

Bury Interchange Metrolink

EMC Control Plan

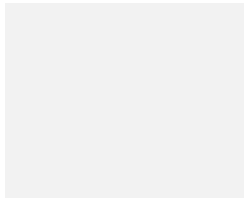
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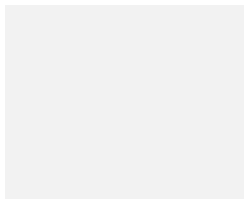
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This report dated 27 February 2026 has been prepared for Wilmott Dixon(the "Client") in accordance with the terms and conditions of appointment dated 27 February 2026(the "Appointment") between the Client and **Arcadis (UK) Ltd** ("Arcadis") for the purposes specified in the Appointment. For avoidance of doubt, no other person(s) may use or rely upon this report or its contents, and Arcadis accepts no responsibility for any such use or reliance thereon by any other third party.

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1 Acronyms and Abbreviations

Abbreviation	Definition
A	Ampere
Al	Aluminium
AFC	Approved for Construction
ALARP	As Low as Reasonably Possible
BS EN	British Standard European Norm
CER	Communications Equipment Room
CMS	Cable Management System
Cu	Copper
DALI	Digital Address Lighting Interface
DNO	Distribution Network Operator
DoC	Declaration of Conformity
EMC	Electro-Magnetic Compatibility
EMI	Electro-Magnetic Interference
EVC	Electric Vehicle Charging
GRP	Glass Reinforced Plastic
IDC	Inter Disciplinary Check
LEB	Low Earth Bonding
LV	Low Voltage
m	metre
MEP	Mechanical Electrification & Public Health
mm	Millimetre
RDL	Reduced Low Voltage
SCADA	Supervisory Control and Data Acquisition
STP	Shielded Twisted Pair
SP&N	Single Phase & Neutral
TP&N	Third Phase & Neutral
V	Voltage

Table 1: List of Abbreviations

2 Definitions

Definitions	Meaning
Critical Systems	Systems or products that, when installed, would be safety-critical or performance-affecting.
Deviation / Variation	A departure or alternative approach from the originally specified requirement.
Engineering Deliverables	Designs, specifications, reports, certificates, data and other information that fulfil the requirements of the Project Engineering Requirements (CRD/RRD/DRRD).
Hazard	Situation with potential to cause harm or loss.
Manufacturer	Produces any equipment.
Project Engineering Requirements (CRD/RRD/DRRD)	The Project Engineering Requirements are included as part of the Sponsors Instructions (SI) and shall be updated by the sponsor whenever the Sponsors Instruction is issued (Previously known as Project Requirements Specification PRS).
Risk	Something that may happen in the future with an adverse effect on the Project.
Sponsor	A person who acts as the single point of contact between the Client and the Project or Development Manager.
Supplier	Any provider of engineering deliverables or functions.

Table 2: List of Definitions

3 Applicable EMC Standards

The standards applicable to this project in line with the recommendations and guidelines provided in this EMC control plan are documented below in Table 3 and within the standards interface matrix in Table 4. The BS EN 50121 set of standards provides a framework for managing the EMC for railways and specifies the limits for the electromagnetic emission within railways, to external 3rd party sources and victims.

The standards below in Table 3 provide a reference to the applicable requirements for the presumption of conformity of equipment with EMC Regulations 2016 SI 2016/1091 for a particular installation environment. (Note: SI 2016/1091 is a transportation of the EU EMC Directive 2014/30/EU into UK Secondary Legislation and amended by the EU Exit Regulations).

Code	Title	Issue Date
BS EN 12016	Electromagnetic Compatibility. Product family standard for lifts, escalators and moving walks. Immunity	2013
BS EN 50121-1	Railway Applications. Electromagnetic Compatibility- General	2017
BS EN 50121-2	Railway applications. Electromagnetic compatibility - Emission of the whole railway system to the outside world	2017
BS EN 50121-4	Railway applications. Electromagnetic compatibility - Emission and immunity of the signalling and telecommunications apparatus	2016+A1:2019
BS EN 50121-5	Railway applications. Electromagnetic compatibility - Emission and immunity of fixed power supply installations and apparatus	2017+A1:2019
BS EN 55015	limits and methods of measurement of radio disturbance characteristics of electrical lighting and similar equipment	2019+A11:2020
BS EN 61000-3-2	Electromagnetic Compatibility (EMC) – Part 3-2: Limits – Limits for harmonic current emissions (equipment input current ≤ 16 A per phase	2019+A2:2024
BS EN 61000-3-3	Electromagnetic compatibility (EMC) - Limits. Limitation of voltage changes, voltage fluctuations and flicker in public low-voltage supply systems, for equipment with rated current ≤ 16 A per phase and not subject to conditional connection	2013+A2:2021
BS EN IEC 60947-1	Low-voltage switchgear and control gear – General rules	2021
BS EN IEC 61851-21-2	Electric vehicle conductive charging system - Electric vehicle requirements for conductive connection to an AC/DC supply. EMC requirements for off board electric vehicle charging systems	2021
BS EN IEC 62040-2	Uninterruptible power systems (UPS) - Electromagnetic compatibility (EMC) requirements	2018
BS EN IEC 62196-2	Plugs, socket-outlets, vehicle connectors and vehicle inlets. Conductive charging of electric vehicles - Dimensional compatibility requirements for AC pin and contact-tube accessories	2022
BS EN IEC 62920	Photovoltaic power generating systems. EMC requirements and test methods for power conversion equipment	2017+A1:2021
BS EN 61547	Equipment for general lighting purposes. EMC immunity requirements	2023
BS EN 61000-6-1	Electromagnetic compatibility (EMC) - Generic standards. Immunity standard for residential, commercial and light-industrial environments	2019
BS EN 61000-6-2	Electromagnetic compatibility (EMC) - Generic standards. Immunity standard for industrial environments	2019
BS EN 61000-6-3	Electromagnetic compatibility (EMC) - Generic standards. Emission standard for equipment in residential environments	2022
BS EN 61000-6-4	Electromagnetic compatibility (EMC) - Generic standards. Emission standard for industrial environments	2019

BS EN 50130-4	Alarm systems - Electromagnetic compatibility. Product family standard: Immunity requirements for components of fire, intruder, hold up, CCTV, access control and social alarm systems.	2011+A1:2014
BS EN 55032	Electromagnetic compatibility of multimedia equipment. Emission requirements.	2015+A1:2020
BS EN 55035	Electromagnetic compatibility of multimedia equipment. Immunity requirements.	2017+A11:2020
BS EN 61000-3-12	Electromagnetic compatibility (EMC) - Limits. Limits for harmonic currents produced by equipment connected to public low-voltage systems with input current > 16 A and ≤ 75 A per phase.	2011+A1:2024
BS EN IEC 61800-3	Adjustable speed electrical power drive systems - EMC requirements and specific test methods for PDS and machine tools.	2023
BS EN IEC 62040-2	Uninterruptible power systems (UPS) – Electromagnetic Compatibility (EMC) requirements	2018
BS 7671	Requirements for Electrical Installations. IET Wiring Regulations	2018/A3:2024

Table 3: List of applicable standards

STANDARD	Lighting	EVC	Solar PV	Fire Alarm	CCTV	Comms	HVAC	LVAC	UPS	Lifts
BS EN 55015	✓									
BS EN 61000-3-2	✓		✓				✓	✓		
BS EN 61000-3-3	✓			✓	✓	✓	✓	✓		
BS EN IEC 61851-21-2		✓								
BS EN IEC 62196-2		✓								
BS EN IEC 62920			✓							
BS EN 61547	✓		✓		✓					
BS EN 61000-6-1	✓		✓	✓	✓					
BS EN 61000-6-2	✓		✓				✓			
BS EN 61000-6-3	✓		✓	✓	✓	✓				
BS EN 61000-6-4		✓	✓	✓			✓			
BS EN 50130-4				✓	✓	✓				
BS EN 55032					✓	✓				
BS EN 55035						✓				
BS EN 61000-3-12								✓	✓	✓
BS EN 61800-3								✓		
BS EN 60947-1									✓	
BS EN 62040-2									✓	
BS EN 12016										✓

Table 4: Applicable Standards Interface Matrix

4 Introduction

Bury Interchange within Bury town centre is undergo redevelopment to create a new Transport Interchange and ancillary infrastructure, including improved Metrolink access (temporary and permanent) and platform works ('the Metrolink Access & Platform Improvement Works'), all of which form part of an overall wider development in the location together referred to as Bury Interchange.

Five scheme objectives for the overall redevelopment of Bury Interchange have been developed as follows:

- **Carbon Neutral:** To minimise embodied carbon in construction and deliver an outcome that is carbon neutral in operation in line with local and national targets.
- **Operability:** To enhance safety and operational resilience and provide sufficient capacity to accommodate future transport services.
- **Regeneration and Economic Growth:** To contribute to regeneration and economic growth in Bury Town Centre, including facilitation of commercial development opportunities.
- **Town Centre Integration:** To improve visibility and strengthen connections between Bury Interchange and key town centre locations.
- **User experience and sustainable travel behaviour:** To facilitate an increase in travel by public transport and active modes to, from and around Bury in line with Greater Manchester's 2040 Transport Strategy Right Mix targets and meet customer requirements based on the Network Principles as defined in the Greater Manchester Transport Strategy 2040.

4.1 Scope of Works

The scope of this project has been divided into two phases of work, phase 1 and phase 2. The extent of each phase can be identified using the temporary staircase at the north end of the platform. Phase 1 includes anything to the south (including the staircase), whilst phase 2 includes any work immediately adjacent and north of the staircase. For clarity the hoarding line in shows the separation.

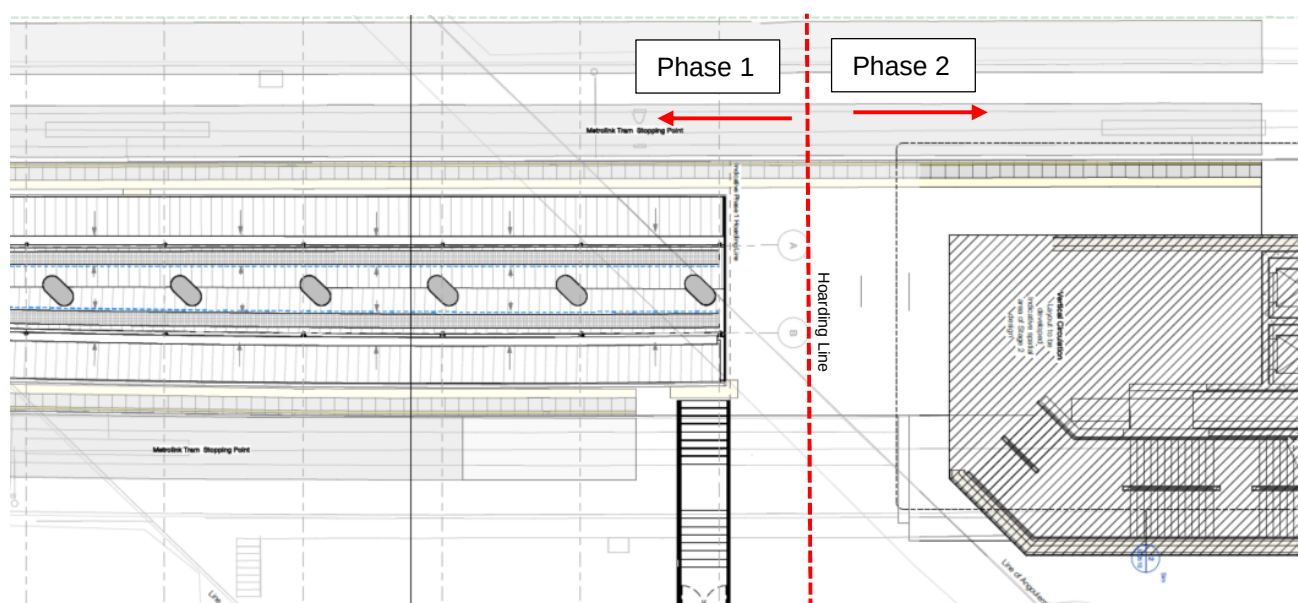


Figure 1: Phase 1 and Phase 2 Hoarding Line

4.2 Purpose of Document

The purpose of this EMC Control Plan is to define the requirements, process and responsibilities to achieve EMC compliance and present corresponding evidence to ensure the proposed systems installation does not in any way impact the performance of the existing system(s). In addition, this document shows that the EMC risks have been identified and where possible at this stage, mitigation measures are provided to reduce the severity and/or likelihood of the risks to ALARP.

