Master Specification
Part PC-EDM6

Systems Engineering Management

September 2024

Government of South Australia
Department for Infrastructure and Transport

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Document Management

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Contents

PC-EDM6 Systems Engineering Management

1 General

a) This Master Specification Part sets out the requirements for systems engineering management including:

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

ii) the systems engineering management requirements, as set out in section 3;

iii) the requirements for technical management processes, as set out in section 4;

iv) the requirements for technical processes, as set out in section 5;

v) the requirements for speciality engineering processes, as set out in section 6;

vi) the tailoring provision requirements, as set out in section 7; and

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

b) The systems engineering management requirements and processes specified in this Master Specification Part must be applied to the systems identified in the Contract Documents as being subject to the requirements of this Master Specification Part.

c) In addition to the glossary of terms included in PC-IN2 “Glossary of Terms”, the abbreviations set out in Table PC-EDM6 1-1 apply to terms used in this Master Specification Part.

d) The Contractor’s systems engineering processes must comply with the Reference Documents, including:

i) AS/NZS ISO/IEC/IEEE 15288 Systems and software engineering - System life cycle processes;

ii) ISO/IEC/IEEE 29148 Systems and software engineering - Life cycle processes - Requirements engineering;

iii) ISO/IEC/IEEE 24748-4 Systems and software engineering - Life cycle management - Part 4: Systems engineering planning;

iv) AS/ISO 10007 Quality management - Guidelines for configuration management;

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

vi) ISO/IEC 27002 Information security, cybersecurity and privacy protection - Information security controls;

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

viii) AS 61508.1 Functional safety of electrical/electronic/programmable electronic safety-related systems, Part 1: General requirements;

ix) AS 61508.2 Functional safety of electrical/electronic/programmable electronic safety-related systems, Part 2: Requirements for electrical/electronic/programmable electronic safety-related systems;

x) AS 61508.3 Functional safety of electrical/electronic/programmable electronic safety-related systems, Part 3: Software requirements;

xi) AS 61508.5 Functional safety of electrical/electronic/programmable electronic safety-related systems, Part 5: Examples of methods for the determination of safety integrity levels;

xii) AS IEC 61882 Hazard and operability studies (HAZOP studies) - Application guide;

xiii) IEC 62443 Industrial communication networks - network and system security;

xiv) National Institute of Standards Technology SP800-53 Security and Privacy Controls for Information Systems and Organizations;

xv) SACSF/G2.0 SACSF Guideline - Suppliers using the SACSF (available from: https://www.security.sa.gov.au/cyber-security/sacsf);

xvi) T MU AM 01002 MA Maintenance Requirements Analysis Manual; and

xvii) T MU MD 2003 GU Quantified Safety Risk Assessment.

Table PC-EDM6 1-1 Abbreviations relevant to this Master Specification Part

Term	Definition
DDR	Detailed design review
FCA	Functional configuration audit
FDR	Final design review
FMECA	Failure modes effects and criticality analysis
FTA	Fault tree analysis
HF	Human factors
HFIL	Human factors issue log
IRR	Implementation readiness review
LOPA	Layer of protection analysis
ORR	Operational readiness review
PCA	Physical configuration audit
PDR	Preliminary design review
RAM	Reliability, availability and maintainability
RTM	Requirements traceability matrix
RMD	Requirements and test management database
RVM	Requirements verification matrix
SACSF	South Australian Government cybersecurity framework
SDIR	System defects and issues register
SEMP	Systems Engineering Management Plan
SIL	Safety integrity level
SIMP	Systems Integration Management Plan
SIRR	Systems integration readiness review
SRR	System requirements review
SRS	Systems requirements specification
SSDD	Subsystem design description
SSP	Systems safety program
SSPP	Systems safety program plan
SSRS	Subsystem requirements specifications
TRAP	Technical Review and Audit Plan

2 Documentation

2.1 General

a) The Contractor must submit the documentation deliverables:

i) as pre-requisites to each technical review milestone as detailed in section 3.2;

ii) in accordance with the submission obligations set out in PC-EDM1 “Design Management”;

iii) in accordance with the submission obligations set out in PC-CN3 “Construction Management”;

iv) in accordance with the submission obligations set out in PC-PM1 “Project Management and Reporting”; and

v) where the Contract Documents require digital engineering, in accordance with the submission obligations set out in PC-EDM5 “Digital Engineering”.

2.2 Systems Engineering Management Plan

a) The Contractor must prepare a Systems Engineering Management Plan (SEMP) which:

i) is in accordance with ISO/IEC/IEEE 24748-4 Systems and software engineering - Life cycle management - Part 4: Systems engineering planning;

ii) addresses in detail the following technical processes as a minimum:

A. system requirements definition process;

B. architecture definition process;

C. design definition process;

D. system analysis;

E. implementation process;

F. integration process;

G. verification process;

H. transition process; and

I. validation process;

iii) addresses speciality engineering including:

A. Safety in Design;

B. system integration management;

C. human factors;

D. reliability, availability, maintainability (RAM) analysis;

E. security and cybersecurity; and

F. environmental conditions;

iv) describes the planning of the technical management process aspects of the systems engineering program in their entirety;

v) describes its relationship with the Project Management Plan, Design Management Plan, Testing and Commissioning Management Plan and Construction Management Plan;

vi) describes how the systems engineering and systems safety processes are integrated to ensure they are appropriately coordinated; and

vii) includes issue-specific sub-plans, where required.

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

c) Where the Contractor engages a Subcontractor to undertake any aspect of the Contractor’s Activities, the Contractor must ensure that:

i) the SEMP incorporates all Subcontractor activities into a cohesive and integrated process; or

ii) the Subcontractor produces a SEMP which:

A. is aligned and coordinated to fully integrate with the Contractor SEMP; and

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

2.3 Configuration Management Plan

a) The Contractor must prepare a Configuration Management Plan which:

i) outlines the configuration management process to be undertaken in accordance with AS/ISO 10007 Quality management - Guidelines for configuration management;

ii) describes a configuration management program that is an integrated process for identifying, documenting, monitoring, evaluating, controlling, and approving all changes made during the life cycle of the Project, including critical information that is shared by more than one individual;

iii) describes:

A. the scope of configuration items including hardware, software, firmware and documentation;

B. the point at which configuration items comes under configuration control;

C. the Configuration Baselines to be developed and at what stages of the Project in accordance with section 4.6;

D. how configuration items will be identified;

E. the configuration management program;

F. the organisation supporting the configuration management program;

G. how the configuration management program will be conducted;

H. the methods, procedures, controls and tools to deliver effective configuration management;

I. how changes will be controlled;

J. status accounting;

K. how functional configuration audits (FCA) and physical configuration audits (PCA) will be conducted; and

L. how the Configuration Management Plan will be coordinated with subsystems developed by third parties.

iv) provides the Principal with a basis for review, evaluation and monitoring of the configuration management program and its proposed components; and

v) identifies the configuration management services and processes in support of the engineering management obligations of the Contract Documents.

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

c) The Configuration Management Plan may be included as a sub-plan to the SEMP.

