

Reliability, Availability, Maintainability and Safety (RAMS)

TITLE:

"International Tender Based on the Open Procedure for the Conclusion of PPP Contract concerning the Operation and Maintenance of the Thessaloniki Metro Network"

RFP-427/22, A.Σ.: 164503

# Reliability, Availability, Maintainability and Safety (RAMS)





«International Tender Based on the Open Procedure **RFP - 427/22** for the Conclusion of PPP Contract concerning the Α.Σ.: 164503

**Operation and Maintenance of the** Thessaloniki Metro Network.»

Reliability, Availability, Maintainability and Safety (RAMS)

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#### **1 PURPOSE**

The Contractor shall operate, maintain and support the Thessaloniki Metro systems (Base Project and Extension to Kalamaria) such that compliance with Reliability, Availability, Maintainability and Safety (RAMS) requirements is maintained. This includes continuously monitoring and evaluating the RAMS performance of the system and deriving measures to address shortcomings and to achieve improvements.

#### 2 SCOPE

This specification shall define and describe RAMS activities to be performed by Contractor during the Operation and Maintenance (O&M) contract period in line with RAMS life cycle phase 11, "Operation, maintenance and performance monitoring" as described in paragraph 7.12 of RAMS standard EN 50126-1. The Contractor shall operate all E/M systems within the design operation limits and he shall follow the operation and maintenance instructions set by the equipment suppliers in order to ensure that RAMS requirements are satisfied.

#### **3 DEFINITIONS, ABBREVIATIONS & REFERENCE DOCUMENTS**

#### 3.1 Definitions

For the purposes of this document, the following definitions apply:

Term	Definition		
	The ability of a product / equipment / system to be in state to perform a required		
Availability	function under given conditions and environment at a given instant of time or		
	over a given interval assuming that the required external resources are provided.		
Condition	Preventive maintenance which includes a combination of condition monitoring		
Based	and/or inspection and/or testing, analysis and the ensuing maintenance actions.		
Maintenance	The condition monitoring and/or inspection and/or testing may be scheduled, on		
(CBM)	request or continuous.		



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Term	Definition		
Corrective	Maintenance carried out after fault recognition and intended to put an item into a		
maintenance	state in which it can perform a required function.		
	A closed loop failure reporting, analysis and corrective action system for		
FRACAS	monitoring RAMS performance. The FRACAS process (system) is an essential		
	element for the achievement of reliability and safety.		
Lino	Element of equipment which is deposited and exchanged directly on the		
Poplacoable	equipment in maintenance of proximity or reinforced maintenance (in workshop).		
	An LRU can be either reparable or consumable. An LRU is exchanged to give in		
	operating condition the complete equipment or a LRU of immediately higher row.		
	The measure of the ability of an item to be retained in or restored to specified		
Maintainability	condition when maintenance is performed by personnel having specified skill		
Maintainability	levels, using prescribed procedures and resources, at each prescribed level of		
	maintenance and repair.		
Maintananca	All actions necessary for retaining an item in or restoring it to a specified		
Maintenance	condition.		
Mean Time	The expected operational time of an item between failures (inverse of rate of		
between	failures ROE)		
Failures (MTBF)			
Mean Time to	Time required performing corrective maintenance tasks are performed on an		
Repair (MTTR)	item. It includes fault recognition, localization and isolation accessibility;		
	interchangeability, a given time interval.		
Predetermined	Preventive maintenance carried out in accordance with established intervals of		
Maintenance	time or number of units of use but without previous condition investigation.		
Predictive	Preventive maintenance carried out in accordance with established intervals of		
Maintenance	time or number of units of use but without previous condition investigation.		
Preventive	Maintenance carried out at predetermined intervals or according to prescribed		
Maintenance	criteria and intended to reduce the probability of failure or the degradation of the		
	functioning of an item.		



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Term	Definition		
	Documented set of time scheduled activities, resources and events serving to		
RAM	implement the organization structure, responsibilities, procedures, activities,		
Demonstration	capabilities and resources that together ensure that an item will satisfy given		
Program (RDT)	reliability performance and maintainability performance requirements relevant to		
	a given contract or project		
Reliability	The probability that an item can perform a required function under given		
Tenability	conditions for given time interval.		
Repair	The part of a corrective maintenance in which manual actions are performed on		
	the item		
Postoration	The event when the item regains the ability to perform a required function after a		
Residiation	fault		
	The conditions in which a product or system must be used, from all perspectives		
	and points of view, due to safety-related reasons, to avoid the occurrence of		
SPACe	risks.		
SRACS	Application conditions can be, as an example, operational restrictions (e.g.		
	speed limit, maximum duration of use), operational rules, maintenance		
	restrictions (e.g. requested maintenance intervals) or environmental conditions.		

#### 3.2 Abbreviations

ARB	Accident Review Board
CBM	Condition Based Maintenance
ECO	Emergency Cut Off
E/M	Electro-Mechanical
FRACAS	Failure Reporting Analysis and Corrective Action System
FRB	Failure Review Board
GR	General Release
HEART	Human Error Assessment and Reduction Technique
HRA	Human Reliability Assessment
ISA	Independent Safety Assessor



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- LAS Lighting and Auxiliary Power Substation
- LRU Line Replaceable Unit
- MTBF Mean Time Between Failure
- MTTR Mean Time to Repair
- O&M Operation and Maintenance
- RAMS Reliability, Availability, Maintainability, Safety
- RCFA Root Cause Failure Analysis
- RDT Reliability Demonstration Tests
- RS Rectifier Substation
- SIL Safety Integrity Level
- SLA Service Level Agreement
- SPI Service Performance Index
- SRAC Safety Related Application Condition
- TCR Traction Current Removal

#### 3.3 Reference Documents

#### 3.3.1 Applicable Norms

EN 50126-1:2017 Railway applications – The specification and demonstration of Reliability, Availability, Maintainability and Safety (RAMS) – Part 1: Basic requirements and generic process EN 50129:2018 Railway applications - Communication, Signaling and processing systems - Safety related electronic systems for Signaling

EN 13306 Maintenance - Maintenance terminology

Directive (EU) 2016/798 of the European Parliament and of the Council of 11 May 2016 on railway safety

#### 3.3.2 Contractual Reference Documents

This section describes the contracts whose Specification documents and designs for Electromechanical and Railway systems of the construction contractors shall be taken into account in this document and concern the Base Project and the Kalamaria extension.

 Base Project Contract: CON-06/004, "Design, construction and commissioning of Thessaloniki Metro"



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#### • Extension to Kalamaria (6 contracts)

- Main contract: CON-06/004-AKTOR: execution of Civil Works and the majority of the Electromechanical and Railway systems. The systems implemented via this contract are the overall systems except for the following which are implemented through independent contracts.
- GEN-080/20-HRACT: the signaling and automatic train control (ATC) system which includes, inter alia, the extension of the Electronic Interlocking systems (EIXL), the Automatic Train Control (ATC), the Automatic Train Operation (ATO), the Positive Train Identification (PTI), the Automatic Train Protection (ATP) and the Automatic Train Supervision (ATS).
- 3. GEN-82/21-HON: the BACS system (Building Automation and Control System)
- 4. GEN-085/22-AKTLV: 10 Low Voltage systems shown below:
  - 1. Power Remote Control System (PRCS)
  - 2. Safety Management System (SMS)
  - 3. Access Control System (ACC)
  - 4. Intrusion Detection System (IDS)
  - 5. Digital Transmission System (DTS)
  - 6. Closed Circuit Television (CCTV)
  - 7. Public Announcement System (PA)
  - 8. Radio Communication (TETRA) System
  - 9. Passenger Information System (PIS)
  - 10. Integrated Communications Control System (ICCS)
- 5. Contract for the fare collection system of the Extension. This contract shall also cover the wider needs of the fare central management for all Mass Transportation Modes in the city of Thessaloniki.
- Contract for Rolling Stock (15 new Trains). They shall be 4-car driverless trains, required to serve the extension to Kalamaria and achieve 90sec headways at the central common section New Railway Station – 25 Martiou.
  - Document entitled "Technical Description and Specifications" and "Payments Document" of this tender



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# 3.3.3 Special Reference documents of the Contractor for the Construction of the Base Project (AIASA JV)

- 1G00GE410A701A System General Description,
- 1G00EN270B101 System RAM Plan,
- 0G00LV601A100, ATC General System Description",
- 0G00LV601A101, CBTC Subsystem Description",
- Attachment 1, SRACs Status per System,
- Attachment 2, 1G00GE270B114E, Hazard Analysis Report, including Appendix A: List and Status of All Hazards and Appendix B: List and Status of All Mitigations.

#### Note:

Annexes 2 and 3 are enclosed herewith in English due to their specialized technical terminology.

#### 4 RAM PERFORMANCE MONITORING MANAGEMENT

#### 4.1 Organization and roles

The Contractor shall put in place an organization that shall serve effectively and efficiently operation performance monitoring activities related to RAM, while Safety performances (i.e. for letter "S" of "RAMS") are described in chapter 6.

The Contractor's Person in Charge of RAM shall collaborate with AM and he shall be responsible for coordinating external RAM resources.

The Performance monitoring activities under the responsibility of the Contactor shall be managed in compliance with RAMS standard EN 50126-1.

The RAM performance monitoring activities shall be summarized in chapter 8.



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#### 4.2 RAM System Performance Demonstration

The RAM System Performance Demonstration shall demonstrate that all Thessaloniki Metro E/M systems as constructed, operated and maintained meet the relevant RAM requirements. The RAM System Performance Demonstration shall document:

- > Fulfilment of Top-level RAM requirements,
- > Fulfilment of RAM requirements identified in System RAM Model Analyses,
- Fulfilment of key RAM requirements identified for single subsystems / equipment belonging to the system to ensure satisfactory function.

For a 2-year period following the first 6 months from commissioning (also referred to as the period with light problems), the Reliability Demonstration Tests (RDT) shall be carried out by the construction contractors. During this period, the Contractor shall cooperate with the construction contractors to receive measurements and record any potential failures deriving from the Reliability Demonstration Tests (RDT).

Subsequently, until the expiry of the Contract, the Contractor - under his exclusive responsibility - shall continue conducting the required measurements and record any potential failures in the context of the Performance Demonstration, certifying, thus, the his compliance during the operation and maintenance of the system with the RAM requirements of this Contract. If this is not the case, for any reason what so ever, the Contractor shall be under the obligation to document the reasons for not complying with the RAMS requirements. Once the Contractor's report is documented and approved by ATTIKO METRO S.A., failures shall be remedied:

- either under the Contractor's responsibility, in case of inadequate maintenance or erroneous choices in terms of operation
- or under the responsibility of the construction contractors of works or systems, in case these reports have been compiled within the three (3)-year guarantee period prior to the acceptance for use
- or under the responsibility of the construction contractors of works or systems, especially in case of "design failure", that are taken into consideration for a more extended time period up to 10 years.



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In case of works failure within the 3-year guarantee period by the construction contractors, the latter shall be entitled, further to their pertinent request to ATTIKO METRO S.A., to check the Contractor's maintenance files for the failed equipment.

#### 4.3 Service Performance Indicators (SPI)

Throughout the Contractor's Contract period, the following performance demonstration indicators for the services provided constitute the basis for the Reliability, Availability, Maintainability and Safety performance demonstration following the aforementioned RDT phase (paragraph 4.2):

- > Train Delivery
- > Train Punctuality or On-Time Performance
- > Technical Availability of systems (core and non-core)
- > Field Reliability of equipment/subsystem/system (MTBF).

#### 4.4 Events to be excluded for calculation of service performance

If events occur outside the jurisdiction and power of the Operator (Force majeure) that may disrupt Thessaloniki Metro Operation, the effect of these events shall be excluded from the calculation of service performance. These events may be:

- ➤ War;
- Internal rioting;
- Mandatory modification which may materially affect the operation of essential equipment;
- > Natural disasters, e.g. earthquake, hurricane, flooding and tidal waves;
- Terrorism attacks;
- Strikes or industrial actions;
- Loss of external power supplies;
- Passenger action, e.g. suicide;
- > Actions of authorities outside the Service's jurisdiction, e.g. police action.



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#### 4.5 Train Delivery

The Train Delivery Performance Indicator (TDP) is defined for monitoring if the service is delivered in accordance to the traffic demand as planned (actual train trips against planned train trips). The Contractor shall use this Indicator to aim for better management of train service during the contract period. The formula to calculate the train delivery performance shall be:

 $TDP = \frac{\Sigma \ Performed \ Train \ trips}{\Sigma \ Scheduled \ Train \ trips}$ (1)

A trip shall be considered as performed provided that the train has covered at least 75% of the distance of the train trip. Data shall be taken from the Signaling System. The average train delivery performance TDP monitored over a year period shall be at least 98%.

#### 4.6 Train Punctuality

The Train Punctuality Performance Indicator (TPU) or On Time Performance (OTP) is defined for monitoring if the service is delivered on time as planned. It is defined as percentage of Train Trips on time. The Contractor shall use this SPI to aim for better management of train service during his contract period. The formula to calculate the train punctuality performance TPU shall be:

$$TPU = \frac{\Sigma \text{ On Time Train Trips in Reference Service Period}}{\Sigma \text{ Train trips in Reference Service Period}}$$
(2)

On time trip is the trip for which  $\Delta t \leq$  set limit time in minutes. The delay time ( $\Delta t$ ) is the time difference expressed in decimal minutes between the actual journey time and scheduled journey time for each train run from the starting station to the terminal station without missing a station stop. Data shall be taken from the Signaling System.

The average Train Punctuality Performance (TPU) monitored over a year period shall be at least:

 $TPU_3 = 0.98$  for  $DT \le 5$  minutes (3)

 $TPU_5 = 0.95 \text{ for } DT \le 3 \text{ minutes}$  (4)

#### 4.7 Technical Availability (TA)

The Technical Availability Performance Indicator (TA) is defined for monitoring if the Thessaloniki Metro E/M systems are available. It is defined as the percentage of the actual operation time against the planned operation time. The Contractor shall use this SPI to aim for



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better management of his activities related to system availability during his contract period. The formula to calculate the technical availability (TA) shall be:

 $TA = 1 - \frac{\Sigma System Downtime during the reference period}{T Reference period of train service}$ (5)

TA shall be calculated and reported yearly (T reference period = 1 year).

### 4.8 E/M systems

Thessaloniki Metro consists of the following E/M systems and or subsystems for which RAM targets (Technical Availability) have been set:

- 1) Signaling System (SIG)
  - > Automatic Train Protection (ATP)
    - CBTC wayside & central
    - CBTC onboard
    - Interlocking
  - Automatic Train Operation (ATO)
    - CBTC onboard,
    - CBTC wayside & central
  - > Automatic Train Supervision System (ATS)
- 2) Data Communication System (DCS)
  - Train Network (TN)
  - Wayside Network (WN)
  - Backbone Network (BN)
  - Central Network (CN)
- 3) Traction Power Supply (TPS)
  - > 750 V DC Supply
  - Power Remote Control System (PCRS)
  - Control and Monitoring System in SMR
  - Inter-tripping
  - Traction Circuit Removal (TCR)
  - General Release (GR)
  - Rectifier Substation Emergency Tripping System



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- 4) Building Automation Control System (BACS)
- 5) Telecommunications (TLC)
  - TETRA Radio System
  - Direct Line Telephone System
  - > Automatic Telephones
  - > Optical Transmission Network and Fiber Optics (FO)
  - Radio Communication
  - Public Address System (PA)
  - Passenger Information System (PIS)
  - Closed Circuit Television System (CCTV)
  - Clock System and Time Distribution
  - Intercom System
  - Digital Transmission System (DTS)
  - Integrated Central Communication System (ICCS)
  - IT Infrastructures
  - Security Management System (SMS)
    - Intrusion Detection (IDS)
    - Access Control (ACC)
- 6) Automatic Fare Collection System (AFC)
  - Central system
  - > Automatic Ticket Validation gates
  - Automatic ticket issuing machines
- 7) Low Voltage Power Supply
  - LV Main Distribution System
  - LV Power Panels
- 8) Medium Voltage (20 kV) Power Supply
  - > MVP / LAS
  - ≻ RS
- 9) 110 V DC System
  - > LAS
  - > RS



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- 10) Platform Screen Doors (PSD)
- 11) Rolling Stock
- 12) Tunnel Ventilation
- 13) HVAC
- 14) Lifts
- 15) Escalators
- 16) Fire Protection
  - Fire Detection
  - > Fire Fighting in Station and in Tunnel
  - Fire Extinction System (Inergen)
- 17) Pumping System
- 18) Trackwork
  - Slab Tracks
  - > Depot Tracks
  - ➢ Third Rail (TR)

19) UPS for critical systems (e.g. telecommunications).

## 4.9 Technical Availability Targets

The following definitions apply for the purposes of RAM System Performance demonstration.

- Core system: The E/M system which if it fails shall cause a major disruption in the operation of Thessaloniki Metro.
- Non-Core system: The E/M system which if it fails shall not cause a major disruption in the operation of Thessaloniki Metro.

#### 4.9.1 Core Systems

The following table lists the core system minimum technical availability requirements to be met during the performance demonstration reference period.

#	System /Subsystem	Minimum Technical Availability
C1	Rolling Stock	99.00%
C2	Automatic Train Supervision (ATS)	99.95%



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#	System /Subsystem	Minimum Technical Availability
C3	Automatic Train Protection (ATP) of the line and on the train	99.98%
C4	Automatic driverless Train Operation (ATO) of the line and on the train	99.50%
C5	Interlocking	99.98%
C6	OCC Workstations	99.75%
C7	Data Communication System (DCS)	99.99%
C8	Traction Power (750 V DC)	99.99%
C9	Traction Current Removal System (TCR)	99.99%
C10	General Release System (GR)	99.98%
C11	Inter-tripping system	99.98%
C12	Rectifier Substation Emergency Tripping System	99.98%
C13	Power Remote Control System (PRCS)	99.98%
C14	Control and Surveillance System in SMR (CMS)	99.99%
C15	Medium Voltage power Supply (20kV)	99.99%
C16	Low Voltage Main Distribution System	99.99%
C17	Platform Screen Doors (PSD)	99.70%
C18	Optical Transmission Network and Fibre Optics (FO)	99.998%
C19	Digital Transmission System (DTS)	99.98%
C20	Integrated Central Communication System (ICCS)	99.98%
C21	TETRA Radio System	99.98%
C22	Radio Communication at the tunnels	99.98%
C23	Telephone System - Automatic and Direct Line	99.98%
C24	Building Automation Control System (BACS)	99.95%
C25	Tunnel Ventilation	99.98%
C26	Trackwork including Third Rail (System wide)	99.99%
C27	110 V DC system (per RS or LAS)	99.99%

## Table 1: Technical Availability Requirements of Core Systems



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#### 4.9.2 Non-core systems

The following table lists the non-core system minimum technical availability requirements to be met during the performance demonstration reference period.

#	System / Subsystem	Minimum Technical Availability
N1	Station Lighting (Interior) – Per area (concourse, platform)	98.00%
N2	Station Lighting (Exterior) – Per Area	99.00%
N3	Tunnel Lighting	99.90%
N4	Emergency Lighting	99.90%
N5	Escalators – Per Station	98.00%
N6	Elevators (Lifts) Per Station	99.00%
N7	HVAC per Station	99.00%
N8	Emergency staircase pressurization fan Per Staircase	99.90%
N9	Fire Detection Per Station	99.00%
N10	Fire Fighting per Station and in Tunnel	99.90%
N11	Fire Extinguishing (Inergen) per Area	99.90%
N12	Pumping System Per Pumping Station	98.00%
N13	Automatic Fare Collection System (AFC) - Central	99.90%
N14	Automatic Ticket Validation Gates Per Station	97.00%
N15	Automatic Ticket Issuing Machines (ATM) Per Station	96.00%
N16	Public Address System (PA) Per Station	99.96%
N17	Passenger Information System (PIS) Per Station	99.98%
N18	Closed Circuit Television System (CCTV) Per Station	99.90%
N19	Clock System and Time Distribution System-Central	99.90%
N20	Clocks Per Station	99.00%
N21	Safety Management System -Intrusion Detection (IDS)	99.90%



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#	System / Subsystem	Minimum Technical Availability
N22	Safety Management System -Access Control (ACC)	99.90%
N23	UPS per System	99.00%

Table 2: Technical Availability Requirements of Non-Core Systems

#### 4.9.3 Equipment

The following table lists the equipment minimum technical availability requirements to be met during the performance demonstration reference period.

#	Equipment	Minimum Technical Availability
E1	RS Transformer	99.99%
E2	RS Rectifier	99.95%
E3	LAS Transformer	99.99%
E4	LAS – LBS	99.00%
E5	Pump	99.00%
E6	20 kV Circuit Breaker	99.99%
E7	750 V DC Circuit Breaker (HSCB)	99.99%
E8	Motorized Switch	99.97%
E9	Motorized Disconnector	99.95%
E10	Protection Relay	99.95%
E11	PC & PLC	99.97%
E12	MV Power Cable	99.76%
E13	IT workstation	99.90%
E14	Battery Charger	99.50%
E15	UPS Unit	99.50%
E16	Blast Shaft Fan – BSF	99.98%



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#	Equipment	Minimum Technical Availability
E17	JET Fan	99.98%
E18	Motorized Damper – MD	99.98%
E19	Roller Shutter Damper - RSD	99.98%
E20	Supply Air Fan - SAF	99.98%
E21	Train car -door and control	99.99%
E22	Train car -propulsion	99.99%
E23	Train car -air supply and friction brake equipment	99.99%
E24	Train car-HVAC	99.99%
E25	Train car-auxiliary electric system	99.99%
E26	Train car-coupler and gear	99.99%
E27	Train car-bogie	99.99%

Table 3: Technical Availability Requirements of Equipment

#### 4.9.4 Field Reliability

The list of expected failures per year of Thessaloniki Metro systems and subsystems is presented in Annex 1. This list is indicative and is given for information purposes.

The actual (field) MTBF of equipment shall be calculated from the formula  $R \{t\} = e^{-MTBF}$ where R is the field reliability N is the number of the installed and operational LRUs of an equipment type. If during the reference period Tref, nLRUs have failed then  $R{Tref} = 1 - 1$  $\frac{n}{N} = e^{-\frac{Tref}{MTBF}}$  and  $MTBF = \frac{-Tref}{\ln(1-\frac{n}{N})}$ .