4.3 Scope of EMC works

The scope of this EMC assessment for Bury Interchange Metrolink project covers all existing and proposed systems on the platform area at Bury Interchange. This equipment will fall into a category of a source or a victim. A well-managed EMC environment prevents malfunction of safety critical electrical equipment. The baseline coverage of this control plan includes the following:

- EMC coupling considerations between infrastructure (radiated emissions, radiated immunity, conducted emissions and conducted immunity)
- Cable segregation and separation concerns
- Zoning Principles
- Risk analysis ALARP/HAZID and mitigation concerns
- Earthing and Bonding guidelines

The proposed works listed below are intended to follow the detailed recommendations within this EMC Control to be best aligned with the verification/Validation exercise which each discipline must partake in to demonstrate compliance to key EMC regulation. The scope of works listed below are derived from Metrolink Access & Platform Improvement Works client requirements [Ref 2] and the RIBA 3 multidiscipline report [Ref. 1], which consists of an exhaustive list of all activities regarding the supply, installation, testing and commissioning of the following railway systems:

4.3.1 Mechanical & Electrical Services –

4.3.1.1 LV Distribution

The proposed LV distribution at Bury Interchange consists of the following:

- A new 18-way TP&N 630 A panel board
 - o DB1 (Split metered L&P) serving the Tram Stop lighting & power
 - o Change Over Switch (supplying DB2 and existing SER General Purpose DB)
 - o Southern Access Evacuation Lift 1 primary supply via life safety Automatic Transfer Switch (ATS)
 - o DB3 for Lighting and Small Power of the Southern Access Footbridge
 - o Northern Access Escalator (Phase 2)
 - o Northern Access Lift 2 (Phase 2)
 - o Northern Access Lift 1 (Phase 2)
 - o DB4 (Split metered L&P) serving the Northern Staff Accommodation (Phase 2)
 - o Photovoltaic Array (Phase 2)
 - o Fire Alarm PA/VA Fire Alarm Panel
 - o DB5 Union Square Feeder Pillar
 - o DB6 Pyramid Park Feeder Pillar
- For the sub distribution, a new 8+8-way TP&N 125 A distribution board

4.3.1.2 Photovoltaic Array

- New PV array to be installed at the Interchange Vertical Circulation Roof level

4.3.1.3 Lighting

Lighting related proposed works are listed as follows:

- New platform standalone lighting fittings – for the canopy area
- New platform 5m heavy duty flange plate mounted raise and lower lighting column
- Pyramid Park Lighting – Proposed illuminated ‘flag’ at the footbridge entrance, additional lighting for the walkway
- Union Square Lighting – Proposed illuminated ‘flag’ at the footbridge entrance, additional lighting for the walkway

4.3.1.4 Cable Management System

There are proposed additions to the existing platform canopy level cable management system., this will be carried out via a combination of high-level compartment trunking, cable tray and buried duct system [Ref. 1].

- New high level compartment trunking within platform canopy to facilitate the supply for the lighting and small power mounted on the canopy structure.
- New cable tray for the fire alarm system power supply.
- Below ground ducting and cable tray for the new submain cables
- Fully co-ordinated CMS for proposed Telecoms SISS

4.3.1.5 Fire Control System

The new fire alarm system features the following additions:

- New 4 loop addressable fire alarm panel (Fed by the proposed 18-way TP&N Panel board ‘PB-1’ installed within the Metrolink Electrical Plant Room (EPR)
- Interface with the proposed vertical circulation & bus interchange fire alarm system

4.3.2 Telecoms

- Video Surveillance System (VSS) – replacing the existing CCTV cameras on the existing Platform canopy with new Dome CCTV cameras (on the new proposed platform canopy) to provide complete CCTV coverage of the Platform areas
- Public Address (PA) System – relocating the existing back-to-back integrated Horn PA speakers on the existing Platform canopy along with new PA Horn speakers (supported by additional PA Amplifiers) to provide complete PA coverage of the Platform areas
- Customer Information System (CIS) – existing Passenger Information Displays underneath the existing station canopies to be relocated underneath the new proposed platform canopy in addition to new multiple Passenger Information Displays along the platforms
- Passenger Emergency Call-Point – replacing the existing Call-point at the platform with new Call-points which are to be installed on posts located at the platform areas
- Emergency Voice Communication (EVC) System – new EVC Call point (Type-B Outstation) at the designated Refuge point associated with the platform area
- Third-Party Assets (Ticket Vending Machines and Smart Ticket Validators) – CAT6 cabling for any data connectivity requirement of the assets

- SISS Telecommunication Cabinets – new headend equipment to support proposed SISS Telecommunications Systems
- SISS Telecommunication Systems cabling – new CAT6/multi-pair copper cabling to support new/relocated SISS Telecommunication assets in the platform

5 Reference Docs

Reference	Document Number	Document Title
Ref. 1	16012-ARC-BRY-ZZZ-T-ZZ-00004	Bury Interchange Metrolink – Multidiscipline RIBA 3 report
Ref 2	16012-TGM-XX-XX-CD-R-0002	Bury Interchange – Metrolink Access & Platform Improvement Works Clients Requirements
Ref 3	16012-ARC-BRY-ZZZ-T-EP-000001.	Bury Interchange Metrolink – E&B Strategy
Ref 4	16012-ARC-BRY-ZZZ-T-EC-000001.	Bury Interchange Metrolink – EMC Strategy
Ref 5	16012-ARC-BRY-ZZZ-T-EC-000004.	Bury Interchange Metrolink – EMC Project File

Table 5: List of Reference Documents

6 Applicable Standards/Specifications

6.1 Metrolink

Code	Title
ITS 3003	Earthing and Bonding Infrastructure Technical Specification

Table 6: List of Metrolink Specifications

6.2 Applicable EMC Standards

The standards applicable to this project in line with the recommendations and guidelines provided

Code	Title	Issue Date
BS EN 12016	Electromagnetic Compatibility. Product family standard for lifts, escalators and moving walks. Immunity	2013
BS EN 50121-1	Railway Applications. Electromagnetic Compatibility- General	2017
BS EN 50121-2	Railway applications. Electromagnetic compatibility - Emission of the whole railway system to the outside world	2017
BS EN 50121-4	Railway applications. Electromagnetic compatibility - Emission and immunity of the signalling and telecommunications apparatus	2016+A1:2019
BS EN 50121-5	Railway applications. Electromagnetic compatibility - Emission and immunity of fixed power supply installations and apparatus	2017+A1:2019
BS EN 55015	limits and methods of measurement of radio disturbance characteristics of electrical lighting and similar equipment	2019+A11:2020
BS EN 61000-3-2	Electromagnetic Compatibility (EMC) – Part 3-2: Limits – Limits for harmonic current emissions (equipment input current ≤ 16 A per phase	2019+A2:2024
BS EN 61000-3-3	Electromagnetic compatibility (EMC) - Limits. Limitation of voltage changes, voltage fluctuations and flicker in public low-voltage supply systems, for equipment with rated current ≤ 16 A per phase and not subject to conditional connection	2013+A2:2021
BS EN IEC 60947-1	Low-voltage switchgear and control gear – General rules	2021
BS EN IEC 62040-2	Uninterruptible power systems (UPS) - Electromagnetic compatibility (EMC) requirements	2018
BS EN IEC 62920	Photovoltaic power generating systems. EMC requirements and test methods for power conversion equipment	2017+A1:2021
BS EN 61547	Equipment for general lighting purposes. EMC immunity requirements	2023
BS EN 61000-6-1	Electromagnetic compatibility (EMC) - Generic standards. Immunity standard for residential, commercial and light-industrial environments	2019

BS EN 61000-6-2	Electromagnetic compatibility (EMC) - Generic standards. Immunity standard for industrial environments	2019
BS EN 61000-6-3	Electromagnetic compatibility (EMC) - Generic standards. Emission standard for equipment in residential environments	2022
BS EN 61000-6-4	Electromagnetic compatibility (EMC) - Generic standards. Emission standard for industrial environments	2019
BS EN 50130-4	Alarm systems - Electromagnetic compatibility. Product family standard: Immunity requirements for components of fire, intruder, hold up, CCTV, access control and social alarm systems.	2011+A1:2014
BS EN 55032	Electromagnetic compatibility of multimedia equipment. Emission requirements.	2015+A1:2020
BS EN 55035	Electromagnetic compatibility of multimedia equipment. Immunity requirements.	2017+A11:2020
BS EN 61000-3-12	Electromagnetic compatibility (EMC) - Limits. Limits for harmonic currents produced by equipment connected to public low-voltage systems with input current > 16 A and ≤ 75 A per phase.	2011+A1:2024
BS EN IEC 61800-3	Adjustable speed electrical power drive systems - EMC requirements and specific test methods for PDS and machine tools.	2023
BS EN IEC 62040-2	Uninterruptible power systems (UPS) – Electromagnetic Compatibility (EMC) requirements	2018
BS 7671	Requirements for Electrical Installations. IET Wiring Regulations	2018/A3:2024

Table 7: List of Applicable British Standards

7 EMC Requirements

Electromagnetic Compatibility applies to all electrical and electronic devices, equipment, systems and installations containing active components that may produce electromagnetic emissions or may be sensitive to electromagnetic disturbances

7.1 Apparatus Requirements

Equipment comprising of various systems shall be compliant with the relevant standard(s) and shall be CE marked for its intended operational environment. Documented evidence such as equipment DoCs from the equipment's supplier shall be obtained where possible to demonstrate EMC compliance.

Where suitable documentation is not available, a gap analysis shall be undertaken to ascertain the risks associated with adding the item of equipment to the EMC environment.

7.2 System Requirements

This section of the report focuses on the typical equipment that is found on the platform level rooms. The aim is to identify which elements of the proposed systems may impact sensitive equipment already existing within the EMC environment. Sources and victims arise from the installation of new systems near existing systems.

It is critical to differentiate these sources and victims to ascertain how the sources are generated and how the victims are affected. These mitigative measures are deemed necessary for the incorporation into the design of the primary sources of EMI following the completion of the proposed works.

Outstanding risks of any significance shall be highlighted for inclusion in the EMC Hazard Log. Specific requirements which are to be noted and/or implemented by responsible contractors shall be documented.

7.3 Cable Management System

In general, cables are classified according to the following criteria:

- Likelihood to induce radiated interference
- Connection to another equipment
- Levels of interference or signal being carried

BS IEC 61000-5-2 provides details on the classification of cable types. This is explained in further detail below. This standard concerns with earthing practices and with cables used in industrial, commercial and residential installations.

Class A (Very Sensitive):

Class A cables generally applies to all low-level signals such as thermocouples, thermistors, RTDs, strain gauges, load cells, micro-phones, etc, also high-rate digital and analogue communications such as Ethernet, video, RF receiver cables from antennae and all other signal with full-scale range less than 1 V, 1 mA, or where their source has an impedance higher than 1 kΩ, or their signal frequency or rate is greater than 1 MHz.

Class B (Sensitive):

This covers ordinary analogue (e.g. 4-20 mA, 0-10 V, less than 1 MHz) and low-rate digital bus communications (e.g. RS232, RS422, RS485, Centronics). Class B also covers digital (i.e. on/off) inputs and outputs such as limit switches, encoders, non-data bus low-rate signals, etc, and the outputs of internal DC power supplies (but not the DC links of power convertors or motor drives, which are class D).

Class C (Indifferent):

Class C covers externally supplied AC (230/415 V) or DC power which does not also supply noisy external equipment, e.g. welders, drives, power convertors, etc. Class C also covers control circuits with resistive and inductive loads where all inductive loads (e.g. the coils of solenoids and contactors) are fitted with suppressors recommended by their manufacturers.

Induction motor (e.g. squirrel cage) cables are Class C providing they are on/off controlled or run from adjustable speed drives with sinusoidal output filters and providing their AC supply.