2.4 Software Development Plan

a) The Contractor must prepare a Software Development Plan which:

i) describes the Contractor’s plans for conducting all software development effort, including the complete, integrated technical effort that the Contractor will apply to define, control, direct and integrate all software development activities during the carrying out of the Contractor’s Activities;

ii) plans software development activities in accordance with the requirements of AS ISO/IEC/IEEE 12207 Systems and software engineering - Software life cycle processes;

iii) identifies the software management and engineering services and processes to be delivered during the operational phase in support of the software engineering management obligations of the Contract Documents;

iv) provides a detailed description of the specific software engineering tasks and activities to be undertaken as described in AS ISO/IEC/IEEE 12207 Systems and software engineering - Software life cycle processes;

v) details the tasks and activities to be undertaken in relation to the supporting life cycle processes as detailed in AS ISO/IEC/IEEE 12207 Systems and software engineering - Software life cycle processes; and

vi) defines how the software development process will address the relevant requirements of AS 61508 Functional safety of electrical/electronic/programmable electronic safety related systems, and specifically AS 61508.3 Functional safety of electrical/electronic/programmable electronic safety related systems, Part 3: Software requirements, for identified safety critical systems.

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

c) The Software Development Plan may be included as a sub-plan to the SEMP.

2.5 Systems Integration Management Plan

a) The Contractor must prepare a Systems Integration Management Plan which:

i) describes the integration strategy, processes, personnel, tools, equipment, technology and any support services required to deliver the systems; and

ii) identifies the party responsible for ensuring that all system elements can be interfaced and integrated into a single system.

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

c) The Systems Integration Management Plan may be included as a sub-plan to the SEMP.

2.6 System Safety Program Plan

a) The Contractor must prepare a System Safety Program Plan (SSPP) for the system safety program described in 6.1 which describes:

i) the systems safety lifecycle;

ii) inputs and outputs for each lifecycle phase;

iii) management activities;

iv) technical activities;

v) roles and responsibilities;

vi) competency requirements;

vii) functional safety (as a placeholder unless a SIL is allocated);

viii) safety requirements identification and management;

ix) configuration management;

x) audit activities;

xi) functional safety assessment;

xii) systems safety assessment;

xiii) the alignment of system safety processes with Safety in Design processes;

xiv) specialist tools;

xv) stakeholders;

xvi) acceptance processes to be undertaken as part of the system safety program (SSP); and

xvii) how the requirements set out in section 6.1 will be achieved.

b) The SSPP must be integrated with the engineering and technical processes described in the SEMP.

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

d) The SSPP may be included as sub-plan to the SEMP.

2.7 Technical Review and Audit Plan

a) The Contractor must prepare a Technical Review and Audit Plan (TRAP) which:

i) must capture the project schedule for reviews and audits;

ii) identifies each technical review to be undertaken and for each technical review:

A. describes the scope of the technical review;

B. describes the entry and exit criteria;

C. identifies the completion checklist items; and

D. documents the responsibility of each party involved in the technical review;

iii) details how the specified technical reviews are to be undertaken, including for readiness reviews which are not covered in the Contract Documents;

iv) details various functional, physical and process audits to be undertaken, including processes, tools, personnel and timing of these audits;

v) describes the technical review processes, technical review stages and configurations (functional and physical) audit plan; and

vi) incorporates a milestone deliverables control matrix as described in Appendix A: Example milestone deliverables control matrix.

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

c) The TRAP may be included as a sub-plan to the SEMP.

d) The Contractor must conduct all technical review and audit activities in accordance with the approved TRAP.

2.8 Testing and Commissioning Management Plan

The Contractor must describe the testing and commissioning activities to be applied in a Testing and Commissioning Management Plan in accordance with PC-CN1 “Testing and Commissioning”.

2.9 Design Documentation

2.9.1 General

a) For the systems identified in the Contract Documents, the Contractor must develop and maintain accurate Design Documentation which supports traceability of the design process and the design decisions taken, and to enable effective maintenance and support of the system.

b) In addition to the requirements of PC-EDM1 “Design Management”, the systems Design Documentation must include:

i) the system Design Documentation necessary to define the integrated solution to be delivered;

ii) all systems, deliverables and functional components that comprise the Contractor’s Activities and project deliverables including the ITS infrastructure and network communications;

iii) definition of the detailed implementation of each subsystem including:

A. subsystem specifications;

B. third party device specifications; and

C. the relationships between the subsystems;

iv) specifications for subsystem functionality and performance formulated in terms that are quantifiable, verifiable and can be readily implemented;

v) specifications for interfaces to other subsystem and human-machine interfaces;

vi) interfaces to individual subsystems and key components;

vii) a requirements traceability matrix which demonstrates that all of the subsystem requirements have been captured in the design process and adequately resolved;

viii) a detailed design of each interface;

ix) a plan for implementing each interface;

x) all devices, networks, applications and systems; and

xi) a system design which integrates all system elements utilising open standards and does not require any proprietary elements in order to function, unless the Principal provides written approval otherwise.

2.9.2 Interface control document

In addition to the requirements of PC-EDM1 “Design Management”, the Design Documentation must include an interface control document for every interface identified in the system design and otherwise as defined in the Contract Documents, which must:

a) specify the interface requirements the participating systems must meet;

b) describe the concept of operations for the interface;

c) define the message structure and protocols that govern the interchange of data;

d) identify the communication paths along which data is expected to flow;

e) list assumptions where appropriate; and

f) provide the estimated size and frequency of data exchange.

2.9.3 Requirements verification matrix

In addition to the requirements of PC-EDM1 “Design Management”, for the systems identified in the Contract Documents the Design Documentation must include a requirements verification matrix (RVM), which must:

a) capture and describe in a summary format how and when each requirement of the Contract Documents will be verified by the Contractor; and

b) map verification activities that demonstrate the system meets each requirement of the Contract Documents.

2.9.4 System requirements specification

a) The Contractor must develop a targeted system requirements specification (SRS) tailored to their system solution and all associated systems that comprise the proposed solution, which will be subject to approval by the Principal.

b) In addition to the requirements of PC-EDM1 “Design Management”, the Design Documentation must include an SRS, which must:

i) encompass the system, all associated systems that comprise the solution and the existing systems and roadside equipment that interface with the systems to define an integrated and operational capability, including:

A. system and all subsystems software requirements;

B. system and all subsystems hardware requirements; and

C. system and all subsystems interface requirements to external systems; and

ii) include:

A. a complete definition of the system requirements and design constraints formulated in terms that are quantifiable and verifiable;

B. a separate section fully specifying all system interface requirements including system to system and human machine interfaces; and

C. an RTM which demonstrates that all requirements have been captured and addressed in the Contractor’s design process.

2.9.5 System specification

a) The Contractor must develop a targeted system specification tailored to their system solution and all associated systems that comprise the contracted solution, which will be subject to approval by the Principal.

b) In addition to the requirements of PC-EDM1 “Design Management”, the Design Documentation must include a system specification, which must:

i) encompass the contracted systems and the existing systems and roadside equipment that interfaces with the control system / systems to define an integrated and operational capability; and

ii) include:

A. specifications for system functionality and performance, formulated in terms that are quantifiable, verifiable and can be readily implemented;

B. specifications for system interfaces including system to system and human to system interface;

C. specifications for the requirements for individual subsystems and key components;

D. specifications for system and associated environmental requirements including positioning, access, power, ventilation, physical security, fire suppression, temperature and humidity control;

E. specifications for telecommunications requirements to support operation of the system including links between sites and to external systems; and

F. an RTM which demonstrates that all of the system requirements have been captured in the Contractor’s design process and adequately resolved.