A simplified formula for MTBF may applied with small error, i.e. MTBF =  $N^{T}$ <sub>ref</sub>/n

The reference period shall start always at the beginning of Contractor FRACAS reporting period, which commences on the date of the commencement of operation of each project and terminates on the expiry of the Contractor's contract. The first reference period duration shall be one year and then adding yearly steps until the end of his contract period.



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Field reliability shall be use purely as a benchmark index for the assessment of equipment durability and the O&M processes quality. It shall be used also for the calculation of spare parts in paragraph 5.5.2, Spares Analysis.

#### 4.10 RAM System Performance Evaluation

The RAM System Performance evaluation shall be based on the SPIs meeting their annual targets. It shall be conducted by AM. Poor performance, i.e. SPIs not meeting their targets may lead to financial penalties as described in the "Payments Document" of the tender documentation and is quantified based on the relevant indicators.

#### 4.11 FRACAS

The FRACAS process shall be used to provide continuous feedback to the operations safety manager, the operations manager and maintenance manager regarding any failures and defects (and possible causes) found during operational service.

The FRACAS Database tool put in place by the Construction Contractor shall be used by the Contractor to calculate accurately and report unambiguously the SPIs for RAM Performance demonstration.

Failures will potentially have a variety of causes including component failures, operational errors, maintenance and other errors. The reporting process shall be clear and logical and there shall be a collective forum for all stakeholders involving Contractor and AM to investigate and agree on the most likely source of failure and subsequent corrective actions.

The FRACAS shall be maintained throughout the operation and maintenance life cycle. To ensure that priority issues are addressed, the failures and defects shall be categorized for both safety and reliability for varying levels of severity/criticality. As a minimum, the FRACAS shall be populated with information about failures and defects identified during operation and maintenance. This information shall include:

- $\succ$  time of the failure;
- cause of the failure;
- detailed description of the failure;
- corrective action taken;
- safety ranking for the failure;
- > when and how the failures and defects have been detected (e.g. in operation or during a



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scheduled maintenance);

> the effects of the failures and defects up to the Thessaloniki Metro system level.

The FRACAS records shall be periodically reviewed to determine whether any improvement is needed in the following:

- Operation and maintenance procedures and manuals;
- System training documentation;
- Operational Hazard Log;
- System design;
- > Human factors aspects of operation and maintenance.

The Contractor shall use Root Cause Failure Analysis (RCFA) techniques (Pareto Analysis, Ishikawa/fishbone, etc.) in order to identify major failure causes and try to eliminate them.

The FRACAS reviews shall be conducted quarterly by the relevant Failure Review Board (FRB), which has to be set up after the Contract signing with the participation of AM as the presiding body, as well as the participation of the Contractor's Person in Charge for RAM system, the Contractor's Person in Charge for Maintenance, the Contractor's Person in Charge of Safety, as well as system / equipment experts if needed (for the extension to Kalamaria, respective executives shall be selected from all contracts involved).

The aforementioned system, which has been initially implemented by the construction contractor of the Base Project and shall then cover the extension to Kalamaria, as well, shall be made fully available to the Contractor in view of facilitating him in the execution of his works and duties, in particular as regards the recording of RAMS objectives, which he must comply with during the operation of the projects (Base Project and Extension to Kalamaria).

It is clarified that FRACAS system receives all necessary information for failures either automatically, through the systems (e.g. signaling), or from the operators.

#### 5 MAINTENANCE RAMS MANAGEMENT

#### 5.1 Organization and roles

The Contractor shall put in place an organization that shall serve effectively and efficiently maintenance activities related to RAMS. The Contractor's Person in Charge of



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Maintenance shall collaborate with AM and he shall be responsible for coordinating external maintenance resources.

The maintenance /maintainability activities under the responsibility of the Contactor shall be managed in compliance with RAMS standard EN 50126-1. The maintainability/maintenance activities shall be summarized in the Operation and Maintenance Plans of the contractors responsible for the construction of the projects that refer to respective manuals.

The list including the operation and maintenance manuals of the Base Project is attached to Annex 3, while all operation and maintenance manuals for the Base Project and the extension to Kalamaria shall be provided to the Contractor.

#### 5.2 **Maintenance Process**

The basic philosophy of the maintenance strategy is to gather information on the behavior of the equipment / components with inspections and tests carried out at regular intervals. These are then processed by specific methods. The general methodology is related to the monitoring of the evolution of various phenomena or findings concerning the progress of damage or events that lead to damage, as it is because failures do not occur instantly but evolve over time. These findings are usually due to mechanical or functional causes, the impact of the environment or both.

The typology of the maintenance process and the related terminology are given in the standard EN 13306. The standard gives the overview view of maintenance which is reproduced below.





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The Contractor shall be responsible for the corrective maintenance tasks (after the elapse of 3 years from the acceptance for use and the commencement of their operation) after equipment failure and the preventive maintenance tasks (after the elapse of 1 year from the acceptance for use and the commencement of their operation) which shall be performed at specified intervals or at a specified number of functions or due to a situation, based on the manuals of the equipment suppliers.

For RAMS purposes, where applicable and, if feasible, preventive condition-based maintenance (CBM) shall be implemented with the use of measurement and control systems that allows the diagnosis of the actual physical condition of the equipment while it is in operation (non-intervening method). Its goal is to predict the time of repair or maintenance before serious problems or damage occur by monitoring the situation and equipment.

The maintenance program based on the condition of the equipment combined with a database with diagnostic tools shall provide warning of imminent damage.

The maintainability requirements, if required, are described in the Specifications of each E/M System in the contracts of the construction contractors.

#### 5.3 Levels of maintenance

The following levels of maintenance are defined in accordance with standard EN 133060.

- > Level 1 characterized by simple actions carried out with minimal training.
- Level 2 characterized by basic actions which should be carried out by qualified personnel using detailed procedures.
- Level 3 characterized by complex actions carried out by qualified technical personnel using detailed procedures and /or by actions which imply the know-how of a technique or a technology and carried out by specialized technical personnel.

The Contractor shall classify all maintenance tasks based on the above levels of maintenance and on the documents of the tender documentation and he shall allocate the appropriate personnel / external resources to perform maintenance.



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#### Schedule and planning 5.4

#### 5.4.1 General

The following factors affect the maintenance schedule and planning:

- Need of Maintenance
- Impact on operation
- Availability of maintenance resources (personnel / spares /tools)

#### 5.4.2 Need of maintenance

The need of maintenance shall be based on the:

- Predetermined Preventive Maintenance Intervals set by the equipment manufacturer,
- Condition based maintenance results.
- Extraordinary environmental and / or operational events (such as earthquake, floods etc.) or short circuits, surge over-voltages etc.),
- Corrective maintenance needs following the failure of equipment.

#### 5.4.3 Impact on operation

Generally, scheduled or unscheduled maintenance activities shall be done with the minimum impact on operation. Due to the architecture of Thessaloniki Metro systems, planned or unplanned maintenance may be carried out without affecting Metro service operation in most of the cases. This is due to the redundancy scheme of the Thessaloniki Metro system.

#### 5.4.4 Availability of resources

The Contractor shall make available the required resources for maintenance support during contract period.

If the complexity of equipment maintenance requires specialized maintenance skills normally available by the Equipment Supplier, then he shall arrange for the necessary Service Level Agreements (SLA) with the Equipment Supplier that shall satisfy resource availability and response times in line with RAM system targets.

A spares policy shall be formulated which shall use forecasting principles and taking into consideration the optimum solution that shall guarantee reliable Metro service operation.



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#### 5.5 Spares

#### 5.5.1 Spare parts Inventory

Following the end of project warranty period and the start of his maintenance operation period, the Project Owner shall deliver to the Contactor the inventory of spare parts assembled by the construction contractors under his contract obligations.

The Contractor shall make the most efficient and effective use of spares and he shall take all necessary measures to replenish the spare parts inventory so that the RAMS availability targets are not compromised by undue spare logistics delays.

At the end of his contract period, the Contractor shall have to deliver the spare parts for all E/M and Railway systems and trains corresponding to spare parts capable of fully supporting the Project operation for 1-year period. The exact number of spare parts shall be based on the Contractor's experience from the (1+10 years) operation of the Project.

#### 5.5.2 Spares Analysis

In order to calculate the minimum number of spares needed to keep in stock with regard to failure rates, number of installed parts and resupply time (order lead time), the "Spares analysis" theory shall be used which is based in the binomial distribution and Poisson equation. Poisson equation gives the probability of a specific number of failures P(r) as follows:

$$P(r) = \frac{(\lambda t)^r e^{-\lambda t}}{r!}$$

Where:

- r is the number of failures in a time period t,
- λ is the failure rate per hour,
- t is the time period in hours,
- P(r) is the probability to get exactly r failures.

The cumulative probability to get k or fewer failures in a time period t is given by the following expression:

$$P(r \le k) = \sum_{0}^{k} P(r)$$



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In order to calculate the number of spares that are necessary in order to have a confidence level greater or equal than CL the following expression is used:

$$CL \leq \sum_{k=0}^{S} \frac{(n\lambda R)^k e^{-(n\lambda R)}}{k!}$$

Where:

- CL is the confidence level for the spare LRU adequacy (normally 90% or more),
- n is the number of the LRUs in operation,
- $\lambda$  is the failure rate per hour,
- R is the resupply time interval in hours (the time to replace spare),
- S is the minimum number of required spare LRUs.

This calculation assumes that failed items cannot be repaired and put back into inventory during the resupply time interval, t.

LRU spares analysis does not accommodate for "Force Majeure" cases such as:

- Natural disasters,
- Vandalism,
- Terrorist acts.

#### 5.5.3 End of Life parts

The Contractor shall take all necessary steps to replace end-of-life parts with their successors, making sure that these are "F3-form, fit, function parts" and he shall make sure that the RAMS performance is not compromised.

#### 5.5.4 Obsolescent parts

If there are cases of part/equipment becoming obsolescent e.g. due to an equipment Supplier terminating his business line and if there are no suitable direct substitute replacements available in the market, then the Contractor shall first Investigate for alternative suppliers to find suitable and functional replacements and secondly use the sparing analysis to forecast replaceable spare needs with a confidence level of at least 90% for the remaining project life and order and stock these parts with the agreement of AM. For large complex repairable equipment which becomes obsolescent, it is expected that the Contractor shall demand from the Equipment Supplier



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or from an appointed by him party to commit for the support of the corrective maintenance process during the remaining project duration through a Service Level Agreements (SLA).

#### 6 SAFETY MANAGEMENT

#### 6.1 Organization and roles

The Contractor shall put in place an organization that shall serve effectively and efficiently safety activities related to RAMS. The Contractor's Person in Charge of Safety shall collaborate with AM and he shall be responsible for coordinating external safety resources.

The Safety activities under the responsibility of the Contactor shall be managed in compliance with RAMS standard EN 50126-1.

#### 6.2 Safety at work

The Contractor shall install a Health and Safety System, as described in the "Technical Description and Specifications" document, of the Tender, that shall incorporate all O&M activities and the Contractor's personnel. The Contractor shall operate a permit to work system requiring authorization before the start of any maintenance work that is safety related. The permit to work shall describe the type of work, the safety measures to be applied and the required maintenance staff supervision.

#### 6.3 Operation & Maintenance Hazard Log

The Contractor shall maintain an Operation and Maintenance (O&M) Hazard Log. The basis for the O&M hazard Log shall be the current reporting SRACs Status, as well as the Hazard Log, as presented in Attachment 2, which has been developed by the construction contractor of the Base Project. The final SRAC reports and the final Hazard Log, following the certification of safety by the Independent Safety Assessor, shall be delivered to the Contractor by ATTIKO METRO S.A..

If during the contract period new hazards are identified, then these shall be recorded in the hazard Log and safety measures shall be discussed and agreed with AM and they shall be implemented to mitigate risk (i.e. reduce it to a tolerable level).



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The status of each hazard shall be closed only if the corresponding risk mitigation safety measures have been implemented by the Contractor, documented by the relative O&M procedures and / or tests and approved by AM.

#### 6.4 Accident Management

#### 6.4.1 Accident Definition

The definition of accidents used in O&M shall be based on the definition of common safety indicators related to accidents from the Railway Safety Directive (EU) 2016/798, 0.

In accordance with the Railway Safety Directive (EU) 2016/798 an accident shall be reported under the type of primary accident, even if the consequences of the secondary accident are more severe, for example a fire following a derailment shall be categorized as a derailment. The Contractor shall use the same grouping of accidents.

Events during O&M leading to accidents that may cause fatalities, serious injuries / disabilities, minor injuries or near misses shall be recorded, investigated, analyzed and reported.

#### 6.4.2 Accident classification

The Contractor shall use the appropriate accident description listed in the first column of the following table.

Accident in Contract period	Accident from Railway Safety Directive		
Train - train collision	Collision of train with rail vehicle		
Train - object collision	Collision of trains with obstacle within the clearance gauge		
Derailment	Derailment of trains		
Level crossing (Pylaia)	Level crossing accident, including accident involving pedestrians at level crossing		
Train – person collision Person falling from train in service	Accident to persons involving rolling stock in		
Person being hit by object caused by train in motion	motion, with the exception of suicides and attempted suicides		



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Accident in Contract period	Accident from Railway Safety Directive			
Fire in train	Fire in rolling stock			
Human injury				
Traction power accident	Othor			
Non movement accident				
Flooding				
Structural collapse				
Tunnel fire	Other			
Station platform fire				
Accident in escalator				
Accident in Lift				
Accident in Platform screen door				

The accident list can be extended by the Contractor after its acceptance by AM.

#### 6.4.3 Accident Investigation

Following an accident causing fatality (-ies) and / or serious injury (ies), an independent accident investigation shall be conducted.

For this purpose, an Accident Review Board (ARB) shall be set up with AM's participation as the presiding body, as well as with the Contractor's Person in Charge of Safety, an Equipment Supplier Expert if needed and external Safety Experts if needed.

#### 6.4.4 Tolerable risk

Thessaloniki Metro systems have been assessed for safety in accordance with the RAMS standards EN 50126-1 0and EN 50129. A System application safety case has been drawn by the construction contractor of the Base Project, which shall be reviewed by an Independent Safety Assessor (ISA) and approved by AM. A similar procedure shall be also followed for the extension to Kalamaria. Thus, eventual hazards would have been mitigated to a tolerable risk level, which allows safe operation.

An acceptable tolerable risk level is 1x 10-6 fatalities per year.



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#### 6.4.5 Safety Goal Requirement

The Contractor shall satisfy during the contract period the safety goal requirement of:

- $\succ$  ≤ one fatality,
- ➤ ≤ ten serious injuries / disabilities,
- $\geq$  one hundred minor(reversible) injuries.

Suicides, self-inflicted injuries and injuries/fatalities caused by acts of violence shall not be included in the calculation of the above safety goal requirement.

#### 6.5 Safety Functions

#### 6.5.1 Continuous/high demand

Continuous/high demand safety functions are required all or most of the time during operation and are related to Train Movement Control, Train Cabin Door Control and Platform Screen Door Control.

These safety functions have been allocated higher SILs (SIL4, SIL3) and they have automatic high diagnostic coverage. They normally fail safely during operation. If a continuous /high demand safety function fails dangerously during operation (e.g. a train is allowed to depart from station while a Platform Screen Door is open), an ad-hoc investigation Failure Review Board shall be set up with the participation of AM as the presiding body, with the Contractor's Person in Charge of Safety, the Equipment Supplier Expert and external Safety Experts if needed, to examine the root cause of failure (should a hidden defect is present leading to a "design failure") and launch immediate remedy measures.

#### 6.5.2 Low demand

Low demand safety functions are required infrequently during operation, mostly after a hazardous event (e.g., fire or risk of electrocution) and they are related to Traction Power removal (TCR, GR, ECO) and Emergency Tunnel Ventilation (Tunnel Ventilation fans, Roller shutters, BACS).

These safety functions of lower SIL (SIL2) normally are in standby mode and they require human intervention for their activation. Sometimes it is possible to have hidden (undetected) dangerous failures during the standby period.



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Therefore, in order to maintain their SIL, the Contractor shall arrange for their periodic testing/activation (half annually or quarterly) depending on the relative SRAC requirement.

### 7 HUMAN RELIABILITY ASSESSMENT (HRA)

The Contractor shall use the Human Error Assessment and Reduction Technique (HEART), a technique in the field of human reliability assessment (HRA), for the purpose of evaluating the probability of a human error occurring throughout the completion of a specific task involving safety (e.g. passenger evacuation for safety reasons, activation of the appropriate tunnel ventilation scenario in case of fire/smoke through BACS, interruption of traction power supply, delay in the timely announcement of an emergency at a station, train accident at the Depot due to the operator's error, etc.).

#### 8 RAMS REPORTS

The Contractor shall issue annual RAMS reports following the commissioning of the system. These shall contain information regarding RAMS activities, SPI achieved, accident investigation reports, safety goals achieved, continuous improvement suggestions and RAMS tasks for implementation in the following year.



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### ANNEX 1

#### SERVICE FAILURES

#### Service Failure Consequence Classes

Considering the duration of service failure (D) as a criterion of classification, and based on experience from other similar systems, the following Service Failure Consequence Classes are defined:

Significant:

- a) Multiple trains must be removed from service or are prevented from entering service when required;
- b) D > 15 min;
- c) A train is immobilized (cannot proceed without assistance).

Major:

- a) A failure is not of a more severe class;
- b) 5 < D < 15 min;
- c) One train must be removed from service or is prevented from entering service when required.

Minor:

- a) the failure is not of a higher service failure class;
- b) 0 < D < 5 min.

Taking account, the data from similar systems, the following percentage for each service failure class can be considered for estimating **the impact on system availability parameters**:

Significant 0,55% Major 9,5% Minor 89,95%

It is noted that a reassessment of the failure class percentage has been performed to take into account the transition to the CBTC signaling system technology, leading to a very minor change.



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SYSTEMS & SUBSYSTEMS		Service Failure Class [F/year]		
Level 1	Level 2	Significant	Major	Minor
Rolling Stock		1,92(*)	41,69(*)	395(*)
Trackwork		0,74	4,28	17,06
Signaling System	ATP, including interlocking	0,91	7,12	92,69
	АТО			
	ATS			
DCS – Data Communic	ation System			
	Direct Line and Automatic		0,17	1,6
	Telephone System			
	Optical Transmission Network and	0.001	0.23	3.0
	Fiber Optics	0,001	0,20	3,2
Telecommunication	PA&PIS	0,001	1,13	8,0
relecommunication	CCTV	0,001	0,17	3,73
	Clock System and Time			
	Distribution			
	Intercom System	-	0,17	1,6
	IT Infrastructures	0,001	0,11	1,6
Radio	Radio system	0,001	0,23	3,2
Third Rail		0,39	0,84	1,6
	Traction Power - GR	0,029	0,23	3,73
Traction Power (**)	Traction Power - RS			
Traction Power ()	Traction Power - TCR			
	UPS supplied by E&M	0,001	0,23	3,2
Power supply	Low Voltage Power Supply	0,01	0,06	2,67
	Medium Voltage Power Supply			
	UPS supplied by CW			
PRCS		0,02	1,13	2,13
BACS	BACS Central	0,01	0,11	0,53
	BACS Wayside	_	0,34	1,6
Security Management System	-	0,06	0,53	
PSD		0,01	2,25	32
Workshop equipment,	-	-	-	
M&E installations	Tunnel Ventilation and HVAC	0,071	1,07	10,13



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SYSTEMS & SUBSYSTEMS		Service Failure Class [F/year]			
Level 1	Level 2	Significant	Major	Minor	
	Lifts and Escalators				
	Fire Protection				
	Water supply sewage and				
	Pumping station				
	Compressed Air System				
	Natural Gas Installation				
	Automatic Fare Collection System				
	Earthing/Stray Current/Lightning				
	Protection				
	Intrusion Detection				
	Access Control				
CW - Structures	Tunnel and Station Structures	0,05	0,51	2,13	
	OCC / Depot Buildings				
Total System		6,40	110,49	1046,1	

(\*) [F/10<sup>6</sup> km] These figures are derived for Rolling Stock by taking into account a total production of 2.160.000 km/year of the whole fleet of 18 vehicles.

(\*\*) includes UPS for ATC, TLC, radio, PSD and OCC.



