

Vocational Training Council

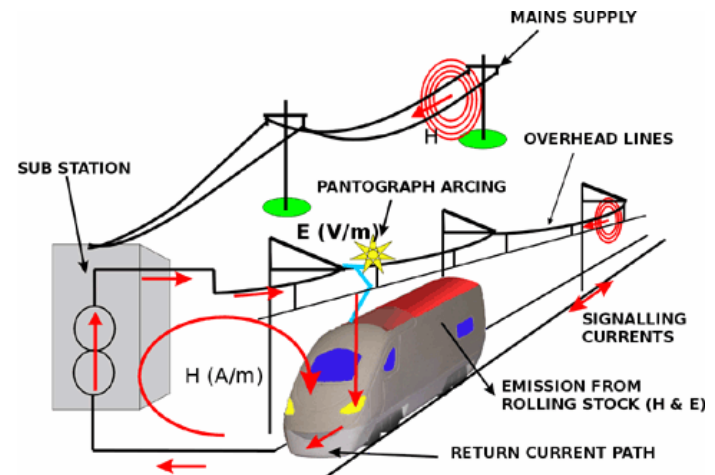
Typical EMC issues encountered in metro projects

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Scope

- The EMC Management serves to cover the following electromagnetic emissions in the railway environment.
 - Conductive;
 - Inductive;
 - Capacitive;
 - Radiated;
 - Electrostatic.



Purpose

- The operational railway environment requires careful consideration for electromagnetic compatibility of the E&M Services with its environment, all the components, sub-systems, and systems, etc., installed by the contractors.



EMC Standards

- All the E&M Services design shall be finalised with a view to operating without degradation in the electromagnetic environment of the railway, refraining from producing intolerable emissions within the operational environment and complying with the following EMC standards as a minimum:
 - IEC 62236-5 Part 5: Emission and Immunity of Fixed Power Supply Installations and apparatus.
 - EN 50122-1 Part 1 : Protective Provisions relating to Electrical Safety and Earthing
 - EN 50122-2 Part 2 : Protective Provisions against the Effects of Stray Currents caused by D.C. Traction Systems
 - ENV 50204 : Radiated Electromagnetic Field from Digital Radio Telephones Immunity Test



EMC Deliverables

- The following deliverables shall be produced ,but are not limited to, the following:
 - EMC Management Plan
 - Installation Guideline
 - EMC Hazard Analysis (Intra and Inter)
 - EMC Specifications for Build Contractor
 - Cabling Routing Plan to address cabling requirements



Equipment Emissions and Susceptibility

Item	Emission		Susceptibility				
	Con	Rad	Con	Rad	Mag	Ind	ESD
Protection, Control and Metering Equipment (note 1)			X	X			X
EPS (Emergency Power Supply)				X			X
UPS (Uninterruptible Power Supply)				X			X
Control Relays (note 2)				X			
Lighting System (e.g. Electronic Ballasts) (note 2)	X	X					
Generators	X	X					
Motors (note 3)	X	X					
Programmable Logic Controller and DDC (note 4)	X	X	X	X			X
Pumps (note 5)	X	X					
Addressable Automatic Fire Alarm System			X	X			X
Hall-Effect Transducer and sensors (note 6)				X	X		
Signal/Data cables (note 7)						X	
Telephone cables (note 8)						X	

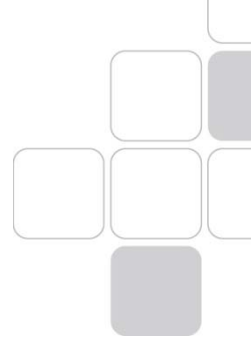


EMC Interfaces

- Signalling Control System;
- Communications Systems;
- Automatic Fare Collection System;
- Maintenance Management System;
- Platform Screen Doors;
- Lifts, Escalators and Passenger Conveyors
- Integrated Supervisory Control System (ISCS);
- Power Supply System (High Voltage & Traction Power);
- Trackwork;
- Passenger Vehicles;
- Travel Information System;
- Access Management System; and
- Battery Operated Motorise Track Trolleys.



