TRAINING CYCLES

March 2025

General Index of RAMS Contents

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Module	Block	Part	Section	Training
RAMS	3	0		**Block 3 – RAMS Intensification**
RAMS	3	0	0	RAMS Intensification
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SAFETY	3	2	2	Application of RE No. 402
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CONTENTS

OBJECTIVES
To provide the initial concepts of RAMS

ATTENDANCE
New RAMS resources

PREREQUISITES
Reading EN-5012x standards

INSTRUCTORS
Various

ORGANIZATION
Duration: 2h
Location:
On-site / Remote

TARGET AUDIENCE
Awareness
New recruits

TYPE
General technical

LEVEL
Block 0

CROSS-CUTTING MODULES
0.2.3 – EN50126-1
0.2.4 – EN50126-2
0.2.5 – EN50128
0.2.6 – EN50129

CONTENTS

v. Newcomer's warning: what to consider and the importance of structuring, formulating and operating correctly.

vi. Exercises and Examples of Availability Calculations

g. Security Management

i. Objective

ii. Distinction between the Concept of Hazard and the Concept of Risk

iii. Quiz on Hazard vs. Risk

iv. The concept of Hazard

v. The concept of Function

vi. Definition of Security Requirements

vii. Security Integrity: Systematic Failures

viii. Security Integrity: Random Failures

ix. Safety: TFFR, THR, PFD and SIL

x. Example of Safety process

xi. Safety Test

OBJECTIVES
To provide the initial concepts of RAMS

ATTENDANCE
Awareness

New RAMS resources

PREREQUISITES
0.0.0 – Initial RAMS concepts

INSTRUCTORS
Various

ORGANIZATION
Duration: 4h
Location:
On-site / Remote

TARGET AUDIENCE
Awareness
New recruits

TYPE
General technical

LEVEL
Block 0

CROSS-CUTTING MODULES

0.3.0 - RAMS Tools

CONTENTS

RAMS LIFE CYCLE

OBJECTIVES
To provide the initial concepts of RAMS.

ATTENDANCE
Awareness

New RAMS resources

PRERREQUISITES
0.0.1 – RAMS Fundamentals (part 1)

INSTRUCTORS
Various

ORGANIZATION
Duration: 3h
Location:
On-site / Remote

CAPACITY
Awareness
New recruits

TYPE
General technical

LEVEL
Block 0

CROSS-CUTTING MODULES

N/A

CONTENTS

i. The use of Codes of Practice
ii. The use of Reference Systems

k. ERE
   i. The use of Explicit Risk Estimation: Frequency and Severity. Initial Risk, Risk Reduction and Final Risk.
   ii. Risk Classification: Risk Levels, Severity Levels and Risk Categorization Levels.

l. Risk Acceptance Criteria: ALARP, GAME and MEM.

m. As Low As Reasonably Practicable (ALARP)
   i. Advantages
   ii. Disadvantages
   iii. Remarks

n. Benefit-Cost Analysis (BCA)

o. “Globalement Au Moins Equivalent “(GAME)
   i. Advantages
   ii. Disadvantages
   iii. Remarks

p. “Minimale Endogene Mortalität” (MEM)
   i. Advantages
   ii. Disadvantages
   iii. Remarks

q. Preliminary Hazard Analysis (PHA)
   i. Definition and characteristics
   ii. Examples: 1, 2 y 3

r. Mitigations and Requirements: Definition and characteristics

s. Hazard Log
   i. Definition and characteristics
   ii. Examples: Continued 2 and 3

t. Exported risks vs SRACs (Safety-Related Application Conditions)

u. Safety Case and Risk Management: Policy, Organization, Processes, Activities and Deliverables. Conditions of Application.

v. Test

OBJECTIVES	ATTENDANCE	PRERREQUISITES	INSTRUCTORS
To provide the initial concepts of RAMS.	Awareness New RAMS	0.0.1 RAMS Fundamentals I 0.0.2 Life Cycle	Various

ORGANIZATION	CAPACITY	TYPE	LEVEL	CROSS-CUTTING MODULES
Duration: 4h Location: Face-to-face / virtual	Awareness New recruits	General technical	Block 0	0.3.0 – RAMS Tools