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### **ANNEX 2**

Safety Related Application Condition

(SRACs)


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AUTOMATIC TRAIN CONTROL				
SRACs ID	MITIGATION ID	MITIGATION DESCRIPTION	HAZARD link	DISCIPLI NE/TOPIC
SRAC_O&M_000 02	ATC_MIT_036	The set of TSR is managed through operational procedure which defines the ATS operator behavior.	ATC_HAZ_317 ATC HAZ 030	ATC
SRAC_O&M_000 03	ATC_MIT_038	Operational Procedures shall safely monitor the access of only authorized personnel to the OCC.	TSK_OSHA_HAZ_047	ATC
SRAC_O&M_000 04	ATC_MIT_050	Operation procedures manages the opening of the train doors I	ocally or remotely	ATC
SRAC_O&M_000 05	ATC_MIT_051	The Driver shall be properly trained in order to safely manage the train doors opening, in permission or bypass mode, under his own responsibility. In particular, the Driver shall ensure the train immobilization and the cut of traction command at station stop for allowing the safe passengers exchange.	ATC_HAZ_037	ATC
SRAC_O&M_000 06	ATC_MIT_057	The Driver shall be properly trained for driving the train in manual mode under his own responsibility according to Signaling rules and the instructions communicated by the Train Dispatcher.	ATC_HAZ_043 ATC_HAZ_060 ATC_HAZ_131	ATC



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SRAC_O&M_000 07	ATC_MIT_061	Training and operational rules must be established to prevent member of staff from resetting an Emergency Brake improperly or prematurely.	ATC_HAZ_044 ATC_HAZ_045	ATC
SRAC_O&M_000 08	ATC_MIT_076	When the door is bypassed, an operational procedure has to manage the train door opening with a key through personal attendant actions	ATC_HAZ_056	ATC
SRAC_O&M_000 09	ATC_MIT_078	Proper control procedures shall be put in place before the local activation of the PSD departure interlock override under Train Dispatcher authorization	ATC_HAZ_058	ATC
SRAC_O&M_000 10	ATC_MIT_080	A train is only allowed to be driven in permission mode on the mainline, in serious degraded conditions, for passengers disembarking at the next station.	ATC_HAZ_060	ATC
SRAC_O&M_000 11	ATC_MIT_109	Operational Procedures shall be established in order to safely resume the traffic operations following an intrusion alarm detection in the affected area, thus avoiding to resume the service with the intruder still on the track.	TSK_OSHA_HAZ_054 ATC_HAZ_093	ATC
SRAC_O&M_000 12	ATC_MIT_116	Operational Procedures shall be established to safely manage the trains uncoupling operations in specific areas of the track.	ATC_HAZ_101	ATC
SRAC_O&M_000 13	ATC_MIT_355	Appropriate operation rules must be established for management of test track/pilot section.	TSK_OSHA_HAZ_001	ATC



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SRAC_O&M_000 14	ATC_MIT_356	Operational procedures shall prevent the O&M staff from entering the mainline for corrective/preventive maintenance activities before having established a workzone for guaranting workers safety.	TSK_OSHA_HAZ_002 TSK_OSHA_HAZ_036 TSK_OSHA_HAZ_041 TSK_OSHA_HAZ_107	ATC
SRAC_O&M_000 15	ATC_MIT_357	Prior to any trackside maintenance, the wayside maintainer must activate the Staff Protection Key switch. This will vitally prevent any restrictions from being removed (but will not interfere with placement of new restrictions).	TSK_OSHA_HAZ_003	ATC
SRAC_O&M_000 16	ATC_MIT_358	Track Blocks can be protected with shunting CWaps or other procedures during field maintenance.	TSK_OSHA_HAZ_004	ATC
SRAC_O&M_000 17	ATC_MIT_359	Training and operational rules must be established to prevent Central operators from properly requesting a premature or unintentional resetting of restrictions.	TSK_OSHA_HAZ_005	ATC



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SRAC_O&M_000 18	ATC_MIT_363	The attendant on the Rescue Vehicle must move the Rescue and Failed coupled vehicles until the OSP at station and ensure the correct alignment with respect to the platform before manually commanding the Train Doors opening. Moreover, the Train Attendant shall communicate via radio with the station attendant in charge of the manual PSD synchronized opening.	TSK_OSHA_HAZ_015	ATC
SRAC_O&M_000 19	ATC_MIT_364	Detailed operating procedures must be established to protect passengers during Rescue operation.	TSK_OSHA_HAZ_016 TSK_OSHA_HAZ_018	ATC
SRAC_O&M_000 20	ATC_MIT_365	The attendant on the Rescue Vehicle and the attendant at the platform must coordinate the Passengers Evacuation at station following a rescue operation.	TSK_OSHA_HAZ_017	ATC
SRAC_O&M_000 21	ATC_MIT_366	The Maintenance staff shall be trained for applying the adequate procedures (e.g for LRU substitution) during corrective/preventing maintenance activities.	TSK_OSHA_HAZ_020 TSK_OSHA_HAZ_086 TSK_OSHA_HAZ_115	ATC
SRAC_O&M_000 22	ATC_MIT_369	After a LRU substitution, The Maintenance Staff shall execute the adequate set of tests to check the correct subsystem behavior.	TSK_OSHA_HAZ_020	ATC



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SRAC_O&M_000 23	ATC_MIT_370	The O&M Staff interacting with Safety Critical Subsystems shall be properly trained.	TSK_OSHA_HAZ_024	ATC
SRAC_O&M_000 24	ATC_MIT_371	Any changes made to software settings must be implemented by authorized personnel and fully tested according established guidelines to check subsystem behavior.	TSK_OSHA_HAZ_028	ATC
SRAC_O&M_000 25	ATC_MIT_372	Trains shall be periodically routed towards the Wheel Set Diagnostic System for monitoring of Wheel diameter and wear status	TSK_OSHA_HAZ_029	ATC
SRAC_O&M_000 26	ATC_MIT_374	Wheel wear setting must be mandatory after wheel replacement with one of different (especially larger) diameter.	TSK_OSHA_HAZ_030	ATC
SRAC_O&M_000 27	ATC_MIT_377	Maintainers must be trained to watch for unexpected train movement. This hazard is minimized for passengers and other non-maintenance personnel on the main line through the use of intrusion detection devices.	TSK_OSHA_HAZ_037	ATC
SRAC_O&M_000 28	ATC_MIT_378	Adequate procedures and operation rules must be established to safely manage the maintenance of vehicles.	TSK_OSHA_HAZ_038 TSK_OSHA_HAZ_056	ATC



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SRAC_O&M_000 29	ATC_MIT_379	All maintenance activities for vehicle in fault should be performed in areas assigned to maintenance where vehicle are prevented from moving while personnel is working under it.	TSK_OSHA_HAZ_039	ATC
SRAC_O&M_000 30	ATC_MIT_380	In order to minimize the possibility of maintainer injury, no under-vehicle maintenance should be attempted in the field (emergency or otherwise).	TSK_OSHA_HAZ_040	ATC
SRAC_O&M_000 31	ATC_MIT_381	Procedures must be established regarding setting of doors bypass switches during maintenance.	TSK_OSHA_HAZ_042	ATC
SRAC_O&M_000 32	ATC_MIT_382	OPERATING RULE: After maintenance, all bypass switches must be verified to be in the unbypassed position.	TSK_OSHA_HAZ_043	ATC
SRAC_O&M_000 33	ATC_MIT_383	Operational procedure for point machines manual control shall be established.	TSK_OSHA_HAZ_045	ATC
SRAC_O&M_000 34	ATC_MIT_384	Operational procedure for signals manual control shall be established.	TSK_OSHA_HAZ_046	ATC
SRAC_O&M_000 35	ATC_MIT_385	Appropriate control procedures must be defined about detection of intrusion inside the technical rooms where vital	TSK_OSHA_HAZ_047	ATC
		components are placed.	TSK_OSHA_HAZ_068	
			TSK_OSHA_HAZ_083	



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SRAC_O&M_000 36	ATC_MIT_387	Appropriate control procedures must be defined about detection of intrusion along the line.	TSK_OSHA_HAZ_054 TSK_OSHA_HAZ_060	ATC
SRAC_O&M_000 37	ATC_MIT_388	Periodic maintenance of tracks and switches must be foreseen.	TSK_OSHA_HAZ_055 TSK_OSHA_HAZ_061	ATC
SRAC_O&M_000 38	ATC_MIT_389	Adequate emergency procedures must be established for allowing passengers to safely evacuate the train following an onboard Fire alarm activation	TSK_OSHA_HAZ_058	ATC
SRAC_O&M_000 39	ATC_MIT_391	Preventive maintenance activities the shall be adequately scheduled in order to ensure the correct functioning of the Signaling Safety Critical Subsystems	TSK_OSHA_HAZ_087	ATC
SRAC_O&M_000 40	ATC_MIT_392	Before allowing the train to be routed towards the Depot, the station attendant must ensure that the vehicle is clear of passengers.	TSK_OSHA_HAZ_070	ATC
SRAC_O&M_000 41	ATC_MIT_393	The following OPERATING RULE is suggested: It must be ensured that trains are clear of passengers before release to non-revenue areas.	TSK_OSHA_HAZ_071	ATC
SRAC_O&M_000 42	ATC_MIT_394	Operational Procedures shall be established for managing unplanned passengers evacuations on the mainline	TSK_OSHA_HAZ_072 TSK_OSHA_HAZ_075	ATC



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SRAC_O&M_000 43	ATC_MIT_395	Detailed operating procedures must be established to protect against this and other aspects of the Rescue operation.	TSK_OSHA_HAZ_073 TSK_OSHA_HAZ_076	ATC
SRAC_O&M_000 44	ATC_MIT_405	Appropriate O&M procedures shall be foreseen in order to resume traffic operation following a loss of traction power affecting the Signaling systems.	TSK_OSHA_HAZ_091	ATC
SRAC_O&M_000 45	ATC_MIT_408	High voltage points must be clearly identified (labels).	TSK_OSHA_HAZ_106	ATC
SRAC_O&M_000 46	ATC_MIT_412	An operational procedure must be established to prevent two trains from being left in the same track circuit (e.g. after manual uncoupling or while in manual driving mode).	TSK_OSHA_HAZ_112	ATC
SRAC_O&M_000 47	ATC_MIT_413	The attendant on the rescue train must ensure that no passenger (who may have exited from the failed vehicle) are in line during the Rescue Procedure	TSK_OSHA_HAZ_113	ATC
SRAC_O&M_000 48	ATC_MIT_424	The O&M staff shall ensure that no objects (e.g. tools or materials) affecting the normal traffic operations are left on the mainline after the Work zone (WZ) removal.	ATC_HAZ_092	ATC
SRAC_O&M_000 49	ATC_MIT_430	The driver shall ascertain the actual driving mode by checking the driving mode selector	TSK_OSHA_HAZ_098 ATC_HAZ_062	ATC



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SRAC_O&M_000 50	ATC_MIT_431	Operational Procedures shall be established for correctly managing the TSR set/unset commands	ATC_HAZ_081 ATC_HAZ_082	ATC
SRAC_O&M_000 51	ATC_MIT_435	Operational Procedures shall be established for safely managing Work zone activation/deactivation as well as the communication between the Mobile staff and the ATS Operator before entering the mainline for Maintenance activities.	ATC_HAZ_085	ATC
SRAC_O&M_000 52	ATC_MIT_454	The local manual bypass of the Train Doors Closed and Locked Status shall be performed under strict operational procedures by the authorized staff.	ATC_HAZ_056	ATC
SRAC_O&M_000 53	ATC_MIT_456	The local PSD door opening interlock bypass shall be performed under strict operational procedures by the authorized staff for failure recovery purposes.	ATC_HAZ_057	ATC
SRAC_O&M_000 54	ATC_MIT_496	The OCC Operator shall be properly trained in order to safely manage the operational procedure for clearing a Track Circuit in case of False occupation detected by the Signaling System	ATC_HAZ_125	ATC
SRAC_O&M_000 55	ATC_MIT_498	The O&M staff shall be properly trained in order to safely apply the operational procedure for the Override of the Access Doors Closed and Locked Status	ATC_HAZ_124	ATC



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SRAC_O&M_000 56	ATC_MIT_501	Operational Procedures shall be set up in order to safely manage test activities on the Test Track with train with an unproven ATP onboard system	ATC_HAZ_128	ATC
SRAC_O&M_000 57	ATC_MIT_507	The O&M staff shall ensure that the Signaling Equipment is de-energized before proceeding with the Maintenance Activities.	TSK_OSHA_HAZ_095	ATC
SRAC_O&M_000 58	ATC_MIT_508	The O&M staff shall ensure that the track is de-energized before having access to the mainline	TSK_OSHA_HAZ_106	ATC
SRAC_O&M_000 59	ATC_MIT_509	The O&M Staff shall follow strict operational procedures for manually moving a service vehicle (or vehicle in bypass mode) through a Work Zone Area.	TSK_OSHA_HAZ_036	ATC
SRAC_O&M_000 60	ATC_MIT_514	The Driver shall consider a blank (i.e. shut down) signal as a danger aspect, when driving in manual modes, and stop the train to the signal.	ATC_HAZ_043	ATC
SRAC_O&M_000 61	ATC_MIT_515	<ul> <li>The Driver shall enforce the maximum speed allowed under his own responsibility while driving in unprotected mode, taking into account:</li> <li>permanent infrastructure speed limits</li> <li>particular class or configuration of train speed limits</li> <li>temporary speed limit</li> </ul>	ATC_HAZ_043	ATC
SRAC_O&M_000 62	ATC_MIT_517	The OCC Operator shall follow strict operational procedures to enforce or revoke a switch block command	ATC_HAZ_083	ATC



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SRAC_O&M_000 63	ATC_MIT_518	In case of Emergency, for a train in PM driving mode, the Driver shall stop the train by applying an immediate emergency brake.	ATC_HAZ_131	ATC
SRAC_O&M_000 64	ATC_MIT_522	Operational Procedures shall be established for safely managing the manual opening/closing and control of platform screen doors thus to ensure the synchronism with the train Doors opening/closing in case of train in unprotected mode stopped at station	ATC_HAZ_133	ATC
SRAC_O&M_000 65	ATC_MIT_523	Operational Procedures shall be established for safely stop traffic operation in case of emergency.	ATC_HAZ_134	ATC
SRAC_O&M_000 66	ATC_MIT_525	The O&M Staff shall apply manual procedures in order to restore a train (PM or bypass mode) in a parking status and to allow the departure of a train in manual mode from a pocket area.	ATC_HAZ_135	ATC
SRAC_O&M_000 67	ATC_MIT_526	Before leaving a train parked on the pocket track or in Depot, the O&M Staff shall apply movable scotches and check for the park brake application, in order to prevent undue movements of the trains	ATC_HAZ_135	ATC



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SRAC_O&M_000 68	ATC_MIT_529	Operational Procedures shall be established for applying the bypass of a failed switch; in particular, the Train Dispatcher shall apply the bypass command only after a field survey in order to check that there is no risk for the train operations	ATC_HAZ_136	ATC
SRAC_O&M_000 69	ATC_MIT_530	Operational Procedures shall be established for applying the bypass of a flank protection; in particular, the Train Dispatcher shall apply the bypass command only after a field survey in order to check that there is no risk for the train operations	ATC_HAZ_136	ATC
SRAC_O&M_000 70	ATC_MIT_532	Upon an evacuation suspicion alarm, Operational procedures shall be established in order to safely resume traffic operation thus to ensure that the track is clear of passengers.	TSK_OSHA_HAZ_072	ATC
SRAC_O&M_000 71	ATC_MIT_533	Upon the loss of PSD closed and locked status, Operational procedures shall be established in order to safely resume traffic operation thus to ensure that the track is clear of passengers.	ATC_HAZ_055	ATC



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SRAC_O&M_000 72	ATC_MIT_536	Upon a loss of integrity alarm, Operational Procedures shall be established for restoring traffic operation in order to check that there is no risk for the train operations	ATC_HAZ_004	ATC
SRAC_O&M_000 73	ATC_MIT_553	Bypass of missing conditions for Route setting shall be done un responsibility. Operator should be sure that safety condition are command.	der Operator met before applying the	ATC
SRAC_O&M_000 74	ATC_MIT_558	Short circuit device application shall be done under Operator re	sponsibility when needed.	ATC
SRAC_O&M_000 75	ATC_MIT_562	Following ATC restart, operating procedure shall be applied for	restarting train service.	ATC
SRAC_O&M_000 76	ATC_MIT_570	Operating procedures for guaranteeing safety shall be establish	ned for train rescue.	ATC
SRAC_O&M_000 77	ATC_MIT_575	Concerning Maintenance activities at the boundaries of a Work shall request the activation of the adjacent Work zone	zone area, the O&M staff	ATC
SRAC_O&M_000 78	ATC_MIT_592	Tracks shall be maintained with appropriate frequency.		ATC



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SRAC_O&M_000 79	ATC_MIT_598	Operational Procedures shall be established to manage the coupling of different types of AV / PV / flatbed into a same consist, ensuring that the leading vehicle is the one positioned at the extremity of the consist	ATC
SRAC_O&M_000 80	ATC_MIT_599	When coupling different types of AV / PV / flatbeds into the same consist, the Driver shall indicate on the END the total number of vehicle in the consist through the dedicated switch on the EDP.	ATC



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Reliability, Availability, Maintainability and Safety (RAMS)

# BACS & CBACS Safe

SRACs ID	MITIGATION ID	MITIGATION DESCRIPTION	HAZARD link	DISCIPLI NE/TOPIC
SRAC_O&M_000 01	CBACS.M11	Regular polling of each equipment monitored.	CBACS.SSHA.01 CBACS.SSHA.02	CBACS
SRAC_O&M_001 38	CBACS.M7	Provide suitable protection ( i.e. interlocks, pilot lines and more ) in Power Supply equipment so that any command issued from PRCS / DMS are discarded in case there not the electrical safety condition to execute the command ( i.e. potential short circuits);	CBACS.SSHA.01 CBACS.SSHA.02	CBACS
SRAC_O&M_001 39	CBACS.M8	Confirmation requests from the operator for particular commands (those that energize the plant) so that operator has a chance to check its own action; moreover, with reference to remote power cut-off from HMI, a confirmation is needed in order to prevent unsuitable de-energization (unintended command). For each one circuit breaker, to be opened from HMI (for specific 750Vdc segment to be de-energized), a confirmation is needed.	CBACS.OSHA.05	CBACS



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SRAC_O&M_001 40	CBACS.SAFE.M1	Maintenance and Operation manual.	CBACS.SAFE.SSHA.01 CBACS.SAFE.SSHA.02 CBACS.SAFE.SSHA.03 CBACS.SAFE.SSHA.05 CBACS.SAFE.OSHA.01 CBACS.SAFE.OSHA.03 CBACS.SAFE.OSHA.04	CBACS Safe
SRAC_O&M_001 41	CBACS.SAFE.M11	HW Redundancy at OCC.WS <j> j=1,2.</j>	CBACS.SAFE.SSHA.01 CBACS.SAFE.SSHA.02 CBACS.SAFE.IHA.03	CBACS Safe



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SRAC_O&M_001 42	CBACS.SAFE.M12	HW Redundancy between adjacent SMR.WS <i> i=1,,13.</i>	CBACS.SAFE.SSHA.01 CBACS.SAFE.SSHA.02 CBACS.SAFE.IHA.03 CBACS.SAFE.IHA.04	CBACS Safe
SRAC_O&M_001 43	CBACS.SAFE.M15	Regular polling of each monitored plant equipment.	CBACS.SAFE.SSHA.03 CBACS.SAFE.SSHA.05	CBACS Safe
SRAC_O&M_001 44	CBACS.SAFE.M16	Fault detection of WS monitoring function.	CBACS.SAFE.SSHA.01 CBACS.SAFE.SSHA.02	CBACS Safe
SRAC_O&M_001 45	CBACS.SAFE.M17	Fault detection of WS command function.	CBACS.SAFE.SSHA.01 CBACS.SAFE.SSHA.02	CBACS Safe



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SRAC_O&M_001 46	CBACS.SAFE.M18	Fault detection of WS VDU.	CBACS.SAFE.SSHA.01 CBACS.SAFE.SSHA.02	CBACS Safe
SRAC_O&M_001 47	CBACS.SAFE.M19	Fault reaction of WS by disabling commands.	CBACS.SAFE.SSHA.01 CBACS.SAFE.SSHA.02	CBACS Safe
SRAC_O&M_001 48	CBACS.SAFE.M2	Monitor SW performances (CPU load, memory allocation, disk free space etc.).	CBACS.SAFE.SSHA.01 CBACS.SAFE.SSHA.02	CBACS Safe
SRAC_O&M_001 49	CBACS.SAFE.M20	Fault indication of WS by clear signalization.	CBACS.SAFE.SSHA.01 CBACS.SAFE.SSHA.02	CBACS Safe



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SRAC_O&M_001 50	CBACS.SAFE.M21	Periodic proof-test of WS commands function.	CBACS.SAFE.SSHA.01 CBACS.SAFE.SSHA.02 CBACS.SAFE.OSHA.03 CBACS.SAFE.OSHA.04	CBACS Safe
SRAC_O&M_001 51	CBACS.SAFE.M22	Periodic test of diagnostic measures.	CBACS.SAFE.SSHA.01 CBACS.SAFE.SSHA.02	CBACS Safe
SRAC_O&M_001 52	CBACS.SAFE.M23	Periodic test of WS VDU.	CBACS.SAFE.SSHA.01 CBACS.SAFE.SSHA.02	CBACS Safe
SRAC_O&M_001 53	CBACS.SAFE.M24	Sub-system's GUI access control through user name and password.	CBACS.SAFE.OSHA.03 CBACS.SAFE.OSHA.04	CBACS Safe



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SRAC_O&M_001 54	CBACS.SAFE.M25	Sub-system's GUI with clear and uniquely identifiable indication of status and alarms of plant equipment.	CBACS.SAFE.OSHA.03 CBACS.SAFE.OSHA.04	CBACS Safe
SRAC_O&M_001 55	CBACS.SAFE.M26	Sub-system's GUI with confirmation request for all operator commands towards plant equipment.	CBACS.SAFE.OSHA.04	CBACS Safe
SRAC_O&M_001 56	CBACS.SAFE.M27	Sub-system's GUI with progress status indication for all operator commands towards plant equipment	CBACS.SAFE.OSHA.03 CBACS.SAFE.OSHA.04	CBACS Safe
SRAC_O&M_001 57	CBACS.SAFE.M28	Station Fireman Box.	CBACS.SAFE.SSHA.01 CBACS.SAFE.SSHA.02	CBACS Safe
SRAC_O&M_001 58	CBACS.SAFE.M3	Design the sub-system by using a modular approach, with LRUs easily accessible.	CBACS.SAFE.OSHA.01	CBACS Safe
SRAC_O&M_001 59	CBACS.SAFE.M4	Do not use antivirus on WS.	CBACS.SAFE.SSHA.01 CBACS.SAFE.SSHA.02	CBACS Safe



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SRAC_O&M_001 60	CBACS.SAFE.M5	Do not install USB devices.	CBACS.SAFE.OSHA.01 CBACS.SAFE.OSHA.02	CBACS Safe
SRAC_O&M_001 61	CBACS.SAFE.M6	Do not install SW other than those specifically tested and approved.	CBACS.SAFE.OSHA.01 CBACS.SAFE.OSHA.02	CBACS Safe
SRAC_O&M_001 62	CBACS.SAFE.M7	Implement SW logic checks, where possible, so that physical incongruence situations are trapped.	CBACS.SAFE.OSHA.02	CBACS Safe
SRAC_O&M_001 63	CBACS.SAFE.M8	LV EC declaration of conformity and tests report.	CBACS.SAFE.SSHA.03 CBACS.SAFE.SSHA.05	CBACS Safe
SRAC_O&M_001 84	MIT_CBACS021	Maintenance personnel must be properly trained	CBACS011	CBACS



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# PRCS

SRACs ID	MITIGATION ID	MITIGATION DESCRIPTION	HAZARD link	DISCIPLI NE/TOPIC
SRAC_O&M_002 62	MIT_PRCS003	Training to operators so that they get used with PRCS functions via HMI	s as well as their access	PRCS
SRAC_O&M_002 63	MIT_PRCS004	case of error the operator has to issue proper commands to correct the undesired ect; in case it would not be possible to issue a remote command a local direct action on a plant is required.		PRCS
SRAC_O&M_002 64	MIT_PRCS013	Maintenance personnel must be properly trained		PRCS
SRAC_O&M_002 65	MIT_PRCS014	Expert personnel must hold maintenance operation responsibility. Moreover before each programmed maintenance mission is started it is required to evaluate service regularity mpacts and minimize it.		PRCS
SRAC_O&M_002 66	MIT_PRCS019	Do not run executables or batch files other than those authorize	ed	PRCS
SRAC_O&M_004 37	PRCS.M11	Regular polling of each equipment monitored	PRCS.SSHA.03 PRCS.SSHA.04	PRCS
SRAC_O&M_004 38	PRCS.M4	Do not install any other than those specifically tested and approved	PRCS.OSHA.02	PRCS



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SRAC_O&M_004 39	PRCS.M5	Design the system by using a modular approach, with LRUs easily accessible	PRCS.OSHA.04	PRCS
SRAC_O&M_004 40	PRCS.M7	Provide suitable protection ( i.e. interlocks, pilot lines and more ) in Power Supply equipment so that any command issued from PRCS / DMS are discarded in case there not the electrical safety condition to execute the command ( i.e. potential short circuits)	PRCS.OSHA.05 PRCS.SSHA.03 PRCS.SSHA.04	PRCS
SRAC_O&M_004 41	PRCS.M8	Confirmation requests to the operator for particular commands (those that energize the plant) so that operator has a chance to check its own action; moreover, with reference to remote power cut-off from HMI, a confirmation is needed in order to prevent unsuitable de-energization (unintended command). For each one circuit breaker, to be opened from HMI (for specific 750Vdc segment to be de-energized), a confirmation is needed.	PRCS.OSHA.08	PRCS



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# SYSTEM

SRACs ID	MITIGATION ID	MITIGATION DESCRIPTION	HAZARD link	DISCIPLI NE/TOPIC
SRAC_O&M_002 99	MIT_SYS002	Locking and clamping of "blocked" switches for future use (e.g. future extensions).	SYS001	SYS
SRAC_O&M_003 00	MIT_SYS003	Periodic inspection of "blocked" switches for future use (e.g. future extensions).	SYS001	SYS
SRAC_O&M_003 01	MIT_SYS005	Adequate operational procedures dealing with temporary speed restrictions.	SYS001 SYS002	SYS
SRAC_O&M_003 02	MIT_SYS020	Line check during the first run in the morning. Appropriate rules for manually operated trains.	SYS001	SYS
		Appropriate procedure for works on the track area Appropriate operation rules for Signaling degraded modes.		



