FNMux Project Management PLAN

FNMux

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TABLE OF CONTENTS

[1.0 Preface 7](#_Toc137399856)

[1.1 Introduction. 7](#_Toc137399857)

[1.2 Purpose 7](#_Toc137399858)

[1.3 Scope 8](#_Toc137399859)

[1.5 Acronyms and Abbreviations 9](#_Toc137399860)

[1.6 References 10](#_Toc137399861)

[2.0 System Description – FNMUX 11](#_Toc137399862)

[3.0 Organization 13](#_Toc137399863)

[3.1 Organization Structure 13](#_Toc137399864)

[3.2 Roles and Responsibilities 13](#_Toc137399865)

[4.0 Environment 22](#_Toc137399866)

[4.1 Development Environment 22](#_Toc137399867)

[5.0 Hardware Verification and validation Tasks of FNMUX 27](#_Toc137399868)

[5.4 Specification of System Requirements Phase 29](#_Toc137399869)

[5.5 Architecture and Apportionment of System Requirements 30](#_Toc137399870)

[5.6 Design and Implementation Phase 31](#_Toc137399871)

[5.6.1 Hardware V & V 31](#_Toc137399872)

[5.6.2 Process for Verification of integrated Hardware during Design and Implementation phase 34](#_Toc137399873)

[5.6.3 Following are the deliverables of Verification of Design and Implementation Phase 35](#_Toc137399874)

[5.6.4 Process for validation of Hardware during Design and Implementation phase 35](#_Toc137399875)

[5.6.5. Following are the deliverables of Validation of Design and Implementation Phase 38](#_Toc137399876)

[5.7 Manufacturing Phase 38](#_Toc137399877)

[5.8 Integration Phase 39](#_Toc137399878)

[5.9 Software 40](#_Toc137399879)

[5.9.1 Software Verification and Validation 40](#_Toc137399880)

[5.9.2 Planning Phase 41](#_Toc137399881)

[5.9.3 Requirement Phase 42](#_Toc137399882)

[5.9.4 Software Architecture and Design Phase 43](#_Toc137399883)

[5.9.5 Software Component Design Phase 44](#_Toc137399884)

[5.9.6 Software Component Implementation and Testing Phase 44](#_Toc137399885)

[5.9.7 Software Integration Phase 45](#_Toc137399886)

[5.9.8 Software Validation 46](#_Toc137399887)

[5.10 FNMUX System Validation 49](#_Toc137399888)

[5.11. System Acceptance Phase 51](#_Toc137399889)

[7.0 ANNEXURES 53](#_Toc137399890)

[7.1 Annexure – A Personnel Identified with Roles 53](#_Toc137399891)

[BLANK PAGE 54](#_Toc137399892)

List of Figures

[Figure 1: System Overview 12](#_Toc137399907)

[Figure 2: Organization Structure 13](#_Toc137399908)

List of Tables

[Table 1:Definitions 9](#_Toc137399893)

[Table 2: Acronyms and Abbreviations 9](#_Toc137399894)

[Table 3: References 11](#_Toc137399895)

[Table 4: Roles & Responsibilities of the Project Director 13](#_Toc137399896)

[Table 5: Roles & Responsibilities of Project Manager 14](#_Toc137399897)

[Table 6: Roles & Responsibilities of Hardware Manager/Designer 15](#_Toc137399898)

[Table 7: Roles & Responsibilities of Software Manager/Designer 15](#_Toc137399899)

[Table 8: Roles & Responsibilities of Hardware Design Implementer 16](#_Toc137399900)

[Table 9: Roles & Responsibilities of Software Design Implementer 17](#_Toc137399901)

[Table 10: Roles & Responsibilities of Software Tester/Validator 18](#_Toc137399902)

[Table 11: Roles & Responsibilities of Hardware Tester/Validator 19](#_Toc137399903)

[Table 12: Roles & Responsibilities of Verifier 20](#_Toc137399904)

[Table 13: Roles & Responsibilities of Validator 20](#_Toc137399905)

[Table 15: Personnel Identification with Roles 53](#_Toc137399906)

# Preface

Fail-safe Network Multiplexer (FNMux) developed by Team Engineers (TE), is required to meet the Technical & Operational requirements of the RDSO specification “RDSO/SPN/11/2022” for transporting vital signalling information from interlocking to field using dual redundant OFC media in a fail-safe manner and driving the relays/end equipment in the field. FNMux consists of the following functions