Typical EMC Issues encountered in Metro Projects



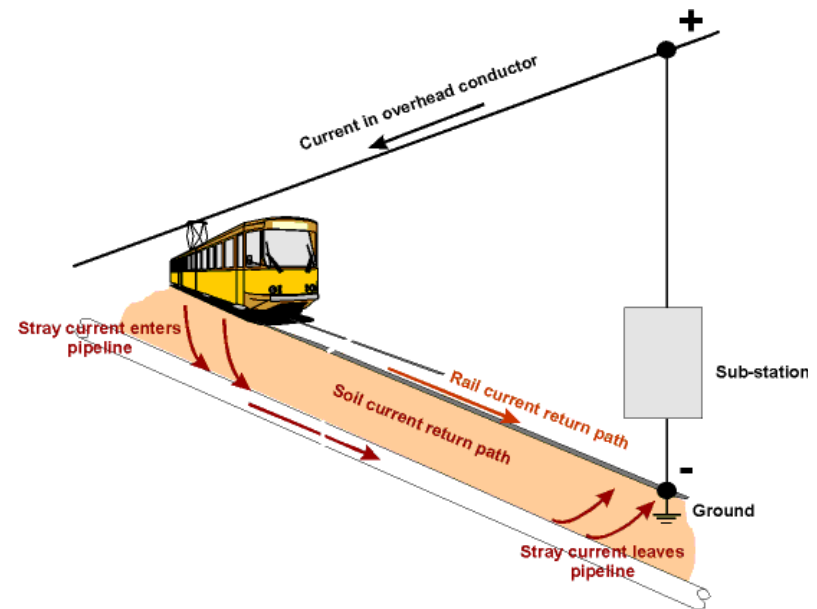
Interfaces with other Electrified Railways (1)

- Electrical interfaces to other railway networks such as KCRC West Rail with Light Rail, MTRC with KCRC, London Underground with Network Rail etc,
- Potential for operational disturbances to inter systems due to failure to either integrate or segregate the earths of the railway electrical systems
- Disturbances to signalling, telecommunications etc
- Failure to integrate the electrical systems properly can increase the probability of an electrical or control system failures

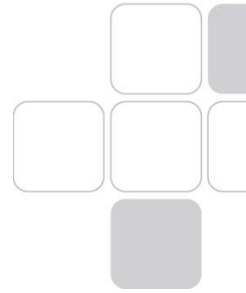


Interfaces with other Electrified Railways (2)

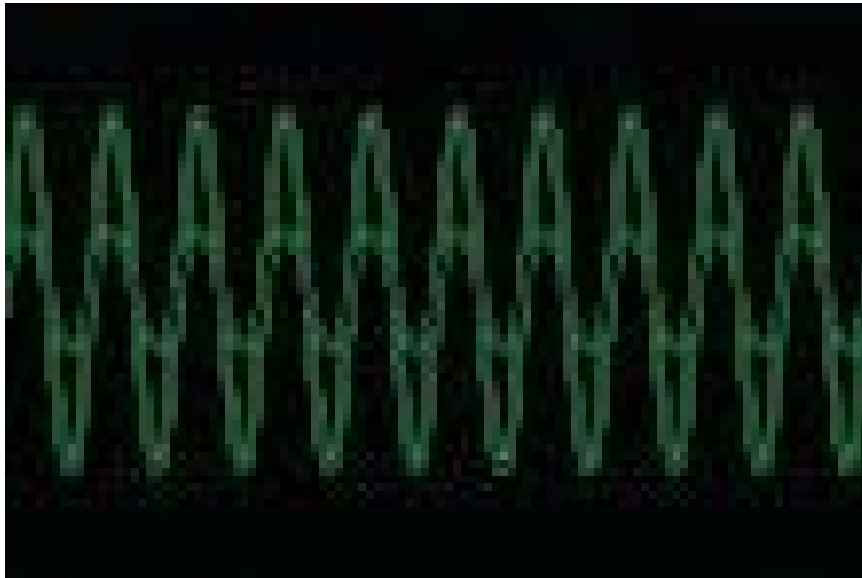
- On AC electrified railways, the following systems are normally required to be functionally integrated because they have a common AC earth / return path or are coupled electromagnetically:
 - Traction, Electrification, Signalling, Telecommunications, Rail vehicles
 - Trackwork, Infrastructure, Third Parties, etc
- Stray DC traction return currents



Harmonics, Dips, Fluctuations



- 66 kV Intake Substation – harmonics, voltage dip and fluctuations at point of common contact (POCC) with the power company



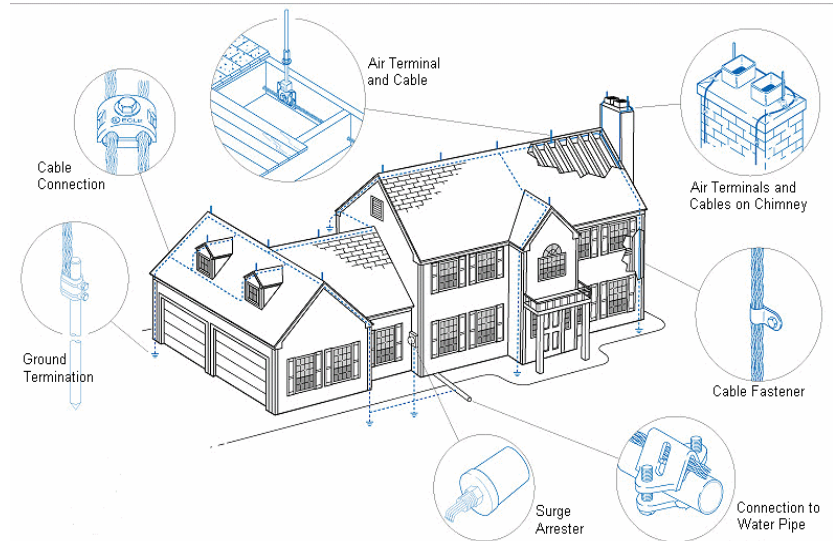
Lightning (1)