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SRAC_O&M_003 03	MIT_SYS021	Appropriate rules for depot operation (e.g. driving rules, stationing procedures).	SYS001 SYS002 SYS003 SYS045	SYS
SRAC_O&M_003 04	MIT_SYS022	Adequate procedure for emergency management (e.g. OCC to call rescue services, etc.).	SYS001 SYS002	SYS
SRAC_O&M_003 05	MIT_SYS023	Adequate maintenance of Rolling Stock.	SYS001 SYS002 SYS003 SYS004 SYS005 SYS006 SYS008 SYS015 SYS020 SYS020 SYS032 SYS055	SYS



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SRAC_O&M_003 06	MIT_SYS024	Adequate maintenance of Signaling system.	SYS001 SYS004 SYS005 SYS006 SYS008 SYS013 SYS015 SYS055	SYS
SRAC_O&M_003 07	MIT_SYS025	Adequate maintenance of track system, including switches. Frequent rail crack detection as requested by CON-06/004- AM-01019.	SYS001 SYS003 SYS005	SYS
SRAC_O&M_003 08	MIT_SYS026	Adequate maintenance of track system, including switches. Frequent rail crack detection as requested by CON-06/004- AM-01019.	SYS001	SYS
SRAC_O&M_003 09	MIT_SYS029	Adequate maintenance of locking device of switch machine.	SYS002	SYS
SRAC_O&M_003 10	MIT_SYS037	Adequate operational procedures dealing with temporary speed restrictions.	SYS002	SYS
SRAC_O&M_003 11	MIT_SYS041	Appropriate rules for depot operation (e.g. driving rules, stationing procedures).	SYS002	SYS



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SRAC_O&M_003 12	MIT_SYS042	Appropriate rules for manually operated trains.	SYS002	SYS
SRAC_O&M_003 13	MIT_SYS043	Appropriate operation rules/procedures for Signaling degraded modes.	SYS002	SYS
SRAC_O&M_003 14	MIT_SYS044	Adequate procedure for emergency management (e.g. OCC to call rescue services, etc.).	SYS002	SYS
SRAC_O&M_003 15	MIT_SYS045	Adequate maintenance of Rolling Stock.	SYS001	SYS
		Adequate maintenance of Signaling system.		
		Adequate maintenance of track system including switches.		
SRAC_O&M_003 16	MIT_SYS058	Procedures for work close to metro system, especially where construction works in public areas might affect the clearance envelope of the trains. Line check during the first run in the morning. Procedure for works on the track area.	SYS003	SYS
SRAC_O&M_003 17	MIT_SYS059	Appropriate rules for depot operation (e.g. driving rules, stationing procedures).	SYS003	SYS
SRAC_O&M_003 18	MIT_SYS060	Adequate maintenance of Rolling Stock. Frequent maintenance of trains' suspensions so that they do not cause a change to the trains gabarit, as requested by CON-06/004-AM-01019. Adequate maintenance of track system, including switches.	SYS003	SYS



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SRAC_O&M_003 19	MIT_SYS061	Adequate emergency procedure.	SYS003 SYS004 SYS007 SYS008 SYS009 SYS011 SYS014 SYS016 SYS017 SYS018 SYS019 SYS019 SYS025 SYS025 SYS026 SYS026 SYS041 SYS042 SYS043 SYS044	SYS
SRAC_O&M_003 20	MIT_SYS064	Adequate rules for coupling/uncoupling.	SYS004	SYS
SRAC_O&M_003 21	MIT_SYS065	Adequate rules for towing.	SYS004	SYS



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SRAC_O&M_003 22	MIT_SYS066	Signaling system adequately designed, tested/commissioned (e.g. avoid as much as possible unexpected braking): E2 to be ensured by appropriate determination of the Non vital speed supervision by ATO	SYS004	SYS
SRAC_O&M_003 23	MIT_SYS067	Adequate emergency procedure.	SYS004	SYS
SRAC_O&M_003 24	MIT_SYS076	Appropriate driving rules for Signaling degraded modes and manual operation (e.g. application of "soft" accelerations during manual mode). Coupling of trains - adequate operational personnel's training for handling the passengers in abnormal situations, as requested by CON-06/004-AM-01019.	SYS005	SYS
SRAC_O&M_003 25	MIT_SYS077	Adequate emergency procedure.	SYS016	SYS
SRAC_O&M_003 26	MIT_SYS078	Adequate maintenance of Rolling Stock. Adequate maintenance of Signaling System. Adequate maintenance of track system.	SYS005	SYS



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SRAC_O&M_003 27	MIT_SYS085	Adequate operational procedures dealing with doors faults. Appropriate driving rules for Signaling degraded modes and manual operation.	SYS006	SYS
SRAC_O&M_003 28	MIT_SYS086	Adequate maintenance of Rolling Stock (doors and related controls). Adequate maintenance of Signaling system.	SYS006	SYS
SRAC_O&M_003 29	MIT_SYS097	Adequate emergency procedure.	SYS007	SYS
SRAC_O&M_003 30	MIT_SYS098	Adequate cleaning including warning signs, indicating wet/sliding floor. Adequate periodic safety inspection. Adequate maintenance of escalators/lifts. Adequate maintenance of ticketing system.	SYS007	SYS

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SRAC_O&M_003 31	MIT_SYS106	Adequate operational procedures dealing with doors faults. Adequate maintenance of Rolling Stock (doors and related controls). Adequate maintenance of Signaling system. Adequate maintenance of PSD.	SYS008	SYS
SRAC_O&M_003 32	MIT_SYS107	Adequate emergency procedure.	SYS008	SYS
SRAC_O&M_003 33	MIT_SYS108	Adequate rules for opening doors on platform side, when manual driving mode is selected.	SYS008	SYS
SRAC_O&M_003 34	MIT_SYS109	Adequate cleaning of platform, including warning signs indicating wet/sliding floor. Adequate maintenance and cleaning of PSD thresholds, as requested by CON-06/004-AM-01019.	SYS008	SYS
SRAC_O&M_003 35	MIT_SYS117	Adequate emergency procedure.	SYS009	SYS

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SRAC_O&M_003 36	MIT_SYS118	Adequate maintenance of PSD.	SYS009	SYS
SRAC_O&M_003 37	MIT_SYS119	Rules for working in tunnel/track way.	SYS009	SYS
SRAC_O&M_003 38	MIT_SYS132	Adequate maintenance of lighting. Adequate periodic inspection of walkway.	SYS010	SYS
SRAC_O&M_003 39	MIT_SYS133	Rules for working in tunnel/track way.	SYS010	SYS
		Adequate procedure for evacuation.		
		Adequate emergency procedure.		
SRAC_O&M_003 40	MIT_SYS139	Adequate maintenance (e.g. fixing equipment). Adequate emergency procedure.	SYS011	SYS
SRAC_O&M_003 41	MIT_SYS147	Emergency procedure. Adequate maintenance (e.g. fixing of equipment).	SYS012	SYS
SRAC_O&M_003 42	MIT_SYS163	Adequate procedure for Signaling degraded mode (e.g. manual driving with ATP off & detection of intrusion, etc.).	SYS013	SYS
SRAC_O&M_003 43	MIT_SYS164	Adequate emergency procedure.	SYS013	SYS
SRAC_O&M_003 44	MIT_SYS165	Adequate maintenance of intrusion detection system.	SYS013	SYS



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SRAC_O&M_003 45	MIT_SYS166	Adequate maintenance of PSD.	SYS013	SYS
SRAC_O&M_003 46	MIT_SYS167	Adequate maintenance of Signaling system.	SYS013	SYS
SRAC_O&M_003 47	MIT_SYS168	Periodic safety inspection of walkways, human envelope, track crossings.	SYS013 SYS027	SYS
SRAC_O&M_003 48	MIT_SYS175	Adequate emergency procedure.	SYS014	SYS
SRAC_O&M_003 49	MIT_SYS183	Adequate rules for doors operation when Signaling degraded mode (e.g. when ATP off).	SYS015	SYS
SRAC_O&M_003 50	MIT_SYS184	Adequate emergency procedure	SYS015	SYS
SRAC_O&M_003 51	MIT_SYS185	Adequate maintenance of train doors and their control. Adequate maintenance of PSD. Adequate maintenance of Signaling control of train doors/PSD.	SYS015	SYS
SRAC_O&M_003 52	MIT_SYS194	Adequate rules for station closure (e.g. check that no passengers inside before closing).	SYS016	SYS
SRAC_O&M_003 53	MIT_SYS195	Adequate emergency procedure.	SYS016	SYS
SRAC_O&M_003 54	MIT_SYS196	Adequate maintenance of escalators/lifts. Adequate maintenance of ticketing system.	SYS016	SYS



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SRAC_O&M_003 55	MIT_SYS200	Adequate maintenance of PSD. Adequate maintenance of train doors and their control. Adequate maintenance of Signaling control of train doors/PSD.	SYS017	SYS
SRAC_O&M_003 56	MIT_SYS201	Adequate emergency procedure.	SYS017	SYS
SRAC_O&M_003 57	MIT_SYS214	Adequate emergency procedure.	SYS018	SYS
SRAC_O&M_003 58	MIT_SYS215	Maintenance rules dealing with hot object/equipment.	SYS018	SYS
SRAC_O&M_003 59	MIT_SYS221	Adequate emergency procedure.	SYS019	SYS
SRAC_O&M_003 60	MIT_SYS227	Adequate maintenance of Rolling Stock, On board TLC.	SYS020	SYS
SRAC_O&M_003 61	MIT_SYS228	Adequate emergency procedure.	SYS020	SYS
SRAC_O&M_003 62	MIT_SYS229	Earthing equipment for safety earthing shall be provided during maintenance or emergency situations.	SYS020 SYS021 SYS022	SYS
SRAC_O&M_003 63	MIT_SYS245	Adequate procedure for de-energization/re-energization of third rail.	SYS021 SYS056	SYS
		Adequate emergency procedure (e.g. station closure if electrocution risk).		



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SRAC_O&M_003 64	MIT_SYS246	Adequate maintenance	SYS021 SYS022 SYS027 SYS028 SYS040 SYS056	SYS
SRAC_O&M_003 65	MIT_SYS249	Earthing equipment for safety earthing shall be provided during maintenance or emergency situations.	SYS021	SYS
SRAC_O&M_003 66	MIT_SYS277	Adequate emergency procedure dealing with fire.	SYS022	SYS
SRAC_O&M_003 67	MIT_SYS278	Adequate maintenance.	SYS022	SYS
SRAC_O&M_003 68	MIT_SYS281	Earthing equipment for safety earthing shall be provided during maintenance or emergency situations.	SYS022	SYS
SRAC_O&M_003 69	MIT_SYS301	Appropriate maintenance procedures for activities involving fire danger.	SYS023 SYS024	SYS
SRAC_O&M_003 70	MIT_SYS302	Adequate emergency procedures in case of station fire (including e.g. all escalators shall be switched off, all the access gates of the fare collection system will be opened in escape direction for passenger evacuation, station closure).	SYS023	SYS
SRAC_O&M_003 71	MIT_SYS327	Appropriate maintenance procedures for activities involving fire danger.	SYS024	SYS

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SRAC_O&M_003 72	MIT_SYS328	Adequate emergency procedures in case of tunnel fire.	SYS024	SYS
SRAC_O&M_003 73	MIT_SYS330	Means to prevent a train from entering in tunnel by procedure (e.g. stop of trains at stations, via ATC).	SYS024	SYS
SRAC_O&M_003 74	MIT_SYS342	Adequate maintenance procedures (precautions).	SYS025	SYS
SRAC_O&M_003 75	MIT_SYS343	Adequate emergency procedure.	SYS025	SYS
SRAC_O&M_003 76	MIT_SYS358	Adequate emergency procedure.	SYS026	SYS
SRAC_O&M_003 77	MIT_SYS376	Adequate procedure for management of evacuation along the line.	SYS027	SYS
SRAC_O&M_003 78	MIT_SYS377	Periodic safety inspection of walkways, human envelope, track crossings.	SYS027	SYS
SRAC_O&M_003 79	MIT_SYS378	Adequate maintenance.	SYS027	SYS
SRAC_O&M_003 80	MIT_SYS381	Adequate design, installation/test of UPS supplying BACS wayside. Measure supporting remote monitoring/control, as well as O&M procedures.	SYS027	SYS
SRAC_O&M_003 81	MIT_SYS392	Adequate procedure for evacuation management.	SYS028	SYS
SRAC_O&M_003 82	MIT_SYS393	Adequate maintenance (e.g. of lighting).	SYS028	SYS


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SRAC_O&M_003 83	MIT_SYS404	Adequate procedure for overcrowding management.	SYS029	SYS
SRAC_O&M_003 84	MIT_SYS408	Adequate procedure (e.g. put train out of service at the end of the run if temperature too high).	SYS030	SYS
SRAC_O&M_003 85	MIT_SYS409	Adequate maintenance of air conditioning system.	SYS030	SYS
SRAC_O&M_003 86	MIT_SYS413	Adequate procedure (e.g. station closure if too hot).	SYS031	SYS
SRAC_O&M_003 87	MIT_SYS414	Adequate maintenance of station ventilation system.	SYS031	SYS
SRAC_O&M_003 88	MIT_SYS420	Adequate maintenance of rolling stock/track system.	SYS032	SYS
SRAC_O&M_003 89	MIT_SYS423	Adequate maintenance of equipment.	SYS033	SYS
SRAC_O&M_003 90	MIT_SYS427	Adequate emergency procedure.	SYS034	SYS
SRAC_O&M_003 91	MIT_SYS429	Long term inspection and monitoring programme. Emergency procedure.	SYS035	SYS
SRAC_O&M_003 92	MIT_SYS432	Adequate procedure for flooding management (e.g. station closure if flooding event and pumping not working).	SYS036	SYS
SRAC_O&M_003 93	MIT_SYS433	Adequate maintenance of pumping system.	SYS036	SYS
SRAC_O&M_003 94	MIT_SYS449	Adequate maintenance.	SYS040	SYS



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SRAC_O&M_003 95	MIT_SYS451	Adequate emergency procedure.	SYS041	SYS
SRAC_O&M_003 96	MIT_SYS453	Adequate emergency procedure.	SYS042	SYS
SRAC_O&M_003 97	MIT_SYS455	Adequate emergency procedure.	SYS043	SYS
SRAC_O&M_003 98	MIT_SYS457	Adequate emergency procedure.	SYS044	SYS
SRAC_O&M_003 99	MIT_SYS458	appropriate rules for depot operation (e.g. driving rules, stationing procedures).	SYS045	SYS
SRAC_O&M_004 00	MIT_SYS460	O&M procedure.	SYS046	SYS
SRAC_O&M_004 01	MIT_SYS462	Adequate rules for operation of service trains. Emergency procedure.	SYS048	SYS
SRAC_O&M_004 02	MIT_SYS466	Adequate procedure for access to train/depot operation. Emergency procedure. Measure mitigating consequences of the hazard.	SYS049	SYS



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SRAC_O&M_004 03	MIT_SYS472	Adequate safety precautions when working at "height", with hot objects, with hazardous substances. Adequate evacuation procedure. Emergency procedure.	SYS050	SYS
SRAC_O&M_004 04	MIT_SYS480	Adequate procedure for de-energization/re-energization of power equipment (e.g. MV switchboard, transformer, etc.). Adequate safety rules for management of workshop equipment/energization and de-energization of third rail. Adequate rules for access/maintenance to the track, train. Attention to be paid to possible contact with the powered shoegear on the side of the train opposite to the 3rd Rail. Emergency procedure.	SYS051	SYS
SRAC_O&M_004 05	MIT_SYS483	Adequate procedure for access to the track. Emergency procedure.	SYS052	SYS
SRAC_O&M_004 06	MIT_SYS489	Appropriate maintenance procedures for activities involving fire danger. Adequate emergency procedures dealing with fire in technical area.	SYS053	SYS



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SRAC_O&M_004 07	MIT_SYS493	Procedure for authorized access. Emergency procedures.	SYS054	SYS
SRAC_O&M_004 08	MIT_SYS498	Adequate maintenance of Rolling Stock (doors and their control). Adequate maintenance of PSD. Adequate maintenance of Signaling system.	SYS055	SYS
SRAC_O&M_004 09	MIT_SYS503	Adequate power supply to PRCS. Measure supporting remote monitoring/control for application of O&M procedures.	SYS056	SYS
SRAC_O&M_004 10	MIT_SYS513	Adequate maintenance.	SYS056	SYS
SRAC_O&M_004 11	MIT_SYS528	Action taken by O&M to stop trains, close stations	SYS034	SYS
SRAC_O&M_004 12	MIT_SYS533	Adequate maintenance of PSD	SYS064	SYS



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# **ESC & LIFTS**

SRACs ID	MITIGATION ID	MITIGATION DESCRIPTION	HAZARD link	DISCIPLI NE/TOPIC
SRAC_O&M_002 30	MIT_ESC&LIFT004	Maintenance staff to ensure adequate fall protection (e.g. guardrail in front of open shaft)	ESC&LIFT007	ESC&LIFT
SRAC_O&M_002 31	MIT_ESC&LIFT005	Switch off power supply, before performing maintenance. If it is necessary to work "live" on electrical equipment, special precautions should be followed	ESC&LIFT008 ESC&LIFT009	ESC&LIFT
SRAC_O&M_002 32	MIT_ESC&LIFT008	Adequate preventive maintenance: periodic cleaning	ESC&LIFT013	ESC&LIFT
SRAC_O&M_002 33	MIT_ESC&LIFT010	Maintenance staff to install adequate signs and protections in order to prevent public to access to lifts/escalators under maintenance	ESC&LIFT016	ESC&LIFT
SRAC_O&M_002 34	MIT_ESC&LIFT011	Adequate maintenance precautions	ESC&LIFT017	ESC&LIFT



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## RADIO

RADIO	MITIGATION ID	MITIGATION DESCRIPTION	HAZARD link	DISCIPLI NE/TOPIC
SRAC_O&M_002 73	MIT_RADIO002	Adequate installation of on board and OCC equipment	RADIO5 RADIO6 RADIO7 RADIO8	RADIO
SRAC_O&M_002 74	MIT_RADIO004	Operation procedure to send immediately personnel on train equipped with Handheld	RADIO1 RADIO2	RADIO
SRAC_O&M_002 75	MIT_RADIO007	Training of Maintenance Personnel	RADIO1 RADIO2 RADIO3 RADIO4	RADIO
SRAC_O&M_002 76	MIT_RADIO008	Proper Operation Procedure (i.e presence of dynamic information alongside the tunnel to indicate the right direction for evacuation)	RADIO1 RADIO2 RADIO3 RADIO4	RADIO
SRAC_O&M_002 77	MIT_RADIO009	Design in accordance with European CE requirements (EN50123 & EN60950 requirements for electrical safety)I	RADIO5 RADIO8	RADIO
SRAC_O&M_002 78	MIT_RADIO026	Validation activities done on site to validate the correct installation	TLC-OSH-001	RADIO



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SRAC_O&M_002 79	MIT_RADIO028	The module is designed with clear indications for ease of system maintenance	TLC-OSH-002	RADIO
SRAC_O&M_002 80	MIT_RADIO029	Maintainers must be properly trained	TLC-OSH-002	RADIO
SRAC_O&M_002 81	MIT_RADIO031	Preventive Maintenance	TLC-OSH-003 TLC-OSH-004 TLC-OSH-005 TLC-OSH-006 TLC-OSH-007 TLC-OSH-008 TLC-OSH-012	RADIO
SRAC_O&M_002 82	MIT_RADIO038	Automatic environment condition checks shall be defined and applied.	TLC-OSH-006	RADIO
SRAC_O&M_002 83	MIT_RADIO040	Train is put out if service at the end of the run	TLC-OSH-006	RADIO
SRAC_O&M_002 84	MIT_RADIO048	High voltage points shall be clearly identified (labels)	TLC-OSH-008	RADIO
SRAC_O&M_002 85	MIT_RADIO049	Appropriate procedures shall be used for corrective/preventive maintenances guaranteeing worker safety (zone protection)	TLC-OSH-008	RADIO
SRAC_O&M_002 86	MIT_RADIO050	Maintainers shall be sufficiently and appropriate trained	TLC-OSH-008	RADIO