CONTENTS

INTENSIFICATION IN RAM BASICS

xxi. Series Systems and Parallel Systems

xxii. RAM analysis

d. Demonstration of RAMS Objectives

e. Cheat-Sheet

INTRODUCTION TO RAMS TOOLS AND HOLDING COST METHODOLOGIES

f. Integrated Logistics Support (ILS)

g. Reliability Centered Maintenance (RCM)

h. Life Cycle Cost (LCC)

i. Markov Diagrams

j. Fault Tree Analysis (FTA)

k. Reliability Block Diagram (RBD)

l. Test

OBJECTIVES To provide the initial concepts of RAMS.	**ATTENDANCE** Awareness New RAMS	**PRERREQUISITES** 0.0.1 – RAMS Fundamentals I		**INSTRUCTORS** Various
ORGANIZACIÓN Duration: 6h Location: On-site / Remote	**CAPACITY** Awareness New recruits	**Type** General technical	**LEVEL** Block 0	**CROSS-CUTTING MODULES** 0.3.0 –RAMS Tools

CONTENTS

RAM – LCC Exercise

- Statement
- Exercise, for practice:
  - o Reliability forecast,
  - o Maintainability forecast,
  - o Discrimination of the times that are part of the MTTR,
  - o LCC,
  - o Quantification of inventories on MTBF and maintenance policy.

OBJECTIVES To provide the initial concepts of RAMS.	**ATTENDANCE** New RAMS resources	**PRERREQUISITES** 0.0.1- RAMS Fundamentals I 0.0.4 –RAMS Fundamentals II	**INSTRUCTORS** GCA
ORGANIZATION Duration: 2h + 2h self-work Location: On-site / Remote	**CAPACITY** New recruits	**TYPE** General technical	**LEVEL** Block 0
			CROSS-CUTTING MODULES N/A

CONTENTS

- Test

OBJECTIVES
To provide the initial concepts of RAMS.

ATTENDANCE
Awareness

New RAMS

PRERREQUISITES
0.0.1 RAMS Fundamentals I
0.0.3 Risk Management

INSTRUCTORS
Various

ORGANIZATION
Duration: 3h + 2h self-work
Location:
On-site / Remote

CAPACITY
Awareness
New recruits

TYPE
General technical

LEVEL
Block 0

CROSS-CUTTING MODULES
0.3.0 –RAMS Tools

CONTENTS

EN50126-1

Support for understanding the standard section by section.

OBJECTIVES	ATTENDANCE	PRERREQUISITES	INSTRUCTORS
Familiarization with the standards	New RAMS resources	None	Various

ORGANIZATION	TYPE	LEVEL	CROSS-CUTTING MODULES
Duration: 4h Location: On-site or self work as a prelude to other RAMS **courses**	Standards	Block 0	0.0.1 RAMS Fundamentals I 0.0.2 Life Cycle

CONTENTS

EN50126-2

Support for understanding the standard section by section.

OBJECTIVES
Contact with the standards

ATTENDANCE
New RAMS resources

PRERREQUISITES
None

INSTRUCTORS
Various

ORGANIZATION
Duration: 4h
Location:
Face-to-face or self
work as a prelude to other RAMS **courses**

TYPE
Standards

LEVEL
Block 0

CROSS-CUTTING MODULES
0.0.1 RAMS Fundamentals I
0.0.2 Life Cycle

CONTENTS

EN50128

Support for understanding the standard section by section. For organizations that are still making use of the moratorium before adapting to EN50716.

OBJECTIVES	ATTENDANCE	PRERREQUISITES	INSTRUCTORS
Contact with the standards	New RAMS resources	None	Various

ORGANIZATION	TYPE	LEVEL	CROSS-CUTTING MODULES
Duration: 8h Location: Face-to-face or self work as a prelude to other RAMS **courses**	Standards	Block 0	0.0.1 RAMS Fundamentals I 0.0.2 Life Cycle

CONTENTS

EN50129

Support for understanding the standard section by section.

