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Metrolinx
System Definition: Product Description

MX-SEA-PD-106

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Date: April 2023

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Amendment Record

Revision	Date (DD/MM/YYYY)	Description of changes

Preface

This is the first edition of the Metrolinx System Definition Product Description (MX-SEA-PD-106). It forms part of a suite of guidance documents that describe the procedures to be followed to comply with Metrolinx's Reliability, Availability, Maintainability and Safety (RAMS) requirements.

The purpose of this document is to describe the System Definition documentation that project proponents may need to generate when they are undertaking a technical change to the railway system or modifying a maintenance regime or undertaking an operational change to the railway system.

Suggestions for revision or improvements can be sent to the Metrolinx Systems Engineering Assurance office at Engineering.Assurance@metrolinx.com. The Director of the Systems Engineering Assurance office authorizes the changes. Include a description of the proposed change, background of the application and any other useful rationale or justification. Be sure to include your name, company affiliation (if applicable), e-mail address, and phone number.

April 2023

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Documents

Table 1 Supporting Documents

Document Number	Document Title	Relation
BS EN 50126-1:2017	Railway Applications – The Specification and Demonstration of Reliability, Availability, Maintainability and Safety (RAMS) (PHASE 1: Adoption of European Standard EN 50126-1:2017)	Parent Standard
MX-SEA-STD-100	RAMS Process Standard	Supporting Standard
MX-SEA-GDC-106	System Definition Guidance	Guidance
MX-SEA-TPL-106	System Definition Template	Template
MXSD-SSA-L1-STD-0001	Railway Risk Assessment Standard	Supporting Standard
ISO 9001:2015	Quality management systems — Requirements	Supporting Standard
MX-SEA-TOR-001	Metrolinx System Review Panel (SRP) Terms of Reference (ToR)	Review Panel ToR
April 5, 2023	Metrolinx Safety Certification Committee (SSC) Terms of Reference (ToR)	Certification Committee ToR

Acronyms and Abbreviations

Table 2 Acronyms and Abbreviations

Abbreviation	Full Name
AIP	Approval In Principle
EMC	Electromagnetic Compatibility
ISA	Independent Safety Assessor
HMI	Human-Machine Interface
PD	Product Description
PDD	Process Description Document
PFD	Process Flow Diagram
RACI	Responsible, Accountable, Consulted and Informed
RAM	Reliability, Availability and Maintainability
RAMS	Reliability, Availability, Maintainability and Safety
SCC	Safety Certification Committee
SDS	Single Design Solution
SRP	System Review Panel
ToR	Terms of Reference

Definitions

Table 3 Definitions

Term	Definition	Source
Availability	Ability of an item to be in a state to perform a required function under given conditions at a given instant of time or over a given time interval, assuming that the required external resources are provided.	BS EN 50126:2017
Maintainability	Ability to be retained in, or restored to, a state to perform as required, under given conditions of use and maintenance.	BS EN 50126:2017
Project Company	The private sector entity which enters into the Project Agreement with Infrastructure Ontario and Lands Corporation and Metrolinx to design, build and where applicable, finance, operate or maintain a Project. The special-purpose entity which has entered into a Project Agreement with the Contracting Authority.	CKH-QMA-FRM-003
Reliability	Ability to perform as required, without failure, for a given time interval, under given conditions.	BS EN 50126:2017
Safety	Freedom from unacceptable risk related to human health or to the environment	BS EN 50126:2017
Subsystem	Part of a system, which is itself a system	BS EN 50126:2017
System	Set of interrelated elements considered in a defined context as a whole and separated from their environment	BS EN 50126:2017

1 System Definition

1.1 Purpose

1.1.1 The System Definition describes the essential characteristics and functions of the system and clarifies the interfaces and boundaries to other systems including the input to be provided and the output that can be expected. The System Definition influences the Safety Plan and the Reliability, Availability and Maintainability (RAM) Plan and defines the scope of the System Risk Analysis.

1.1.2 The System Definition builds upon the Preliminary System Definition and is relied upon for developing the System Safety Plan and RAM Plan, and the activities therein. It is useful to think of it as a high-level overview of the change to the railway, with references to detailed documentation, such as site plans, where required.

1.1.3 The System Definition supports the hazard identification process to ensure that it has systematically covered the complete system. Clear diagrams showing a logical breakdown of the system into subsystems or functional blocks are invaluable for hazard workshops.

1.1.4 The System Definition is a key document that is relied upon throughout the project lifecycle; it is updated as the design matures to provide enough detail to support project activities.

1.2 Applicability

1.2.1 This product is mandatory for any project that undertakes a technical change to the railway system (i.e., introduction of a new sub-system, renewal of an existing sub-system, a modification to an existing sub-system, or introduction of a new or modified maintenance regime) or undertakes an operational change to the railway system.

1.2.2 For all applicable projects it is mandatory for the System Definition to be maintained and updated through the life of the project.

1.2.3 This product is not applicable for established routine maintenance activities including like-for-like replacement of components.

1.3 Supporting Material

1.3.1 The System Definition template is MX-SEA-TPL-106.

1.3.2 Guidance on completing the System Definition is located in MX-SEA-GDC-106.

1.4 Products

1.4.1 The System Definition is a product of the System Assurance process. Guidance on this process is available in the RAMS Process Standard, MX-SEA-STD-100.

1.5 Key Responsibilities

1.5.1 The Project Company is responsible for the production of the System Definition. Preparation of the System Definition may be delegated; however the Project Company is responsible for its content and quality.

1.5.2 The Project Company is the organization that is responsible for the contracted scope of work at the time of development.