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SRAC_O&M_002 87	MIT_RADIO053	No maintenance procedures shall be applied without having received a confirmation by OCC	TLC-OSH-009 TLC-OSH-010	RADIO
SRAC_O&M_002 88	MIT_RADIO055	The maintenance procedures have to be correctly defined by the network operator	TLC-OSH-009 TLC-OSH-010	RADIO
SRAC_O&M_002 89	MIT_RADIO061	Maintainers have been sufficiently trained	TLC-OSH-013 TLC-OSH-016 TLC-OSH-014 TLC-OSH-018	RADIO
SRAC_O&M_002 90	MIT_RADIO062	Appropriate procedures and training shall be used for corrective/preventive maintenances guaranteeing worker safety (zone protection).	TLC-OSH-013 TLC-OSH-014 TLC-OSH-015 TLC-OSH-018	RADIO
SRAC_O&M_002 91	MIT_RADIO064	Appropriate procedures have been established for maintenance operations	TLC-OSH-016	RADIO
SRAC_O&M_002 92	MIT_RADIO065	Appropriate procedures for LRU substitution shall be defined in order to prevent incorrect substitutions	TLC-OSH-017	RADIO
SRAC_O&M_002 93	MIT_RADIO066	The maintenance procedures have to be defined in such a way that proposed substitution procedures reduce as low as possible mistakes in LRU substitution.	TLC-OSH-017	RADIO
SRAC_O&M_002 94	MIT_RADIO067	The maintenance procedures have to be defined in such a way that proposed substitution procedures reduce as low as possible errors in connecting the different involved LRUs.	TLC-OSH-017	RADIO



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SRAC_O&M_002 95	MIT_RADIO068	After a LRU substitution, an appropriate set of tests must be executed, to check subsystem behavior.	TLC-OSH-017	RADIO
SRAC_O&M_002 96	MIT_RADIO069	Staff that interacts with safety related systems should be properly trained.	TLC-OSH-019	RADIO
SRAC_O&M_002 97	MIT_RADIO070	Training Operations are done on a sample system	TLC-OSH-019	RADIO



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### TRACKWO RK

SRACs ID	MITIGATION ID	MITIGATION DESCRIPTION	HAZARD link	DISCIPLI NE/TOPIC
SRAC_O&M_002 47	MIT_HIA_TWK_010	Line check during first run in the morning. Maintenance procedures to reflect instructions given by the Trackworks and Rolling Stock maintenance manuals. Maintenance staff adequately trained. Measure mitigating causes 1 to 8, 12, 13, 14 Emergency procedure in case of broken rail, switch, fastenings, sleepers. Measure mitigating the consequence of the hazard.	HIA_TWK_001	тwк
SRAC_O&M_002 48	MIT_HIA_TWK_019	Adequate preventive maintenance of trackworks. Measure mitigating cause 1 and 2.	HIA_TWK_002	ТWК
SRAC_O&M_002 49	MIT_HIA_TWK_021	Line check during first run in the morning. Measure mitigating causes 1 and 2	HIA_TWK_002	Т₩К
SRAC_O&M_002 50	MIT_HIA_TWK_027	Adequate procedure for approaching switch in reverse direction. Measure mitigating cause.	HIA_TWK_003	ТWК



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SRAC_O&M_002 51	MIT_HIA_TWK_030	Adequate evacuation procedure Measure mitigating consequence	HIA_TWK_004	TWK
SRAC_O&M_002 52	MIT_HIA_TWK_031	Adequate instructions in case of maintenance task Measure mitigating cause 2	HIA_TWK_004	тwк
SRAC_O&M_002 53	MIT_HIA_TWK_033	Periodic check of adequacy of evacuation path. Measure mitigating cause 1 and 2	HIA_TWK_004	тwк
SRAC_O&M_002 54	MIT_HIA_TWK_035	Adequate preventive maintenance. Measure mitigating cause	HIA_TWK_005	ТWК
SRAC_O&M_002 55	MIT_HIA_TWK_040	Adequate rules for maintenance trackside Measure mitigating cause 1 and 2	HIA_TWK_006	ТWК
SRAC_O&M_002 56	MIT_HIA_TWK_043	Adequate procedure in case of flooding Measure mitigating the consequence	HIA_TWK_008	ТWК
SRAC_O&M_002 57	MIT_HIA_TWK_045	Adequate maintenance of ballast Measure mitigating the cause	HIA_TWK_009	ТWК
SRAC_O&M_002 58	MIT_HIA_TWK_046	Intensive schedule of preventive maintenance and testing	HIA_TWK_010	ТWК



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## TUNNEL VENTILATION

SRACs ID	MITIGATION ID	MITIGATION DESCRIPTION	HAZARD link	DISCIPLI NE/TOPIC
SRAC_O&M_002 35	MIT_ETV04	Adequate preventive and corrective maintenance of ETV equipment	TV001	TV
SRAC_O&M_002 36	MIT_ETV08	During the operation because of wrong fixing of anchors, corrosion of supports, vibration of unbalancing fans, concrete cracks etc, the jet fans can be moved inside train envelope. Regular checking of the supports by maintenance staff is needed.	TV004	τν



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SRACs ID	MITIGATION ID	MITIGATION DESCRIPTION	HAZARD link	DISCIPLI NE/TOPIC
SRAC_O&M_000 81	BW02	No undulations in conductor rail.	PHA1	TR
SRAC_O&M_000 82	BW04	Use approved insulated tools during maintenance.	PHA2 PHA28	TR
SRAC_O&M_000 83	BW05	Follow safety Instructions in the maintenance manual.	PHA2	TR
SRAC_O&M_000 84	BW06	Operational control at system level.	PHA3	TR
SRAC_O&M_000 85	BW101	Medical fitness	OSHA17	TR
SRAC_O&M_000 86	BW102	Isolate power when possible	OSHA17	TR
SRAC_O&M_000 87	BW104	Wear protective clothing e.g. hard hat Medical fitness	OSHA16 OSHA17	TR



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SRAC_O&M_000 88	BW14	Periodic maintenance check. Refer to maintenance manual.	PHA7 PHA8 PHA9 PHA10 PHA11 PHA12 PHA12 PHA13 PHA14 PHA16 PHA16 PHA16 PHA18 PHA19 PHA20 PHA20 PHA21 PHA25 PHA25 PHA25 PHA25 PHA25 PHA25 PHA29	TR
SRAC_O&M_000 89	BW15	Training and competence of personnel	PHA15	TR
SRAC_O&M_000 90	BW16	Ensure isolated section is earthed down by 3 position switch	PHA15	TR
SRAC_O&M_000 91	BW17	Track earthing links	PHA15	TR



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SRAC\_O&M\_000 **BW20** Regular maintenance inspections to detect any cable damage PHA17 TR 92 SRAC O&M 000 BW21 Report and monitor all detached parts from vehicle shoegear PHA22 TR interfacing with third rail 93 SRAC O&M 000 **BW22** Review of maintenance procedures at system level PHA22 TR 94 SRAC\_O&M\_000 **BW23** Monitor cracking of shoegear frangible parts PHA22 TR 95 SRAC\_O&M\_000 **BW25** Keep trackside clear of combustible material PHA24 TR 96 SRAC O&M 000 **BW26** Always power off with interlock during maintenance of stinger PHA28 TR 97 system OSHA1 SRAC O&M 000 **BW28** Caution to be taken when rail is live. All maintenance TR OSHA2 98 personnel are to be certified in accordance with project requirements prior to gaining access to the third rail system SRAC O&M 000 **BW29** Caution to be taken when trolley is live. All maintenance OSHA2 TR personnel are to be certified in accordance with project 99 requirements prior to gaining access to the trolley system. SRAC O&M 001 **BW30** Interlock to isolate supply to be used during maintenance OSHA2 TR 00 SRAC O&M 001 BW31 Ensure correct lifting procedure and number of men required. OSHA3 TR OSHA4 01 OSHA5



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SRAC_O&M_001 02	BW32	Ensure correct protective equipment is used / worn	OSHA3 OSHA4 OSHA5 OSHA7 OSHA8 OSHA9 OSHA10 OSHA11 OSHA12 OSHA13 OSHA14 OSHA15	TR
SRAC_O&M_001 03	BW33	Keep clear of raised rail	OSHA5	TR
SRAC_O&M_001 04	BW34	Ensure power is off before detraining.	OSHA6	TR
SRAC_O&M_001 05	BW35	Ensure correct emergency procedures in place	OSHA6	TR
SRAC_O&M_001 06	BW36	Training in the use of huckbolt gun.	OSHA10	TR
SRAC_O&M_001 07	BW37	Training in the use of rail saw	OSHA11	TR
SRAC_O&M_001	BW38	Training in the use of rail dressing equipment.	OSHA12	TR



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08				
SRAC_O&M_001 09	BW39	Training in the use of drill.	OSHA13	TR
SRAC_O&M_001 10	BW40	Training in the use of the short circuit device	OSHA14	TR
SRAC_O&M_001 11	BW41	Correct use of tools and equipment.	OSHA15	TR
SRAC_O&M_001 12	BW42	Take care when lineside.	OSHA16 OSHA17	TR
SRAC_O&M_001 13	BW43	Ensure good illumination.	OSHA16 OSHA17	TR
SRAC_O&M_001 14	BW44	Area free of debris.	OSHA16 OSHA17	TR
SRAC_O&M_001 15	BW45	Correct selection of shroud material.	OSHA18	TR
SRAC_O&M_001 16	BW46	Evacuation of the vicinity	OSHA18	TR
SRAC_O&M_001 17	BW47	System level controls for possession	OSHA19	TR
SRAC_O&M_001 18	BW48	Station lookouts either end of isolated section	OSHA19	TR
SRAC_O&M_001 19	BW49	Use of short circuit device.	OSHA20	TR



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SRAC_O&M_001 20	BW50	Check site after maintenance to ensure all items are removed	OSHA21	TR
SRAC_O&M_001 21	BW54	Routine inspection as specified in Maintenance Manual	SSHA1 SSHA2 SSHA3 SSHA4 SSHA28 SSHA29 SSHA30 SSHA31 SSHA32	TR
SRAC_O&M_001 22	BW59	Routine inspection as specified in Maintenance Manual to identify out of gauge equipment	SSHA5 SSHA6 SSHA8 SSHA9 SSHA10 SSHA17 SSHA18	TR
SRAC_O&M_001 23	BW62	Routine inspection as specified in Maintenance Manual to identify electrical failure of insulator	SSHA7	TR



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SRAC_O&M_001 24	BW68	Routine inspection as specified in Maintenance Manual to identify seized expansion joint	SSHA11 SSHA12 SSHA13	TR
SRAC_O&M_001 25	BW72	Routine inspection as specified in Maintenance Manual to identify damaged / missing cover	SSHA14 SSHA20	TR
SRAC_O&M_001 26	BW74	Excessive deposits removed during maintenance	SSHA14	TR
SRAC_O&M_001 27	BW76	Routine inspection as specified in Maintenance Manual to identify failed mid point anchor	SSHA16	TR
SRAC_O&M_001 28	BW79	Routine inspection as specified in Maintenance Manual to minimise misalignment leading to increased arcing	SSHA19 SSHA20 SSHA26 SSHA27	TR
SRAC_O&M_001 29	BW82	Routine inspection as specified in Maintenance Manual to identify failed cable terminals	SSHA21 SSHA22 SSHA23	TR
SRAC_O&M_001 30	BW86	Routine inspection as specified in Maintenance Manual to identify failed bolted joints	SSHA24 SSHA25	TR
SRAC_O&M_001 31	BW88	Controls at system level to ensure lineside is kept clear of combustible material	SSHA26 SSHA27	TR



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SRAC_O&M_001 32	BW90	Controls at system level to ensure height restrictions are observed.	SSHA28 SSHA29 SSHA30 SSHA31 SSHA32	TR
SRAC_O&M_001 33	BW93	Cleanliness and maintenance of the infrastructure to be ensured	IHA3 IHA5	TR
SRAC_O&M_001 34	BW94	Regular maintenance checks and corrective action	IHA4 IHA7 IHA9 IHA11 IHA17	TR
SRAC_O&M_001 35	BW97	Clear specification of operating and exceptional environmental parameters. Operational procedures to be put into place for actions to be taken in the event of environmental threats to the system.	IHA14	TR
SRAC_O&M_001 36	BW98	Control procedures to be put into place for actions to be taken in the event of excessive passenger loads or exceptional operational movements (multiple train/units moves etc)	IHA15	TR



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SRAC_O&M_001 37	BW99	Maintenance Manual complies with EN50110	PHA27 PHA28 PHA29 OSHA20 SSHA28 SSHA29 SSHA30 SSHA31 SSHA32 IHA1 IHA2 IHA3 IHA4 IHA5 IHA6 IHA7 IHA8 IHA9 IHA10 IHA11	TR
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SRAC_O&M_001 64	MIT _TR061	Control Recommendations: No control measures planned as initial hazard prediction falls within 'acceptable' band. – make reference to maintenance procedures to identify out of gauge equipment	TR050 TR051 TR053 TR054 TR055 TR062 TR063	TR
SRAC_O&M_001 65	MIT _TR068	Control Recommendations: No control measures planned as initial hazard prediction falls within 'acceptable' band make reference to maintenance procedures to identify electrical failure of insulator	TR052	TR
SRAC_O&M_001 66	MIT _TR075	Control Recommendations: No control measures planned as initial hazard prediction falls within 'acceptable' band make reference to maintenance procedures to identify seized expansion joint	TR056	TR
SRAC_O&M_001 67	MIT_TR076	Routine inspection as specified in Maintenance Manual ref to identify failed expansion joint	TR057 TR058	TR
SRAC_O&M_001 68	MIT _TR078	Control Recommendations: No control measures planned as initial hazard prediction falls within 'acceptable' band make reference to maintenance procedures to identify failed expansion joint	TR057 TR058	TR



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SRAC_O&M_001 69	MIT _TR084	Control Recommendations: No control measures planned as initial hazard prediction falls within 'acceptable' band. – make reference to maintenance procedures to identify damaged / missing cover	TR059 TR060	TR
SRAC_O&M_001 70	MIT _TR086	Routine inspection as No control measures planned as initial hazard prediction falls within 'acceptable' band. – make reference to maintenance procedures to identify failed mid point anchor	SSHA15	TR
SRAC_O&M_001 71	MIT _TR090	Control Recommendations: No control measures planned as initial hazard prediction falls within 'acceptable' band. – make reference to maintenance procedures to identify failed mid point anchor	TR061	TR
SRAC_O&M_001 72	MIT_TR091	Material selection	TR062 TR063	TR
SRAC_O&M_001 73	MIT _TR098	Control Recommendations: No control measures planned as initial hazard prediction falls within 'acceptable' band. – make reference to maintenance procedures to: - minimise misalignment leading to increased arcing - identify damaged / missing covers	TR064 TR065	TR
SRAC_O&M_001 74	MIT _TR099	Material selection	TR066 TR067 TR068	TR



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SRAC_O&M_001 75	MIT_TR102	Control Recommendations: No control measures planned as initial hazard prediction falls within 'acceptable' band make reference to maintenance procedures to identify failed cable terminals	TR066 TR067 TR068	TR
SRAC_O&M_001 76	MIT_TR107	Control Recommendations: No control measures planned as initial hazard prediction falls within 'acceptable' band make reference to maintenance procedures to identify failed bolted joints	TR069 TR070	TR
SRAC_O&M_001 77	MIT_TR108	Routine inspection as specified in Maintenance Manual to minimise misalignment leading to increased arcing.	TR071	TR
SRAC_O&M_001 78	MIT_TR110	Control Recommendations: No control measures planned as initial hazard prediction falls within 'acceptable' band make reference to maintenance procedures to identify damaged/missing covers	TR071	TR
SRAC_O&M_001 79	MIT_TR112	Routine inspection as specified in Maintenance Manual to minimise misalignment leading to increased arcing	TR072	TR
SRAC_O&M_001 80	MIT_TR113	Control Recommendations: No control measures planned as initial hazard prediction falls within 'acceptable' band. – make reference to maintenance and system control procedures to identify damaged / missing covers	TR072	TR
SRAC_O&M_001 81	MIT _TR116	Caution to be taken when trolley is live	TR076	TR



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SRAC_O&M_001 82	MIT _TR117	All maintenance personnel are to be certified in accordance with project requirements prior to gaining access to the trolley system	TR076	TR
SRAC_O&M_001 83	MIT _TR120	No control measures planned as initial hazard prediction falls within 'acceptable' band.	TR077 TR078 TR079 TR080 TR081	TR



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## **TRACTION POWER SUPPLY**

SRACs ID	MITIGATION ID	MITIGATION DESCRIPTION	HAZARD link	DISCIPLI NE/TOPIC
SRAC_O&M_004 26	MIT_TPS021	Subsystem Recommended actions: Periodically inspect earthin	g bondings	TPS
SRAC_O&M_004 27	MIT_TPS036	Subsystem Recommended actions: Establish Work Permit pro Train workers to operate with HV components.	cedure.	TPS
SRAC_O&M_004 28	MIT_TPS056	O&M procedures to avoid braking train to revert power to sub-s Foresee the use of shunting/earthing devices during maintenar	station. nce	TPS
SRAC_O&M_004 29	MM_TP_THS_007	Maintenance procedure to be defined, requiring component de-energization prior maintenance activity	TPS.HZ03 TPS.HZ08 TPS.HZ17 TPS.HZ19 TPS.HZ30 TPS.HZ31 TPS.HZ32	TPS



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SRAC_O&M_004 30	MM_TP_THS_008	Equipment shall be connected to earth during the maintenance	TPS.HZ10 TPS.HZ17 TPS.HZ19 TPS.HZ25 TPS.HZ32	TPS
SRAC_O&M_004 31	MM_TP_THS_031	TP equipment rooms shall be located at the intermediate floor of underground stations	TPS.HZ23	TPS
SRAC_O&M_004 32	MM_TP_THS_043	Maintenance procedures defined	TPS.HZ04 TPS.HZ13 TPS.HZ14 TPS.HZ16 TPS.HZ17 TPS.HZ18 TPS.HZ19 TPS.HZ25	TPS
SRAC_O&M_004 33	MM_TP_THS_054	Instruction to perform correct maintenance of Traction Power equipment supplying vital loads	TPS.HZ04	TPS
SRAC_O&M_004 34	MM_TP_THS_069	Instruction to perform correct maintenance of TP&PS equipment	TPS.HZ13 TPS.HZ16 TPS.HZ17	TPS



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SRAC_O&M_004 35	MM_TP_THS_075	Adequate training of maintenance staff	TPS.HZ17 TPS.HZ25 TPS.HZ28	TPS
SRAC_O&M_004 36	MM_TP_THS_087	Maintenance procedure shall be defined enabling SMR operator to test TCR circuit and to detect its state of activation	TPS.HZ31	TPS



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## **TELECOMMUNICATIONS**

SRACs ID	MITIGATION ID	MITIGATION DESCRIPTION	HAZARD link	DISCIPLI NE/TOPIC
SRAC_O&M_004 13	MIT_TLC015	Operator to go through proper guidance or vigilance i.e. during degraded conditions of operation in case of emergency an operator has sometimes to be guided through particular sequence of operation by a supervisor	TLC012 TLC013 TLC014 TLC015 TLC016 TLC017 TLC018 TLC019	TLC
SRAC_O&M_004 14	MIT_TLC016	More operators assigned to work in shifts. For each position the potential overload (over 75%) over 24- hour period of time could require an additional operator	TLC020 TLC021 TLC022 TLC023 TLC024 TLC025 TLC026 TLC027	TLC



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SRAC_O&M_004 15	MIT_TLC029	The railway operator should have good lines of communication and procedures in place for their operations and maintenance staff so that proper and quick maintenance action can be taken	TLC045	TLC
SRAC_O&M_004 16	MIT_TLC035	Establish of proper O&M procedures	TLC050 TLC051	TLC
SRAC_O&M_004 17	MIT_TLC037	Train to be stopped at the next station while station staff is boarding the train to check the problem	TLC053	TLC
SRAC_O&M_004 18	MIT_TLC038	Train to be stopped by ATC operator at the next station so that station staff can board the train and check the situation	TLC054	TLC
SRAC_O&M_004 19	MIT_TLC039	Use of other communication means (PIS) with proper procedures	TLC055 TLC056 TLC058 TLC059	TLC
SRAC_O&M_004 20	MIT_TLC040	OCC operator to activate passengers information sequences with proper procedures	TLC055 TLC056	TLC
SRAC_O&M_004 21	MIT_TLC041	Message to be broadcast in case of absence of TLC	TLC057	TLC
SRAC_O&M_004 22	MIT_TLC042	Cancellation of the evacuation to be confirmed by the operator	TLC057	TLC
SRAC_O&M_004 23	MIT_TLC043	DST operator to activate passengers information sequences with proper procedures	TLC058 TLC059	TLC



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SRAC_O&M_004 24	MIT_TLC044	Use of backup PA if a message cannot be broadcast	TLC059	TLC
SRAC_O&M_004 25	MIT_TLC047	Use of hardcopy of the directory by operator	TLC061	TLC

### SECURITY MANAGEMENT SYSTEM

SRACs ID	MITIGATION ID	MITIGATION DESCRIPTION	HAZARD link	DISCIPLIN E/TOPIC
SRAC_O&M_00298	MIT_SMS013	Maintenance personnel must be properly trained		SMS



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### ROLLING STOCK

SRACs ID	MITIGATION ID	MITIGATION DESCRIPTION	HAZARD link	DISCIPLIN E/TOPIC
SRAC_O&M_00442	ROS004-5(OLD)	Is an Authority duty, the line control and maintenance; however, the "Mitigation Measures" of Haz.ROS001 allow the mitigation of this hazard too.	ROS004 ROS005	ROS
SRAC_O&M_00443	ROS007-9(OLD)	Is an Authority duty, the line control and maintenance. The OSD cannot be considered as a mitigation device in case of person stuck/crusched, along the line, when the train is running.	ROS007	ROS
SRAC_O&M_00444	ROS022-28(OLD)	Authority is responsible to apply the Maintenance Manual instructions.	ROS022 ROS023 ROS034	ROS
SRAC_O&M_00445	ROS029-38(OLD)	Authority is responsible to apply the Maintenance Manual instructions.	ROS029	ROS
SRAC_O&M_00446	ROS031-41(OLD)	Authority is responsible the tunnel fire safety	ROS031 ROS036	ROS
SRAC_O&M_00447	ROS038-51(OLD)	Authority is responsible for the emergency management	ROS038	ROS



