AUTOMATIC TRAIN CONTROL AND SAFETY APPROACH IN CBTC PROJECTS

November 2022
RAM + S
OUTLINE

CBTC
- WHAT IS CBTC?
- AUTONOMOUS OPERATION

SAFETY
- STRATEGY
- POLICY
- ORGANIZATION

AUTOMATIC TRAIN CONTROL
- KEY COMPONENTS
- ASELSAN APPROACH
- ATC & SAFETY RELATION
CBTC SYSTEM
CBTC | AELSAN METRO SIGNALING SYSTEM

SAFETY INTEGRITY LEVEL 4 (SIL4) | INFORMATION SECURITY
ENERGY EFFICIENCY | AUTOMATIC TRAIN OPERATOR

ON BOARD ATP
ATO SYSTEM

COMMUNICATION
SYSTEM

TRAFFIC MANAGEMENT
SYSTEM

TRACKSIDE AUTOMATIC
TRAIN CONTROL SYSTEM

TRACKSIDE EQUIPMENT

“ASELSAN’s autograph on rails”
1. Train B calculates its position and speed

2. Train B transmits its position and speed via MDR

3. ATC system calculates Moving Authority (MA)

4. Wayside ATC system transmits MA to Train A via Wi-Fi

5. Onboard ATC system calculates safe braking curve according to given MA and speed limit
RAILWAY SYSTEMS

CBTC SYSTEMS | AUTONOMOUS OPERATION ADVANTAGE

- COST
  - Deployment
  - Operation

- EFFICIENCY
  - Accurate Operation
  - Adaptive Planning
  - High Capacity
  - High Punctuality

- SAFETY
  - Determinism
  - Accuracy
  - Low Error Rate
  - Progressive Improvement
RAILWAY SYSTEMS

SAFETY | STRATEGY

SAFETY | STRATEGY

THE HOURGLASS MODEL (EN50129)

Risk Assessment

- System Definition
- Risk Analysis, including:
  - Hazard Identification
  - Consequence Analysis
  - Selection of RAP
  - Risk Evaluation

System Requirements Specification

- List of identified hazards with associated safety measures
- Safety Requirements:
  - Selected Codes of Practice
  - Objectives from ERE
  - Reference systems specifications

Hazard Analysis

- Causal Analysis
- Hazard Identification (refinement)
- Common Cause Analysis
- Demonstration of Compliance

Railway Duty Holder's responsibility

Note. During each project, responsibilities are clarified unambiguously in order to avoid gaps or unaccounted overlaps

Supplier's responsibility

Safety always comes first!
All staff are responsible for the achievement
Conformity with the requirements of CENELEC EN50126-50128-50129-50159 standards

- Build a common safety culture between project stakeholders
- RAMS Team Regular Meetings
- Safety Reviews
- Emphasize Safety in each Project meetings
- Project Partners and Sub-contractors informed and audited if necessary

Prevent fatalities and serious injuries

- Analysis
- Engineering activities

Reduce the frequency and impacts of hazards

- Safety Measures
- Safety Related Application Conditions (SRAC)
AUTOMATIC
TRAIN CONTROL
ATC | SAFETY RELATED DESIGN PRINCIPLES

RAILWAY SYSTEMS

SYSTEMATIC FAILURES

RANDOM FAILURES

SAFETY INTEGRITY
RAILWAY SYSTEMS

ATC | SAFETY RELATED DESIGN PRINCIPLES

PROJECT MANAGEMENT
Systematic & Quality Based Project Management
FMECA, FTA, HazOp, CCF, etc - Engineering Activities
Peer Review
Expert Verification

DESIGN
Composite Fail-Safe Design
Sensor Fusion – Odometer System (2oo3)
Redundant System Architecture
Maintenance Friendliness – Modular Design
Hardware Diversity
Self Diagnostic Functions
CENELEC Compliant Methods Applied

SUB-SYSTEMS/INTERFACES
SIL4 Safe Protocol
SIL4 Safe Computers & Safe Relays / SIL4 BTM & Balises
EN50128 Compliant Software Development
RAILWAY SYSTEMS

ATC | AUTONOMOUS

AUTONOMOUS

- Accurate Operation
- Adaptive Planning
- High Capacity
- High Punctuality
- Low Error Rate
- Progressive Improvement

SAFETY

- Determinism
- Accuracy
- Low Error Rate
- Progressive Improvement
**RAILWAY SYSTEMS**

**PROJECTS | GEBZE-DARICA METRO (GDM) PROJECT**

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<tr>
<th>İdare</th>
<th>Altyapılar Genel Müdürlüğü</th>
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<tbody>
<tr>
<td>Müşteri</td>
<td>EZE</td>
</tr>
<tr>
<td>Hat Uzunluğu</td>
<td>15,4 km</td>
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<tr>
<td>Operasyon Hızı</td>
<td>80 km/s</td>
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<td>İstasyon Sayısı</td>
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<tr>
<td>Araç Sayısı</td>
<td>28 Araç (4 Araç x 7 set)</td>
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<td>Otomasyon Seviyesi</td>
<td>Sürücüsüz (GoA4)</td>
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<td>Emniyet Seviyesi</td>
<td>SIL4</td>
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<td>Emre Amadeliğ</td>
<td>Sıcak yedekli sistem tasarımı</td>
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<tr>
<td>Kumanda Merkezi</td>
<td>2 adet coğrafi ve sıcak yedekli merkez</td>
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<td>Depo bölgesi</td>
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![Map of Gebze-Darica Metro Project](image)
THANK YOU