OBJECTIVES
Contact with the standards

ATTENDANCE
New RAMS resources

PRERREQUISITES
None

INSTRUCTORS
Various

ORGANIZATION
Duration: 4h
Location:
Face-to-face or self
work as a prelude to other RAMS courses

TYPE
Standards

LEVEL
Block 0

CROSS-CUTTING MODULES
0.0.1 RAMS Fundamentals I
0.0.2 Life Cycle

CONTENTS

ROLES, ORGANIZATION AND C

a. Requirements Management
    i. Designer
    ii. Implementer
    iii. Tester in charge of testing
    iv. Verifier
    v. Project Manager
    vi. Configuration Manager
    vii. Validator
    viii. Evaluator
b. Multiple organizations

SW WARRANTY

a. Software Warranty
    i. Software Testing
    ii. Software Verification
    iii. Software Validation
    iv. Software Quality Assurance
    v. Modifications and Modification Control
    vi. Support tools and languages: T1, T2 and T3. Usage, diversity and validation methods.

INTERACTION BETWEEN SAFETY CASES

a. Generic products (GPSC), generic projects (GASC) and specific applications (SASG).
b. Safety-related application conditions (SRAC)
    i. Mandatory characteristics
    ii. Desired characteristics
c. Security Cases and their Interaction: Test

GENERIC SW DEVELOPMENT

a. Generic SW Development - Life Cycle and Documentation
b. Planning

c. Requirements
d. Design Architecture
e. Component Design
f. Component Implementation and Testing
g. Integration
h. Overall, SW Testing/Final Validation
i. Systems configured using application data/algorithms
j. Software Implementation
k. Software Maintenance
l. Software Evaluation

SYSTEMS CONFIGURED USING DATA/ALGORITHMS

a. Objectives
    i. Generic software - Generic software with application-specific data/algorithms.
    ii. Generic interlocking - Specific interlocking
b. Procedure
    i. Application Development Process
    ii. Application Requirements Specification
    iii. Architecture and Design
    iv. Application Data/Algorithm Production
    v. Application Integration and Test Acceptance
    vi. Application Validation and Evaluation
    vii. Application Preparation Procedures and Tools
    viii. Generic Software Development
c. Input Documentation and Output Documentation

SW IMPLEMENTATION AND MAINTENANCE

d. Implementation + Maintenance
e. Implementation Requirements
f. Maintenance Requirements

CRITERIA FOR THE SELECTION

a. Requisites: “M” Mandatory, “HR” Highly Recommended, “R” Recommended, “NR” Not Recommended

EXEMPLES

OBJECTIVES
To provide the initial concepts of RAMS.

ATTENDANCE
Confirmed RAMS resources

PRERREQUISITES
0.0.2 Life Cycle

0.0.6 Safety Integrity

INSTRUCTORS
Various

ORGANIZATION
Duration: 8h
Location:
On-site / Remote

CAPACITY
RAMS Staff
RAMS study validators

TYPE
Specific technical

LEVEL
Block 0

CROSS-CUTTING MODULES
0.3.0 RAMS Tools

CONTENTS

RAMS TOOLS

- FMEA/FMECA (Failure Mode, Effects and Criticality Analysis)
- FTA (Fault Tree Analysis)
- RBD (Reliability Block Diagram)
- RPA (Reliability Prediction Analysis)
- CCA (Common Cause Analysis)
- Beta Factor
- ZSA (Zonal Safety Analysis)
- PRA (Particular Risk Analysis)
- FMECA-FTA Exercise
- Assignment of Requirements that need Quantitative ERE

OBJECTIVES
To provide the initial concepts of RAMS.