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SRAC_O&M_00448	ROS040-54(OLD)	Authority is responsible for track maintenance	ROS040 ROS041	ROS
SRAC_O&M_00449	ROS050-69(OLD)	Authority is responsible for maintenance	ROS050 ROS051	ROS
SRAC_O&M_00450	ROS054-75(OLD)	Is an Authority duty, the establishment of operative instruction and limit	ROS054	ROS
SRAC_O&M_00451	RS_PHA_00166	In case of complete degradation of brake system, service shall be interrupted (disembarkment of passengers and return of vehicle in depot)	RS_HAZ_0005	ROS
SRAC_O&M_00452	RS_PHA_00253	Periodic inspection of the whole line shall be scheduled	RS_HAZ_0012 RS_HAZ_0028 RS_HAZ_0029	ROS



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SRAC_O&M_00453	RS_PHA_00269	Maintenance personnel shall wear appropriate safety equipment (helmet, gloves, safety shoes, goggles,) and in general shall follow instructions reported in maintenance manuals during maintenance activities	RS_HAZ_0036 RS_HAZ_0037 RS_HAZ_0038 RS_HAZ_0039 RS_HAZ_0040 RS_HAZ_0041 RS_HAZ_0042 RS_HAZ_0043 RS_HAZ_0044 RS_HAZ_0045 RS_HAZ_0046	ROS



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SRAC_O&M_00454	RS_PHA_00280	Manual modes shall be used only to rescue a vehicle and not for normal passengers service	RS_HAZ_0001 RS_HAZ_0002 RS_HAZ_0003 RS_HAZ_0007 RS_HAZ_0009 RS_HAZ_0009 RS_HAZ_0020 RS_HAZ_0023 RS_HAZ_0023 RS_HAZ_0047 RS_HAZ_0048 RS_HAZ_0050 RS_HAZ_0051 RS_HAZ_0052	ROS
SRAC_O&M_00455	RS_PHA_00285	Appropriate supervision of stations shall be foreseen	RS_HAZ_0011 RS_HAZ_0013	ROS
SRAC_O&M_00456	RS_PHA_00286	Depot where maintenance is performed shall be equipped with adequate equipment to perform maintenance on the roof	RS_HAZ_0042	ROS
SRAC_O&M_00457	RS_PHA_00289	In manual modes, driver shall take away the driver desk enabling key when leaves the vehicle	RS_HAZ_0023	ROS



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SRAC_O&M_00458	RS_PHA_00290	Procedures to embark / disembark passengers shall be established by the Operator	RS_HAZ_0052	ROS
SRAC_O&M_00459	RS_PHA_00292	Personnel in charge to drive vehicle shall be trained	RS_HAZ_0007 RS_HAZ_0008 RS_HAZ_0009 RS_HAZ_0023RS_HAZ_0 048 RS_HAZ_0050 RS_HAZ_0051 RS_HAZ_0052	ROS
SRAC_O&M_00460	RS_PHA_00293	In case of reflections on the windscreen due to the internal lights, driver shall switch-off lights of driver car	RS_HAZ_0002	ROS
SRAC_O&M_00461	RS_PHA_00367	Procedures to avoid the presence of unauthorized or maintenance people on the main line shall be foreseen	RS_HAZ_0019	ROS


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SRAC_O&M_00462	RS_PHA_00396	Personnel performing maintenance activities must be properly trained	RS_HAZ_0036 RS_HAZ_0037 RS_HAZ_0038 RS_HAZ_0039 RS_HAZ_0040 RS_HAZ_0041 RS_HAZ_0042 RS_HAZ_0043 RS_HAZ_0043 RS_HAZ_0045 RS_HAZ_0046	ROS
SRAC_O&M_00463	RS_PHA_00398	Personnel in charge to drive vehicle shall be trained regarding the coupling/decoupling vehicle procedures	RS_HAZ_0015	ROS
SRAC_O&M_00464	RS_PHA_00507	Procedures to protect against erroneous re-energization of third rail shall be provided	RS_HAZ_0030 RS_HAZ_0043	ROS



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SRAC_O&M_00465	RS_PHA_00509	Driver shall be trained in driving at reduced speed (15 km/h) in by-pass mode	RS_HAZ_0001 RS_HAZ_0002 RS_HAZ_0003 RS_HAZ_0007 RS_HAZ_0008 RS_HAZ_0009 RS_HAZ_0020 RS_HAZ_0023 RS_HAZ_0047 RS_HAZ_0051	ROS
SRAC_O&M_00466	RS_PHA_04004	Door shall be isolated at next opportunity (latest at next station) in case of door failures requiring isolation	RS_HAZ_0047 RS_HAZ_0052 RS_HAZ_0069	ROS
SRAC_O&M_00467	RS_PHA_06001	In case of Major Fault of both FDUs, the vehicle shall be removed from service at the earliest possible opportunity (latest at the end of the day trip)	RS_HAZ_0030 RS_HAZ_0031 RS_HAZ_0033 RS_HAZ_0071	ROS
SRAC_O&M_00468	RS_PHA_07000	O&M staff has to ensure regular maintenance according to rolling stock maintenance plan	RS_HAZ_0001	ROS

# PLATFORM SCREEN DOORS



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SRACs ID	MITIGATION ID	MITIGATION DESCRIPTION	HAZARD link	DISCIPLIN E/TOPIC
SRAC_O&M_00267	MIT_PSD047	Scheduled inspection of PSD Header structure and cabling.	PSD039	PSD
SRAC_O&M_00268	MIT_PSD050	Provision and use of PPE by Maintainer	PSD040 PSD041 PSD042 PSD044 PSD045 PSD046	PSD
SRAC_O&M_00269	MIT_PSD054	Appropriate possession of track and protection against train movement during maintenance.	PSD043 PSD047	PSD
SRAC_O&M_00270	MIT_PSD056	Use of appropriate handling procedures and crew size.	PSD044	PSD
SRAC_O&M_00271	MIT_PSD057	Scheduled inspection and proof testing of handling equipment.	PSD045 PSD046	PSD
SRAC_O&M_00272	MIT_PSD059	Inspections of completed maintenance work to be carried out to ensure correct completion .	PSD048	PSD



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# ID & AC

SRACs ID	MITIGATION ID	MITIGATION DESCRIPTION	HAZARD link	DISCIPLIN E/TOPIC
SRAC_O&M_00237	MIT_HIA_AC&ID_005	Procedure for access of O&M to track.	HIA_AC&ID_001 HIA_AC&ID_004	ID&AC
SRAC_O&M_00238	MIT_HIA_AC&ID_009	O&M Rules for access to SMR	HIA_AC&ID_002 HIA_AC&ID_003	ID&AC
SRAC_O&M_00239	MIT_HIA_AC&ID_013	O&M Rules for access to OCC	HIA_AC&ID_006	ID&AC
SRAC_O&M_00240	MIT_HIA_AC&ID_019	Preventive maintenance, operating procedures, preventing major failures	HIA_AC&ID_011	ID&AC
SRAC_O&M_00241	MIT_HIA_AC&ID_020	Access only for authorized, well-trained and experienced personnel	HIA_AC&ID_012	ID&AC

# HVAC

SRACs ID	MITIGATION ID	MITIGATION DESCRIPTION	HAZARD link	DISCIPLIN E/TOPIC
SRAC_O&M_00260	MIT_OSHA_HVAC_00 2	Permit for maintenance works must be linked with LOTO procedure	OSHA_HVAC_003	HVAC
SRAC_O&M_00261	MIT_OSHA_HVAC_00 3	Permit for maintenance works must be linked with LOTO procedure	OSHA_HVAC_005	HVAC



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# GROUNDING

SRACs ID	MITIGATION ID	MITIGATION DESCRIPTION	HAZARD link	DISCIPLIN E/TOPIC
SRAC_O&M_00244	MIT_HIA_GND_002	The installations of Earthing-LP-SC conform to Article 24 of AM General Specifications «Earthing, Bonding and Corrosion Protection».	HIA_GND_001 HIA_GND_002 HIA_GND_003 HIA_GND_004 HIA_GND_005 HIA_GND_006 HIA_GND_007 HIA_LP_001 HIA_LP_003 IHA_GND_002 IHA_SC_001	GND
SRAC_O&M_00245	MIT_HIA_GND_006	Specific instructions to all maintenance personnel for detailed check of Earthing/ Lightning protection installation after any work of repair or maintenance	HIA_GND_001 HIA_GND_002 HIA_GND_003 HIA_GND_004	GND
SRAC_O&M_00246	MIT_HIA_GND_007	Frequent inspections in Earthing & Lightning Protection (if applicable) installation of all involved subsystems	HIA_GND_004	GND



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# FIRE PROTECTION

SRACs ID	MITIGATION ID	MITIGATION DESCRIPTION	HAZARD link	DISCIPLIN E/TOPIC
SRAC_O&M_00243	MIT_HIA_FP_029	Adequate emergency procedure covering conditions and requirements for safe use of emergency walkways	HIA_FP_005 OSHA_FP_015 OSHA_FP_016	FP
SRAC_O&M_00259	MIT_OSHA_FP_020	Adequate rules for access/ maintenance to the track, train. Attention to be paid to possible contact with the powered shoegear on the side of the train opposite to the 3rd Rail	OSHA_FP_016	FP

# DATA COMMUNICATION SYSTEM

SRACs ID	MITIGATION ID	MITIGATION DESCRIPTION	HAZARD link	DISCIPLIN E/TOPIC
SRAC_O&M_00186	MIT_DCS004	Quick maintenance according to maintainability plan	DCS_1_OSHA	DCS
SRAC_O&M_00187	MIT_DCS021	Use of safety equipment	DCS_12_OSHA	DCS
SRAC_O&M_00188	MIT_DCS023	At least two people are required to implement the task of DCS_12_OSHA maintenance for each item		DCS



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# CW

SRACs ID	MITIGATION ID	MITIGATION DESCRIPTION	HAZARD link	DISCIPLIN E/TOPIC
SRAC_O&M_00185	MIT_CW018	Adequate maintenance instructions	CW015	CW
SRAC_O&M_00242	MIT_HIA_CW_015	Action taken by O&M to stop trains, close stations	CW002	CW



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# DEPOT

SRACs ID	MITIG ATION ID	MITIGATION DESCRIPTION	HAZARD link	DISCIPLINE/TOPI C
SRAC_O& M_00189	MIT_D EP_03 1	Adequate driver training	HAZ.DEP.016 HAZ.DEP.031 HAZ.DEP.035 HAZ.DEP.360	DEP
SRAC_O& M_00190	MIT_D EP_03 2	Adequate emergency procedure	HAZ.DEP.006 HAZ.DEP.118 HAZ.DEP.209 HAZ.DEP.297 HAZ.DEP.332 HAZ.DEP.361	DEP



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SRAC_O& M_00191	MIT_D EP_03 5	Adequate maintenance (e.g. certification)	HAZ.DEP.024 HAZ.DEP.027 HAZ.DEP.037 HAZ.DEP.038 HAZ.DEP.041 HAZ.DEP.042 HAZ.DEP.043 HAZ.DEP.044 HAZ.DEP.045 HAZ.DEP.051 HAZ.DEP.052 HAZ.DEP.053 HAZ.DEP.057 HAZ.DEP.064 HAZ.DEP.069 HAZ.DEP.075 HAZ.DEP.080 HAZ.DEP.085 HAZ.DEP.092 HAZ.DEP.087 HAZ.DEP.089 HAZ.DEP.092 HAZ.DEP.095 HAZ.DEP.096 HAZ.DEP.098 HAZ.DEP.101 HAZ.DEP.104 HAZ.DEP.107 HAZ.DEP.108 HAZ.DEP.109 HAZ.DEP.111 HAZ.DEP.113 HAZ.DEP.115 HAZ.DEP.117 HAZ.DEP.121 HAZ.DEP.122 HAZ.DEP.131 HAZ.DEP.122 HAZ.DEP.136 HAZ.DEP.131 HAZ.DEP.140 HAZ.DEP.136 HAZ.DEP.145 HAZ.DEP.146 HAZ.DEP.141 HAZ.DEP.145 HAZ.DEP.151 HAZ.DEP.147 HAZ.DEP.148 HAZ.DEP.151 HAZ.DEP.153 HAZ.DEP.156 HAZ.DEP.157 HAZ.DEP.159
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	HAZ.DEP.160 HAZ.DEP.161 HAZ.DEP.162
	HAZ.DEP.163 HAZ.DEP.166 HAZ.DEP.168
	HAZ.DEP.170 HAZ.DEP.171 HAZ.DEP.175
	HAZ.DEP.176 HAZ.DEP.177 HAZ.DEP.179
	HAZ.DEP.180 HAZ.DEP.182 HAZ.DEP.183
	HAZ.DEP.185 HAZ.DEP.188 HAZ.DEP.191
	HAZ.DEP.194 HAZ.DEP.198 HAZ.DEP.199
	HAZ DEP 201 HAZ DEP 203 HAZ DEP 205
	HAZ DEP 207 HAZ DEP 208 HAZ DEP 212
	HAZ DEP 215 HAZ DEP 218 HAZ DEP 210
	HAZ.DEP.249 HAZ.DEP.250 HAZ.DEP.251
	HAZ.DEP.253 HAZ.DEP.254 HAZ.DEP.257
	HAZ.DEP.259 HAZ.DEP.261 HAZ.DEP.262
	HAZ.DEP.264 HAZ.DEP.268



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			HAZ.DEP.272 HAZ.DEP.274 HAZ.DEP.275 HAZ.DEP.277 HAZ.DEP.278 HAZ.DEP.280 HAZ.DEP.284 HAZ.DEP.286 HAZ.DEP.291 HAZ.DEP.295 HAZ.DEP.301 HAZ.DEP.303 HAZ.DEP.304 HAZ.DEP.305 HAZ.DEP.308 HAZ.DEP.309 HAZ.DEP.310 HAZ.DEP.315 HAZ.DEP.321 HAZ.DEP.322 HAZ.DEP.324 HAZ.DEP.326 HAZ.DEP.328 HAZ.DEP.329 HAZ.DEP.330 HAZ.DEP.344 HAZ.DEP.345 HAZ.DEP.355 HAZ.DEP.362 HAZ.DEP.373 HAZ.DEP.374	
SRAC_O& M_00192	MIT_D EP_03 6	Adequate maintenance of buildings.	HAZ.DEP.006	DEP
SRAC_O& M_00193	MIT_D EP_03 7	Adequate maintenance of pumping system.	HAZ.DEP.001	DEP



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SRAC_O& MIT_D M_00194 9	Adequate maintenance of the equipment	HAZ.DEP.047 HAZ.DEP.060 HAZ.DEP.090 HAZ.DEP.093 HAZ.DEP.102 HAZ.DEP.112 HAZ.DEP.119 HAZ.DEP.124 HAZ.DEP.129 HAZ.DEP.134 HAZ.DEP.142 HAZ.DEP.150 HAZ.DEP.154 HAZ.DEP.165 HAZ.DEP.167 HAZ.DEP.173 HAZ.DEP.187 HAZ.DEP.189 HAZ.DEP.190 HAZ.DEP.196 HAZ.DEP.204 HAZ.DEP.214 HAZ.DEP.230 HAZ.DEP.236 HAZ.DEP.239 HAZ.DEP.256 HAZ.DEP.236 HAZ.DEP.289 HAZ.DEP.302 HAZ.DEP.307 HAZ.DEP.312 HAZ.DEP.319 HAZ.DEP.336 HAZ.DEP.348 HAZ.DEP.357 HAZ.DEP.370	DEP
SRAC_O& HIT_D M_00195 04 0	Adequate maintenance of Ventilation System	HAZ.DEP.003 HAZ.DEP.004	DEP



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SRAC_O& M_00196	MIT_D EP_04 1	Adequate operative & maintenance procedures	HAZ.DEP.339 HAZ.DEP.351 HAZ.DEP.363	DEP
SRAC_O& M_00197	MIT_D EP_04 3	Adequate procedures aim to define the general rules for the waste collection or hazardous material storage in specific area	HAZ.DEP.029	DEPOT
SRAC_O& M_00198	MIT_D EP_04 4	Adequate rules for coupling/uncoupling	HAZ.DEP.049 HAZ.DEP.083 HAZ.DEP.283 HAZ.DEP.338 HAZ.DEP.350	DEP
SRAC_O& M_00199	MIT_D EP_04 5	Adequate rules for towing	HAZ.DEP.049HAZ.DEP.083HAZ.DEP.283H AZ.DEP.338HAZ.DEP.350	DEP
SRAC_O& M_00200	MIT_D EP_04 6	Adequate safety rules for management of workshop equipment/energization and de-energization of third rail.	HAZ.DEP.024	DEP



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SRAC_O& M_00201	MIT_D EP_04 7	Adequate rules for access/maintenance to the track, train. Attention to be paid to possible contact with the powered shoegear on the side of the train opposite to the 3rd Rail.	HAZ.DEP.024	DEP
SRAC_O& M_00202	MIT_D EP_04 8	Adequate Staff training for Depot Operations	HAZ.DEP.030 HAZ.DEP.099 HAZ.DEP.048	DEP
SRAC_O& M_00203	MIT_D EP_04 9	AIASA answer in letter AIASA 01467 - Depot GFD1, dated 14/11/2007: In case the design will confirm the need to access the pit from the tracks safety means will be provided to avoid that trains can be erroneously routed to the test track.	HAZ.DEP.020	DEP
SRAC_O& M_00204	MIT_D EP_05 4	Appropriate maintenance procedures for activities involving fire of the vehicle	HAZ.DEP.287 HAZ.DEP.292 HAZ.DEP.346	DEP



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SRAC_08 M_00205	MIT_D EP_05 5	Appropriate rules for manual area tracks (e.g. driving rules, stationing procedures)	HAZ.DEP.224 HAZ.DEP.225 HAZ.DEP.231 HAZ.DEP.232 HAZ.DEP.270 HAZ.DEP.282 HAZ.DEP.294 HAZ.DEP.349	DEP
SRAC_08 M_00206	MIT_D EP_05 6	Appropriate rules for manually operated trains.	HAZ.DEP.014	DEP
SRAC_08 M_00207	MIT_D EP_05 7	Appropriate rules for workshop operation (e.g. driving rules, stationing procedures).	HAZ.DEP.048HAZ.DEP.055HAZ.DEP.061H AZ.DEP.066HAZ.DEP.072HAZ.DEP.077HA Z.DEP.082HAZ.DEP.137HAZ.DEP.143HAZ. DEP.337	DEP



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SRAC_O& M_00208	MIT_D EP_06 4	Proper procedures aimed to identify rules for the depot operation (e.g. low speed of vehicles moving in the depot area)	HAZ.DEP.137	DEP
SRAC_O& M_00209	MIT_D EP_06 5	Compliance of equipment with European standards and Greek regulations	HAZ.DEP.046 HAZ.DEP.054 HAZ.DEP.058 HAZ.DEP.065 HAZ.DEP.071 HAZ.DEP.076 HAZ.DEP.081 HAZ.DEP.088 HAZ.DEP.100 HAZ.DEP.110 HAZ.DEP.114 HAZ.DEP.120 HAZ.DEP.123 HAZ.DEP.133 HAZ.DEP.141 HAZ.DEP.147 HAZ.DEP.157 HAZ.DEP.160 HAZ.DEP.177 HAZ.DEP.180 HAZ.DEP.183 HAZ.DEP.200 HAZ.DEP.211 HAZ.DEP.183 HAZ.DEP.249 HAZ.DEP.253 HAZ.DEP.246 HAZ.DEP.274 HAZ.DEP.300 HAZ.DEP.301 HAZ.DEP.328 HAZ.DEP.335 HAZ.DEP.358 HAZ.DEP.373 HAZ.DEP.374	DEP



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SRAC_O& M_00210	MIT_D EP_06 9	Depot staff by track with walkie talkies	HAZ.DEP.009	DEP
SRAC_O& M_00211	MIT_D <sup>t</sup> EP_07 1	ECR Emergency Control Room activation in case of loss of MCR	HAZ.DEP.009	DEP
SRAC_O& M_00212	MIT_D <sup>t</sup> EP_07 9	The Signaling systems shall prevent trains movements through the Work Zones established by O&M staff for maintenance purposes.	HAZ.DEP.034	DEP
SRAC_O& M_00213	MIT_D <sup>t</sup> EP_08 8	O&M manuals shall state not to leave the equipment/tools on the track	HAZ.DEP.359	DEP
SRAC_O& M_00214	MIT_D EP_08 9	O&M Procedure - When train is passing from the entrance gate to the workshop, no O&M staff shall be in proximity of the tracks.	HAZ.DEP.024	DEP



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	HAZ.DEP.188 HAZ.DEP.189 HAZ.DEP.190	
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	HAZ DEP 204 HAZ DEP 205 HAZ DEP 207	
	HAZ.DEP.221 HAZ.DEP.222 HAZ.DEP.224	
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	HAZ.DEP.245 HAZ.DEP.247	



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	HAZ.DEP.248 HAZ.DEP.250 HAZ.DEP.251 HAZ.DEP.252 HAZ.DEP.254 HAZ.DEP.255 HAZ.DEP.256 HAZ.DEP.257 HAZ.DEP.258 HAZ.DEP.259 HAZ.DEP.260 HAZ.DEP.261 HAZ.DEP.262 HAZ.DEP.263 HAZ.DEP.264 HAZ.DEP.265 HAZ.DEP.266 HAZ.DEP.267 HAZ.DEP.268 HAZ.DEP.269 HAZ.DEP.270 HAZ.DEP.271 HAZ.DEP.272 HAZ.DEP.273 HAZ.DEP.275 HAZ.DEP.276 HAZ.DEP.273 HAZ.DEP.278 HAZ.DEP.279 HAZ.DEP.280 HAZ.DEP.281 HAZ.DEP.282 HAZ.DEP.280 HAZ.DEP.285 HAZ.DEP.286 HAZ.DEP.284 HAZ.DEP.289 HAZ.DEP.290 HAZ.DEP.291 HAZ.DEP.293 HAZ.DEP.294 HAZ.DEP.295 HAZ.DEP.296 HAZ.DEP.297