2.10 Quality Management Records

In addition to the requirements of PC-QA1 “Quality Management Requirements” or PC-QA2 “Quality Management Requirements for Major Projects” (as applicable), the Quality Management Records must include all information required by the Contract Documents, including:

a) the system defects and issues register (SDIR);

b) objective quality evidence required by this Master Specification Part, including those set out in accordance with sections 5.9 and 5.11; and

c) the transition information set out in section 5.10b).

3 Systems engineering management

3.1 General

a) The Contractor must ensure that the structure and execution of the systems engineering management processes follows a logical sequence with one activity following the other in accordance with the guidance provided in AS/NZS ISO/IEC/IEEE 15288 Systems and software engineering - System life cycle processes.

b) Where the Project involves the delivery of multiple systems, individual systems may be at differing stages of the systems engineering life cycle at any particular point in time, but the Contractor must ultimately deliver an integrated system that meets the requirements of the Contract Documents.

c) The Contractor must:

   i) describe in the document deliverables:

      A. how the systems engineering processes for each individual system are integrated and programmed to deliver the completed and integrated Works;

      B. how the systems engineering processes are coordinated with and complement the design management activities specified in PC-EDM1 “Design Management”; and

      C. how the systems engineering processes are coordinated with and complement the construction management activities specified in PC-CN3 “Construction Management”; and

   ii) comply with the document deliverables required by this Master Specification Part.

d) Where the Contract Documents require digital engineering, the Contractor must:

   i) provide access to the Principal, Independent Design Certifier (where relevant) and Construction Verifier (where relevant) to all systems engineering management published information;

   ii) ensure that all reviews are undertaken within the digital engineering environment in accordance with PC-EDM5 “Digital Engineering”;

   iii) ensure that all testing, verification and inspection data is captured within the digital engineering environment in accordance with PC-EDM5 “Digital Engineering”; and

   iv) comply with PC-EDM5 “Digital Engineering”.

e) The Contractor must manage all information in accordance with the Contract Documents, including PC-PM5 “Information Management”.

3.2 Technical reviews

a) The Contractor's Activities must proceed in several phases, separated by technical review milestones as described in AS/NZS ISO/IEC/IEEE 15288 Systems and software engineering - System life cycle processes.

b) The Contractor must:

i) demonstrate its readiness to progress through successive phases by hosting a technical review (including design reviews) for each milestone listed in the TRAP;

ii) conduct design reviews for each milestone described in the TRAP in accordance with PC-EDM1 "Design Management";

iii) conduct implementation reviews for each milestone described in the TRAP in accordance with PC-CN3 "Construction Management"; and

iv) not proceed to a subsequent phase until the Principal has approved the outcomes of the corresponding technical review.

c) The Contractor must arrange and attend each technical review including, as a minimum:

i) system requirements review (SRR), including following the Design Basis requirements of PC-EDM1 "Design Management" prior to the finalisation of the technical review;

ii) preliminary design reviews (PDR), including following the Preliminary Design requirements of PC-EDM1 "Design Management" prior to the finalisation of the technical review;

iii) detailed design reviews (DDR), including following the Detailed Design requirements of PC-EDM1 "Design Management" prior to the finalisation of the technical review;

iv) final design reviews (FDR), including following the Final Design requirements of PC-EDM1 "Design Management" prior to the finalisation of the technical review;

v) operations services design review;

vi) test readiness reviews for each formal test phase;

vii) implementation readiness review (IRR);

viii) systems integration readiness review (SIRR); and

ix) operational readiness reviews (ORR) for each transition to the operations phase.

d) The Contractor must:

i) not commence a technical review until all entry criteria defined in the TRAP for that technical review have been met to the satisfaction of the Principal;

ii) prepare and distribute to attendees the agenda for each technical review a minimum of 3 Business Days prior to the technical review;

iii) prepare and distribute to attendees the draft minutes for each technical review for review and comment;

iv) prepare and distribute to attendees the minutes for each technical review that all attendees agree are a true and correct record of the technical review;

v) not declare a technical review complete until all exit criteria defined in the TRAP for that technical review and associated milestone have been met to the satisfaction of the Principal and minutes have been distributed; and

vi) comply with timeframes defined in the TRAP for the distribution of technical review agendas and minutes.

e) The acceptance of the draft minutes in accordance with section 3.2d)iii) will constitute a **Hold Point**. The finalised minutes in accordance with section 3.2d)iv) must not be submitted until the Contractor has proceeded beyond this Witness Point.

f) Technical reviews may be hosted virtually.

g) The Contractor must:

i) develop a technical audit program with sufficient audit activities to confirm the systems engineering processes:

A. have been effectively implemented; and

B. are achieving their intended purpose;

ii) report the findings of the audits to the Principal; and

iii) undertake the following, where deficiencies are identified from a technical audit:

A. conduct an impact analysis; and

B. develop an action plan to:

I. quarantine and address adverse impacts of the deficiency; and

II. correct the identified deficiency.

4 Technical management processes

4.1 General

a) The Contractor must perform the activities outlined in this section 4 as part of overall Contractor's Activities.

b) Where the requirements of this Master Specification Part are encompassed in Contract Documents deliverables, specific systems engineering deliverables may not be required or may be integrated or combined with the requirements of various deliverables, subject to the tailoring provisions in accordance with section 7.

4.2 Project planning

a) The Contractor must plan the systems engineering activities in accordance with ISO/IEC/IEEE 24748-4 Systems and software engineering - Life cycle management - Part 4: Systems engineering planning.

b) The Contractor must ensure that the systems engineering planning activities incorporate the agreed milestones and associated technical review activities agreed with the Principal and detailed in the TRAP in accordance with section 3.2.

c) The Contractor must ensure that the systems engineering activities are integrated into the broader Project Plan activities in accordance with the requirements set out in PC-PM1 "Project Management and Reporting".

d) The Contractor must ensure that the systems engineering processes are coordinated with and complement the design management activities specified in PC-EDM1 "Design Management" and the construction management activities specified in PC-CN3 "Construction Management".

4.3 Project assessment and control

a) The Contractor must conduct project assessment and control activities as part of the systems engineering process.

b) The Contractor must prepare a TRAP, outlining the technical reviews and audits to be undertaken.

4.4 Decision making

The Contractor must capture formal project and design decisions in the Design Documentation and ensure that there is traceability between the decisions made and their impacts on the Project and design in accordance with PC-EDM1 “Design Management”.

4.5 Risk management

a) The Contractor must undertake management of the technical risks as part of the integrated risk management framework in accordance with PC-PM4 “Risk Management”.

b) The Contractor must undertake technical risk analysis, identifying the potential technical risks and control measures to mitigate these risks as part of all technical review activities.

c) The Contractor must create, maintain, and regularly update a technical risk register throughout the Contractor’s Activities, either as part of the overarching project risk register, or as a separate register.