ATTENDANCE
RAMS Staff

RAMS managers,

PRERREQUISITES
0.0.3 Risk Management
0.0.6 Safety Integrity

INSTRUCTORS
Various

ORGANIZATION
Duration: 4h+3h self-work
Location:
On-site / Remote

CAPACITY
RAMS staff training, validators, project managers

TYPE
Tools

LEVEL
Block 0

CROSS-CUTTING MODULES
0.0.4 –RAMS Fundamentals II

CONTENTS

OBJECTIVES
Equipping the RAMS tool: FMECA

ATTENDANCE
RAMS Staff Responsible, RAMS validators

PRERREQUISITES
0.0.3 Risk Management
0.0.6 Safety Integrity

INSTRUCTORS
Various

ORGANIZATION
Duration: 2h
Location: On-site / Remote

CAPACITY
RAMS staff training, validators, project managers

TYPE
Tools

LEVEL
Block 0

CROSS-CUTTING MODULES
0.0.4 – RAMS Fundamentals
0.3.2 – FTA
0.3.3 – Exercise FMECA-FTA
0.3.4 –RBD

CONTENTS

g. Use of the FTA associated with the LIS
    v. Distribution and demonstration of objectives
    vi. SIL Demonstration
h. Use of FTA to calculate occurrences and examples.
i. FTA vs FMECA: Pro's & Con's
    i. Complementary Techniques
j. Test
k. Quiz

OBJECTIVES
Equip with RAMS tool: FTA

ATTENDANCE
RAMS staff RAMS managers, RAMS validators

PRERREQUISITES
0.0.3 Risk Management
0.0.6 Safety Integrity

INSTRUCTORS
Various

ORGANIZATION
Duration: 4h
Location: On-site / Remote

CAPACITY
Personal trainings RAMS, validators, project managers

TYPE
Tools

LEVEL
Block 0

CROSS-CUTTING MODULES
0.0.4 – RAMS Fundamentals II
0.3.1 – AMFEC
0.3.3 – AMFEC-FTA Exercise
0.3.4 – RBD Training

CONTENTS

OBJECTIVES
To provide practical resources to use the RAMS tools of AMFEC and FTAs.

ATTENDANCE
RAMS staff RAMS managers, RAMS validators

PRERREQUISITES
0.0.3 Risk Management
0.0.6 Safety Integrity

INSTRUCTORS
Various

ORGANIZATION
Duration: 1h+3h
Location:
On-site / Remote

CAPACITY
Training of RAMS personnel, validators, project leaders

TYPE
Tools

LEVEL
Block 0

CROSS-CUTTING MODULES
0.0.4 – RAMS Fundamentals II
0.3.1 – FMECA
0.3.2 – FTA
0.3.4 – RBD

CONTENTS

CONCEPTS

OBJECTIVES
Equipping the RAMS tool: RBD

ATTENDANCE
RAMS staff RAMS managers, RAMS validators

PRERREQUISITES
0.0.3 Risk management
0.0.6 Safety Integrity

INSTRUCTORS
Various

ORGANIZATION
Duration: 2h
Location: On-site / Remote

CAPACITY
RAMS personal trainings, validators, project managers

TYPE
Tools

LEVEL
Block 0

CROSS-CUTTING MODULES
0.0.4 – RAMS Fundamentals II
0.3.1 – AMFEC
0.3.2 – FTA
0.3.3 – AMFEC-FTA Exercise

CONTENTS

RAM – RBD EXERCISE

- Statement
- Exercise
- Solutions

OBJECTIVES
Equipping the RAMS tool: RBD

ATTENDANCE
RAMS staff RAMS managers, RAMS validators

PRERREQUISITES
0.0.3Risk management
0.0.6 Safey integrity

INSTRUCTORS
Various

ORGANIZATION
Duration: 2h
Location: On-site / Remote

CAPACITY
Personal training for RAMS, validators, project managers, etc.

TYPE
Tools

LEVEL
Block 0

CROSS-CUTTING MODULES
0.0.4 – RAMS Fundamentals II
0.3.1 – AMFEC
0.3.2 – FTA
0.3.3 – AMFEC-FTA Exercise

CONTENTS

OBJECTIVES
Providing the initial railway concepts

ATTENDANCE
Beginners in railway technology

PRERREQUISITES
None

INSTRUCTORS
Various

ORGANIZACIÓN
Duration: 2h
Location:
On-site / Remote

CAPACITY
Rail subsystems training

TYPE
Specific technical

LEVEL
Block 0

CROSS-CUTTING MODULES
0.5.0 Railway Technology
0.5.2 Rolling Stock -I
0.5.3 Signaling -I
0.5.4 Infrastructure and Energy -I

CONTENIDO

ROLLING STOCK CLASSIFICATIONS

a. Type of material
   i. Motor equipment
   ii. Towed material
b. Type of material for your service
   i. Long and medium distance
   ii. Mass Transit
   iii. Others
c. Classification of UIC lines
   i. By axle load
   ii. Per meter charge
d. Concentrated traction vs. distributed traction
e. Demystifying myths (II): non-conventional systems (light rail, VAL and APM, Maglev, rail-less tramway).