* Exchange of vital signaling digital I/O information from interlocking to field using the dual redundant OFC
* Driving the relays / end equipment in the field

For detailed explanation of each of the above functions and supporting functions refer RDSO Specification RDSO /SPN /211/2022, Effective Date: 24.11.2022 [Ref 1]

## 1.2 Purpose

The purpose of the document is to provide a plan for system design and development that covers the project lifecycle including hardware, software and project schedules for FNMux. This plan is the basis for the execution and tracking of all design and development activities of FNMux. It shall be used throughout the design and development lifecycle of the Project and shall be kept up to date to reflect the actual accomplishments and plans of the Project. This plan covers the FNMux RAM and Safety activities. Following are included as part of this plan

1. Provide the standards, practices and lifecycle methodology adopted for Design and Development
2. FNMux Organization Structure
3. Procedure for development of TCAS System Requirement Specification
4. FNMux Design tasks and responsibilities
5. FNMux Resource requirements
6. Provide reference documents and guidelines to perform the Design activities
7. Provides interfaces for all different stakeholders of the project.
8. Provides Overall Work Breakdown structure for the project, with Schedule, budget and manpower allocations.
9. Provides Risk analysis for handling the lifecycle of the project.
10. Relationship with Other Plans
11. Training Plan

## Project Deliverables

The Project Deliverables are identified as part of each phase activity of design and development lifecycle in subsequent clauses of this document.

## Schedule

The Project Schedules are identified as part of project deliverables in Work Breakdown Structure and is added as Annexure – A.

## Budget Summary

The Budget for this project may be approved by MD based on the following factors

* Manpower pertaining to design, development, installation, commissioning and field trials given subsequent sections.
* Material requirement for the project shall be available in Engineering department and shall be base for calculation of cost of equipment.

Budget shall be worked out independently and approved by MD and any further changes in budgetary allocations shall be initiated by the PM and shall be approved by MD as and when required.

Definitions

Abbrevations

## 1.6 References

The following are the reference documents for Verification and Validation of FNMUX:

|  |  |  |
| --- | --- | --- |
| Ref. | Document Title | Document Description |
| Ref. 1 | RDSO /SPN /211/2022, Date Effective:24.11.2022 | Specification for Failsafe Network Multiplexer (FNmux). |
| Ref. 2 | EN 50126-1: 2017  EN 50126-2:2017 | Railway Applications- Specifications and demonstration of Reliability, Availability, Maintainability & Safety. |
| Ref. 3 | EN 50155:2017 | Railway applications - Rolling stock  - Electronic equipment |
| Ref. 4 | EN 50128-2020 | Railway Applications-Communications, Signaling and processing systems-Software for Railway Control and Protection Systems. |
| Ref. 5 | EN 50129:2018 | Railway Applications-Communications, Signaling and processing systems- Safety Related Electronics Systems for Signaling. |
| Ref. 7 | EN50159:2010 | Railway Applications-Communications, Signaling and processing systems - Safety related communication in closed transmission systems. |

Table 3: References

**2.0 System Description – FNMUX**

1. Fail safe Network Multiplexer system will consist of a distributed multiplexer. modules, connected in a network, constituting a network of fail-safe multiplexer modules for exchange of vital signaling information among fail-safe multiplexer modules. The system architecture shall allow the formation of a scalable centralized unit of modules (FNmux Central Unit -CU) to concentrate I/O from the distributed field modules (FNmux Field Unit -FU). Furthermore, the network protocol and addressing technique adopted shall be such that any pair of vital modules, either in the central unit or in the field unit can be virtually connected from any point to any point. The FNMux Central unit shall also be able to communicate with Data Logger
2. The main purpose of FNMux is to transfer vital signaling information from FU to CU and from CU to CU meeting SIL4
3. A picture containing text, screenshot, diagram, colorfulness

   Description automatically generatedThe Figure 1 below gives the FNMUX top level block diagram.