4.6 Configuration management

4.6.1 General

a) The Contractor must prepare a Configuration Management Plan that describes the configuration management process for the Contractor’s Activities.

b) The Contractor must employ configuration management in accordance with the Configuration Management Plan to manage the following:

   i) development and delivery of systems, and associated supplies necessary to support the systems; and

   ii) identification of the methods, procedures and controls used to assure effective configuration identification, change control, status accounting and audits of the total configuration, including hardware and software configuration items.

4.6.2 Configuration Baselines

a) For projects delivering complex systems, the system may be developed in stages and managed as a number of Configuration Baselines.

b) The Contractor must:

   i) develop the Configuration Baselines to enable the systems development to be reviewed in a logical path by following the processes in this Master Specification Part and formalising agreement with relevant stakeholders prior to the next process stage and Configuration Baseline;

   ii) ensure that formal change management control is undertaken and evidenced following the Configuration Baselining of any deliverable;

   iii) develop appropriate Configuration Baselines to cover systems design development, testing and delivery; and

   iv) indicate in the Configuration Management Plan the contents of these Configuration Baselines, when they are set in the Project life cycle and how they align with various design stages outlined in the Contract Documents.

c) Configuration Baselines as a minimum for the systems must include:

   i) system functional baseline (which defines the system’s functional, performance, interoperability, and interface requirements and the verifications required to demonstrate the achievement of those specified requirements) that must be established subsequent to the systems requirements review agreement;

   ii) system allocated baseline (which defines the configuration items which constitute the system and how they are allocated and assigned across lower-level configuration items,

with the functionality and performance of each configuration item identified at this level described in its preliminary design stage) that must be established subsequent to the preliminary design review agreement;

iii) system product baseline (which describes the configuration of the system during the production, fielding/deployment, and operational support phases of its life cycle) that must be established at the completion of final design review; and

iv) system Configuration Baseline (which defines the as-built and delivered products, consisting of as-built drawings, manuals, test documentation etc) that must be established at the completion of ORR.

d) The Contractor must also develop and update Configuration Baselines as a pre-requisite to every major test activity including:

i) Factory Acceptance Testing;

ii) Factory Integration Acceptance Testing;

iii) Site Acceptance Testing;

iv) System Integration Acceptance Testing;

v) Operational Scenario Testing; and

vi) User Acceptance Testing.

e) The Contractor may refer to section 4.2 for guidance on the alignment between Configuration Baselines and design stages.

4.7 Measurement

a) The Contractor must develop and apply project and system level performance measures parameters, such as technical performance measures, to ensure satisfactory Project progress and success of each specified system and the integrated systems.

b) The parameters in accordance with section 4.7a) must be identified early, monitored, and tracked to provide greater details on project progress and risks associated with systems development.

c) The Contractor must develop key technical parameters which can be measured during testing and commissioning and which may be used during technical reviews and audits. These parameters include:

i) system and integrated system response times;

ii) overall systems availability; and

iii) system RAM.

4.8 Quality assurance

a) The Contractor must maintain a systems defects and issues register (SDIR) throughout the Project as part of the broader quality assurance activities set out in PC-QA1 “Quality Management Requirements” or PC-QA2 “Quality Management Requirements for Major Projects” (as applicable).

b) The Contractor must:

i) ensure the SDIR captures all the issues and problems which occurred during various technical processes and activities;

ii) ensure that the SDIR includes the following details for each item in the register:

A. a unique Defect/issue number;

B. the activity where an issue has been identified;

C. a title;

D. a description, including photos where applicable;

E. the proposed resolution;

F. the actions taken;

G. defective item identification, including version;

H. a workaround (if applicable);

I. the proposed closure date;

J. the closure date;

K. the acceptance date;

L. any comments; and

M. the status.

c) The Contractor must:

i) provide the SDIR to the Principal monthly, unless otherwise approved by the Principal; and

ii) provide a copy of the final SDIR as part of the validation process and as part of the Quality Management Records.

4.9 Work breakdown structure

For all systems, the Contract Program must be developed using the following structure and description:

a) the entire system required for the Works must be represented at a single level of the work breakdown structure;

b) all system major elements of the goods (products) and associated activities (including project management, systems engineering and system test and evaluation) must be represented one work breakdown structure level down from the entire system level; and

c) the work breakdown structure must be extended from the level described in section 4.9b) to the point where increments of work of manageable size can be defined, ensuring that all work efforts by all participants is represented in the structure and avoids extending the into a detailed checklist of piece parts.

5 Technical processes

5.1 General

This section 5 covers the technical elements and systems engineering methodology required to execute design and engineering activities, including supporting tasks. These requirements and activities in this section 5 are specific and technically focussed.

5.2 Needs and requirements definition

a) The Contractor must undertake concept of operations activities to clarify user needs for specific applications and scenarios. The concept of operations activities must cover operations and maintenance and be based on a higher level or broader concept of operations documentation, where available.

b) The concept of operations documentation must be maintained, reviewed and updated at each design stage and at Handover. All changes to existing concept of operations documentation must be approved by the Principal.

c) The Contractor must prepare concept of operations documents which capture the outcomes of concept of operations activities and submit these documents to the Principal for review with the associated Design Documentation.

d) The Contractor must review the Contract Documents requirements against the requirements derived from the concept of operations activities and identify any conflicts. All conflicts identified must be detailed in the concept of operations documentation and resolved during design development to provide an outcome that complies with the requirements of the Contract Documents and is acceptable to the Principal.

5.3 System requirements definition

a) The Contractor must undertake a system requirements definition activity.

b) The Contractor must, on the basis of the needs and requirements in the concept of operations and Contract Documents, establish system-level technical requirements, including functional and performance requirements, system constraints and quality factors.

c) The Contractor must prepare requirements specifications covering systems and any specific hardware and software requirements. The Contractor must undertake a requirements analysis to ensure that the developed requirements are unique, clear, unambiguous, non-conflicting and are verifiable.

d) The Contractor must:

   i) manage the requirements throughout various project stages in accordance with the Configuration Management Plan;

   ii) manage Configuration Baselines of the requirements specifications; and

   iii) establish and maintain a change management process to ensure that any changes to requirements are clarified and agreed by all stakeholders, including the Principal and Third Parties.

e) The Contractor must manage traceability between various requirements documents and their allocation as the design develops. The Contractor must provide a requirements traceability matrix (RTM), which shows requirements traceability between developed specifications and design.

f) The Contractor must use a suitable and recognised requirements management tool for all requirements management as described in section 5.15.

g) The RTM and requirements verification matrix (RVM) may be combined in a single matrix. RVM requirements are detailed in section 5.9.

h) The Contractor must conduct requirements engineering activities in accordance with ISO/IEC/IEEE 29148 Systems and software engineering - Life cycle processes - Requirements engineering.

i) The Contractor must capture all necessary system-level design and design decisions made to provide an integrated system and prepare a subsystem design description (SSDD) document. The SSDD document must detail the system or subsystem wide design, operating environment, system and subsystem architecture design, human machine interfaces, external interfaces and any system level design decisions made.

j) In support of the requirements analysis, the Contractor must produce the following as part of the SRR technical review:

   i) systems requirements specification (SRS);

   ii) software requirements specification;

   iii) hardware requirements specification;

   iv) SRS RTM;

   v) SRS RVM;

vi) SSDD;

vii) a specifications tree, illustrating the specifications envisaged to be developed and their relationship with each other; and

viii) layout drawings (concept), covering the design at a conceptual level to ensure that systems requirements can be achieved by the physical design.

k) The Contractor must give the Principal access to the system requirements:

i) where the Contract Documents require digital engineering, through digital engineering tools in accordance with PC-EDM5 “Digital Engineering”; or

ii) where the Contract Documents do not require digital engineering, through a periodic output file from the requirements management tool in a native format approved by the Principal for the duration of the Project.