1.5.3 The System Review Panel (SRP) has delegated authority from the Safety Certification Committee (SCC) and is responsible for endorsing the System Definition. The System Review Panel ensures that the System Definition is compliant with the project requirements, applicable legislation, and national, industry, and Metrolinx standards. The SRP may also identify uncertainties, issues, and assumptions that may arise as the project progresses that should be addressed.

1.5.4 The Project Management may be performed by Metrolinx or may be contracted, for example in a Design/Build, whereby Metrolinx Project Management would ensure contract provisions for the System Definition are met and would not develop the System Definition.

1.5.5 Some of the Asset Owner obligations and responsibilities may be transferred through contracting, whereby the contract contains Reliability, Availability, Maintainability and Safety (RAMS) and operating requirements. The Metrolinx Asset Owner would participate in endorsing the System Definition whereas a contracted party responsible for RAMS would develop the System Definition as directed by the Project Management.

1.5.6 The full Responsible, Accountable, Consulted, and Informed (RACI) information that sets out the interaction between all stakeholders involved in the production and endorsement of the System Definition is available in MX-SEA-STD-100.

1.6 Competence

1.6.1 The System Definition shall be drafted by a person in the project company with competence in safety management supported by persons with technical competence in the systems impacted by the proposed change.

1.7 Structure

1.7.1 The structure of the System Definition is described in the System Definition guidance document located in MX-SEA-GDC-106.

1.7.2 The document requires the following section titles:

a) Project Goals and Purpose

b) General Description of the System;

c) System Functions and Constituent Subsystems;

d) Boundaries and Interfaces;

e) Operational and Maintenance Requirements;

f) Environment;

g) Safety Measures and Requirements;

h) Assumptions

i) Scope of System Hazard Analysis

1.8 Contents

1.8.1 The contents of the System Definition are described further with guidance on completing the System Definition in MX-SEA-GDC-106.

1.8.2 As a minimum, it shall contain the following:

a) description of the project goals and mission profile, including a description of the program goals if the project is part of a larger program;

b) description of the scope of work including the impact to any related/interfacing projects, and the conclusion on the significance or non-significance of the change under CMREA, with reference to the Preliminary System Definition;

c) description of the system, including diagrams that show the planned configuration of the system and its current configuration, if applicable;

d) description of the system and subsystem functions, long-term operating strategies and conditions, life-time considerations, and logistics considerations;

e) a definition of the system boundaries and interfaces including:

1) Boundaries and interfaces between other projects and other systems;

2) Physical and geographical boundaries of the system;

3) Interfaces with human elements and processes (e.g. maintenance, repair activities, passenger management, operational procedures, emergency procedures, staff competency and training), and in case of no human activities included in the description, provide the reasons for it;

4) Technological boundaries and interfaces (e.g. power, EMC, signalling and telecoms, interlocking and control centres, HMIs with control desks);

5) Physical interfaces with the environment, and other systems (e.g. mechanical contact, civil structures, noise, vibration, air quality);

6) Interfaces and boundaries with other organizations (e.g. railway duty holders, suppliers);

7) Interfaces between the system/project and internal and external stakeholders (e.g. technical disciplines, users, neighbors, road users, customers);

f) description of operational requirements influencing the system, including:

1) modes of operation;
2) external requirements;
3) constraints imposed by existing infrastructure;
4) system operating conditions and constraints;
5) system maintenance conditions;
6) logistic support considerations;
7) review of past experience data for similar systems;
8) Impact on operational and maintenance personnel, passengers and public, or a rationale explaining why they are unaffected;
9) the description of operating procedures, identification of personnel permitted to carry out these actions and indication of the skills, qualifications and time-resources required, if part of the system operating conditions and constraints;
10) if no human activities have been included in the analysis, the reasons for this shall be stated; and
11) operational scenarios to be considered within the analysis to be incorporated into the RAM Plan for the system;

g) Description of how safety measures and requirements shall be identified and managed by the project company including existing and planned safety measures and prescribed safety requirements (e.g. contractual documents, regulations, standards, codes of practice) to be incorporated into the Safety Plan for the system;

h) Outline any assumptions that determine the limits for the risk assessment or were identified while defining the system and planned steps to validate assumptions, including assumptions made about particular functions or subsystems that are different from an existing reference version, explicitly stating and justifying the deviations;

i) The system architecture, describing the structured decomposition of the system into subsystems and/or components completely defined interfaces, must be added during phase 5 (apportionment) to support the development of subsystem design requirements. A reference to a document that meets the same intent is also acceptable.

1.8.3 The system definition shall be continuously updated as more information becomes available and the design matures.

1.9 Quality Criteria

1.9.1 The quality management system used shall conform to ISO 9001 rules or equivalent rules accepted by the Metrolinx Project Delivery Team and be appropriate for the system under consideration.

1.9.2 A System Definition shall be considered complete and adequate if it describes the system elements, boundaries and interfaces, as well as what the system does. The Independent Safety Assessor (ISA), by reading the System Definition, shall be able to achieve a good understanding of how the system under change shall implement the required functions.

1.10 Document Management

1.10.1 The System Definition shall be considered a 'live' document until completion of the project and should be updated continuously as the design matures to ensure alignment among project stakeholders.

1.10.2 The document is a requirement for Design Gate progression at the Approval In Principle (AIP) Gate, the Single Design Solution (SDS) Gate and the Consent to Operate (CTO) gate.

1.10.3 Table 4 provides an overview of the System Definition document phases.

Document	Phase
System Definition	2 - System Definition
System Definition (update)	5 - Apportionment
System Definition (update)	10 - Acceptance

TABLE 4: DOCUMENT PHASES