Figure 1: System Overview

# 3.0 FNMux project Organization structure

## 3.1 Organization Structure



Figure 2: Organization Structure

## 3.2 Roles and Responsibilities

3.2.1 Head Technical/CEO

|  |  |
| --- | --- |
| Role | Project Director |
| Responsibilities | - Design & Engineering Technical Support  - Support of Safety Process documentation  - Project Contractual fulfillment  - Budget reviews and allocations |

Table 4: Roles & Responsibilities of the Project Director

3.2.2 Project Manager

|  |  |
| --- | --- |
| Role | Project In charge |
| Responsibilities | - Project Contractual fulfillment  - Design & Engineering Process Implementation and approval  -Project Field Trials and project approval  - Project Safety Certification - coordination and support.  - Product Delivery as per SIL4 |
| Key Competencies | - Shall have experience in design as per EN standard  - Shall have experience in design of Embedded systems involving multiple processor architecture  - Shall have experience in development processes associated with safety systems  - shall understand quality, competencies, organizational and management requirements as per EN 50126, EN 50129 and ISO 9001:2015. |

Table 5: Roles & Responsibilities of Project Manager

3.2.3 Hardware Manager/Designer

|  |  |
| --- | --- |
| Role | Hardware Requirements and Design |
| Responsibilities | - Hardware Design & Engineering Process Implementation  - Shall own the System Requirements Specification allocated to the hardware  - Shall maintain traceability between system level requirements and Hardware requirements  - Shall ensure configuration management of Hardware design changes  - Shall develop and maintain hardware and safety documents related to safety process |
| Key Competencies | - Shall be competent in requirements engineering  - Shall understand the safety attributes of FNMUX application domain  - shall understand quality, competencies, organisational and management requirements as per EN 50126, EN 50129 and ISO 9001:2015  - Shall have min 5 years of experience in hardware design |

Table 6: Roles & Responsibilities of Hardware Manager/Designer

3.2.4 Software Manager/Designer

|  |  |
| --- | --- |
| Role | Software Requirements and Design |
| Responsibilities | - Software Design & Engineering Process Implementation  - Shall own the System/Software Requirements Specification  - Shall maintain traceability between system level requirements and Software requirements  - Shall ensure configuration management of Software design changes  - Shall develop and maintain Software documents related to design including safety and non-safety functions. |
| Key Competencies | - Shall be competent in requirements engineering  - Shall understand the safety attributes of FNMUX application domain  - shall understand quality, competencies, organizational and management requirements as per EN 50126, EN 50128, EN 50129,and ISO 9001:2015.  - Shall be graduate with min 5 years of experience in Software design |

Table 7: Roles & Responsibilities of Software Manager/Designer

3.2.5 Hardware Design Implementer

|  |  |
| --- | --- |
| Role | Hardware Design & Implementation |
| Responsibilities | - Shall transform the Hardware requirements into acceptable design solutions  - Shall implement and test as per the architecture and design solutions  - Shall apply appropriate design principles and standards  - Shall ensure traceability of hardware requirements to design  - Shall develop and maintain design documents and implement change control for the same |
| Key Competencies | - Shall be competent in hardware design and implementation  - Shall have exposure to safety design principles  - Shall be competent in design principles and design test methods  - shall understand relevant parts of EN 50126, EN 50128, EN 50129 and ISO 9001:2015  - Shall be graduate with min 2 years of experience in Hardware design |

Table 8: Roles & Responsibilities of Hardware Design Implementer

3.2.6 Software Design Implementer

|  |  |
| --- | --- |
| Role | Software Design & Implementation |
| Responsibilities | - Shall transform the Software requirements into acceptable design solutions  - Shall implement as per the architecture and design solutions  - Shall apply appropriate design principles and standards  - Shall ensure traceability of Software requirements to design  - Shall develop and maintain design documents and implement change control for the same |
| Key Competencies | - Shall be competent in Software design and implementation  - Shall have exposure to safety design principles  - Shall be competent in design principles and design test methods  - shall understand relevant parts of EN 50128-2011 and ISO 9001:2015  - Shall be graduate with min 2 years of experience in Software design |