Class D (Noisy):

Applies to the cables associated with the power inputs and outputs and DC links of adjustable speed motor drives (DC, AC, steppers, servos, etc), welding equipment, and similar electrically noisy equipment.

Cables to on/off controlled DC motors or sliprings are also Class D, although sparkless types such as pancake motors, or motors fitted with spark suppressed rotors or integral filters could be Class C.

Class D also covers control cables to unsuppressed inductive loads (relays, contactors, solenoids, etc), which may use unscreened twisted pairs but only as long as they operate infrequently (every few minutes or longer). If they operate more frequently than every few minutes, they should either be suppressed or use screened cables.

Class D can include all LV supplies which also power external noisy electrical equipment (e.g. drives, power convertors, welding, etc.) which may not meet their relevant harmonized EMC emissions standard, or which lack supply filters. Cables to RF transmitting antennae are also Class D.

Class E and F, (Very Noisy): (for MV and HV)

Cables carrying supplies at voltages higher than 630 V are commonly called High Voltage (HV), although more correctly these should be divided into Medium Voltage (MV) and HV according to the IEC's definitions. MV and HV cables are much more exposed to external disturbances such as lightning and powerful transients and surges caused by the operation of heavy-duty switchgear, than are LV cables. MV power distribution cables are Class E, and HV power distribution cables are Class F.

Class	Applicable System Cables
Class A - Very sensitive	Copper Telephone Video and Low-Level Audio
Class B - Sensitive	Ethernet Cable 10/100 and Twisted Pair PAVA Audio Signalling Circuits/Point Detection RS 422 / RS 485 / RS 232 Proprietary Data (PHP) Analogue Sensor 4-20 mA PLC / SCADA Cables without an inductive load (e.g. door contacts/interlocks)
Class C - Indifferent	60 V AC, 110 V AC, 230 V AC < 13 A Domestic Power Supply DC Power Cables (<50 V)
Class D - Noisy	Electric Vehicle Chargers (EVC) - Mennekes Solar PV System - DC inverter cables 230 V AC, 415 V AC, 630 V AC Power Cables > 13 A Control Cables for inductive loads
Class E and F - Very Noisy	11 kV / 22 kV / 33 kV DNO Power 750 V DC Traction Power 25 kV AC Traction Power Low level feeders, Traction power feeders

Table 8: Cable classification based on IEC 61000-5-2

Minimum separation distances are necessary to mitigated against disturbance coupling. Mitigation against disturbance coupling is independent on various properties of cables such as:

- Cable type (shielded/unshielded or twisted pair)
- Balance of the cable
- Cable termination impedance & signal levels
- Use of metal dividers
- Inherent immunity of equipment ports

Below is a structured guideline on cable separation distances (as per BS IEC 61000-5-2) that shall be followed in the proposed works for Bury Interchange Metrolink project [section 4.3], in order to decrease the likelihood of generating excessive EMI exceeding the limits specified in BS EN 50121 and BS EN 50174-2.

Cable Class	A	B	C	D	E/F
A					
B	20 mm				
C	125 mm	50 mm			
D	450 mm	300 mm	50 mm		
E/F	1000 mm	1000 mm	1000 mm	300 mm	

Table 9: Recommended minimum cable separation distances in non-metallic trunking (source: BS IEC 61000-5-2 and BS EN 50174-2)

In the event the separation distances quoted above cannot be implemented, the assessment should be carried out on a case-by-case basis to determine the maximum parallel length between Category A to D cables).

The distances provided in Table 9 assumes that the cables are unshielded. The separation distances may be reduced if adequate shielding is fitted to cable class A to D as follows:

- Shielding fitted to either cable - half separation distance e.g. Class A to D - 225 mm.
- Shielding fitted to both cables - quarter separation distance e.g. Class A to D — 125 mm.

As a general rule, the following principles apply to cable separation design/installation:

- Fibre optic connection can be rule with any class of cable and aren't susceptible to the same EMC constraints as the cables listed above in Table 8. Note this applies to fibre optic cables that don't contain metallic reinforcement within the armouring/sheath.
- The larger the physical separation between the cables, the lower the level of induced voltages.
- As per BS EN 50174-2, the minimum distance between sensitive cables and LED lamps shall be 130 mm.
- Where the use and characteristics of third-party cables is unknown, a separation of 500 mm shall be maintained between the third-party cables.
- Cables of different types where they cross shall run at right angles to one another wherever feasible.

The use of compliant CMS minimises the risk of EMI caused by induced coupling between power and RF circuits and potentially voice and data circuits. The basic requirements for achieving EMC are:

- The provision of reliable bonding with an adequately low value of impedance over the relevant frequency range between CMS sections. This method includes bonding any metallic CMS trunking using tinned copper links. Wire straps have proven ineffective, and braids have been found to have high degradation levels over time.
- Where bonding links are applied to the metallic trunking, a full metal-to-metal contact shall be made between the link and trunking. Trunking with power coated finishes need to have links installed such that there is no finish layer between the two. If links must be installed internally, regular inspection should be carried out to ensure that their links to ensure that these links are correctly installed prior to the installation of the cables.
- Since electrical continuity shall deteriorate over time, where links are applied, an anti-corrosion finish shall be applied to prevent moisture ingress.

The recommended cable segregation and separation requirements are shown below in Figure 2.

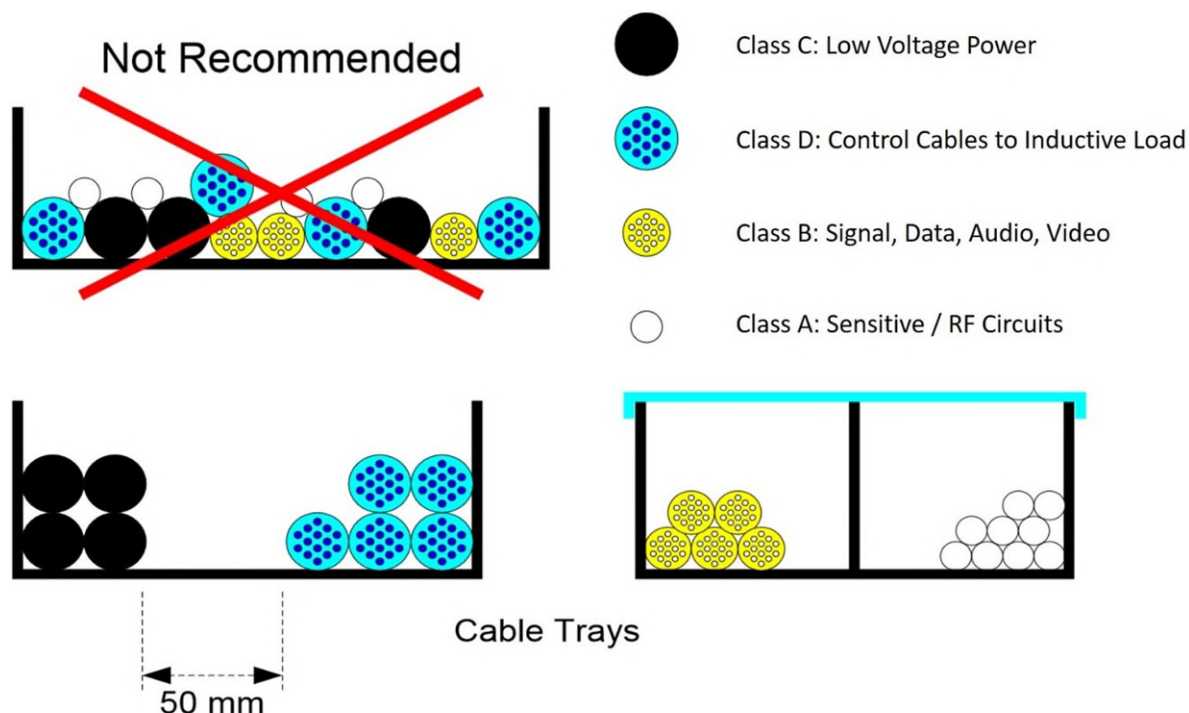


Figure 2: Recommended Cable Management Arrangement

7.3.1.1 Cable Transits

Where metal cable trays are used, they can provide good shielding for the enclosed cables by diverting common-mode disturbance currents away from the differential mode signal current (whether the victim cable is shielded or unshielded). Where possible, they should be bonded to other metallic structures to reduce the level of induced voltages.

Fully enclosed cable conduits of high integrity EMC performance is not always practical. Trunking and conduits shall be considered in areas where appropriate separation distances between power cables is not achievable and where additional electromagnetic protection is considered necessary for high-speed signal cables which would normally be run on a cable ladder rack.

The following installation guidelines are recommended to maximise the EMC performance CRMS whether in racking, trunking or conduits.

- A fully circumferential tubular conduit provides the best EMC performance, followed by a U-shaped cable tray with cover, followed by a ground plate, followed by a metallic cable rack.
- Cable trunking and cable racks shall be bonded to earth at multiple points along their length. To be effective at high frequencies, cable transit shall form a continuous well-conducting metallic structure over their full length.
- When the cable transits are made of several shorter sections, care will be taken to ensure continuity by correct low impedance bonding between individual sections.
- Excessive High-Frequency common mode disturbance currents flowing in the loop formed between the cable shield and the cable transit can be reduced with the use of ferrite chokes where necessary.

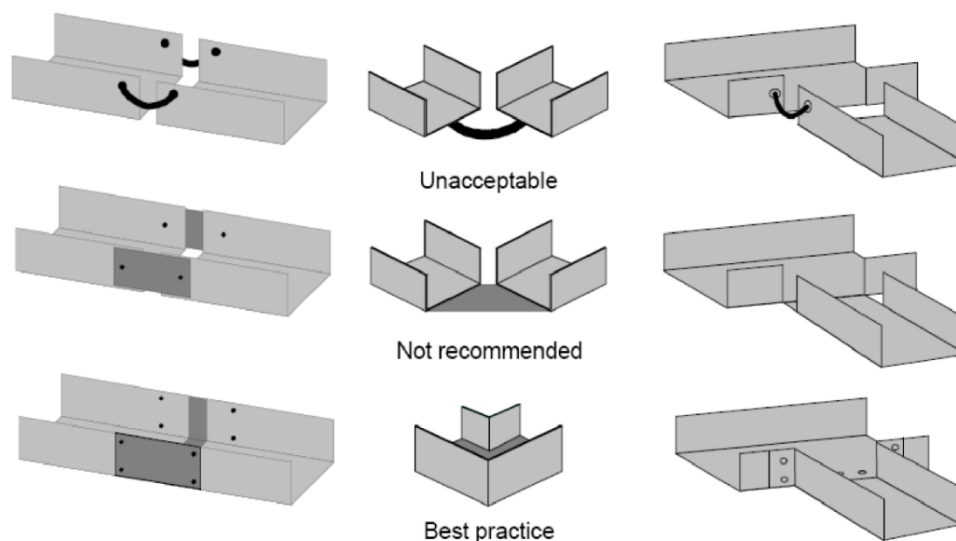


Figure 3: Recommended bonding of cable trunking

7.3.1.2 Equipment Enclosure Design and Layout

In addition to the provision of environmental protection, metallic enclosures also provide shielding from electromagnetic interference. For the enclosure to provide an acceptable level of shielding, it is important to minimise the number and size of apertures in the metal.

The guidelines and recommendations are as follows:

- Aperture size should be minimised so that it still permits entry of the cables into the enclosure as the shielding effectiveness of any enclosure degrades with increasing aperture size.
- For sensitive equipment, specifically designed shielded enclosure should be used. They normally incorporate conductive finger strips or gaskets along door edges to ensure as close to a solid conductive enclosure is achieved. Their use should be limited as they are expensive and unsuitable for installation outside without additional environmental protection. They also require ongoing maintenance.
- Where cooling vents are required, the use of metallic mesh grilles that are electrically connected to the rest of the enclosure is recommended.

Ferrite cores are generally effective at mitigating against risks associated with EMI. They are often manufactured from metal-oxide ceramic that contain iron oxides of magnesium or nickel-zinc. This ceramic composition provides the ideal balance of magnetic properties and electrical insulation. They can be effective for suppressing high frequency noise (primarily in the MHz range) but are unlikely to address low frequency EMI (e.g, harmonics or mains related interference).