- Susceptible to disturbances where there is a high incidence of lightning
- Lightning is attracted to the line conductors and the earthed structures, such as earth wires, earthed masts
- Low voltage electrical and control systems, in close proximity to, or commonly bonded to the earth return, may be susceptible,
- Independent earths (earth pits) are required for viaduct or elevated trackwork,



Lightning (2)

- Well earthed viaducts are more susceptible to lightning strikes.
- Flash over across support insulator
- Induced voltages up to KVs to appear on overhead lines
- Rise of Earth Potential (ROEP)



Electrostatic Interference

- Electrostatically induced voltages due to capacitive coupling may induce high voltage on metal conductors.
- Damage to ESD sensitive circuitry such as PCBs
- Damage to semiconductors, chips etc
- Fire risk as a result of ESD giving off sparks.



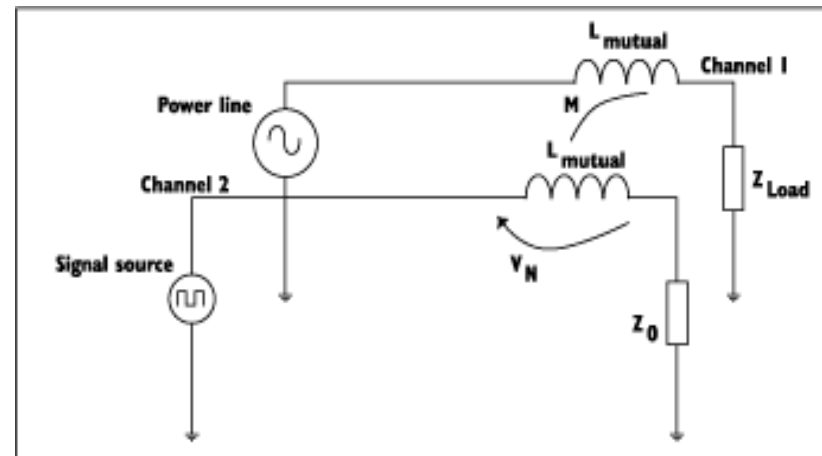
Electromagnetic Induced Voltage

- Where a magnetic field is changing due to an AC source or a transient phenomenon as a result of high energy spikes, DC short circuits etc, an electromotive force will be induced in a conductor that is mutually coupled.
- The level of the induced voltage depends on whether the return current flows via the earth.
- Low frequency magnetic fields occur as a result of operations of transformers and switching stations.
- This interference can affect magnetically sensitive equipment including CRTs, Hall Effect Transducers, microphones etc.



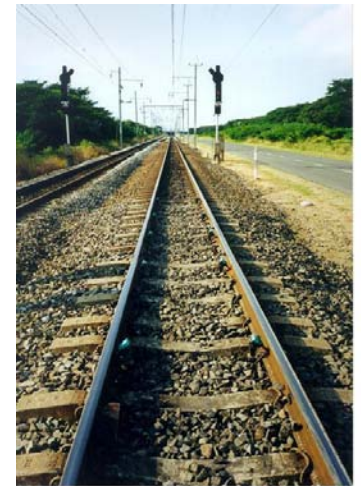
Inductive Interference

- When railway overhead contact system is energized or where overhead power lines (such as that from CLPP) over the railway, any unearthed conductor position above ground will have a voltage induced on the conductor.
- Power transformers, fluorescent lighting and trains can cause EMI
- Preventive measures: installation of snubber circuits



Radiated Frequency Interference

- Radiated frequency interference on railways consists of E and M radiation;
- Due to high power switching converters on trains or arcing on overhead lines;
- Impact on operations of Signalling, train control systems, telecommunications circuits, third party communications etc.



External EMI

- External EMI – E&M Services may interfere with or be interrupted by passengers' personal devices such as cardiac pacemakers and communication equipment



Touch potential during normal and fault conditions

- Personal safety – touch potential during normal and fault conditions



Cabling

- Parallel running control and power cables should be distant enough such that the induced voltage on the weak signal carrying cable is to be lower than the specified noise rejection limit of the connecting circuitry.
- Measures shall be carried out to ensure that the cables are installed at a safe distance apart from potential interfering sources, including power cables, LCX, etc.
- External shielding such as metal conduits and trunking should be provided to strengthen the internal shielding if the cable separation is insufficient.

