) all other requirements of the Design Documentation (as applicable for the Requirements Definition Design Documentation) as set out in the Contract Documents.

b) The Contractor must submit the Requirements Definition Design Documentation to the Principal which will constitute a **Hold Point**. The Contractor must not progress the Preliminary Design Documentation to Preliminary Design and must not submit the associated Preliminary Design Documentation until this Hold Point is released.

4.4 Inspection, maintenance and operations documentation

Draft and final inspection, maintenance, and operations procedures for Rail Infrastructure must be submitted in accordance with PC-RW60 "Asset Management Handover".

5 ICT and software systems management

a) The Contractor must develop an ICT and Software Systems Management Plan for Rail Infrastructure as required in section 2.2.

b) The Contractor must develop and deliver software documentation, including the software data and documents referenced in PC-RW60 "Asset Handover", that provides sufficient detail to enable the software to be supported and maintained throughout the Design Life and must be provided as part of the Design Documentation. For all software developed or significantly modified for the Works, the Contractor must provide Design Documentation including:

i) software details;

ii) a software product technical specification, including source code and details of the software development environment;

iii) identification and designation of all safety-critical software systems; and

iv) software integrity test results.

6 Human factors

a) The Contractor must adopt and document in the Human Factors Integration Plan required by section 2.3, human factors principles and processes to meet the requirements of AS 7470 Human factors integration in engineering design - General requirements.

b) The Contractor must identify all human factors risks associated with the Works and ensure integration with safety and design reviews.

c) The Contractor must establish and maintain a Human Factors Issue Register (**HFIR**) and provide this register as part of the Human Factors Integration Plan.

d) The Contractor must record all identified human factors issues in the HFIR and the management of controls required to comply with the requirements within a Human Factors Integration Plan (HFIP) in accordance with section 2.3.

e) In addition to the requirements in section 6a), the Contractor must establish a human factors integration process to maximise effectiveness and efficiency by full consideration of the human contribution to system performance including:

i) reduce the likelihood and severity of accidents resulting from human behaviour;

ii) identify the influence human factors may have on a particular project before starting development or construction;

iii) identify and understand the user population and their physical and cognitive needs;

iv) reduce the need to redesign at a later stage to accommodate user requirements and limitations which were not identified at the outset;

v) develop a product or system that “fits” the user population and the objectives of the organisation (increasing user and customer acceptance of the system);

vi) save money and time by removing the need to redesign and shortening the process of regulatory acceptance;

vii) reduce health and safety costs by designing out conditions that may cause harm to users; and

viii) improve recruitment and retention by improving the working environment and fitting the task to the user.

f) The Contractor must prepare and submit a human factors summary report in accordance with PC-RW60 “ Asset Handover”.

7 Construction specification

a) The Contractor must prepare construction specifications for Rail Infrastructure, which must be reasonable and suitable for use with the relevant Design Documentation and comply with the Contract Documents.

b) Each construction specification must comply to the Design Documentation and set out all the construction requirements relating to the relevant Rail Infrastructure Design Documentation, which includes:

i) scope of Works;

ii) details of the standards, technical requirements and specifications related to construction that apply;

iii) all Hold Points and Witness Points that apply;

iv) details of all technical requirements for all materials and products;

v) details of testing and commissioning requirements; and

vi) design requirements for specific fabrication, delivery and construction sequencing.

c) In addition to the certification requirement in PC-EDM1 “Design Management”, the Contractor must ensure that the Designer inspects the Works or relevant parts thereof when so required by the construction specification, the Contractor or the Principal.

d) Whenever the Designer is required to inspect the Works, the Contractor must obtain from the Designer a certificate stating that:

i) the Designer has inspected the Works or relevant parts thereof; and

ii) any relevant assumption relating to the actual site conditions that the design was based on (e.g. geotechnical conditions) remains valid.

e) The Contractor must provide the Designer's certificate issued pursuant to section 7d) to the Principal within 5 Business Days of the Designer inspecting the Works and include the certificate in the Quality Management Records.

f) For buildings and facilities, the construction specification must be developed from the NATSPEC - DPTI Amendments (227) and incorporate the requirements of the Contract Documents.

g) For the purposes of section 7f):

i) subject to section 7g)ii), the requirements in the NATSPEC - DPTI Amendments (227) must be complied with; and

ii) the Contract Documents (including the Master Specification) take precedence over the requirements of the NATSPEC - DPTI Amendments (227).

8 Hold Points

Table PC-RW30 8-1 details the review period or notification period, and type (documentation or construction quality) for each Hold Point referred to in this Master Specification Part.

Table PC-RW30 8-1 Hold Points

Section reference	Hold Point	Documentation or construction quality	Review period or notification period
3.1f)	Gated reviews (for gates 4A, 4B, 4C, 4D and 4E)	Documentation	10 Business Days
3.2b)	Contractor proposed alternative approach	Documentation	10 Business Days
4.3b)	Requirements Definition Design Documentation	Documentation	10 Business Days