At lower frequencies, ferrite cores maintain high permeability and low losses, allowing the core to behave as efficient inductors. The inductive reactance (X_L) of the ferrite core increases proportionally with frequency. At higher frequencies, ferrite cores experience a degradation of their magnetic properties due to increased losses (eddy currents and hysteresis) and decreased permeability. Additionally, parasitic capacitance in the core and winding structure becomes more dominant, altering the impedance behaviour.

At very high frequencies, the impedance of the ferrite core begins to decrease due to reduced inductance and increased parasitic effects. This behaviour, combined with the lossy nature of the ferrite material, allows ferrite cores to effectively attenuate high-frequency noise, making them useful in EMI suppression applications

This makes them suitable for EMI suppression in class B cables (see Table 8) which are typically unshielded or have limited shielding and thus are more susceptible to interference from external sources of electromagnetic

noise. Class A cable is already heavily shielded due to the sensitive nature especially in heavily industrial environments, the utilisation of ferrite cores for this classification of cables is typically less significant due to the already present robust EMI suppression provided by the cable shield.

However, for equipment considered as high emitters of EMI and are consisting of class D, E or F cables it is important to note ferrite cores are unlikely to provide suitable protection against EMI due to the high current which alters the magnetic field. Ferrite materials have a specific saturation flux density, which is effectively the operation limit of the max magnetic field strength the core can handle before it becomes fully saturated. Once saturated, the ferrite core can no longer provide the desired inductive impedance or attenuation of high-frequency EMI. Instead, for high emitters of EMI the other mitigation techniques discussed in section 7.3.1.1 & 7.3.1.3 would prove to be more effective.

BS EN IEC 62920 and BS IEC 63093 standards apply for the installation of ferrite cores. An enclosure selection guide is outlined below.

Field	Frequency Range	Necessary Material Properties	Results
Electric	DC - 100 MHz	High Conductivity	Effective Attenuation up to HF
LF Magnetic	DC - 100 Hz	High Permeability Significant material thickness	No significant skin depth effect Effective attenuation only by flux guidance and sufficient material thickness
MF Magnetic RF Magnetic	100 Hz - 10 MHz	High conductivity and permeability at lower frequencies. Reduction of thickness with increasing frequency	Skin depth becomes effective with higher frequencies More effective attenuation at higher frequencies
Plane Electromagnetic Wave	From 100 MHz	High conductivity Enclosure dimensions and discontinuities become important	No Further improvement of attenuation. Holes, slots and surface resonances reduce shielding effectiveness.

Table 10: Enclosure selection based on frequency

Designing the layout of equipment inside an enclosure is critical to achieving EMC and best practice normally recommends the use of a “zoning concept.” This identifies where significant sources of interference such as power supplies or motor drive circuits are segregated from other more sensitive systems like transducers and low-level signal lines. The zoning concept is shown graphically in Figure 4 below,

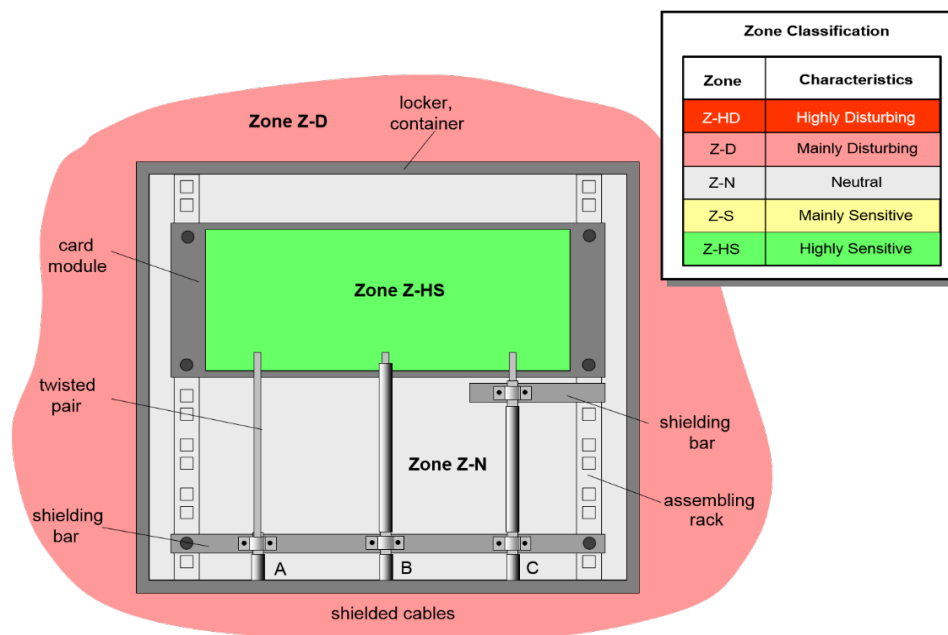


Figure 4: Enclosure Zoning

7.3.1.3 Shielded and Armoured cable termination

EMC standards recommend that cable screens are bonded to earth at both ends of their run - e.g. BS IEC 61000-5-2 Section 7.3d; BS EN 50310 Section 5.5 and BS EN 50714-2 Section 6.3.2.

In terms of preference, 360° peripheral termination offers the best termination for short runs of cable.

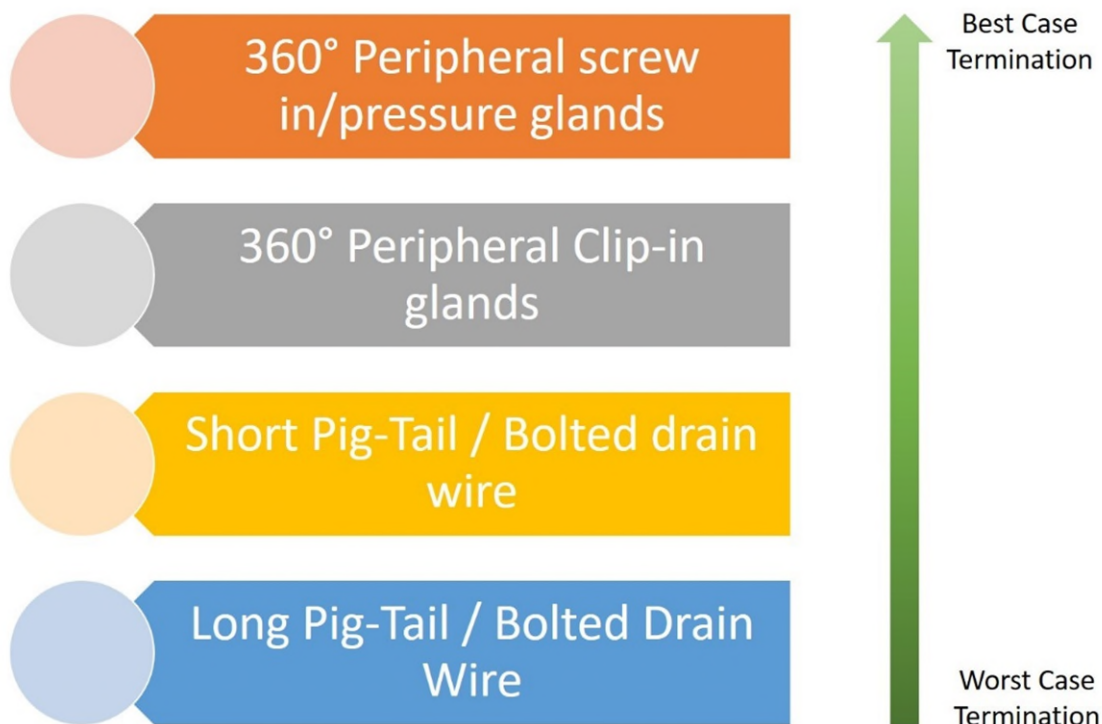


Figure 5: Preferred shielded cable transmission

Electronic equipment manufacturers commonly recommend that cable screens are connected to earth at one end only to remove possible earth loop currents (primarily at power frequency). Earth loops will be present in cases where the earth impedance (across a wide range of frequencies) between any two separate reference points is significantly different.

Generally, screen cables running locally, with cable lengths typically < 15 m, will not suffer earth loop problems. Where issues exist with high levels of screen current on cables running distances of up to 100 m, the shield shall be disconnected at the receiver end of the cable and terminated at the transmitter end. Where particularly sensitive circuits are involved, double shielded cables can be used on runs of 100 m or greater and the shields should also be terminated

Screen Bonding Methods:

Peripheral Bonding:

- 360° termination of the cable screen is the preferred method of cable screen bonding. Peripheral bonding essentially provides an RF termination of the screen.
- The separation of the wanted signal on the inside and the disturbance signal on the outside of the conductor is maintained by the skin depth at the radio frequencies concerned.
- Any extraneous RF coupled to the cable will be on the outside of the outer conductor and decoupled by the bonded connector at the cabinet wall or earthed trunking. Peripheral bonding methods are illustrated in Table 8

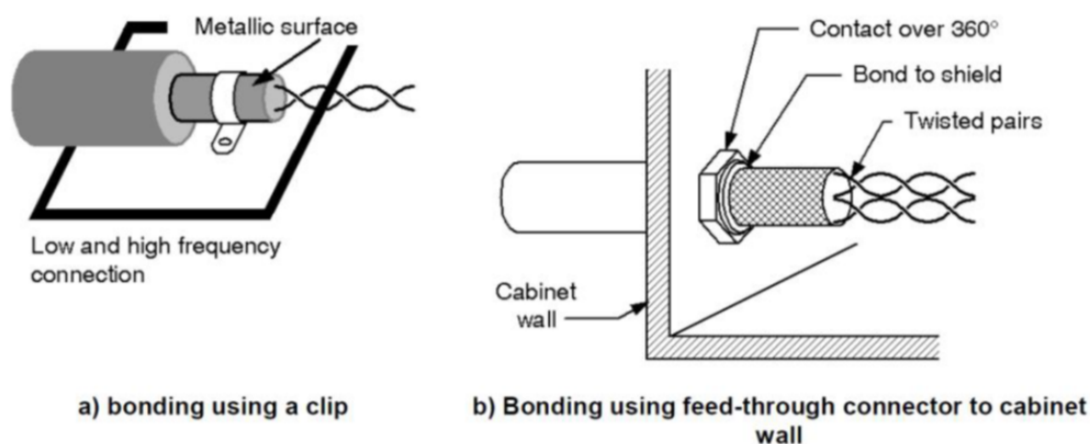


Figure 6: Examples of Peripheral Cable Screen Bonding

Pigtail Bonding

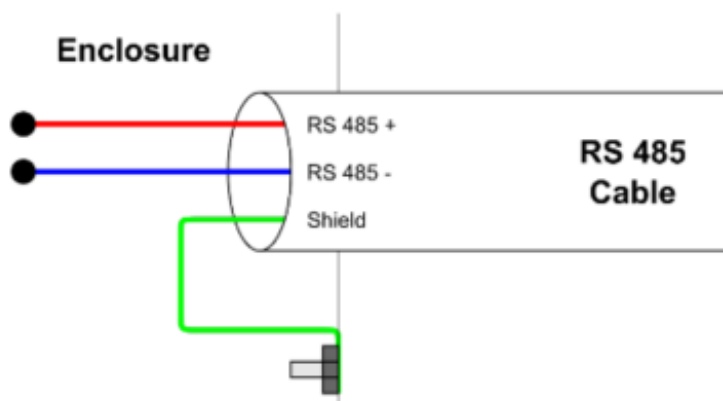


Figure 7: Example of Pigtail Bonding

Screens connected to earth using drain wires or pig tails (as in Table 10) will provide adequate screening for low frequencies (< 150 kHz) but the bonding wire inductance will present a higher impedance to noise current as the frequency increases. Pigtail lengths shall be as short as possible to minimise the bonding impedance.

7.4 Earthing & Bonding

The next most critical method of mitigating against unwanted EMI interfering with sensitive equipment, is to ensure a robust Earthing and Bonding Network is available. Earthing & Bonding plays a vital role in mitigating against EMI by creating a low impedance path to ground for electrical currents, thus reducing the risks of conducted & radiated EMI.