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Reliability, Availability, Maintainability

			HAZ.DEP.342 HAZ.DEP.343 HAZ.DEP.344 HAZ.DEP.345 HAZ.DEP.347 HAZ.DEP.348 HAZ.DEP.353 HAZ.DEP.354 HAZ.DEP.355 HAZ.DEP.356 HAZ.DEP.357 HAZ.DEP.358 HAZ.DEP.359 HAZ.DEP.360 HAZ.DEP.361 HAZ.DEP.362 HAZ.DEP.366 HAZ.DEP.367 HAZ.DEP.368 HAZ.DEP.369 HAZ.DEP.370 HAZ.DEP.371 HAZ.DEP.372	
SRAC_O& M_00216	MIT_D EP_09 1	O&M procedures and adequate safety training in order to avoid, for example, the operators to wear loose clothing long hair, jewelry or gloves	HAZ.DEP.028 HAZ.DEP.091 HAZ.DEP.094 HAZ.DEP.097 HAZ.DEP.105 HAZ.DEP.116 HAZ.DEP.149 HAZ.DEP.164 HAZ.DEP.172 HAZ.DEP.186 HAZ.DEP.195 HAZ.DEP.202 HAZ.DEP.206 HAZ.DEP.213 HAZ.DEP.216 HAZ.DEP.241 HAZ.DEP.316 HAZ.DEP.331	DEP



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SRAC_0& MIT_D M_00217	O&M procedures and adequate safety training in order to manage depot activities in case of loss of MCR	HAZ.DEP.009	DEP
SRAC_O& MIT_D M_00218	O&M procedures and adequate safety training in order to manage depot activities in case of loss of power supply of OCC	HAZ.DEP.010 HAZ.DEP.011	DEP
SRAC_O& MIT_D M_00219	O&M procedures and adequate safety training: the procedures will provide information related to the JB crane movements	HAZ.DEP.137	DEP
SRAC_O& MIT_D M_00220 6	Procedure for authorized access	HAZ.DEP.018 HAZ.DEP.019 HAZ.DEP.099 HAZ.DEP.106 HAZ.DEP.193 HAZ.DEP.299 HAZ.DEP.318 HAZ.DEP.334	DEP
SRAC_O& MIT_D M_00221	Procedure for authorized used of the workshop equipment	HAZ.DEP.018	DEP
SRAC_O& MIT_D	Proper maintenance activities have to be performed	HAZ.DEP.270	DEP



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M_00222	EP_11 8			
SRAC_O& M_00223	MIT_D EP_11 9	Proper O&M manual handling	HAZ.DEP.006 HAZ.DEP.007 HAZ.DEP.012 HAZ.DEP.021 HAZ.DEP.021 HAZ.DEP.023 HAZ.DEP.024 HAZ.DEP.027 HAZ.DEP.033 HAZ.DEP.037 HAZ.DEP.038 HAZ.DEP.041 HAZ.DEP.042 HAZ.DEP.043 HAZ.DEP.041 HAZ.DEP.045 HAZ.DEP.043 HAZ.DEP.044 HAZ.DEP.051 HAZ.DEP.052 HAZ.DEP.047 HAZ.DEP.054 HAZ.DEP.052 HAZ.DEP.053 HAZ.DEP.059 HAZ.DEP.057 HAZ.DEP.058 HAZ.DEP.064 HAZ.DEP.060 HAZ.DEP.062 HAZ.DEP.069 HAZ.DEP.065 HAZ.DEP.067 HAZ.DEP.073 HAZ.DEP.075 HAZ.DEP.076	DEP



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		HAZ.DEP.266 HAZ.DEP.267	HAZ.DEP.268	
		HAZ.DEP.272 HAZ.DEP.274	HAZ.DEP.275	
		HAZ DEP 277 HAZ DEP 278	HAZ DEP 280	
		HAZ DEP 284 HAZ DEP 286	HAZ DEP 289	
		HAZ DEP 291 HAZ DEP 295	HAZ DEP 297	
		HAZ DEP 300 HAZ DEP 301	HAZ DEP 302	
		HAZ DEP 303 HAZ DEP 304	HAZ DEP 305	
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SRAC_O& MIT_D M_00224	Proper procedures aimed to identify rules for the depot operation (e.g. low speed of vehicles moving in the depot area)	DEP
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	HAZ.DEP.249 HAZ.DEP.251 HAZ.DEP.253 HAZ.DEP.254 HAZ.DEP.257 HAZ.DEP.259 HAZ.DEP.261 HAZ.DEP.262 HAZ.DEP.264 HAZ.DEP.266 HAZ.DEP.268 HAZ.DEP.271 HAZ.DEP.272 HAZ.DEP.274 HAZ.DEP.275 HAZ.DEP.278 HAZ.DEP.285 HAZ.DEP.290 HAZ.DEP.291 HAZ.DEP.295 HAZ.DEP.290 HAZ.DEP.297 HAZ.DEP.300 HAZ.DEP.301 HAZ.DEP.303 HAZ.DEP.304 HAZ.DEP.305 HAZ.DEP.308 HAZ.DEP.309 HAZ.DEP.310 HAZ.DEP.313 HAZ.DEP.314 HAZ.DEP.315 HAZ.DEP.316 HAZ.DEP.322 HAZ.DEP.324	



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SRAC_O& M_00226	MIT_D EP_12 8	Proper use of personal protective equipment	HAZ.DEP.003 HAZ.DEP.004 HAZ.DEP.022 HAZ.DEP.023 HAZ.DEP.027 HAZ.DEP.031 HAZ.DEP.032 HAZ.DEP.033 HAZ.DEP.034 HAZ.DEP.037 HAZ.DEP.041 HAZ.DEP.042 HAZ.DEP.047 HAZ.DEP.050 HAZ.DEP.052 DEP HAZ.DEP.054 HAZ.DEP.057 HAZ.DEP.059 HAZ.DEP.060 HAZ.DEP.063 HAZ.DEP.065 HAZ.DEP.068 HAZ.DEP.070 HAZ.DEP.075 HAZ.DEP.076 HAZ.DEP.079
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	HAZ.DEP.080 HAZ.DEP.082 HAZ.DEP.083 HAZ.DEP.085 HAZ.DEP.086 HAZ.DEP.088 HAZ.DEP.091 HAZ.DEP.092 HAZ.DEP.094 HAZ.DEP.098 HAZ.DEP.099 HAZ.DEP.101 HAZ.DEP.102 HAZ.DEP.103 HAZ.DEP.105 HAZ.DEP.107 HAZ.DEP.109 HAZ.DEP.111 HAZ.DEP.112 HAZ.DEP.114 HAZ.DEP.115 HAZ.DEP.116 HAZ.DEP.117 HAZ.DEP.118 HAZ.DEP.119 HAZ.DEP.120 HAZ.DEP.121 HAZ.DEP.122 HAZ.DEP.124 HAZ.DEP.121 HAZ.DEP.126 HAZ.DEP.128 HAZ.DEP.129 HAZ.DEP.130 HAZ.DEP.132 HAZ.DEP.134 HAZ.DEP.135 HAZ.DEP.136	



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			HAZ.DEP.138 HAZ.DEP.140 HAZ.DEP.141 HAZ.DEP.143 HAZ.DEP.144 HAZ.DEP.145 HAZ.DEP.146 HAZ.DEP.148 HAZ.DEP.149 HAZ.DEP.151 HAZ.DEP.152 HAZ.DEP.153 HAZ.DEP.155 HAZ.DEP.156 HAZ.DEP.157 HAZ.DEP.158 HAZ.DEP.159 HAZ.DEP.161 HAZ.DEP.163 HAZ.DEP.164 HAZ.DEP.165 HAZ.DEP.166 HAZ.DEP.168 HAZ.DEP.169 HAZ.DEP.171 HAZ.DEP.172 HAZ.DEP.174 HAZ.DEP.175 HAZ.DEP.177 HAZ.DEP.178 HAZ.DEP.179 HAZ.DEP.180 HAZ.DEP.181 HAZ.DEP.184 HAZ.DEP.186 HAZ.DEP.188	
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	HAZ.DEP.191 HAZ.DEP.193 HAZ.DEP.194 HAZ.DEP.195 HAZ.DEP.197 HAZ.DEP.202 HAZ.DEP.204 HAZ.DEP.205 HAZ.DEP.207 HAZ.DEP.208 HAZ.DEP.210 HAZ.DEP.211 HAZ.DEP.216 HAZ.DEP.217 HAZ.DEP.220 HAZ.DEP.223 HAZ.DEP.224 HAZ.DEP.226 HAZ.DEP.227 HAZ.DEP.229 HAZ.DEP.230 HAZ.DEP.233 HAZ.DEP.234 HAZ.DEP.237 HAZ.DEP.238 HAZ.DEP.241 HAZ.DEP.244	
	HAZ.DEP.246 HAZ.DEP.247 HAZ.DEP.249	
	HAZ.DEP.251 HAZ.DEP.252 HAZ.DEP.254 HAZ.DEP.257 HAZ.DEP.258 HAZ.DEP.262	
	HAZ.DEP.265 HAZ.DEP.268	



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HAZ.DEP.357 HAZ.DEP.358 HAZ.DEP.359 HAZ.DEP.360 HAZ.DEP.361 HAZ.DEP.362
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#### and Safety (RAMS)

SRAC_O M_00227	MIT_D EP_14 7	Staff on ground during shunting in order to correctly manage depot operations and avoid errors due to uncorrect commands or equipment failures (e.g. loss of CCTV data)	HAZ.DEP.009	DEP
SRAC_O M_00228	& MIT_D EP_16 0	Welding activities has to not be performed in the proximity of the trolley system	HAZ.DEP.199	DEP
SRAC_O M_00229	& MIT_D EP_16 1	Workers are informed about the cable position	HAZ.DEP.007	DEP



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**ANNEX** 3

#### **OPERATION & MAINTENANCE DOCUMENT LIST**



«International Tender Based on the Open Procedure RFP - 427/22 for the Conclusion of PPP Contract concerning the **Operation and Maintenance of the** Thessaloniki Metro Network.»

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No	SYSTEM	TYPOLOGY	DOC. CODE	TITLE
1	TLC	O&M manual	1G00LV110X301	Automatic Telephone System – Maintenance and User Manuals
2	TLC	O&M manual	1G00LV115X301	Direct Line Telephone System – Maintenance and User Manuals
3	TLC	O&M manual	1G00LV140X301	Digital Transmission System – Maintenance and User Manuals
4	TLC	O&M manual	1G00LV146X301	IT Infrastructure System – Maintenance and User Manuals
5	TLC	O&M manual	1G00LV300X301	Public Address System – Maintenance and User Manuals
6	TLC	O&M manual	1G00LV400X301	Closed Circuit TV System – Maintenance and User Manuals
7	TLC	O&M manual	1G00LV500X301	Clock System and Time Distribution System – Maintenance and User Manuals
8	TLC	O&M manual	1G00LV812X301	Passenger Information System – Maintenance and User Manuals
9	TLC	O&M manual	1G00LV910X301	Telecommunications - Passenger Information System – Maintenance and User Manuals
10	TLC	O&M manual	1G00LV644X301	Telecommunications - On Board System – Maintenance and User Manuals
11	TLC	O&M manual	1DEMWS095X600	Telecommunication Equipment Test Bench : User and Maintenance Manual
12	Radio System	Operation Manual	1G00LV170X800	DFD - Radio System - User Manual
13	Radio System	Maintenance Manual	1G00LV170X801	DFD - Radio System - Maintenance Manual



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14	BACS	Operation Manual	1G00PS250X205	(Central Building Automation Control System) DFD - User Manual
15	BACS	Operation Manual	1G00PS250X206	(Central Building Automation Control System) DFD - System Administrator Manual
16	BACS	Maintenance Manual	1G00PS250X208	(Central Building Automation Control System) DFD - Maintenance Manual
17	BACS-SIL2	Operation Manual	1G00PS258X205	(Central Building Automation Control System) Safe DFD - User Manual
18	BACS-SIL2	Operation Manual	1G00PS258X206	(Central Building Automation Control System) Safe DFD - System Administrator Manual
19	BACS-SIL2	Maintenance Manual	1G00PS258X208	(Central Building Automation Control System) Safe DFD - Maintenance Manual
20	SMS	Operation Manual	1G00LV490X205	SMS (Security Management System) DFD - User Manual
21	SMS	Operation Manual	1G00LV490X206	SMS (Security Management System) DFD - System Administrator Manual
22	SMS	Maintenance Manual	1G00LV490X208	SMS (Security Management System) DFD - Maintenance Manual
23	PRCS	Operation Manual	1G00PS200X205	PRCS (Power Remote Control System) DFD - User Manual
24	PRCS	Operation Manual	1G00PS200X206	PRCS (Power Remote Control System) DFD - System Administrator Manual
25	PRCS	Maintenance Manual	1G00PS200X208	PRCS (Power Remote Control System) DFD - Maintenance Manual



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26	ATS	Maintenance Manual	0B00LV638X300	DFD - ATC (Automatic Train Control) - ATS System Maintenance Manual
27	ATS	Operation Manual	0B00LV638X301	DFD - ATC (Automatic Train Control) - ATS Operation Manual
28	ATS	Operation Manual	1DG0LV638X900	DFD - ATC (Automatic Train Control) - ATS SCT Manual
29	CBTC	Maintenance Manual	0G00LV615X300	DFD - ATC (Automatic Train Control) - Reduced Balise Maintenance Manual
30	CBTC	Maintenance Manual	0B00LV638X302	DFD - ATC (Automatic Train Control) - ZONE CONTROLLER - MAINTENANCE MANUAL
31	CBTC	Maintenance Manual	0B00LV638X303	DFD - ATC (Automatic Train Control) - FRONTAM - MAINTENANCE MANUAL
32	CBTC	Maintenance Manual	0G00LV640X300	DFD - ATC (Automatic Train Control) - CBTC Onboard Equipment for PV Maintenance Manual
33	CBTC	Maintenance Manual	0G00LV640X301	DFD - ATC (Automatic Train Control) - CBTC Onboard Equipment for SV Maintenance Manual
34	IXL	Operation Manual	0G00LV601X302	DFD - ATC (Automatic Train Control) - IXL VHMI USER (operational) MANUAL
35	IXL	Maintenance Manual	1B00LV638X300	DFD - ATC (Automatic Train Control) - IXL Central Post Maintenance Manual
36	IXL	Maintenance Manual	1B00LV638X301	DFD - ATC (Automatic Train Control) - IXL VHMI Maintenance Manual
37	IXL	Maintenance Manual	1G00LV601X310	DFD - ATC (Automatic Train Control) - IXL Field Interface Management Maintenance Manual



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38	IXL	Maintenance Manual	1G00LV612X311	DFD - ATC (Automatic Train Control) - IXL Light Signal Management Maintenance Manual
39	IXL	Maintenance Manual	1G00LV611X312	DFD - ATC (Automatic Train Control) - IXL Point Machine Management Maintenance Manual
40	IXL	Maintenance Manual	1G00LV616X313	DFD - ATC (Automatic Train Control) - IXL CBDAC Track Circuit Management Maintenance Manual
41	IXL	Maintenance Manual	1G00LV611X800	DFD - ATC (AUTOMATIC TRAIN CONTROL) - SIGNALING TEST BENCH FOR POINT MACHINE (ITEM 93) - INSTALLATION, OPERATION AND MAINTENANCE MANUAL
42	PSDS	O&M manual	1G00LV950X848	PSD-Operation and Maintenance Manual
43	ТР	O&M manual	1S00PS311X300	Traction Power - Rectifier Substation Medium Voltage Switchboard - Operation and Maintennace Manual
44	ТР	O&M manual	1G00PS110X300	Traction Power - 100KVA 20KV/420V AUXILIARY TRANSFORMER - 2554KVA 20KV/2x585V RECTIFIER TRANSFORMER - Operation and Maintennace Manual
45	TP	O&M manual	1S00PS150X300	Traction power - DC switchboard mainline RS - Operation and Maintennace Manual
46	ТР	O&M manual	1S00PS150X301	Traction power - DC switchboard TPP) - Operation and Maintennace Manual
47	ТР	O&M manual	1D00PS150X303	Traction power - DC switchboard Depot RS - Operation and Maintennace Manual
48	TP	O&M manual	1S00PS123X300	Traction power - 110V/24V DC Batteries Charger and 110V DC Batteries System - Operation and Maintennace Manual
49	TP	O&M manual	1G00PS331X300	Traction power - Low voltage switchboard RS - Operation and maintenance manual



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50	ТР	O&M manual	1S00PS160X300	Traction Power - TCR & Intertripping panel - Operaton and maintenance manual
51	ТР	O&M manual	1S00PS162X300	Traction Power - Voltage Limiting Device - Operation and Maintenance Manual
52	ТР	O&M manual	1G00PS150X300	Traction Power - Switch Disconnectors - Operation and Maintennace Manual
53	UPS TLC	O&M manual	1S00LV131X300	Telecommunication - UPS system - Operation and Maintenance
54	UPS SIG	O&M manual	1S00LV602X300	Signaling - UPS system - Operation and Maintenance Manual
55	UDP SIG	O&M manual	1G00LV332X300	ATC PDP - Operation and Maintenance Manual
56	Third Rail	Maintenance Manual	1G00PS140X300	Third Rail - Maintenance Manual
57	Stinger	Operation Manual	1G00PS146X200	Stinger System - User Manual
58	Stinger	Maintenance Manual	1G00PS146X300	Stinger System Maintenance Manual
59	DCS	O&M manual	1G00LV260X700	DCS- User an Maintenance Manual
60	Rolling Stock	Maintenance Manual	0GS1RS001X151	Running Maintenance Manual
61	Rolling Stock	Maintenance Manual	0GS1RS001X154	Scheduled Maintenance Manual
62	Rolling Stock	Overhaul Manual	0GS1RS001X152	Overhaul Manual
63	Rolling Stock	Illustrated Parts Catalog	0GS1RS001X153	Illsutrated Parts Catalog



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64	Rolling Stock	Operation Manual	0GS1RS001X150	Oeprator's Manual
65	Rolling Stock	Operation / Maintenance Manuals	0GS1RS001X155	Technical Descriptions & Troubleshooting Guides Book
66	TUNNEL VENTILATION	O&M manual	1G00PS930X601	O+M MANUAL FOR FREQUENCY CONVERTERS
67	TUNNEL VENTILATION	O&M manual	1G00PS910X603	O+M MANUAL FOR TUNNEL VENTILATION FANS
68	TUNNEL VENTILATION	O&M manual	1G00PS910X604	O+M MANUAL FOR TUNNEL VENTILATION EQUIPMENT (DAMPERS)
69	HVAC	O&M manual	1G00PS912X602	O + M Manual FOR HVAC FANS
70	HVAC	O&M manual	1G00PS961X611	O + M manual FOR AIR TO WATER HEAT PUMPS AND CHILLERS (ABB)
71	HVAC	O&M manual	1G00PS923X611	O + M manual FOR FAN COIL UNITS
72	HVAC	O&M manual	1G00PS915X611	O + M manual FOR THERMAL (FDTM) and ELECTROTHERMAL (FDETM) FIRE DAMPERS
73	HVAC	O&M manual	1G00PS915X612	O + M manual FOR FIRE DAMPERS FSDM TYPE FOR HVAC SYSTEM
74	HVAC	O&M manual	1G00PS922X611	O + M manual FOR CLOSE CONTROL UNITS (CCU)
75	HVAC	O&M manual	1G00PS921X611	O + M manual FOR AIR TO AIR HEAT PUMPS
76	HVAC	O&M manual	1G00PS924X611	O + M manual FOR AIR HANDLING UNITS
77	HVAC	O&M manual	1G00PS965X611	O + M manual FOR AIR HEATERS
78	HVAC	O&M manual	1G00PS951X612	O+M Manual FOR BOILERS, BUNRERS AND CIRCULATING PUMPS



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79	DRAINAGE AND SEWAGE	O&M manual	1G00PS530X612	O + M manual FOR PUMPING SYSTEM
80	INERGEN SYSTEM	O&M manual	1G00PS621X612	O + M manual FOR AUTOMATIC FIRE EXTINGUISHING SYSTEM
81	ESCALATORS	O&M manual	1G00PS700X611	O + M manual FOR ESCALATORS
82	LIFTS	O&M manual	1G00PS800X611	O + M manual FOR LIFTS
83	TRACKWORK	O&M manual	1G00TW700X613	O + M manual FOR TRACKWORK SYSTEM
84	AFC	Operation Manual	1G00LV702X300	ATIM User Manual - Sales Mode
85	AFC	Maintenance Manual	1G00LV702X301	ATIM Maintenance Manual
86	AFC	Maintenance Manual	1G00LV702X303	ATIM User Manual - Maintenance and Supervision
87	AFC	Operation Manual	1G00LV702X306	ATIM Technical Manual
88	AFC	Operation Manual	1G00LV708X300	Cash Counting Equipment User Manual
89	AFC	Maintenance Manual	1G00LV708X301	Cash Counting Equipment Maintenance Manual
90	AFC	Operation Manual	1G00LV710X300	Station Computer User Manual
91	AFC	O&M manual	1G00LV710X301	Station Computer Technical Manual
92	AFC	Maintenance Manual	1G00LV712X301	AFC Gate Maintenance Manual



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93	AFC	Operation Manual	1G00LV712X303	AFC Gate Technical Manual
94	AFC	Operation Manual	1G00LV713X300	CIT User Manual - General & Ticket Seller
95	AFC	Maintenance Manual	1G00LV713X303	CIT User Manual - Maintenance
96	AFC	Operation Manual	1G00LV713X311	CIT Software Installation Manual
97	AFC	Maintenance Manual	1G00LV713X310	CIT Software Technical Manual
98	AFC	Operation Manual	1G00LV714X300	Portable Ticket Readers User Manual
99	AFC	Maintenance Manual	1G00LV714X301	Portable Ticket Readers Maintenance Manual
100	AFC	Operation Manual	1G00LV716X300	Management Centre User Manual
101	AFC	Operation Manual	1G00LV716X301	Management Centre Software Technical Manual
102	PS	O&M manual	1G00PS360X610	O + M Manual FOR MV SWITCHBOARDS
103	PS	O&M manual	1G00PS312X612	O + M Manual FOR STATION LAS - MVP SWITCHBOARDS
104	PS	O&M manual	1G00PS315X611	O + M Manual FOR POWER TRANSFORMERS 20KV/0,4KV LAS
105	PS	O&M manual	1G00PS312X613	O + M Manual FOR MAIN LOW VOLTAGE SWITCHBOARD LAS



