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Metrolinx
Reliability, Availability and Maintainability Analysis Report: Product Description

MX-SEA-PD-120

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Amendment Record

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

Preface

This is the first edition of the Metrolinx Reliability, Availability and Maintainability (RAM) Analysis Report Product Description (MX-SEA-PD-120). 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 RAM Analysis Report that project proponents may need to produce 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.

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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	Related Standard
MX-SEA-PD-117	RAM Analysis Process Product Description	Related Product
MX-SEA-PD-119	RAM Plan Product Description	Related Product
MX-SEA-GDC-120	Reliability, Availability and Maintainability Analysis Report Guidance	Guidance
MX-SEA-TPL-120	Reliability, Availability and Maintainability Analysis Report Template	Template
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**
CMREA	Canadian Method for Risk Evaluation and Assessment for Railway Systems
ISA	Independent Safety Assessor
RACI	Responsible, Accountable, Consulted and Informed
RAM	Reliability, Availability and Maintainability
RAMS	Reliability, Availability, Maintainability and Safety
SCC	Safety Certification Committee
SRP	System Review Panel

Definitions

Table 3 Definitions

Term	Definition	Source
Asset owner	Groups and individuals that are responsible for asset ownership, asset maintenance, inventory management, document control, asset handover and reliability engineering	MX-ALM-STD-001
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
Project Manager	Appointed by Metrolinx as its representative and is responsible for the delivery of the Project within the prescribed Schedule and budget. Metrolinx employees fulfilling the role of the Project Manager may also be considered the Cost Centre Manager, if this person is also delegated signing authority in accordance with the Metrolinx Corporate Administrative Manual, Administrative Management, Approval Authorization Controls and Designations. It is noted that non-Metrolinx employees fulfilling the role of the Project Manager are not considered Cost Centre Managers. In such cases refer to approved Project Chart of Accounts for the Program for the designated Cost Centre Manager.	CKH-QMA-FRM-003

Reliability	Ability to perform as required, without failure, for a given time interval, under given conditions.	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 Reliability, Availability and Maintainability Analysis Report

1.1 Purpose

1.1.1 The Reliability, Availability and Maintainability (RAM) Analysis Report collects the result of the activities defined in the RAM Plan for the system and/or subsystem under analysis.

1.1.2 The overall objective of the RAM Analysis Report is to assure that the equipment meets its reliability requirements. This is achieved through demonstration that all the RAM targets defined in the RAM Plan have been met.

1.1.3 The purpose of the RAM Analysis Report is therefore to

a) describe the RAM analysis activities undertaken for the equipment;

b) collect the results of these activities; and

c) compare these results with the project RAM targets.

1.1.4 In case the system and/or subsystem under analysis does not achieve the project RAM targets, the results of the RAM activities and analyses shall be fed back into the design process to ensure that the reliability of the system is improved and that any threats to the reliability performance are addressed.

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 subsystem, renewal of an existing subsystem, a modification to an existing subsystem, or introduction of a new or modified maintenance regime) or undertakes an operational change to the railway system.

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

1.1.2 This product is considered good practice when developing or modifying any complex system.

1.3 Supporting Material

1.3.1 The RAM Analysis Report template is located in MX-SEA-TPL-120.

1.3.2 Guidance on completing the RAM Analysis Report is located in MX-SEA-GDC-120.

1.3.3 The RAM Plan Product Description is found in MX-SEA-PD-119.

1.4 Products

1.4.1 The RAM Analysis Report is a product of the System Assurance process. Guidance on this process is available via MX-SEA-STD-100.

1.5 Key Responsibilities

1.5.1 The Project Company is responsible for the production of the RAM Analysis Report. Preparation of the RAM Analysis Report may be delegated, however the Project Company is responsible for its content and quality.

1.5.2 The Project Company is the organization 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 RAM Analysis Report. The System Review Panel ensures that the RAM Analysis Report 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 RAM Analysis Report are met and would not develop the RAM Analysis Report.

1.5.5 Some of the Asset Owner obligations and responsibilities may be transferred through contracting, whereby the contract contains RAM and operating requirements. The Metrolinx Asset Owner would participate in endorsing the RAM Analysis Report whereas a contracted party responsible for RAM would develop the RAM Analysis Report 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 RAM Analysis Report is available in MX-SEA-STD-100.

1.6 Competence

1.6.1 All personnel responsible for the delivery of the RAM Analysis Report shall possess the necessary competence to deliver the works. This shall be competency in RAM management, project management and a technical understanding of the project and the system under analysis.

1.7 Structure

1.7.1 The Structure of the RAM Analysis Report is described in the RAM Analysis Report Guidance document located in MX-SEA-GDC-120.

1.7.2 The document requires the following section titles:

a) Introduction;

b) System Boundary;

c) System Description;

d) Assumptions and Limitations;

e) RAM Targets;

f) RAM Data;

g) RAM Analysis; and

h) Conclusions and Compliance with RAM Targets.

1.8 Contents

1.8.1 The contents of the RAM Analysis Report are described in the RAM Analysis Report Guidance located in MX-SEA-GDC-120.

1.8.2 As a minimum, it shall contain the following:

a) a description of the scope of the RAM Analysis Report;

b) a description of the system and/or subsystem under analysis, including boundaries and interfaces with third parties;

c) all the assumptions and limitations specified in the RAM Plan as well as any additional assumptions and limitations that become evident while performing the RAM analysis activities;

d) a list of all the RAM targets the system and/or subsystem under analysis shall achieve as per the contractual requirements documents, including clear reference to the source for each RAM target;

e) the data used in the RAM analysis for each component, including reference to the data source or a justification for the data used;

f) a description of the RAM activities performed, including justification for any changes from the planned activities and methodologies detailed in the RAM Plan;

g) a presentation of the results of the RAM activities performed; and

h) a comparison of the results against the RAM targets.

1.9 Quality Criteria

1.9.1 The RAM Analysis Report shall provide clear results against the RAM targets.

1.9.2 The quality management system used shall conform to ISO 9001:2015 rules or equivalent rules accepted by the Metrolinx Project Delivery Team and be appropriate for the system under consideration.

1.10 Document Management

1.10.1 The RAM Analysis Report shall be prepared in the Design and Implementation Phase (Phase 6) of the product lifecycle as defined in the EN 50126.

1.10.2 Table 4 provides an overview of the RAM Analysis Report document phases.

Document	Phase
RAM Analysis Report	6 – Design and Implementation

TABLE 4: DOCUMENT PHASES