Refer to the Earthing & Bonding Strategy [Ref 3] for the proposed earthing and bonding guidelines for the Bury Interchange Metrolink Project.

8 Compliance with Safety Requirements

To achieve a compliant EMC design and successfully mitigate risks of excessive EMI levels within the station confines, the essential requirements of the UK electromagnetic Compatibility Regulations, SI 2016/1091 shall be applied.

The regulation requires that all equipment must be designed and manufactured, having regard to the state of the art, to ensure that:

- The electromagnetic disturbance it generates does not exceed a level above which radio and telecommunications equipment or other equipment cannot operate as intended, and;
- It has a level of immunity to the electromagnetic disturbance to be expected in its intended use which allows it to operate without unacceptable degradation of its intended use.

For installations, the EMC Directive requires that a responsible person be identified and that good engineering practices be implemented and documented as evidenced by the completion of an EMC Project File.

Under the EMC Directive, new or upgraded infrastructure is classified as a “fixed installation” which is defined as a particular combination of several types of apparatus and, where applicable, other devices, which are assembled, installed and intended to be used permanently at a predefined location. Bury interchange falls into this category.

Fixed installations are not subject to the need for free movement within the EU and therefore, they are not subject to the requirements for CE marking, DoCs or for formal EMC assessment before putting into service. However, fixed installations must comply with the protection requirements and other specific requirements (Annex I of the Directive) which are applicable to them.

8.1 EMC Zoning Principles

The EMC zoning principle provides guidance on the relevant standards which govern deployment and use of equipment installed at various locations. Specifically, it provides the landscape for the limits to be considered with regards to the distance from the centre line of the nearest track.

The following characterisation zones are recognised based on the BS EN 50121-X series of standards

- Within 10 m of the centre line of the running rail or within 3 m of a traction substation.
- Beyond 20 m of the centre line of the running rail; and,
- There are some specific limits for equipment placed within 3 m of the nearest running line. This area is also referred to as the safety critical zone.

Equipment placed within the railway boundary shall be compliant to the BS EN 50121-X series of standards. It is important to note any equipment which is located outside the railway boundary but has cabling that extends into the railway boundary shall also be compliant to the relevant BS EN 50121 standard.

Beyond the railway boundary, “light industrial” EMC standards are applicable. Practically, it is more feasible that there is a steady transition from the heavy industrial limits to light industrial limits at the 20m boundary. Considering this, it is recommended that equipment supplied for the “buffer zone” that extends beyond the 10m boundary is also compliant to EMC standards applicable to heavy industrial environments or to the equivalent BS EN 50121 series of standards to achieve acceptable levels of immunity from EMI. This characterisation serves as a guide to identifying relevant requirements for equipment located in any particular zone and provides about 90% satisfactory close of EMC risks for a fixed installation.

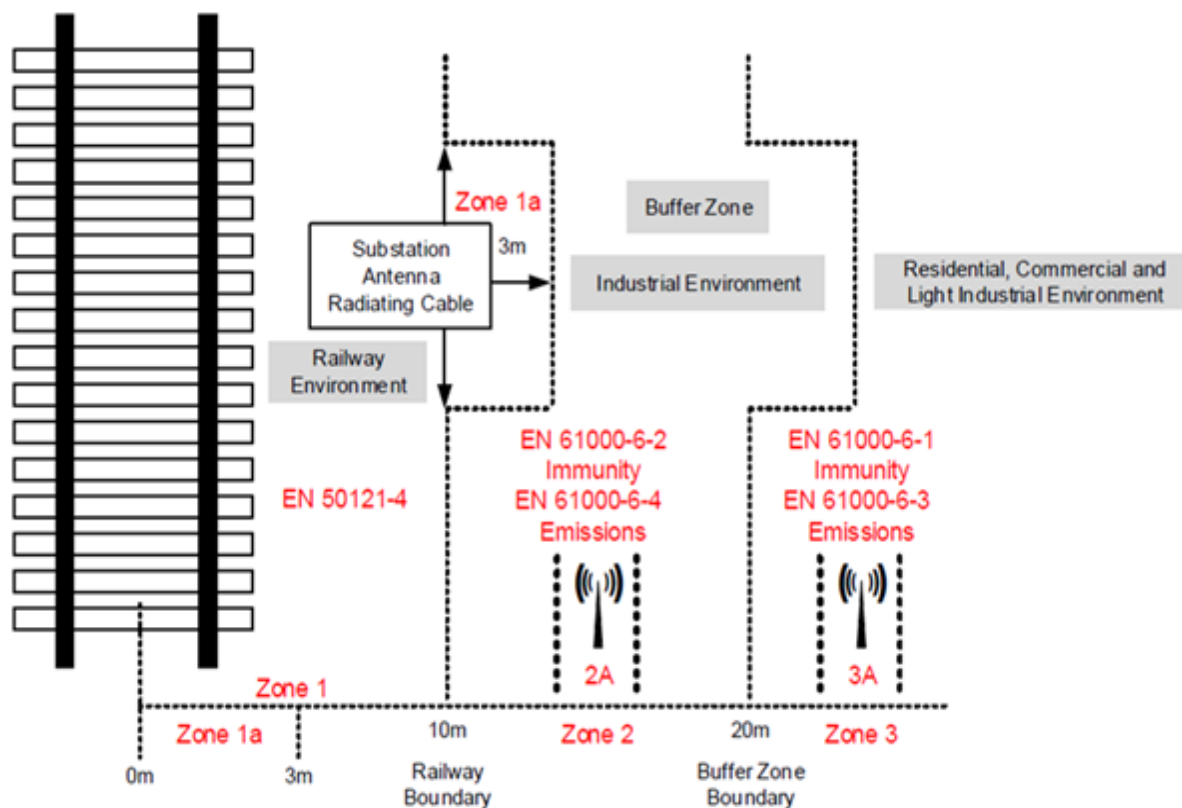


Figure 8: EMC Zoning Concept

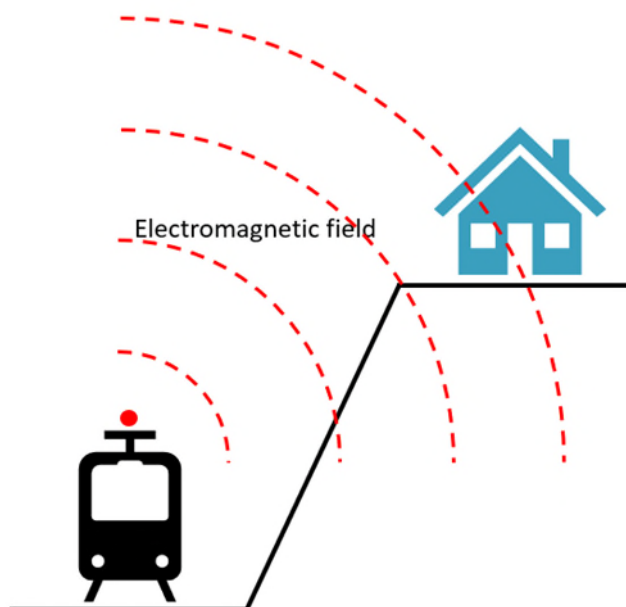


Figure 9: Additional recommended assumption on EM fields to be used during HAZID process

9 EMC HAZID Process

9.1 Introduction to the HAZID process

As an extension of the EMC interface matrix (see Appendix A), a HAZID exercise has been undertaken for RIBA 4 project stage. The process has utilised a combination of technical experience, generic EMC hazards to address possible issues which may arise as per the proposed works.

This EMC HAZID process is one of the most fundamental processes to identify the EMC requirements that should be applied to the systems and sub-systems to ensure electromagnetic compatibility between the equipment and its intended operational environment.

Satisfaction and closure of the EMC hazards which could be met on the project will be achieved:

- By performing a detailed hazard analysis of the Generic Hazards usually met on similar projects.
- All remaining hazards will be transferred to the project risk log which shall then be tracked and closed out throughout the remaining project stages.

9.2 Methodology

At the initial stage of a HAZID assessment, each source of EMI is clearly identified, and EMI threats that these sources pose to each of the possible victim sub-systems shall be carefully considered.

Threats identified are categorised as electromagnetic disturbances which comprise the functionality of the victim sub-system and or safety in some cases. This identification process is achieved by listing all possible EMI sources and all possible items of equipment which are susceptible and assessing the risks of EM incompatibility within the EMC Hazard Matrix.

As the list of equipment is no-exclusive, the equipment identified shall be included within the analysis - irrespective of the equipment's low risk-classification. Utilising the interface matrix, all potential EMI threats are ranked from 1-5 which rationalises the equipment's in need of assessment. The rationalised becomes the basis of the HAZIDs.

The assessment is performed by providing an estimation of both:

- The severity of the hazard
- The likelihood of the hazard

The assessment also considers what electromagnetic disturbances the new and existing sub-system(s) are exposed to as a result of the project. The following questions are derived from the assessment.

- What are the coupling mechanisms
- What are the potential side effects of such disturbances being introduced to the existent sub-system(s)?
- How might emissions emitted by the equipment /system affect other systems (tram systems and neighbouring systems to the tram stop)- both existing and planned under the project?
- What are the safety implications of such effects/disturbances?
- What are the potential economic constraints of such effects/disturbances?
- What level of confidence is required that the above have been fully considered and all actions taken to achieve full compliance and the desired level of safety?

9.3 Hazard Scoring

The scale of evaluation of evaluation used for the classification of severity and likelihood of the potential hazards are shown in Table 11

SEVERITY		LIKELIHOOD		
1	Minor injury, damage, sickness or other loss (with no time off)	1	Very unlikely	< 0.01 per year
2	First Aid injury or illness, minor damage or loss (and/or up to 3 days off) Lost time injury	2	Unlikely	0.01 - 0.10 per year
3	Reportable injury or illness, substantial damage or loss (or over 3 days off)	3	Likely	0.20 - 1 per year
4	Major injury, long term absence	4	Very Likely	2 - 10 per year
5	Fatality, catastrophic damage or loss (Death)	5	Certain	> 10 per year

Table 11: Hazard Evaluation Scale

The global assessment of the EMC hazards utilises the EMC assurance derivation of the risk factor by summing the combined severity and likelihood, as shown in Table 12

Likelihood	5	6	7	8	9	10
	4	5	6	7	8	9
	3	4	5	6	7	8
	2	3	4	5	6	7
	1	2	3	4	5	6
		1	2	3	4	5
	Severity					

Table 12: Evaluation of EMC Hazards

Table 13 illustrates the final acceptance criteria of the EMC Hazards

KEY			ALARP CRITERIA
High	7-10	Hazard must be avoided (or the level of risk reduced significantly and reliably by controls)	Intolerable risk
Moderate	5-6	Hazard should be avoided (or the level of risk reduced significantly and reliably by controls)	Within the ALARP region, but the higher the number the greater the criticality of risk reduction
Low	0-4	Risks to be controlled	Tolerable

Table 13: Acceptance of the EMC Hazards

Any risks identified by the risk assessment between medium – high category would require the implementation of specific control measures to reduce the risk to ALARP.

9.4 Hazard Status

All hazards shall be recorded as one of the following:

- **Open:** Controls, mitigations or actions have been identified that remain open or unverified.
- **Closed:** All identified controls, mitigations and actions have been completed and the hazard is deemed as tolerable.
- **Eliminated:** System design changes have been made or other factors have changed which have eliminated the hazard since it was first identified.
- **Mitigation Identified:** Mitigation strategy is known or identified but some of the implications of the hazard are still persistent throughout additional phases of the project lifecycle.
- **Transferred:** ownership of risk is reassigned to another party during the project lifecycle; for example, maintenance engineers taking ownership of the hazard as part of their Operations and Maintenance procedures.

The categories above may be subject to modification as per any project defined hazard recording process/format.

9.5 Management of Hazards

Hazards identified in the EMC Hazard Log will be transferred to the Project Hazard Log. An identified hazard will be deemed to have been closed once the relevant requirements in the EMC requirements specification have been closed out.

10 Roles and Responsibilities

The following section outlines the designers & contractors' roles and responsibilities for the actions/guidelines stipulated in this EMC assessment for Bury Interchange Metrolink project.