Table 9: Roles & Responsibilities of Software Design Implementer

3.2.7 Software Tester

|  |  |
| --- | --- |
| Role | Software Testing |
| Responsibilities | - Shall transform the System/Software requirements into Test Plan and Test specifications  - Shall test the system/Software as per the Test Plan, Test Specification  - Shall apply appropriate testing principles and standards  - Shall ensure traceability of requirements to Test Cases  - Shall develop and maintain Test documents and implement change control for the same |
| Key Competencies | - Shall be competent in System/Software testing and implementation  - Shall have exposure to safety requirements  - Shall be competent in testing principles and test methods and ability to choose the right method for testing process as per SIL-4  - Shall have the analytical thinking ability and good observation skills  - shall understand relevant parts of EN 50128-2020 and ISO 9001:2015.  - Shall be graduate with min 1 years of experience in Software testing |

Table 10: Roles & Responsibilities of Software Tester/Validator

3.2.8 Hardware Tester

|  |  |
| --- | --- |
| Role | Hardware Testing |
| Responsibilities | - Shall transform the System/Hardware requirements into Test Plan and Test specifications  - Shall implement as per the Test Plan, Test Specification  - Shall apply appropriate testing principles and standards  - Shall ensure traceability of system/hardware requirements to Test Cases  - Shall develop and maintain Test documents and implement change control for the same |
| Key Competencies | - Shall be competent in System/Hardware testing and implementation  - Shall have exposure to safety requirements  - Shall be competent in testing principles and test methods and ability to choose the right method for testing process for SIL-4  - Shall have the analytical thinking ability and good observation skills  - shall understand relevant parts of EN 50126, EN 50129 and ISO 9001:2015  - Shall be graduate with min 1 years of experience in Hardware testing |

Table 11: Roles & Responsibilities of Hardware Tester/Validator

3.2.9 Verifier

|  |  |
| --- | --- |
| Role | System, Hardware, and Software Verification |
| Responsibilities | - Shall transform the System/Hardware/Software requirements into Verification Requirements  - Shall apply appropriate verification techniques/measurers mentioned in E.8 of EN50129 and B.5 of EN50128  - Shall be responsible for Safety, including Safety Audits and Reviews  - Shall be responsible for Quality Audit  - Shall apply appropriate verification principles and standards  - Shall ensure traceability of requirements to design to Test Cases and results  - Shall develop and maintain Verification documents and implement change control for the same |
| Key Competencies | - Shall be competent in System, Hardware, and Software Verification  - Shall have exposure to safety requirements  - Shall be competent in various verification methods and ability to choose the right method for the verification  - Shall be capable of deriving the types of verification from the given specification  - shall understand relevant parts of FNMUX Specification, CENELEC Standards and ISO 9001:2015.  - Shall have min 3 years of experience in Verification |

Table 12: Roles & Responsibilities of Verifier

3.2.10 Validation & Safety Manager

|  |  |
| --- | --- |
| Role | Validator |
| Responsibilities | - Shall transform the System, Hardware, and software requirements into Validation Requirements  - Shall apply appropriate validation principles and standards as per E.8 of EN50129 and B.7 of EN50128  - Shall evaluate all applicable phases of life cycle to validate that the evidence is adequate to fulfil the FNMUX Specification.  - Shall generate a Validation Report based on which Hardware and Software Release is done  - Shall ensure the FNMux system design is safe as per EN50126  - Shall ensure that the techniques and methods selected for Software development of FNMux are adequate for the SIL-4. |
| Key Competencies | - Shall be competent in System/Hardware and Software Validation  - Shall have exposure to safety requirements  - Shall be competent in various validation methods and ability to choose the right method for the validation  - Shall be capable of deriving the types of validation tools, techniques, and methods from the given specification  - shall understand relevant parts of EN 50126, EN 50128-2011+A2-2020 , EN 50129 and ISO 9001:2015  - Shall be graduate with min 5 years of experience in System Validation. |

Table 13: Roles & Responsibilities of Validator

# 7.0 ANNEXURES

## 7.1 Annexure – A Personnel Identified with Roles

|  |  |  |
| --- | --- | --- |
| S. No | Role | Name |
|  | Project in-charge |  |
|  | Project Manager |  |
|  | Validation In-charge |  |
|  | Software Development Manager |  |
|  | Hardware Manager |  |
|  | Verification Manager |  |
|  | Validator Engineer |  |
|  | Verification Engineer |  |
|  | CM In charge (SCM & HCM) |  |
|  | Hardware Engineer |  |
|  | Hardware Technician |  |
|  | Software Engineers |  |
|  | System integration Tester |  |

Table 15: Personnel Identification with Roles

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