



EMC Hazard/Risk Analysis for Railway Projects, including a Case study

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About the presenter



Dr Alex Gavrilakis is a Senior Design Engineer on EMC for Network Rail since 2016. He is a Chartered Engineer, a Senior Member of IEEE and Chairman of IET's EM Technical Network Executive Committee.

Currently, Alex's main technical focus is on the EMC effects of railways traction power and harmonics on railway systems and third-party interfaces

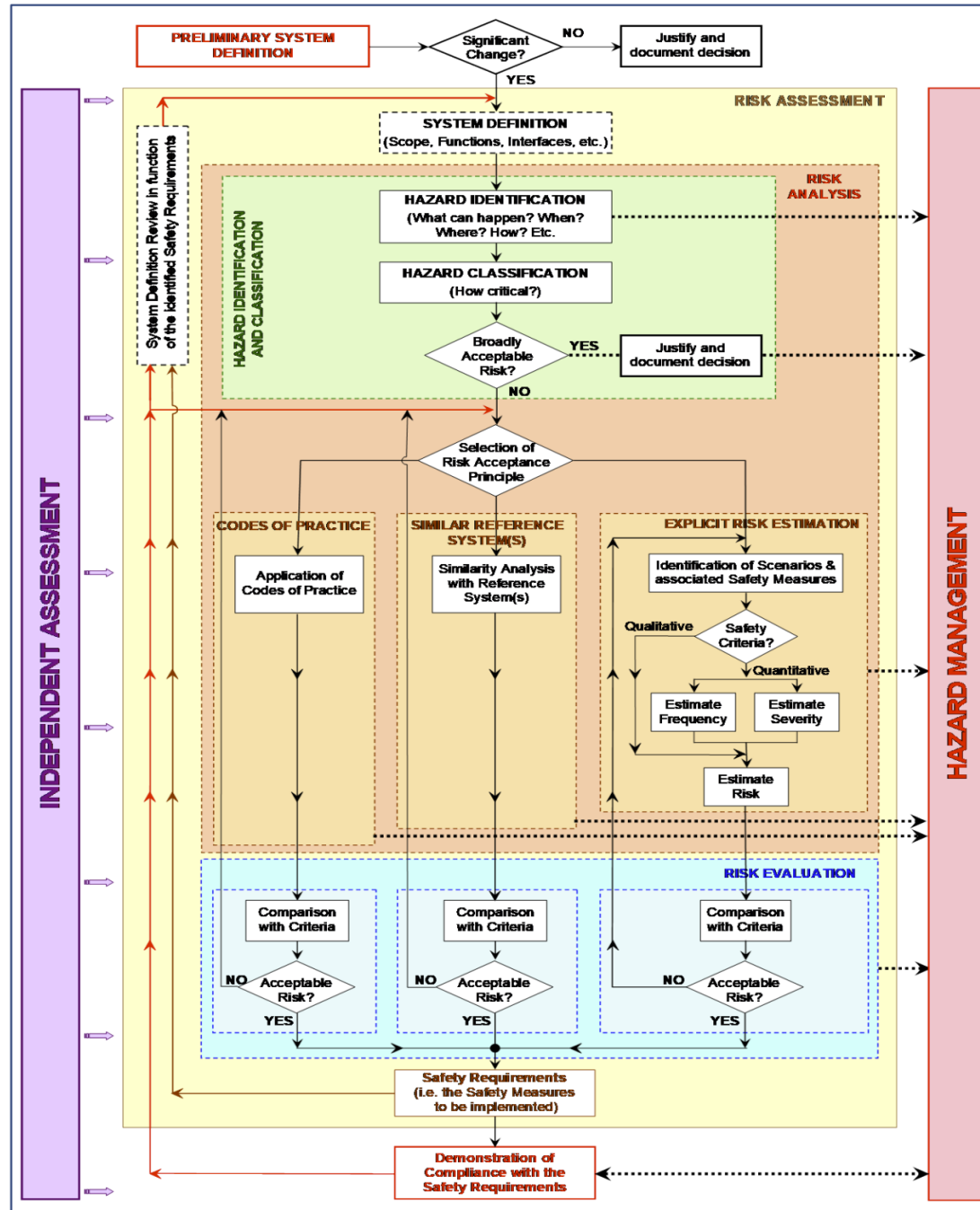
Definitions

- **Hazard** is a situation that can cause harm, damage or loss.
- A **risk** is the possibility or probability that a hazard may cause harm, damage or loss.