RAIL TRACTION

a. Electric drive vs. diesel
b. Electrification systems
   i. Direct current
   ii. Single-phase alternating current
   iii. Three-phase current

c. Traction chain
    i. Main components
    ii. Transmission of motive power
    iii. Traction equipment cabinet
    iv. Efficiency
    v. Line responsiveness
    vi. Energy capture
d. Energy conversion by static converters
e. Types of traction by their control
    i. Rheostatic control
    ii. “Chopper” control
    iii. Frequency inverter
    iv. By rectifier
    v. By pulse width modulation
f. Types of autonomous traction
    i. Diesel drive
    ii. Diesel-electric drive
g. Types of transmission
    i. Hydraulic transmission (hydrostatic and hydrodynamic)
    ii. Mechanical transmission
    iii. Electrical transmission
h. Dual/multiple traction
    i. Locomotives
    ii. RFIG electrification systems in Europe
    iii. Adaptation between electrified and non-electrified track.

ROLLING

a. Bogies
b. End crossbeam / End transversal beam
c. Curve inscription
d. Typology:
    i. Tramway bogies
e. Patent Talgo stands
f. Automatic width changes systems
g. Classification of UIC rolling stock by axle distribution.

BRAKING

a. Braking systems and mode
b. Types
    i. Electric braking
    ii. Mechanical braking
    iii. Magnetic braking

ETI ROLLING STOCK

a. Classification of UIC rolling stock by axle distribution: Axle arrangement
b. UIC Rolling Stock Registration
    iv. By type of car
    v. By type of goods
c. Registration of special UIC vehicles

OBJECTIVES
Providing the initial concepts of Rolling Stock

ATTENDANCE
Beginners in railway technology

PRERREQUISITES
None

INSTRUCTORS
Various

ORGANIZATION
Duration: 4h
Location:
On-site / Remote

CAPACITY
Capacitation in railway subsystems

TYPE
Technical specifical

LEVEL
Block 0

CROSS-CUTTING MODULES
0.5.0 Railway Technology
0.5.1Railway concepts that every railroader should know
0.5.3 Signaling -I
0.5.4 Infrastructure and Energy -I

CONTENTS

d. Audio frequency path circuits
    i. Short-circuit loops + tuning units
    ii. Complementary tuning boxes
    iii. S-loops with complementary tuning units
    iv. Operating mode of a generic audio-frequency CV
e. Train detection: axle counters
    i. Definition
    ii. Principle of operation
    iii. Axle counter vs. track circuit
    iv. Applications
    v. Advantages
    vi. Disadvantages
f. Components of an axle counter
    i. Detector heads
    ii. Track unit
    iii. Transmission system
    iv. Evaluator
g. States of an axle counter
    i. Free
    ii. Occupied
    iii. Amended
    iv. In process of release
h. Treadle
    i. Electromechanical
    ii. Electronics
i. Odometer systems
    i. Electronics

DEVIATIONS

a. Track devices
    i. Crossings
b. Deviations
c. Switches: types
    i. Switch blades
    ii. Movable point frogs
    iii. Switches with multiple point machines
d. Switches: Concepts
    i. Switch Heel
    ii. Stock rail heel
    iii. Frog heel
    iv. Trailable switches
    v. Trailing of a turnout
e. Tie rods
f. Frog
g. Electric point machine
h. Rail expansion devices
i. Crossings
j. Switchovers
k. Complex track layouts
    i. Diamond crossings
    ii. Escape track
    iii. Double slip
    iv. Diagonal
    v. Track triangle and flyover or (grade-separated junction)
    vi. Derailers and chocks

l. Level crossings
    i. Definition
    ii. Types: protected and unprotected
m. Bouré locks
n. Local switch controls
o. Trackside posts