All parties involved have a requirement to:

- Be aware of this EMC Control Plan as well as all documents produced as part of this EMC assessment.
- Showcase a clear understanding of how to achieve compliance within their respective design and the requirements of the EMC Control Plan & EMC strategy.

10.1 Responsibilities for EMC Deliverables

Role	EMC Deliverable
Designers EMC Discipline Lead	EMC Control Plan EMC Strategy EMC Review Report EMC HAZID and Regular review meeting coordination for EMC EMC HAZID Log and implementation record EMC Project File
Systems Integration Manager & Construction Contractor Discipline Lead	Contribute to EMC HAZID workshops Attend EMC Meetings as required by the Designer's EMC Discipline Lead Provide documentary evidence for EMC compliance (DofC, EMC Test Reports, etc.)

Table 14: Table Identifying EMC Deliverables Responsibilities

11 EMC Actions list for the next project stage

11.1 General Actions list

The list of key actions required at RIBA 3 through to RIBA 4, as an output of the HAZID process (RIBA 4) and because of the EMC considerations highlighted at RIBA 3, is stated within the Table Below.

It should be noted that the detailed mitigations, which should be applied to each hazard, will be stipulated within the EMC Hazard log (EMC Generic and Specific HAZID matrices). Also included is an indication of which project stage the design verification will be applied and what will be required to validate that mitigation has been implemented satisfactorily at RIBA 5 and beyond. This would then allow the final close out of the hazard.

Stage	Actions	
RIBA 3/4	Developed/Detailed Design	Action Completed
1.	Undertake an EMC HAZID workshop as per section 9 of this EMC Control Plan	HAZID workshop held on 05/12/2025.
2.	Design the electrification system and earthing & bonding to comply with the requirements of the Earthing and Bonding Strategy produced [Ref 3], ensure M&E design is fully compliant	M&E design package fully co-ordinated with earthing and bonding strategy. No non-compliance
3.	Follow the cable separation recommendations as defined section 7.3 and undertake EMC assessment where required.	Co-ordinated design CMS are compliant with EMC separation distances. Hazards noted and documented in the EMC Hazard log as workshop outcomes – See EMC Hazard Log.
4.	Record all compliance of all systems being introduced in an EMC product list. Ensure that all procured equipment is compliant with the requirements of section 8. Where equipment is not compliant with the above-mentioned requirements, a gap analysis shall be carried out.	EMC register produced as part of EMC Project File.
6.	Update RIBA 3 EMC Control Plan to RIBA 4 EMC Control Plan and Project File.	EMC Control Plan updated to RIBA 4. See RIBA 4 EMC Project File [Ref 5]
RIBA 5	Construction/Testing & Commissioning	Action Completed
7.	Procure E&P equipment to EN 50121-5 and test shortfalls where identified by the compliance gap analysis within the EMC Product List.	
8.	Further detail the verification and Validation programme to ensure EMC related hazards are adequately mitigated.	

9.	Produce Applicable test specifications, test plans and method statements	
10.	Compile EMC checks into appropriate inspection check sheets and carry out inspections and record findings	
11.	Maintain Hazard log and formally close out all EMC hazards following the verification and validation programme.	
12.	Define maintenance requirements within the O&M manual to ensure on-going EMC	
13.	Compile and complete the final EMC Project File.	

Table 15: Project EMC Actions List

12 EMC Methodology – System Design

The process chart below outlines the EMC activities that shall be undertaken by the contracts as part of the design.

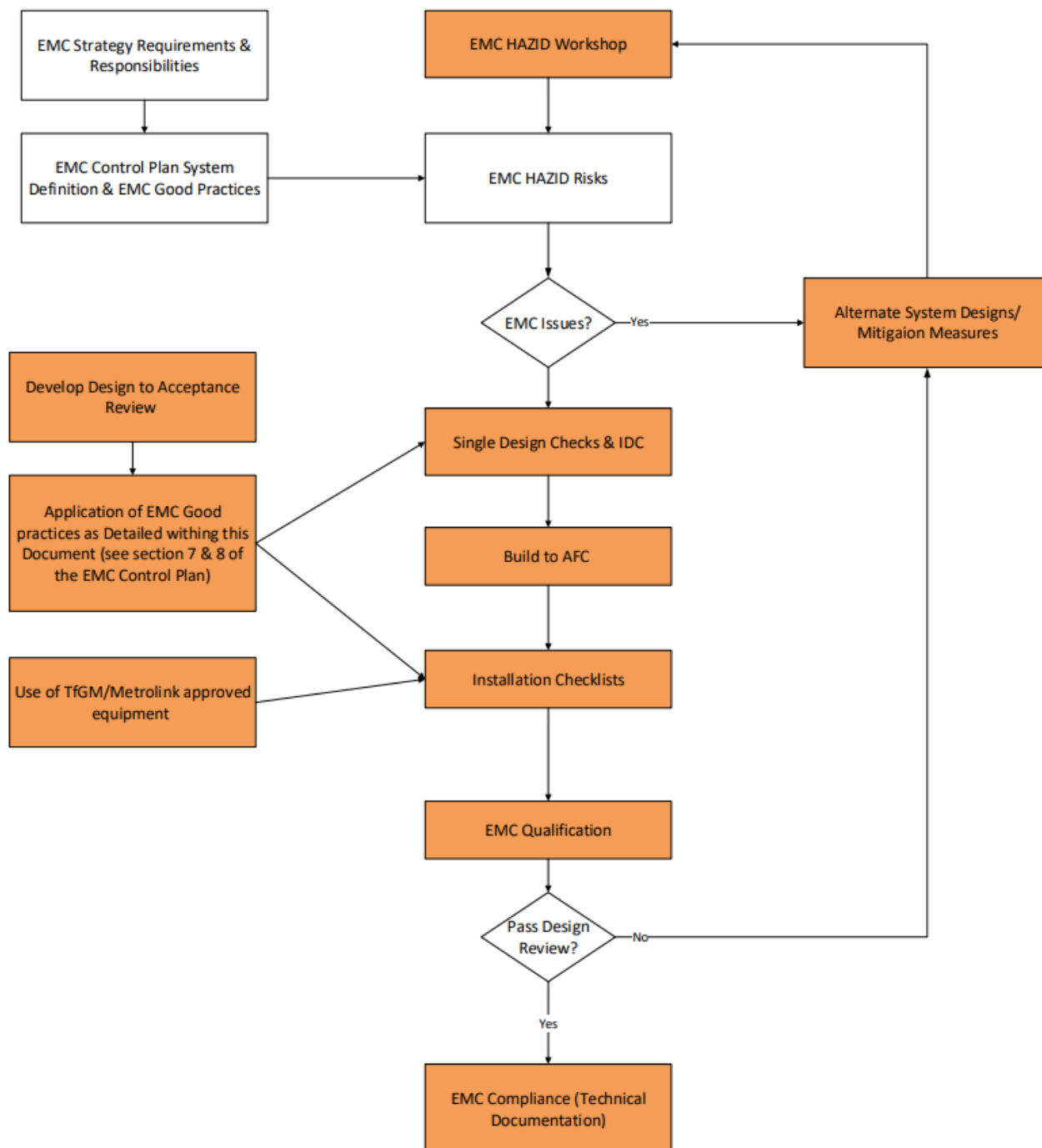


Figure 10: Process Chart - EMC Methodology

13 EMC HAZID Workshop

An EMC HAZID workshop was held on 05/12/2025 for the Bury Interchange – Metrolink Access & Platform Improvement Works. The HAZID briefing note has been appended to this document.

Appendix A

EMC Interface Matrix

The first stage of the Hazard Identification for the EMC assessment is the EMC interface matrix. The matrix considers all probable sources within Bury Interchange boundary, to the equipment installed and/or sources generated externally from third party or neighbouring locations. All systems potentially impacted by the proposed works within and external to Bury Interchange will also be considered as victims.

The interface matrix shown below should be read as follows:

- A “✓” means that there is potentially an EMC interface between a given source and a given victim.
- A “✗” means that no plausible EMI interaction should occur between two systems, either because the equipment is not sensitive to the source of disturbance, or the source of interference is too far from the victim to exceed the immunity test levels required to place the product on the market.

As previously stated, the interface matrix below identifies the potential EMC issues. The Matrix will be used as a source to establish the EMC Hazard Log during the EMC HAZID to be held at RIBA 4 stage.

	DC Traction System (750 V DC OLE)	Bus Station Systems	Protection & Control	CCTV, PA Systems	Signaling Power Supplies	LV DNO, other DNOs	Passenger Information Displays (Platform)	Telecoms FTN, WAN, Copper, SCADA	Radio, Wireless Comms	3 rd Party Radio Stations	Rolling Stock	Lightning Protection	Vertical Transportation (Lifts & Escalators)	PV Array	Fire Protection Control Systems	Staff	Public
DC Traction System (750 V DC OLE)		✗	✓	✓	✓	✓	✓	✓	✓	✓	✓	✗	✓	✓	✓	✓	✓
Bus Station Systems	✗		✗	✓	✗	✗	✗	✗	✓	✗	✗	✗	✗	✗	✓	✓	✓
Protection & Control	✓	✗		✗	✓	✓	✗	✓	✓	✗	✗	✗	✗	✓	✓	✓	✓
CCTV, PA Systems	✓	✓	✗		✓	✗	✗	✓	✗	✗	✓	✗	✗	✗	✓	✗	✗
Signalling Power Supplies	✓	✗	✓	✓		✓	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗
LV DNO, other DNOs	✓	✗	✓	✗	✓		✗	✗	✗	✗	✗	✗	✓	✗	✓	✗	✗
Passenger Information Displays (Platform)	✓	✗	✗	✗	✗	✗		✗	✗	✗	✗	✗	✗	✗	✗	✗	✗
Telecoms FTN, WAN Copper SCADA	✓	✗	✓	✓	✗	✗	✗		✓	✗	✗	✗	✗	✗	✗	✗	✗
Radio Wireless Comms	✓	✗	✗	✗	✗	✗	✗	✓		✗	✗	✗	✗	✗	✗	✗	✗
3 rd Party Radio Stations	✓	✓	✗	✗	✗	✗	✗	✗	✓		✓	✗	✗	✗	✗	✗	✗
Rolling Stock	✓	✗	✗	✓	✗	✗	✗	✗	✓	✗		✗	✗	✗	✗	✗	✗
Lightning Protection	✗	✗	✗	✗	✗	✓	✗	✗	✗	✗	✗		✗	✗	✗	✗	✗
Vertical Transportation (Lifts & Escalators)	✓	✗	✓	✗	✗	✓	✗	✗	✗	✗	✗	✗		✗	✗	✗	✗
PV Array	✓	✗	✓	✗	✗	✓	✗	✗	✗	✗	✗	✗	✗		✗	✗	✗
Fire Protection Control Systems	✓	✓	✓	✓	✗	✓	✗	✗	✗	✗	✗	✗	✗	✗		✗	✗
Staff	✓	✓	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗		✗
Public	✓	✓	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	

Table 16: EMC Interface Matrix

Appendix B

EMC HAZID Workshop Briefing Note

Bury Interchange

EMC HAZID Briefing Note

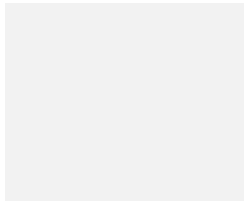
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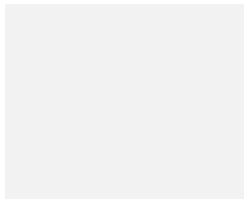
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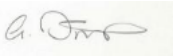
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Bury Interchange MetrolinkBury Interchange

EMC HAZID Briefing NoteEMC HAZID Briefing Note

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P01	28/11/2025	CO	AK	GD	RIBA 4 HAZID Workshop

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1 Abbreviations & Definitions

Table 1: List of Abbreviations

Abbreviation	Terminology
AC	Alternating Current
ALARP	As Low as Reasonably Possible
BS	British Standard
DC	Direct Current
E&P	Electrical & Plant
EMC	Electromagnetic Compatibility
EN	European norm
HV	High Voltage
kV	kiloVolt
LV	Low Voltage
NR	Network Rail

1.1 Definitions

Table 2: List of Definitions

Term	Definition
Risk	The likelihood or probability of an accident if expose to a hazard
Hazard	Any situation or source that has the potential to cause an accident.
Accident	An incident which causes death or injury to passengers, personnel working on the railway, or members of the public.
Incident	An event which, under different circumstances could have resulted in causing harm to people or damage to property.