5.4 Architecture definition

a) The Contractor must undertake an architecture definition activity.

b) The Contractor must, on the basis of the requirements developed during the systems requirements definition stage, decompose and derive relevant lower-level subsystem requirements and develop a systems architecture design, both in functional and physical aspects.

c) The systems architecture design must include both hardware and software elements and must be developed to ensure that requirements can be met by a physical architecture, physical systems or components.

d) During the architectural definition stage, derived functional and performance requirements must be allocated to each functional and physical element in the architecture.

e) System requirements must be reviewed through an iterative process to ensure that high-level requirements are complied with.

f) The Contractor must capture systems requirements which apply to the interfaces and control and monitoring of other equipment. These requirements must form part of the requirements of the systems engineering processes.

g) For projects modifying operational systems, such as system upgrades, enhancements and replacements, the Contractor must assess the impact which the ’new‘ design has on the existing infrastructure, equipment, operational and maintenance processes and services and capture these in a design impact statement document. This document must also include a checklist to ensure that the full impact of the Project on the existing asset has been assessed and captured for future reference.

h) The Contractor must identify necessary systems interfaces and the network communications topology and carry out specialist engineering activities (such as human factors (HF), system safety and cybersecurity) at a high-level to ensure the suitability of the design.

i) In developing the systems architecture, the Contractor must produce the following as part of the PDR technical review:

i) a subsystem requirements specifications (SSRS);

ii) a functional architecture design;

iii) a physical architecture design;

iv) a design impact statement;

v) the interface definitions, including interface control documents and N^2 diagram;

vi) a HF specification;

vii) a network architecture design, including:

A. the topology diagram;

B. equipment connection diagrams;

C. high-level design description documents; and

D. initial cables and conduits plans;

viii) layout drawings (concept), covering design at a conceptual level to ensure that systems requirements can be supported by the physical design;

ix) power and communications single line diagrams;

x) an initial HF design, including human machine interface;

xi) an initial RAM analysis;

xii) an initial asset register;

xiii) safety assurance;

xiv) an initial drawings and documents list;

xv) an initial asset management strategy;

xvi) an updated RTM, showing traceability between SRS and SSRS requirements;

xvii) an updated RVM, providing analysis against SSRS requirements; and

xviii) the security architecture design.

j) The Contractor must use the architecture design as the basis and design input for the design definition activity.

5.5 Design definition

a) The Contractor must undertake a design definition activity.

b) The Contractor must, on the basis of the architecture design developed during architecture definition stage, develop the detailed design. The detailed design must provide sufficient systems and equipment information and data which enable the products to be built, manufactured, constructed, installed and maintained.

c) The Contractor must develop the design by an iterative process, to satisfy functional and physical architecture(s) requirements, systems requirements and high-level requirements. The Contractor must align the Design Documentation produced during this activity with the architecture design elements and show the traceability between activities.

d) For projects modifying operational systems, the Contractor must assess current products baselines, equipment and services and ensure that the ‘new’ design captures all necessary changes to the existing state.

e) The Contractor must design all necessary systems interfaces, network communications designs and undertake supporting specialists engineering activities, such as HF, RAM, safety assurance and security, at a detailed design level to ensure suitability of the design.

f) Due to the nature of the design definition stage and potential alignment with other disciplines, the level of details required and the need to engage stakeholders and users, the design definition stage must comprise at least the Preliminary Design and Final Design stages to ensure that the Final Design aligns with project requirements and user expectations.

g) In support of developing each design stage, the Contractor must produce the following:

i) layout drawings;

ii) installation design;

iii) design calculations, electrical, mechanical and structural;

iv) network design, including detailed design documents;

v) software design documents;

vi) HF design;

vii) cables and conduits plans;

viii) power and communications single line diagrams;

ix) cable schedules;

x) interface requirements specification / interface control document;

xi) RAM analysis;

xii) drawings and documents list;

xiii) asset register;

xiv) safety assurance artefacts; and

xv) other artefacts required by the Contract Documents.

5.6 System analysis

a) The Contractor must perform system analysis activities during the design process to assist in making design decisions, selecting products, developing cost effective solutions and optimisation of necessary processes.

b) The Contractor must capture the results of the system analysis activities as background, rationales and design decisions in the architecture and design documentation artefacts developed in accordance with sections 5.4 and 5.5.

5.7 Implementation

a) The Contractor must undertake implementation activities to provision and commission the specified systems and products (hardware and software) which meet the requirements of the specified systems and design.

b) The Contractor must develop an implementation procedure that details the implementation strategy, processes, constraints, personnel, tools, equipment, technology and any support services required to complete the implementation activities.

c) For projects modifying operational systems, the Contractor must assess current systems, equipment and services and, where possible, provide commonality and interoperability between ’current‘ and ’new‘ systems/items.

d) The Contractor must undertake an implementation readiness review (IRR) with relevant stakeholders to assess readiness to commence the implementation activities.

e) The IRR may be a desktop documentation review, a formal stakeholder’s meeting/workshop or a combination of both.

f) The Contractor may make use of other approved processes in the design and construction processes (e.g. Issued for Construction Design Documentation and Construction Documentation processes as set out in PC-EDM1 “Design Management” and PC-CN3 “Construction Management”) to fulfill the requirements of this section 5.7.

5.8 Integration

a) The Contractor must undertake systems integration activities.

b) The Contractor must, on the basis of the detailed design, provide an integrated system, involving the interfacing and integration of specified lower-level systems and products (both hardware and software), which meets the requirements of the specified systems, architecture design and detailed design.

c) The Contractor must develop a Systems Integration Management Plan (SIMP), which outlines the integration strategy, processes, personnel, tools, equipment, technology and any support services required. The SIMP must assign the party responsible for ensuring all system elements can be interfaced and integrated into a single system, such as the Systems Integrator (refer to section 6.2).

d) For projects modifying operational systems:

   i) the Contractor must assess current systems, equipment and services and, where possible, prepare a systems integration strategy suitable for the operational environment; and

   ii) the systems integration stage can be executed at off-site premises (development site), using techniques, tools and equipment which replicate as close as possible the current operational environment.

e) The Contractor must undertake a systems integration readiness review (SIRR) with relevant stakeholders to assess readiness to commence the integration stage, based on the outputs delivered from earlier stages, awareness and acceptance of applicable risks and any known issues. The SIRR can be a desktop documentation review, a formal stakeholder's meeting/workshop or a combination of both.