Legislation

- Health and Safety at Work Act 1974
- Electricity at Work Regulations 1989
- Construction Design and Management (CDM) Regulations 2015
- Management of Health and Safety at Work Regulations 1999
- The Railway Interoperability Regulation 2011
- Office Rail Regulation CSM Guidance
- NR EMC Assurance Process, NR/L2/RSE/30041

Risk Management Process (CSM-RA)



Description of change (New electrification)



EMC &
COMPLIANCE
INTERNATIONAL



Interaction Matrix

Source \ Victim	AC Traction	Station Systems	Signalling Supplies	Train Detection	Other Signalling ATP, SSI, TPWS, AWS	Telecoms FTN, WAN, Copper	Radio GSM-R, Station Radio	Rolling Stock	Lightning	LV supplies e.g. Points Heating	Staff	Public	Neighbours	Vandals
AC Traction		Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y
Station Systems	N		N	N	N	N	Y	N	N	N	N	N	N	N
Signalling Supplies	N	N		N	N	N	N	N	N	Y	Y	Y	N	Y
Train Detection	N	N	N		Y	N	N	N	N	N	N	N	N	N
Other Signalling ATP, SSI, TPWS, AWS	N	N	N	N		N	N	N	N	N	N	N	N	N
Telecoms FTN, WAN, Copper	N	N	N	N	Y		N	N	N	N	N	N	N	Y
Radio GSM-R, Station Radio	N	Y	Y	N	N	N		N	N	N	Y	Y	Y	Y
Rolling Stock	Y	Y	N	N	N	Y	N		N	N	Y	Y	Y	N
Lightning	Y	Y	Y	Y	Y	Y	Y	Y		Y	Y	Y	Y	Y
LV supplies e.g. Points Heating	N	N	N	N	N	N	N	N	N		Y	N	Y	Y
Staff	N	N	N	N	N	N	N	N	N	N				
Public	N	N	N	N	N	N	N	N	N	N				
Neighbours	N	Y	N	N	N	Y	Y	N	N	N				
Vandals	N	N	N	N	N	Y	Y	N	N	N				

Identification of hazards and risk



AC			
	Yes	No	Don't Know
Is a previously non-Electrified route being AC Electrified?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Are there any Level Crossings?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Is there an interface between 12 kA AT and 6kA BT system?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Is a BT system being upgraded to AT?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Is the system being upgraded to 12kA?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Is legacy protection employed in the area?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Is AT Lite being introduced? (-25 kV is taken from a single phase of a 132 kV supply)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Will the electrification system be AT?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Is there any mechanical signalling already present or being introduced?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Are ATPs present or newly installed?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Is AWS present or being newly installed?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Are SSI systems (including trackside) present or newly installed?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Is TPWS present or newly installed?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Is ERTMS being deployed?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Are there any interfaces with non-electrified Lines?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Are DNO Supplies being modified?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Is Protection and Control Equipment being modified?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Are any substations being upgraded or newly installed?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Are there any tunnels in the electrification route?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Are there any leaky feeders in the tunnel or will they be introduced in the future?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Generate the list of EMC Hazards

Return to Start Menu

Score		Consequence				
		5	4	3	2	1
Frequency	5	I	I	I	I	T
	4	I	I	I	T	T
	3	I	I	T	T	N
	2	I	T	T	N	N
	1	T	T	N	N	N

4 or less	Negligible low risk (N)	5-6	Tolerable risk (T)	7 or more	Intolerable Risk (I)
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Example of hazard matrix

RISK DEFINITION									RATING			MITIGATION			RATING		
ID No	Hazard Type	Source of Hazard	Cause or Description of Hazard	Consequence	Immediate Victim (system or people)	Ultimate Victim	RSSB Safety Risk Model Code	Primary Business Objectives	Severity	Frequency	Combined	Safety Measures (Mitigations)	Safety Requirement (Actions)	Actor (Action owner)	Severity	Frequency	Combined
15	EMC	AC Traction	Induction to lineside cables	Train delay	AZLM axle counter			Performance	2	6	8	Keep circuit lengths short. Install in accordance with installation requirements.			2	4	6
16	EMC	AC Traction	Magnetic field due to current in rails at head frequency	Train delay	AZLM axle counter			Performance	2	6	8	Compliance of axle counters to EN 50121-4 and EN 50238-3.			2	4	6
17	EMC	AC Traction	Electric noise from pantograph	Train delay	AZLM axle counter			Performance	2	6	8	Compliance of axle counters to EN 50121-4 and EN 50238-3.			2	4	6

Example of Mitigations and Requirements



- Ensure all equipment is tested/compliant with the NR EMC Standards (i.e. EN 50121 etc.)
- Keep circuit lengths short when there is a risk of induction
- Perform modelling for scenarios not covered by standards.
- Consider Earthing and Bonding design

Summary

- Control of Hazards and Risks is a **Legal** requirement
- Network Rail assurance process requires **all** EMC hazards closed/controlled before designers can handover Project
- Common Safety Method –Risk Assessment (**CSM-RA**) adopted
- A good EMC Hazard/Risk assessment will lead to a good set of **EMC requirements**
- EMC Hazard/Risk records is the responsibility of **everyone** within a Project (manufacturers, suppliers, designers, constructors, clients, maintainers)