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106	PS	O&M manual	1G00PS313X611	O + M Manual FOR 110V DC BATTERY CHARGER
107	PS	O&M manual	1G00PS000X601	O + M Manual FOR POWER GENERATOR
108	PS	O&M manual	1G00PS331X601	O+M Manual FOR BUS DUCTS
109	PS	O&M manual	1G00PS300X601	O+M Manual FOR MOTOR CONTROL LOW VOLTAGE SWITCHBOARDS
110	LIGHTING	O&M manual	1G00PS400X612	O + M manual FOR LIGHTING SYSTEM INCLUDING LIGHTING SWITCHBOARDS
111	LIGHTING	O&M manual	1G00PS400X611	O + M manual FOR UPS SYSTEM FOR LIGHTING
112	FIRE DETECTION	O&M manual	1G00PS610X611	O + M manual FOR FIRE DETECTION SYSTEM
113	LBACS	O&M manual	1G00PS250X301	O + M manual FOR BACS LOCAL EQUIPMENT
114	ACC-IDS	Operation Manual	1G00LV470X300	Operation manual FOR ACC-IDS
115	ACC-IDS	Maintenance Manual	1G00LV470X301	Maintenance manual FOR ACC-IDS
116	COMPRESSED AIR	O&M manual	1D00PS761X611	O + M manual FOR Compressed air system equipment
			DEPOT	
117	Bath, Bearing Heating - Item 001	MSS	1DMWWS001Q501	Material Submittal Sheet - Item 001 - Bearing Heating Bath
118	Battery Charger, Road Motor Vehicles - Item 003	MSS	1D00WS003Q501	Material Submittal Sheet - Item 003 - Battery Charger, Road Motor Vehicles
119	Battery Charger Track Motor Cars - Item 004	MSS	1DMWWS004Q501	Material Submittal Sheet - Item 004 - Battery Charger Track Motor Cars
120	Battery Charger, Train - Item 005	O&M manual	1DMWWS005X800	Operating and Maintenance Manual - Item 005 - BATTERY CHARGER TRAIN



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121	Battery Electrical Vehicle Auxiliary Tractor - Item 006	O&M manual	1D00WS006X800	Operating and Maintenance Manual - Item 006 - Battery Electrical Vehicle Auxiliary Tractor
122	Battery Electric Vehicle Bogie Transporter - Item 007	O&M manual	1D00WS007X800	Operating and Maintenance Manual - Item 007 - Battery Electric Vehicle Bogie Transporter
123	Vehicle Fornt-End Forklift General Purpose - Item 008	MSS	1D00WS008Q501	Material Submittal Sheet - Item 008 - BATTERY ELECTRIC VEHICLE FRONT-END FORKLIFT GENERAL PURPOSE
124	Battery Electric Vehicle Lift Platform Truck - Item 009	MSS	1D00WS009Q501	Material Submittal Sheet - Item 009 - BATTERY ELECTRIC VEHICLE LIFT PLATFORM TRUCK
125	Battery Electric Vehicle Operator Down Turret Truck - Item 010	MSS	1D00WS010Q501	Material Submittal Sheet - Item 010 - BATTERY ELECTRIC VEHICLE OPERATOR DOWN TURRET TRUCK
126	Battery Electric Vehicle Powered Walkie Stacker - Item 011	MSS	1D00WS011Q501	Material Submittal Sheet - Item 011 - BATTERY ELECTRIC VEHICLE POWERED WALKIE STACKER
127	Battery EV Shunting Road/Rail Tractor - Item 012	O&M manual	1D00WS012X800	Operating and Maintenance Manual - Item 012 - Battery Electrc Vehicle Shunting Road/Rail Tractor
128	Bending and Folding Machine - Item 013	MSS	1D00WS013Q501	Material Submittal Sheet - Item 013- Bending and Folding Machine
129	Bending Round Machine - Item 014	MSS	1D00WS014Q501	Material Submittal Sheet - Item 014 - Bending Round Machine
130	Bogie Accommodation - Item 015	O&M manual	1D00WS015X800	Operating and Maintenance Manual - Item 015 - BOGIE ACCOMMODATION
131	Bogie Cleaning Plan - Item 016	O&M manual	1DMWWS016X800	Operating and Maintenance Manual - Item 016 - Bogie Cleaning Plant
132	Bogie Deflection test Rig - Item 017	O&M manual	1DMWWS017X800	Operating and Maintenance Manual - Item 017 - Bogie Deflection test Rig



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133	Bogie frame squaring test platform - Item 018	O&M manual	1DMWWS018X800	Operating and Maintenance Manual - Item 018 – Bogie frame squaring test platform
134	Cleaning Booth For Traction Motors Frames And Rotors - Item 019	MSS	1DMWWS019Q501	Material Submittal Sheet - Item 019 - CLEANING BOOTH FOR TRACTION MOTORS FRAMES AND ROTORS
135	Cleaning Equipment Abrasion - Item 020	MSS	1DEMWS020Q501	Material Submittal Sheet - Item 020 - CLEANING EQUIPMENT ABRASION
136	Cleaning Equipment Air Filter - Item 021	MSS	1DEMWS021Q501	Material Submittal Sheet - Item021 - CLEANING EQUIPMENT AIR FILTER
137	Cleaning Equipment BEARING - Item 022	MSS	1DMWWS022Q501	Material Submittal Sheet - Item 022 - CLEANING EQUIPMENT BEARING
138	Cleaning Equipment Trains and Workshops(SET) - Item 023	MSS	1DSSWS023Q501	Material Submittal Sheet - Item 023 - CLEANING EQUIPMENT TRAINS AND WORKSHOPS (SET)
139	Cleaning Equipment Small Parts - Item 024	MSS	1D00WS024Q501	Material Submittal Sheet - Item 024 - CLEANING EQUIPMENT SMALL PARTS
140	Cleaning Equipment Soda Bath - Item 025	MSS	1DEMWS025Q501	Material Submittal Sheet - Item 025 - CLEANING EQUIPMENT SODA BATH
141	Cradle, Air Filter - Item 026	O&M manual	1DMWWS026X800	Operating and Maintenance Manual - Item 026- Cradle, Air Filter
142	Cradle, Converter/Compressor - Item 027	O&M manual	1DEMWS027X800	Operating and Maintenance Manual -Item 027 - Cradle, Converter/Compressor
143	Cradle, Traction Motor - Item 028	O&M manual	1DMWWS028X800	Operating and Maintenance Manual -Item 028 - Cradle, Traction Motor
144	Crane JIB - Item 029	O&M manual	1DMWWS029X800	Operating and Maintenance Manual - Item 029 - CRANE JIB



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145	Drilling Machine, Bench Mounted - Item 036	MSS	1D00WS036Q501	Material Submittal Sheet - Item036 - DRILLING MACHINE BENCH MOUNTED
146	Drilling Machine Heavy Duty Pedestal - Item 037	MSS	1DMWWS037Q501	Material Submittal Sheet - Item 037 - DRILLING MACHINE HEAVY DUTY PEDESTAL
147	Drilling Machine Radial - Item 038	MSS	1DMWWS038Q501	Material Submittal Sheet - Item 038 - DRILLING MACHINE RADIAL
148	Dynamic Balancing Machine - Item 039	MSS	1DMWWS039Q501	Material Submittal Sheet - Item 039 - DYNAMIC BALANCING MACHINE
149	Extractor Set Wheel Bearing - Item 040	MSS	1DMWWS040Q501	Material Submittal Sheet - Item 040 - EXTRACTOR SET WHEEL BEARING
150	Fixture for Sling Stowage - Item 041	MSS	1DMWWS041Q501	Material Submittal Sheet - Item 041 - Fixture for Sling Stowage
151	Frame Stand for Train Doors, Mobile - Item 042	O&M manual	1DMWWS042X800	Operation and Maintenance Manual -Item 042 - Frame Stand for Train Doors
152	Frame Stand for Train Doors, Mobile - Item 043	O&M manual	1DMWWS043X800	Operation and Maintenance Manual -Item 043 - Frame Stand for Train Windows
153	Gauges and Test Equipment (set) - Item 044	MSS	1DMWWS044Q501	Material Submittal Sheet - Item 044 - Gauges and Test Equipment (set)
154	Grinding Machine Double Ended Pedestal - Item 045	MSS	1DMWWS045Q501	Material Submittal Sheet - Item045 - GRINDING MACHINE DOUBLE ENDED PEDESTAL
155	Grinding Machine Surface - Item 046	MSS	1DTEWS046Q501	Material Submittal Sheet - Item 046 - GRINDING MACHINE SURFACE
156	Grinding Machine Tool and Cutter - Item 047	MSS	1DMWWS047Q501	Material Submittal Sheet - Item 047 - GRINDING MACHINE TOOL AND CUTTER
157	Joiner's Multi-Works Machine - Item 048	MSS	1DMWWS048Q501	Material Submittal Sheet - Item 048 - JOINER'S MULTI-WORKS MACHINE



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158	Ladder, General Purpose - Item 049	MSS	1D00WS049Q501	Material Submittal Sheet - Item 049 - Ladder, General Purpose
159	Lathe, General Purpose, Medium - Item 050	MSS	1DMWWS050Q501	Material Submittal Sheet - Item 050 - LATHE GENERAL PURPOSE MEDIUM
160	Lathe General Purpose Small - Item 051	MSS	1D00WS051Q501	Material Submittal Sheet - Item 051 - LATHE GENERAL PURPOSE SMALL
161	Lathe general purpose Wheels and Axles - Item 052	O&M manual	1DMWWS052X800	Operating and Maintenance Manual - Item 052 - LATHE GENERAL PURPOSE WHEELS AND AXLES
162	Lifting Fixture, Traction Motor Rotor - Item 053	MSS	1D00WS053Q501	Material Submittal Sheet - Item 053 - Lifting Fixture, Traction Motor Rotor
163	Lifting Jack Set - Item 054	O&M manual	1DMWWS054X800	Operating and Maintenance Manual Item 054 – Lifting Jack Set
164	Lifting Plant Underfloor Bogie - Item 055	O&M manual	1DMWWS055X800	Operating and Maintenance Manual - Item 055 – Lifting Plant Underfloor Bogie
165	Lifting Plant Underfloor Train - Item 056	O&M manual	1DMWWS056X800	Operating and Maintenance Manual - Item 056 – Lifting Plant Underfloor Train
166	Lifting Table - Item 057	O&M manual	1DMWWS057X800	Operating and Maintenance Manual - Item 057 - LIFTING TABLE
167	Manipulator Traction Motor - Item 058	O&M manual	1DMWWS058X800	Operating and Maintenance Manual - Item 058 - MANIPULATOR TRACTION MOTOR
168	Measurement Equipment Brake Pad Thickness (SET) - Item 059	O&M manual	1DSSWS059X800	Operating and Maintenance Manual - Item 059 - MEASUREMENT EQUIPMENT BRAKE PAD THICKNESS (SET)
169	Measurement Equipment Wheel Set Diagnostic System (SET) - Item 060	O&M manual	1DSSWS060X800	Operating and Maintenance Manual - Item 060 - MEASUREMENT EQUIPMENT WHEEL SET DIAGNOSTIC SYSTEM
170	Milling Machine - Item 061	MSS	1DMWWS061Q501	Material Submittal Sheet - Item 061 - MILLING MACHINE



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# Reliability, Availability, Maintainability

### and Safety (RAMS)

171	Oil Supply Station and Waste Takl (SET) - Item 062	MSS	1DRSWS062Q501	Material Submittal Sheet - Item 062 - OIL SUPPLY STATION AND WASTE TANK (SET)
172	Oven Drying of Traction Motor Rotor - Item 063	MSS	1DMWWS063Q501	Material Submittal Sheet - Item 063 - OVEN DRYING OF TRACTION MOTOR ROTOR
173	Press, General Purpose - Item 065	MSS	1DMWWS065Q501	Material Submittal Sheet - Item 065 - Press, General Purpose
174	Press Wheel - Item 066	O&M manual	1DMWWS066X800	Operating and Maintenance Manual - Item 066 - Press Wheel
175	Punch and Shear Machine - Item 067	MSS	1DMWWS067Q501	Material Submittal Sheet - Item 067 - Punch and Shear Machine
176	Racking System Main Store (SET) - Item 068	O&M manual	1DMWWS068X800	Operating and Maintenance Manual - Item 068 - RACKING SYSTEM MAIN STORE (SET)
177	Racking System, Various Workshops - Item 069	MSS	1DMWWS069Q501	Material Submittal Sheet - Item 069 - Racking System, Various Workshops
178	Rack, Traction Motor Storage - Item 070	MSS	1DMWWS070Q501	Material Submittal Sheet - Item 070 - Rack, Traction Motor Storage
179	Rail Crack Detector - Item 071	O&M manual	1D00WS071X800	Operating and Maintenance Manual - Item 071 - RAIL CRACK DETECTOR
180	Rail Replacement and Track maintenance Equipment (SET) - Item 072	O&M manual	1D00WS072X800	Operating and Maintenance Manual - Item 072 - RAIL REPLACEMENT AND TRACK MAINTENANCE EQUIPMENT
181	Re-railing equipment - Item 073	O&M manual	1D00WS073X800	Operating and Maintenance Manual - Item 073 - RE-RAILING EQUIPMENT (SET)
182	Sawing Machine - Item 074	MSS	1D00WS074Q501	Material Submittal Sheet - Item 074 - SAWING MACHINE
183	Sling, Bogie Lifting - Item 075	MSS	1D00WS075Q501	Material Submittal Sheet - Item 075 - Sling, Bogie Lifting
184	Sling, General Purpose - Item 076	MSS	1D00WS076Q501	Material Submittal Sheet - Item 076 - Sling, General Purpose



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185	Sling, Traction Motor Lifting and Traction Motor Rotor Lifting - Item 077	MSS	1D00WS077Q501	Material Submittal Sheet - Item 077 - Sling, Traction Motor Lifting and Traction Motor Rotor Lifting
186	Sling, Wheelset Lifting - Item 078	MSS	1D00WS078Q501	Material Submittal Sheet - Item 078 - Sling, Wheelset Lifting
187	Staircase, Access, High, Fixed - Item 079	MSS	1DRSWS079Q501	Material Submittal Sheet - Item 079 - Staircase, Access, High, Fixed
188	Staircase, Access, High, Mobile - Item 080	MSS	1DRSWS080Q501	Material Submittal Sheet - Item 080 - Staircase, Access, High, Mobile
189	Staircase, Access, Low, Mobile - Item 081	MSS	1DMWWS081Q501	Material Submittal Sheet - Item 081 - Staircase, Access, Low, Mobile
190	Stand Traction Motor - Item 082	O&M manual	1DMWWS082X800	Operating and Maintenance Manual - Item 082 - STAND TRACTION MOTOR ROTOR
191	Tech Bench AC/DC Including Mobile Pectifer - Item 083	O&M manual	1DEMWS083X800	Operating and Maintenance Manual - Item 083 - TEST BENCH AC/DC INCLUDING MOBILE RECTIFER
192	Test Bench Analog/Digital Equipment - Item 084	O&M manual	1D00WS084X800	Operating and Maintenance Manual - Item 084 - TEST BENCH ANALOG/DIGITAL EQUIPMENT
193	Test Bench Brake Hydrauling Equipment - Item 086a	O&M manual	1DEMWS086X800	Operating and Maintenance Manual - Item 086 - TEST BENCH BRAKE HYDRAULIC EQUIPMENT (SET)
194	Test Bench Electrovalve Equipments - Item 086b	O&M manual	1DEMWS086X850	Operating and Maintenance Manual - Item 086 - TEST BENCH ELECTROVALVE EQUIPMENTS (SET)
195	Test Bench Compressor and Pneumatic Equipment - Item 087	O&M manual	1DEMWS087X800	Operating and Maintenance Manual - Item 087 - TEST BENCH COMPRESSOR AND PNEUMATIC EQUIPMENT
196	Test Bench Door Gear - Item 088	O&M manual	1DEMWS088X800	Operating and Maintenance Manual - Item 088 - TEST BENCH DOOR GEAR (SET)



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197	Test Bench HVAC - Item 089	O&M manual	1DTEWS090X800	Operating and Maintenance Manual - Item 090 - TEST BENCH HEATING VENTILATION AIR CONDITIONING (SET)
198	Test Bench Shock Absorber - Item 092	O&M manual	1DMWWS092X800	Operating and Maintenance Manual - Item 092 - TEST BENCH SHOCK ABSORBER
199	Universal Spring Test Bench - Item 094	O&M manual	1DMWWS094X800	Operating and Maintenance Manual - Item 094 - UNIVERSAL SPRING TEST BENCH
200	Test Bench Traction Motor - Item 085 -Item 096	O&M manual	1DMWWS096X800	Operating and Maintenance Manual - Item 085 - Item 096 - TEST BENCH TRACTION MOTOR (SET) - TEST BENCH AUXILIARY MACHNINE (SET)
201	Test Equipment, Non-destructive (set) - Item 097	MSS	1DMWWS097Q501	Material Submittal Sheet - Item 097 - Test Equipment, Non-destructive (set)
202	Tools, General User (set) - Item 098	MSS	1D00WS098Q501	Material Submittal Sheet - Item 098 - Tools, General User (set)
203	Tools, Personal (set) - Item 099	MSS	1D00WS099Q501	Material Submittal Sheet - Item 099 - Tools, Personal (set)
204	Traverser - Item 101	O&M manual	1DTRWS101X800	Operating and Maintenance Manual - Item 101 - Traverser
205	Battery Charging Mobile Trolley - Item 102	MSS	1D00WS102Q501	Material Submittal Sheet - Item 102 - BATTERY CHARGING MOBILE TROLLEY
206	Battery Transportation Trolley - Item 103	MSS	1D00WS103Q501	Material Submittal Sheet - Item 103 - BATTERY TRANSPORTATION TROLLEY
207	General Purpose Towable Trolley - Item 104	MSS	1D00WS104Q501	Material Submittal Sheet - Item 104 - GENERAL PURPOSE TOWABLE TROLLEY
208	Vehicle Road/Rail Tractor - Item 105	O&M manual	1D00WS105X800	Operating and Maintenance Manual - Item 105 - VEHICLE ROAD/RAIL TRACTOR
209	Vehicle Road General Purpose Lorry - Item 106	MSS	1D00WS106Q501	Material Submittal Sheet - Item 106 - VEHICLE ROAD GENERAL PURPOSE LORRY



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#### Reliability, Availability, Maintainability and Safety (RAMS)

#### Vehicle Road Vanette Covered - Item Material Submittal Sheet - Item 107 - VEHICLE ROAD VANETTE 210 MSS 1D00WS107Q501 COVERED 107 Vehicle Road Vanette Open - Item 211 MSS 1D00WS108Q501 Material Submittal Sheet - Item 108 - VEHICLE ROAD VANETTE OPEN 108 Washing Plant Train & Underframe Operating and Maintenance Manual - Item 109-119 - Washing Plant 212 O&M manual 1DWPWS109X800 Cleaning Plant - Item 109 - Item 119 Train & Underframe Cleaning Plant Welding Shop Ancillary Equipment Material Submittal Sheet - Item 110 - WELDING SHOP ANCILLARY 213 MSS 1DMWWS110Q501 (SET) - Item 110 EQUIPMENT (SET) Electric Arc Welding Equiment - Item Material Submittal Sheet - Item 111 - ELECTRIC ARC WELDING 214 MSS 1D00WS111Q501 EQUIPMENT 111 Gaw Welding Equipment (SET) -Material Submittal Sheet - Item 112 - GAS WELDING EQUIPMENT 215 MSS 1DMWWS112Q501 Item 112 (SET) Welding Equipment, Inert Gas - Item Material Submittal Sheet - Item 113 - WELDING EQUIPMENT, INERT 216 MSS 1DMWWS113Q501 GAS 113 Operating and Maintenance Manual - Item 114 - Under Floor Wheel 217 Underfloor Wheel Lathe - Item 114 1DMWWS114X800 O&M manual Lathe Material Submittal Sheet - Item 115 - Work Brench 218 Work Brench - Item 115 MSS 1D00WS115Q501 219 Work Cupboard - Item 116 MSS 1DTEWS116Q501 Material Submittal Sheet - Item 116 - Work Cupboard Operating and Maintenance Manual - Item 120 - TRACK MOTOR CAR 220 Track Motor Car - Item 120 O&M manual 1D00WS120X800 Operating and Maintenance Manual - Item 121 - SERVICE WAGON 221 Service Wagon Flat - Item 121 O&M manual 1D00WS121X800 FLAT Service Wagon Flat Track Cleaning -Operating and Maintenance Manual - Item 122 - SERVICE WAGON 222 O&M manual 1D00WS122X800 Item 122 FLAT TRACK CLEANING



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223	Service Wagon Well - Item 123	O&M manual	1D00WS123X800	Operating and Maintenance Manual - Item 123 - SERVICE WAGON WELL
224	Service Wagon Workshop - Item 124	O&M manual	1D00WS124X800	Operating and Maintenance Manual - Item 124 - SERVICE WAGON WORKSHOP
225	Crane, Overhead Traveling, Bogie Workshop - Item 30	O&M manual	1DMWWS030X800	O + M manual FOR Gantry crane item 30
226	Crane, Overhead Traveling, Bogie Storage Area - Item 31	O&M manual	1DMWWS031X800	O + M manual FOR Gantry crane item 31
227	Crane Overhead Traveling, Electro Mechanical Workshop - Item 32	O&M manual	1DMWWS032X800	O + M manual FOR Gantry crane item 32
228	Crane Overhead Traveling, Machine Fitting Area - Item 33	O&M manual	1DMWWS033X800	O + M manual FOR Gantry crane item 33
229	Crane Overhead Traveling, Track 14 - Item 34	O&M manual	1DMWWS034X800	O + M manual FOR Gantry crane item 34
230	Crane Overhead Traveling, Traction Motor Area - Item 35	O&M manual	1DMWWS035X800	O + M manual FOR Gantry crane item 35
231	Painting Facilities (set) - Item 64	O&M manual	1DMWWS064X800	O + M manual FOR Paint Shop item 64