5.9 Verification

a) Verification activities are included with in this Master Specification Part for consistency with AS/NZS ISO/IEC/IEEE 15288 Systems and software engineering - System life cycle processes. Depending on project size, duration and number of systems, there may be a number of testing and commissioning stages covering these systems, which must be undertaken in accordance with the Contract Documents, including PC-CN1 "Testing and Commissioning".

b) The Contractor must incorporate verification activities in the overall systems engineering process to ensure that the delivered systems and system elements meet specified requirements and characteristics.

c) The Contractor must ensure that all requirements are covered by verification activities that include:

   i) inspection;

   ii) analysis;

   iii) demonstration; or

   iv) testing.

d) The Contractor must ensure that all testing activities are developed in accordance with PC-CN1 "Testing and Commissioning".

e) The Contractor must provide objective quality evidence to substantiate the verification in accordance with PC-QA1 "Quality Management Requirements" or PC-QA2 "Quality Management Requirements for Major Projects" (as applicable) and as part of the Quality Management Records.

f) The Contractor must develop an RVM to manage traceability between specified requirements and relevant acceptance tests, other tests and associated artefacts which form part of the verification and validation regime.

g) The RVM must contain details of verification analysis, verification results and issues relevant to each requirement.

h) The RVM must include details of non-testing verification activities including analysis and demonstration to ensure there is 100% coverage of the requirements.

i) The Contractor must:

i) undertake FCAs and PCAs in accordance with the Configuration Management Plan; and

ii) use the RVM to support FCAs and PCAs.

j) The Contractor must undertake a test readiness review prior to commencing any testing and commissioning activity described in PC-CN1 “Testing and Commissioning” in accordance with section 3.2.

5.10 Transition

a) The Contractor must undertake the activities listed in the Contract Documents, which cover transition from implementation to operations.

b) In addition to Master Specification Part PC-CN2 “Asset Handover”, and as a condition precedent to Handover, the Contractor must deliver the following as part of the Quality Management Records:

i) RVMs for various specifications, including systems, subsystems and interface specifications;

ii) SDIR;

iii) software release notes;

iv) FCA report for the complete transitioned system; and

v) PCA report for the complete transitioned system.

5.11 Validation

a) Validation activities are included within this Master Specification Part for consistency with AS/NZS ISO/IEC/IEEE 15288 Systems and software engineering - System life cycle processes. Depending on project size, duration and number of systems, there may be a number of testing and commissioning stages covering these systems.

b) The Contractor must ensure that all stakeholder requirements are covered by validation activities that include:

i) inspection;

ii) analysis;

iii) demonstration; or

iv) testing.

c) The Contractor must incorporate validation activities in the overall systems engineering process to ensure that systems and equipment delivered by the Project meet user objectives, outcomes and stakeholder requirements in its intended operational environment.

d) The Contractor must ensure that all validation testing activities are developed in accordance with PC-CN1 “Testing and Commissioning”.

e) The Contractor must provide objective quality evidence to substantiate the validation in accordance with PC-QA1 “Quality Management Requirements” or PC-QA2 “Quality Management Requirements for Major Projects” (as applicable) and as part of Quality Management Records.

f) Prior to commencing validation activities, the Contractor must develop:

i) an operational readiness evaluation plan; and

ii) testing and commissioning documentation, as set out in PC-CN1 “Testing and Commissioning” and PC-QA1 “Quality Management Requirements” or PC-QA2 “Quality Management Requirements for Major Projects” (as applicable).

5.12 Operational readiness

a) In accordance with section 3.2, the Contractor must conduct an ORR to assess readiness to commence operations.

b) As a condition precedent to Handover and before operations can commence in accordance with the Contract Documents the Contractor must:

   i) demonstrate that all risks and hazards pertaining to operations have been identified, assessed and addressed;

   ii) ensure that all enabling functions are available and that the systems can perform their services and meet specified systems, architecture design and detailed design requirements; and

   iii) confirm with operators and maintainers that all activities necessary for safe and effective operations have been completed.

c) The Contractor must deliver the following as part of the ORR:

   i) operation and maintenance documents in accordance with the Contract Documents and PC-CN2 “Asset Handover”; and

   ii) SDIR in accordance with section 4.8.

5.13 Maintenance

a) The Contractor must ensure that all maintenance activities are documented in accordance with PC-CN2 “Asset Handover”.

b) As part of the ORR, the Contractor must verify the readiness of the maintenance and support organisation and supporting equipment and systems to commence maintenance activities.

5.14 Through-life support

a) The Contractor must prepare a through-life support plan and submit as part of the asset handover activities.

b) The through-life support plan must capture all the requirements necessary to support, sustain and update the systems so that they can function as required during their design and operational life.

5.15 Requirements management database

a) The Contractor must maintain a requirements management database (RMD) for the duration of the Contract Documents.

b) The Contractor must provide the necessary reports and outputs from the RMD to support the activities described in this Master Specification Part.

c) The Contractor must describe the intended use of the RMD in the SEMP.

d) The RMD must utilise a commercially available software platform with requirements and test management as its primary function.

e) The RMD must demonstrate traceability between the requirements at various levels.

f) The RMD must be used to capture traceability of verification and validation activities, issues, design decisions, engineering changes, technical performance measures, requirement clarification requests, and configuration audit results.

g) The Contractor must use the RMD to automatically generate the RTM and RVM artefacts required by this Master Specification Part.

h) The Contractor must provide the Principal with remote access to the RMD, including the ability to generate reports for the duration of the Contract Documents.

i) The Contractor must deliver the RMD to the Principal as a condition precedent to Handover. The RMD must include:

   i) all utilities, macros, scripts, tools, reports, templates etc required to operate and maintain the RMD;

   ii) all documentation required to rebuild, operate and maintain the RMD, including a database design description; and

   iii) details of the administrator (or equivalent level) user accounts.

j) The Contractor must transfer the RMD service account/licenses to the Principal. The party responsible for all fees and charges for the first twelve months from the date of transfer must be as identified in the Contract Documents.

k) The Contractor must make the RMD available for auditing on a periodic basis to assist in ensuring data integrity. The audits must determine if the correct specification versions are being used by all parties and that the requirements are fully traced and verified for compliance.

6 Specialty engineering processes

6.1 System safety

a) Systems safety is the application of engineering and management principles, criteria and techniques to optimise safety. The goal of systems safety is to optimise safety by:

   i) identifying safety related risks; and

   ii) eliminating or controlling safety related risks by design and or procedures, based on acceptable system safety precedence (such as the FAA System Safety Handbook).

b) The Contractor must undertake system safety assurance activities to provide confidence that the delivered systems are safe for all stakeholders including motorists, operators and maintainers.

c) The Contractor must implement a SSP that:

   i) complies with AS 61508.1 Functional safety of electrical/electronic/programmable electronic safety-related systems, Part 1: General requirements;

   ii) is integrated with the Safety in Design requirements and processes detailed in PC-EDM2 “Safety Management in Design”;

   iii) is integrated with the design management process detailed in PC-EDM1 “Design Management”; and

   iv) is integrated with the construction management process set out in PC-CN3 “Construction Management”.

d) The Contractor must ensure that the SSP:

   i) identifies and analyses intrinsic hazards and hazards expected to arise through the life of the system;

   ii) develops risk mitigation and management strategies for each hazard;

   iii) integrates requirements for risk mitigation strategies into design and product deliverables;

   iv) verifies the implementation of risk mitigation and management strategies for the delivered products; and

   v) tracks hazards from identification through to verification of mitigation and management strategies.

e) The Contractor must maintain an accurate hazard log at all times.