3 References

Source	Document Title	Document Number
Ref1	Bury Interchange EMC Control Plan	16012-ARC-BRY-ZZZ-T-EC-000002
Ref 2	Bury Interchange EMC Strategy	16012-ARC-BRY-ZZZ-T-EC-000001
Ref 3	Bury Interchange EMC Project File	16012-ARC-BRY-ZZ-T-EP-000004

4 Introduction

4.1 Purpose of this document

This document is the EMC HAZID briefing note for the Bury Interchange project at RIBA 4 to be distributed to participants ahead of the HAZID workshop in the aim of identifying potential EMC risks and providing adequate mitigation for each risk. Its purpose is to define the method to be adopted for performing the hazard identification and risk assessment.

4.2 Scope

The HAZID brief's scope is focused on identifying and addressing potential hazards and risks associated with the EMC aspects of the Bury Interchange. It covers new infrastructure within the project's designated limits, including commercial interfaces that may be affected by EMC requirements. The HAZID brief outlines the necessity for compliance with the EMC strategy & Control Plan, ensuring that design processes and methodologies adhere to EMC directives. It involves a systematic approach to identifying EMC-related hazards and assessing and managing risks throughout various project phases. Additionally, the brief aims to engage relevant stakeholders by distributing the document to participants and facilitating collaborative workshops to foster understanding and proactive risk mitigation.

4.3 Geographical Extents



Figure 1: Geographical View of Bury Interchange Tramstop

The geographical boundaries which are covered by this EMC HAZID consist of the following:

- Bury Interchange Tramstop approximately 9.9 miles 72 chains (15.9 km) from Manchester Victoria on the Metrolink Bury Line.

5 EMC HAZID Workshop Approach

5.1 Objectives

The EMC HAZID workshops will systematically and comprehensively identify the hazards and safety risks associated with EMC in the project. The workshop will be organised via MS Teams as a separate virtual meeting. The EMC CRE or their delegated representative shall plan, organise and chair the EMC HAZID workshop. Arcadis will provide a suitable engineer to support the meeting chair by preparing this document and by acting as a workshop scribe.

This EMC workshop emphasises the identification of new hazards associated specifically with Electromagnetic Compatibility within Bury Interchange Metrolink facility. The proposed design will be reviewed during the HAZID workshop, focusing on those areas that may deviated from existing standards to identify:

- Potential new hazards associated with the Bury Interchange and Rail Systems design caused sources of EMI;
- Mitigation measures that control EMC hazards to an acceptable risk of risk and safety:
- New, novel and complex interfaces that will be identified during the HAZID process e.g. between the end users, systems and sub-systems encompassed by the Tramstop.

5.2 Workshop Participants

For this workshop to be beneficial to the participants in observing the systems, operations and interfaces, the following actions are encouraged:

- Read this EMC brief carefully to become familiar with the workshop process
- Contribute openly and constructively to the workshop to provide an expert insight on how your proposed works may impact the EMC via specific interfaces with sources and victims of a system/sub-system.
- Have supporting information which may further inform the workshop discussions.

The EMC lead (Graham Divers), the workshop chairperson (Chuma Odinye) and workshop scribe (Tim Dunning) can be contacted for any queries (relating to the project and the workshop respectively) as follows:

- Graham.Divers@Arcadis.com
- Chuma.odinye2@arcadis.com
- seyi.sanni@arcadis.com

The workshop participants (as see on the attendance list below) have been selected based on their relevant disciplines potential impact on the existing and proposed EMC environment.

6 Workshop Purpose

This HAZID workshop shall focus on specific changes to the EMC environment within Bury Interchange Metrolink facilities, including both phase 1 and phase 2 proposed works, and any hazard arising from changes to the EMC environment.

Note EMC risks considered as part of this HAZID exercise do not take into account CDM hazards as these will be covered by the project wide designers risk register. Therefore, there is no differentiation between Phase 1 and Phase 2 EMC risks as the Metrolink boundary for Bury Interchange is considered as one environment regardless of the construction sequence.

6.1 Bury Interchange Project Overview

Bury Interchange within Bury town centre is to undergo redevelopment to create a new Transport Interchange and ancillary infrastructure, including improved Metrolink access (temporary and permanent) and platform works ('the Metrolink Access & Platform Improvement Works'), all of which form part of an overall wider development in the location together referred to as Bury Interchange.

Five scheme objectives for the overall redevelopment of Bury Interchange have been developed as follows:

- **Carbon Neutral:** To minimise embodied carbon in construction and deliver an outcome that is carbon neutral in operation in line with local and national targets.
- **Operability:** To enhance safety and operational resilience and provide sufficient capacity to accommodate future transport services.
- **Regeneration and Economic Growth:** To contribute to regeneration and economic growth in Bury Town Centre, including facilitation of commercial development opportunities.
- **Town Centre Integration:** To improve visibility and strengthen connections between Bury Interchange and key town centre locations.
- **User experience and sustainable travel behaviour:** To facilitate an increase in travel by public transport and active modes to, from and around Bury in line with Greater Manchester's 2040 Transport Strategy Right Mix targets and meet customer requirements based on the Network Principles as defined in the Greater Manchester Transport Strategy 2040.

6.2 Discipline Specific Scope of Works

For the analysis of the electromagnetic coupling, the immunity (susceptibility) of devices under threat (victims e.g. track circuits for signalling systems) against known emitters (e.g. traction power, radiated interference sources) have been consolidated in the list of specific disciplines scope of works below based on the sensitive systems/sub-systems interfaces.

6.2.1 Mechanical & Electrical

A summary of the proposed M&E works is shown below as follows:

6.2.1.1 LV Distribution

The proposed LV distribution at Bury Interchange consists of the following:

- A new 18-way TP&N 630 A panel board
 - DB1 (Split metered L&P) serving the Tram Stop lighting & power
 - Change Over Switch (supplying DB2 and existing SER General Purpose DB)

- Southern Access Evacuation Lift 1 primary supply via life safety Automatic Transfer Switch (ATS)
 - DB3 for Lighting and Small Power of the Southern Access Footbridge
 - Northern Access Escalator (Phase 2)
 - Northern Access Lift 2 (Phase 2)
 - Northern Access Lift 1 (Phase 2)
 - DB4 (Split metered L&P) serving the Northern Staff Accommodation (Phase 2)
 - Photovoltaic Array (Phase 2)
 - Fire Alarm PA/VA Fire Alarm Panel
 - DB5 Union Square Feeder Pillar
 - DB6 Pyramid Park Feeder Pillar
- For the sub distribution, a new 8+8-way TP&N 125 A distribution board

6.2.1.2 Photovoltaic Array

- New PV array to be installed at the Interchange Vertical Circulation Roof level

6.2.1.3 Lighting

Lighting related proposed works are listed as follows:

- New platform standalone lighting fittings – for the canopy area
- New platform 5m heavy duty flange plate mounted raise and lower lighting column
- Pyramid Park Lighting – Proposed illuminated ‘flag’ at the footbridge entrance, additional lighting for the walkway
- Union Square Lighting – Proposed illuminated ‘flag’ at the footbridge entrance, additional lighting for the walkway

6.2.1.4 Cable Management System

There are proposed additions to the existing platform canopy level cable management system., this will be carried out via a combination of high-level compartment trunking, cable tray and buried duct system. New high level compartment trunking within platform canopy to facilitate the supply for the lighting and small power mounted on the canopy structure.

- New cable tray for the fire alarm system power supply.
- Below ground ducting and cable tray for the new submain cables
- Fully co-ordinated CMS for proposed Telecoms SISS

6.2.1.5 Fire Control System

The new fire alarm system features the following additions:

- New 4 loop addressable fire alarm panel (Fed by the proposed 18-way TP&N Panel board ‘PB-1’ installed within the Metrolink Electrical Plant Room (EPR)
- Interface with the proposed vertical circulation & bus interchange fire alarm system

6.2.2 Signalling

Hitachi is the lead signalling designer for the Bury Interchange works and will be responsible for ensuring the safe implementation of the signalling changes. However, the signalling interfaces with all other elements of the works, as detailed in this document, will still be subject to this workshop to ensure that potential hazards are identified and appropriately managed and/or transferred.

6.2.3 Telecoms

A summary of the proposed SISS Telecommunications Systems works is shown below as follows:

- Video Surveillance System (VSS) – replacing the existing CCTV cameras on the existing Platform canopy with new Dome CCTV cameras (on the new proposed platform canopy) to provide complete CCTV coverage of the Platform areas
- Public Address (PA) System – relocating the existing back-to-back integrated Horn PA speakers on the existing Platform canopy along with new PA Horn speakers (supported by additional PA Amplifiers) to provide complete PA coverage of the Platform areas
- Customer Information System (CIS) – existing Passenger Information Displays underneath the existing station canopies to be relocated underneath the new proposed platform canopy in addition to new multiple Passenger Information Displays along the platforms
- Passenger Emergency Call-Point – replacing the existing Call-point at the platform with new Call-points which are to be installed on posts located at the platform areas
- Emergency Voice Communication (EVC) System – new EVC Call point (Type-B Outstation) at the designated Refuge point associated with the platform area
- Third-Party Assets (Ticket Vending Machines and Smart Ticket Validators) – CAT6 cabling for any data connectivity requirement of the assets
- SISS Telecommunication Cabinets – new headend equipment to support proposed SISS Telecommunications Systems
- SISS Telecommunication Systems cabling – new CAT6/multi-pair copper cabling to support new/relocated SISS Telecommunication assets in the platform

6.2.4 OLE

The OLE scope of works involves changes to the existing OLE arrangements to accommodate the design of the Southern Access with the proposed footbridge. This also involves changes to the current anchoring positions to align with both the buffer stop positioning and also ensuring the OLE clearances to the platform, canopies and overbridges are maintained.

For the purpose of this EMC HAZID workshop the OLE is considered to be the main source of EMI due to the EMF generated along the transmission line as well as the transients caused by the switching of the onboard rectifiers as the rolling stock draws current from the electrification system, induced coupling occurs to lineside electronic systems which may be susceptible to electromagnetic interference (EMI) and connected copper cables and other CSS systems for example.

7 EMC HAZID Workshop Methodology

An overview of the project, design and scope of works will be presented at the start of the meeting. The workshop chairperson will provide an introduction into the scope of the EMC HAZID workshop, the methodology employed and the expected outcomes.

7.1 EMC HAZID Identification Process

To carry out the HAZID assessment, each source of EMI shall be identified (whether it is a generic source commonly met on DC electrification projects, or a source specific to the project), and the EMI threats that the sources pose to each of the possible victim's sub-systems considered.

Threats in this context are defined as electromagnetic disturbances which compromise the functionality of the victim sub-systems and/or safety.

This is achieved by listing all possible EMI sources and all possible items of equipment under threat and assessing the risks of EM incompatibility within one EMC Hazard matrix.

It is important to note this is a o-exhaustive list and all identified items of equipment shall be included with the analysis even if it is assumed that some of these items of equipment will result in a low-risk classification

An initial interface matrix has been constructed, along with a ranking of the potential threats due to EMI ranging from 1-5, to rationalise the equipment that needs assessment. The rationalised list will then form a basis of all HAZID activities.

The scale used for this evaluation during the EMC HAZID workshop is shown below in Table 3

Table 3: Hazards and Evaluation Scale

SEVERITY		LIKELIHOOD		
1	Minor injury, damage, sickness or other loss (with no time off)	1	Very Likely	<0.01 per year
2	First Aid injury or illness, minor damage or loss (and/or up to 3 days off) Lost time injury	2	Unlikely	0.01-0.10 per year
3	Reportable injury or illness, substantial damage or loss (over 3 days off)	3	Likely	0.20-1 per year
4	Major Injury, long term absence	4	Very Likely	2-10 per year
5	Fatality, catastrophic damage or loss (Death)	5	Certain	> 10 per year

Below are the final acceptance criteria of the EMC Hazards.