CONTROL CENTERS

ELECTRONIC INTERLOCKINGS

a. Interlockings
b. Historical development
c. Electronic interlockings

BLOCK SYSTEMS

a. General concepts: Single track, double track, bi-directional double track. Manual mutual exclusion, BT, BTC, BTS, CCR, ABS (Automatic Block Signaling), Occupancy block, BAU, BAD, BAB or BVB
b. Types of block systems
    i. Manual mutual exclusion
    ii. Telephone block
    iii. Centralized telephone block
    iv. Supplementary telephone block
    v. Radio-based traffic control
    vi. Track occupancy block
    vii. Automatic block for single, double, and bi-directional double tracks

ROUTES

a. General concepts and conditions
b. Types of routes
    i. Routes within a facility
    ii. Between stations
    iii. Shunting routes
    iv. Set route
    v. Slip route
c. Route setting table and conflicts
d. Legend

OBJECTIVES Training newcomers in Signaling	**ATTENDANCE** RAMS resources working in Signaling	**PRERREQUISITES** None		**INSTRUCTORS** Various
ORGANIZATION Duration: 6h Location: On-site / Remote	**CAPACITY** RAMS Staff RAMS study validators	**TYPE** Specific technical	**LEVEL** Block 0	**CROSS-CUTTING MODULES** N/A

CONTENTS

v. Sectioning, compensation, and neutral sections in conventional and high-speed railways

TRACTION SUBSTATIONS

a. Basic general concepts: DC and AC electrification
b. AC vs DC: Why energy conversion is introduced
c. Operation schemes: Urban conventional railways, Interurban conventional railways, High-speed rail
d. Urban conventional railways: Pi-type layout
e. Interurban conventional railways: Cantilever-type layout
f. High-speed rail
g. Remote control systems (SCADA)
h. Conclusions
i. Energy Supply – Part II (preview)

OBJECTIVES
To provide the initial concepts of Energy in Railway Technology.

ATTENDANCE
Beginner in railway technology

PRERREQUISITES
None

INSTRUCTORS
Various

ORGANIZATION
Duration: 2h
Location:
On-site / Remote

CAPACITY
Rail subsystems training

TYPE
Technical specifical

LEVEL
Block 0

CROSS-CUTTING MODULES
0.5.1 - Concepts that every railroader should know
0.5.2 - Rolling Stock
0.5.3 - Signaling I - Field elements
0.5.5 - Infrastructure
0.5.6 - Signaling II

CONTENTS

SECTIONS

a. Standard cross-section for high-speed ballast track
b. Open-cut section
c. Tunnel section
d. Viaduct section

PARAMETERS DEFINING TRACK GEOMETRIC QUALITY

a. Track gauge
b. Longitudinal level
c. Cross level (cant)
d. Alignment
e. Warp (track twist)
f. Track layout
g. Track geometry in curves → Superelevation (cant)
h. Evolution of horizontal geometric characteristics in high-speed lines

RAILWAY TUNNELS

a. Special case: L9 of Barcelona Metro
b. Longest railway tunnels
c. Helical tunnels:
    i. Gotthard Base Tunnel
    ii. Toses or Cargol Tunnel
d. Determining the cross-sectional area of a railway tunnel
e. Summary of current comfort and health criteria regarding pressure variations
f. Influence of the train cross-section on tunnel design
g. Variation of tunnel cross-section with train speed
h. Typical tunnel cross-sections

OBJECTIVES
Providing initial infrastructure concepts

ATTENDANCE
Beginner in railway technology

PRERREQUISITES
None

INSTRUCTORS
Various

ORGANIZATION
Duration: 2h
Location:
On-site / Remote

CAPACITY
Rail subsystems training

TYPE
Technical specifical

LEVEL
Block 0

CROSS-CUTTING MODULES
0.5.1 - Concepts that every railroader should know
0.5.2 - Rolling Stock
0.5.3 - Signalling I - Field elements
0.5.4 - Railway Technology Energy
0.5.6 - Signaling II