f) The Contractor must develop and deliver the following hazard assessments:

i) an initial hazard and risk assessment. Based on comprehensive hazard scenarios, this assessment must cover initial hazards identification, probable mitigations and preliminary assessment of risk reduction measures. This assessment outcome must cover high-level design issues, use of appropriate standards, design methodology and development of safety requirements and safety features;

ii) a preliminary hazard and risk assessment. This assessment must be based on the initial hazard and risk assessment and cover review of Preliminary Design, identification of hazards from design resilience, robustness, installation, testing, operations, maintenance and disposal points of view and determination of appropriate control measures; and

iii) a hazard and risk assessment. This assessment must be based on the preliminary hazard and risk assessment and cover review of critical aspects of Final Design to ensure that necessary control measures are captured in the design and that appropriate safety verification activities are undertaken.

g) When undertaking the safety assessment activities, the Contractor must comply with the following:

i) determination of hazards and risks must be in accordance with:

A. T MU MD 2003 GU Quantified Safety Risk Assessment; and

B. AS 61508.5 Functional safety of electrical/electronic/programmable electronic safety-related systems, Part 5: Examples of methods for the determination of safety integrity levels;

ii) the determination of hazards and risks must include qualitative and quantitative methods, such as:

A. hazard and operability studies in accordance with AS IEC 61882 Hazard and operability studies (HAZOP studies) - Application guide;

B. failure modes effects and criticality analysis (FMECA) in accordance with T MU AM 01002 MA Maintenance Requirements Analysis Manual, and

C. fault tree analysis (FTA) and layer of protection analysis (LOPA); and

iii) the determination and allocation of safety requirements for the systems must comply with AS 61508.1 Functional safety of electrical/electronic/programmable electronic safety-related systems, Part 1: General requirements.

h) Where a function implemented by a control system is allocated a safety integrity level (SIL), that control system must be considered as a safety-related control system and engineered in accordance with AS 61508.1- Functional safety of electrical/electronic/programmable electronic safety-related systems, Part 1: General requirements and:

i) the definitions of systems architectural description must be in accordance with AS 61508.2 Functional safety of electrical/electronic/programmable electronic safety-related systems, Part 2: Requirements for electrical/electronic/programmable electronic safety-related systems;

ii) the definitions of systems software architectural description must be in accordance with AS 61508.2 Functional safety of electrical/electronic/programmable electronic safety-related systems, Part 2: Requirements for electrical/electronic/programmable electronic safety-related systems;

iii) safety requirements for systems software functions must be in accordance with AS 61508.3 Functional safety of electrical/electronic/programmable electronic safety-related systems, Part 3: Software requirements;

iv) the safety requirements specification must indicate for each safety function whether it is a continuous, high or low demand function, its demand rate, its tolerable failure rate and its SIL to provide the required risk reduction. Integrity requirements allocation must

be performed prior to systems development and must be available as an input to systems design;

v) a SIL verification activity must be undertaken to verify the design for each safety instrumented system satisfies:

A. architectural constraints;

B. random failure rate; and

C. systematic safety integrity;

vi) the SIL verification activity must be undertaken independent of the Designers;

vii) the SIL verification results must be provided prior to the manufacture of the safety-related control system and included in the safety assessment report;

viii) adopt a proof test frequency of 12 months, or where more frequent proof-testing is proposed, it must:

A. be justified and approved by the Principal;

B. run automatically; and

C. automatically report failures; and

ix) functional safety assessments must be conducted in accordance with AS 61508.1 Functional safety of electrical/electronic/programmable electronic safety-related systems, Part 1: General requirements after completion of:

A. specification of derived safety requirements for identified safety related control systems;

B. completion of the design of each of the safety related control systems; and

C. after testing and commissioning of safety related control systems and prior to Handover.

i) The Contractor must:

i) complete a 'final inspection walkthrough' with relevant stakeholders, including operations and maintenance personnel, to ensure that the final installed product is safe to operate and maintain; and

ii) complete a safety assessment report(s), as a condition precedent to Handover, that details the overall SSP undertaken for the Project and must include:

A. all SSP artefacts developed as part of the Project in one document; and

B. the final list of residual hazards to be transferred to the operators and maintainers.

j) The submission of the safety assessment report to and approval from the Principal in accordance with section 6.1i)ii) will constitute a **Hold Point**. Release of this Hold Point is a condition precedent to Handover.

6.2 Systems integration management

a) The Contractor must undertake a systems integration management activity.

b) The Contractor must ensure appropriate management of the system integration activity and that the integration stage provides the capability to meet specified systems requirements.

c) The Contractor must assign a Systems Integrator for the integration of the various systems and the delivery of an integrated system (**Systems Integrator**).

d) During the systems integration management activity, the Contractor must:

i) have a clear acknowledgement and identification of systems integration design activities for the Project and all associated activities;

ii) have a clear identification of the agencies and individuals responsible for systems integration across the entire systems deliverables for the Project. This includes integration of all internal systems elements, as well as integration of the Contractor's systems with other Principal or third party systems;

iii) describe the role of individual 'black box' or subsystem elements suppliers, such as Subcontractors supporting the Systems Integrator, in the overall systems integration function;

iv) include well-defined and documented interface specifications for system elements and subsystems (addressing multiple levels within the open systems interconnection 7-layer model);

v) include clearly defined work boundaries between differing system elements vendors;

vi) address the appropriate level of systems integration design effort required to ensure the successful integration of subsystem elements into the overall system and the achievement of overall system performance requirements;

vii) for mature commercial off the shelf products, the level of customisation, configuration, and adaptation required to account for their operations under the unique operational and installation environment of the Project;

viii) include the appropriate level of systems integration testing required to ensure the successful integration of subsystem elements into the overall system to enable its performance requirements to be achieved; and

ix) identify specific systems integration risks for the Project.

6.3 Human factors

a) The Contractor must engage relevant stakeholders, such as operations and maintenance staff and human factors (HF) subject matter experts, to undertake HF workshops, as part of the design process to assist with achieving agreement on the planned human factors engineering design for the system including the interaction of personnel operating, maintaining or using the equipment (visual, audio and tactile) for each of the designed and implemented systems and products.

b) The Contractor must specify HF requirements and ensure that they form part of the systems requirements and are managed as part of systems engineering methodology.

c) The Contractor must deliver the following:

i) HF specification(s);

ii) HF design; and

iii) HF issue log (HFIL).

d) The Contractor must undertake all activities necessary (such as development of prototype(s), mock ups and trials) to enable early engagement and input from users so as to ensure that the HF aspect is fit for purpose and meets the user's needs.

6.4 Reliability, availability and maintainability

a) The Contractor must undertake a RAM activity, which must include an analysis to verify the RAM of the complete roadway / motorway and specific systems, in accordance with the requirements of the Contract Documents.

b) The Contractor must establish with the stakeholders (including the Principal and relevant Third Parties) an agreed definition of system failure as the basis for availability analysis.

c) The specified availability criteria must become the key design parameters for systems design process, including the identification and selection of appropriate subsystems.

d) Reliability and availability criteria and associated iterative design practices must be adopted as the basis for the RAM analysis undertaken by the Contractor.

e) The Contractor must adopt Best Industry Practice design, along with the use of appropriate industry standard computer design tools, for developing RAM analysis.

f) RAM analysis must include availability requirements identified for each key subsystem component.

g) The RAM analysis must include availability modelling at a functional level to verify compliance to availability requirements specified in the Contract Documents. Each function must be modelled 'end to end' and include all systems, subsystems, interfaces, services and field equipment required to perform the function.

h) RAM analysis must also cover disaster recovery aspects, including:

   i) the use of duplicated and physically isolated operational command and control systems, central processing systems and data storage facilities; and

   ii) the use of redundant sources of electricity, communications paths, and other essential services.

i) The Contractor must document RAM analysis during design and provide the documentation to stakeholders (including the Principal and relevant Third Parties) for review.

j) The Contractor must produce the following:

   i) as part of the SRR, an initial RAM analysis;

   ii) as part of the PDR, a preliminary RAM analysis; and

   iii) as part of the FDR and the Detailed Design Documentation submission, a finalised RAM analysis.

k) The Contractor must engage specialist RAM subject matter experts to undertake RAM analysis.

l) The Contractor must submit to the Principal, RAM calculations and models in native formats.

m) The Contractor must perform a FMECA in accordance with T MU AM 01002 MA Maintenance Requirements Analysis Manual, and Best Industry Practice.

n) The Contractor must verify that the outcomes from the FMECA analysis to mitigate the consequences of failures in safety and mission critical systems have been incorporated into the design.

o) The Contractor must produce the following:

   i) as part of the SRR, an initial FMECA analysis;

   ii) as part of the PDR, a preliminary FMECA analysis; and

   iii) as part of the FDR and the Detailed Design Documentation submission, a finalised FMECA analysis.

p) The Contractor must use the outputs of the RAM process to develop the maintenance strategy for the system including:

   i) the schedule of spares; and

   ii) the Code of Maintenance Standards in accordance with the PC-CN2 "Asset Handover".

6.5 Security and cybersecurity

The Contractor must undertake a security activity, covering physical security and cyber security, to ensure the provided systems comply with:

a) the Contract Documents;

b) RD-ITS-D1 "Design of Intelligent Transport Systems (ITS)"; and

c) the South Australian Government Cybersecurity Framework (SACSF).

6.6 Environmental conditions

a) The Contractor must undertake an environmental conditions activity, covering the environmental conditions and elements to which the systems will be exposed after installation and during operation. The activity must also cover any environmental requirements specified in the Contract Documents.

b) The Contractor must specify the applicable environmental conditions under which the equipment will be required to operate and still meet the allocated functional and performance requirements.

c) The Contractor must include all environmental conditions as part of the initial requirements analysis stated as operational constraints.

d) Any derived requirements must be managed as part of systems engineering processes.

e) The Contractor must engage environmental conditions subject matter experts during design review and project life cycle to manage various environmental conditions, including:

i) vibration;

ii) temperature;

iii) humidity;

iv) dust;

v) weather;

vi) electromagnetic interference / electromagnetic compatibility;

vii) flooding; and

viii) bushfires.

7 Tailoring provisions

a) The level of systems engineering applied to the Project must be detailed in the SEMP or may be detailed in the Project Management Plan where approved by the Principal in accordance with PC-PM1 “Project Management and Reporting” (depending on the Project size).

b) Either the SEMP or the Project Management Plan (as determined in accordance with section 7a)) must address the requirements of this Master Specification Part.

c) The systems engineering processes specified in this Master Specifications Part may be scaled and tailored, where specified in this Master Specification Part, or as approved by the Principal, with appropriate level of effort and rigour, to suit project risk, outcomes, schedule and budget cost profile.

d) The approval from the Principal in accordance with section 7c) to scale or tailor the systems engineering process will constitute a **Hold Point**. Scaling or tailoring of the systems engineering processes must not occur until this Hold Point is released.

e) Although the level of tailoring will depend on Project drivers, the level of tailoring must be determined collectively by personnel with appropriate systems engineering, systems and road industry knowledge and experience, including appreciation of the complete life cycle and operations and maintenance principles and practices.

f) The Contractor must describe the tailoring of the requirements of this Master Specification Part in the SEMP and in conformity with this section 7.

g) The following equipment does not need to undergo the processes for equipment compliance as detailed in this Master Specification:

i) all equipment listed on the Department Approved Products List; and

ii) any nominated equipment in the Master Specification,

as long as it complies with the following:

iii) the Contract Documents; and

iv) any relevant exclusions.

h) Department approved products and nominated equipment will be subject to the processes detailed in this Master Specification Part, when integrated as part of a system.

8 Hold Points

Table PC-EDM6 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-EDM6 8-1 Hold Points

Section reference	Hold Point	Documentation or construction quality	Review period or notification period
3.2e)	Draft formal technical review minutes	Documentation	10 Business Days review
6.1j)	Safety assessment report	Documentation	20 Business Days review
7d)	Scaling and tailoring systems engineering processes	Documentation	20 Business Days review

9 Appendix A: Example milestone deliverables control matrix

a) The milestone deliverables control matrix defines a series of events that must occur and document deliverables that must be presented, associated with each technical review proposed in section 3.2.

b) The milestone deliverables control matrix specifies the document deliverable that are required as pre-requisites to entry for each technical review together with the notice period necessary to provide the Principal adequate review time before the review. Note that a number of the document deliverables may need to be updated and presented as pre-requisites for subsequent technical reviews.

Table PC-EDM6 9-1 Example milestone deliverable control matrix

System life cycle processes	Process	Deliverables	Milestone
Technical management process	Project planning	Systems Engineering Management Plan	Release of the relevant Project Plan Hold Point
		System Safety Program Plan	Release of the relevant Project Plan Hold Point
		Testing and Commissioning Management Plan	Release of the relevant Project Plan Hold Point
		Systems Integration Management Plan	Release of the relevant Project Plan Hold Point
		Software Development Plan	Release of the relevant Project Plan Hold Point
	Project assessment and control	TRAP	Release of the relevant Project Plan Hold Point
	Risk management	Risk register	
	Configuration management	Configuration Management Plan	Release of the relevant Project Plan Hold Point
Technical processes	Needs and requirements definition	Concept of operations	a) RFP b) Release of the relevant Project Plan Hold Point
	System requirements definition	SRS	SRR
		Software requirements specification	SRR
		RTM	SRR
		RVM	SRR
	Architecture definition	System design description	PDR
		Interface control document	PDR
		Functional architecture design	PDR
		Physical architecture design	PDR
		Security architecture design	PDR
		HF design - initial	PDR

System life cycle processes	Process	Deliverables	Milestone
		HFIL	PDR
		RAM analysis - initial	PDR
		FMECA - initial	PDR
		Safety in Design report - initial	PDR
	Design definition	System design description	DDR
		SSDD	DDR
	Implementation	ITPs	DDR
	Integration	SIMP	FDR
	Verification	FAT Plan	PDR
		FAT procedure	DDR
		FAT report	
		FCA report (post FAT)	
		PCA report (post FAT)	
		FIAT Plan	PDR
		FIAT procedure	DDR
		FIAT report	
		PCA report (post FIAT)	
		SAT Plan	PDR
		SAT procedure	DDR
		SAT report	
		FCA report (post SAT)	
		PCA report (post SAT)	
		SIAT Plan	PDR
		SIAT procedure	DDR
		SIAT report	
		PCA report (post SIAT)	