Table 4: Evaluation of EMC Hazards

Likelihood	5	6	7	8	9	10
	4	5	6	7	8	9
	3	4	5	6	7	8
	2	3	4	5	6	7
	1	2	3	4	5	6
		1	2	3	4	5
Severity						

Below shows the final acceptance criteria of the EMC Hazards

Table 5: Acceptance of EMC Hazards

Key	Scoring	Description	ALARP CRITERIA
High	7-10	Hazard must be avoided (or the level of risk reduced significantly and reliably by controls)	Intolerable risk
Moderate	5-6	Hazard should be avoided (or the level of risk reduced significantly and reliably by controls)	Within the ALARP region, but the higher the number the greater the criticality of risk reduction
Low	0-4	Risks to be controlled	Tolerable

Any risks identified by the risk assessment to be in the medium – high category would require implementation of specific control measures by the risk owner, to reduce the risk to ALARP.

The assessment is performed by providing an estimation of both:

- The severity of the hazard.
- The likelihood of the hazard event.

The assessment considers what electromagnetic disturbances the ‘new’ and existing sub-systems /systems might be exposed to, as a result of the Bury Interchange renewal project – such subsidiary questions may arise:

- What are the potential effects of such disturbances on the system?
- How might emissions emitted by the equipment / systems affect other 3rd party infrastructure (Railway systems and near neighbours)?
- What are the potential safety implications of such effects / disturbances?
- What are potential business implications of such effects / disturbances?
- What level of confidence is required that the above have been fully considered and all actions have been taken to keep risks to ALARP?

7.2 EMC Interface Matrix

The first stage of the Hazard Identification for the EMC assessment is the EMC interface matrix. The matrix considers all probable sources within Bury Interchange boundary, to the equipment installed and/or sources generated externally from third party or neighbouring locations. All systems potentially impacted by the proposed works within and external to Bury Interchange will also be considered as victims.

The interface matrix shown below should be read as follows:

- A “✓” means that there is potentially an EMC interface between a given source and a given victim.
- A “✗” means that no plausible EMI interaction should occur between two systems, either because the equipment is not sensitive to the source of disturbance, or the source of interference is too far from the victim to exceed the immunity test levels required to place the product on the market.

	DC Traction System (750 V DC OLE)	Bus Station Systems	Protection & Control	CCTV, PA Systems	Signaling Power Supplies	LV DNO, other DNOs	Passenger Information Displays (Platform)	Telecoms FTN, WAN, Copper, SCADA	Radio, Wireless Comms	3 rd Party Radio Stations	Rolling Stock	Lightning Protection	Vertical Transportation (Lifts & Escalators)	PV Array	Fire Protection Control Systems	Staff	Public
DC Traction System (750 V DC OLE)		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Bus Station Systems	✓		✗	✓	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗
Protection & Control	✓	✗		✗	✓	✓	✗	✓	✓	✗	✗	✗	✗	✓	✓	✓	✓
CCTV, PA Systems	✓	✓	✗		✓	✗	✗	✓	✗	✗	✗	✗	✗	✗	✗	✗	✗
Signalling Power Supplies	✓	✗	✓	✓		✓	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗
LV DNO, other DNOs	✓	✗	✓	✗	✓		✗	✗	✗	✗	✗	✗	✓	✓	✗	✗	✗
Passenger Information Displays (Platform)	✓	✗	✗	✗	✗	✗		✗	✗	✗	✗	✗	✗	✗	✗	✗	✗
Telecoms FTN, WAN Copper SCADA	✓	✗	✓	✓	✗	✗	✗		✗	✗	✗	✗	✗	✗	✗	✗	✗
Radio Wireless Comms	✓	✗	✗	✗	✗	✗	✗	✗		✗	✗	✗	✗	✗	✗	✗	✗
3 rd Party Radio Stations	✓	✗	✗	✗	✗	✗	✗	✗	✓		✗	✗	✗	✗	✗	✗	✗
Rolling Stock	✓	✗	✗	✗	✗	✗	✗	✗	✗	✗		✗	✗	✗	✗	✗	✗
Lightning Protection	✓	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗		✗	✓	✗	✗	✗
Vertical Transportation (Lifts & Escalators)	✓	✗	✓	✗	✗	✓	✗	✗	✗	✗	✗	✗		✗	✗	✗	✗
PV Array	✓	✗	✓	✗	✗	✓	✗	✗	✗	✗	✗	✗	✗		✗	✗	✗
Fire Protection Control Systems	✓	✗	✓	✓	✓	✓	✗	✗	✗	✗	✗	✗	✗	✗		✗	✗
Staff	✓	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗		✗
Public	✓	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	

8 EMC HAZID Workshop Details

This section will outline the EMC HAZID workshop schedule and agenda. Please note that the time slot presented below are indicative and subject to variation on the day.

8.1 EMC HAZID Workshop

Table 6: Meeting Arrangements

EMC HAZID Workshop	
Date	05/12/25
Time	9:30 am
Location	Via MS Teams

Table 7: Workshop Agenda

Time	Activity
09:30 – 10:00	• Welcome and Introductions. • Project overview and status • EMC Brief for Declaration of Conformity • Workshop ground rules • Scope, methodology and expected outcomes
10:00 – 11:00	Session 1 – EMC Hazard Identification – (EMC Hazard Log)
11:00 – 11:10	Break (10 mins)
11:10 – 12:10	Session 2 – EMC Hazard Identification – (EMC HAZID Matrix)
12:10 – 12:30	Close out

8.2 EMC HAZID Workshop Output

The output from the EMX HAZID workshop will be included to the project hazard records, including any follow-up actions raised in order to close out hazards. Hazard record management may require additional follow-up sessions with the hazard owner and discipline leads during this stage of the project.

8.3 Relevant Standards and Regulations

This HAZID session shall fulfil the requirements of NR/L2/RSE/30041, section 15 with respects to the Hazard Identification. Once all hazards relating to the project have been identified and risk ranked; high priority risks shall be entered into the project hazard record.

EMC HAZID Participants

Name	Company	Role	Signature
Chuma Odinye	Arcadis	E&P Design Engineer	
Graham Divers	Arcadis	EMC CRE	
Seyi Sanni	Arcadis	E&P Engineer	
Joey Clark	Arcadis	M&E Lead	
Souvik Banerjee	Arcadis	Telecoms Lead	
Thomas Nicholas	Arcadis	OLE Lead	
Piotr Stencel	Arcadis	Associate Project Manager	
Alex Littlewood	Arcadis	Design Manger	
Latifah Meadowcroft	Willmott Dixon	Principle Design Manager	
Max Bryan	Futureserve	M&E Lead (Non-Linside)	
Jesus Gil	OFR Consultants	Fire Engineer	
Adam Turner	OFR Consultants	Fire Engineer	
Sooyash Dosonyee	Nextec Engineering	Safety Engineer	
Chris Lee	Nextec Engineering	Safety Engineer	

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Appendix C

EMC Hazard Log

RISK DEFINITION										RATING			MITIGATION			RATING			RISK MANAGEMENT		
Ref ID	Hazard Type	Hazard Owner	Source	Victim	EMC Hazard Description	Consequence	Primary Bus objective	Comments (From HAZID Workshop)	ROGS Significant?	SEVERITY	LIKELIHOOD	RISK	Mitigation Action	SEVERITY	LIKELIHOOD	RISK	Applicable Standards	Design Hazard Open/Close	Closure Comment & Evidence		
1	EMC	Transport for Greater Manchester (TfGM) Greater Manchester Combined Authority (GMCA)	DC Traction System (OLE- Increased Traffic)	Lineside Cables (Telecoms/signalling)	Any future traffic capacity improvement may increase the induction between any energised and non-energised cales. Long parallel runs increased magnetic coupling into unshielded or poorly bonded cables. Common mode noise enters via equipment I/O, power or reference conductors. Degradation of Signal to Noise ratio of radio communications	Radio Communication Disruption, Data loss or corruption & Compromised Safety Reliability	SAFETY	Potential for a 3rd platform - Currently a passive provision included as part of this project. Headroom for Bury line unlikely to change, no increased traffic. TMS to be reviewed again once third platform is constructed. This is will require a revaluation of all EMC related activities. Cable length will be kept within 90 m.(CAT6 Cu Cable)	YES	5	2	7	Increase cable segregation, use orthogonal crossings and dedicated S&T CMS especially in congested areas. Check that the EMC good practices recommended within the EMC Control Plan (16012-ARC-BRY-ZZZ-T-EC-000002) have been applied during the design and installation phases – EMC Action list within the EMC Project File . Circuit lengths must be kept to permitted limits: •Cable lengths should not exceed 1 km and Return Screen Conductor installed in cable troughs •Spacing between HV and sensitive class A & B cables as detailed in the EMC Control Plan as per BS IEC 61000-5-2 and BS EN 50174-2. •Check that the EMC good practices recommended within the EMC Control Plan (16012-ARC-BRY-ZZZ-T-EC-000002) have been applied during the design and installation phases – EMC Action list within the EMC Project File. •Ensure equipment has Declaration of Conformity EMC Certificates •Undertake specific induced voltages calculations for S&T cables longer than 1 km.	5	1	6	BS EN 50238-3: Railway applications. Compatibility between rolling stock and train detection systems - Compatibility with axle counters BS EN 50121-4: Electromagnetic compatibility - Emission and immunity of the signalling and telecommunications apparatus BS EN 50121-5: Railway applications. Electromagnetic compatibility - Emission and immunity of fixed power supply installations and apparatus IEC 61643: Low-voltage surge protective devices - General Requirements and test methods BS IEC 61000-5-2: Electromagnetic compatibility (EMC). Installation and mitigation guidelines - Earthing and cabling BS EN 50174-2: Information technology. Cabling installation - Installation planning and practices inside buildings	CLOSED	No cable runs exceed 1km as part of the Telecoms Design. EMC Project File includes the EMC documentation for Telecoms equipment. Risk to calculated as per Gap Analysis scoring. 300x50 mm cable try for LV and 600x50 mm cable tray for Telecoms Services mounted to the front wall of the platform void with 100 mm clearance. See Bury Tram Stop Below Platform CMS: 16012-ARC-BRY-ZZZ-T-EP-000001.		
2	EMC	Transport for Greater Manchester (TfGM)	DC Traction System (OLE)	Third Party Telecommunications	Electrical Noise on station and neighbouring telecommunications circuits: •Analogue phone lines •GSM cell towers	Reputational Issues	PERFORMANCE	Annual EMC Baseline Testing conducted Theres no existing information on the location of 3rd-party comms. As Source the source DC - Immunisation testing should've been carried out prior to Tramstop commission. Additional 3rd-party infrastructure should've been subjected to a full EMC assessment.	YES	3	3	6	Third party telecommunications towers and landlines to be identified as being at risk during surveys (RIBA 5) TfGM to liaise with the owners.	3	1	4	BS IEC 61000-5-2: Electromagnetic compatibility (EMC). Installation and mitigation guidelines - Earthing and cabling BS EN 61000-6-4: Electromagnetic compatibility (EMC) - Generic standards. Emission standard for industrial environments BS EN 50174-2: Information technology. Cabling installation - Installation planning and practices inside buildings BS EN 50121-2:2017: Railway applications. Electromagnetic compatibility - Emission of the whole railway system to the outside world	CLOSED	Theres no existing information on location of 3rd-party comms. Source is DC - Immunisation testing should've been carried out prior to Tramstop commission. Additional 3rd-party infrastructure should've been subjected to a full EMC assessment. TfGM to provide results from annual EMC Baseline Testing as well as any desktop survey's conducted as part of this assessment. Refer to Actions No.5 in the EMC HAZID Workshop Output Report: 16012-ARC-BRY-ZZ-T-EC-000005.		
3	EMC	Transport for Greater Manchester (TfGM)	DC Traction System (OLE)	Station Fire Alarm System (FAS)	Arcing generated at the pantographs of switching operations through inverters and rectifiers generate large transient currents.	False Alarms due to induced voltages/noise Missed or delayed alarms if signals are corrupted.	PERFORMANCE / SAFETY	Fire Alarm cabling to run on its own dedicated cable tray before terminating at the proposed Fire Alarm Panel within the proposed Metrolink Electrical Room 9-Way Multiduct System	YES	5	3	8	keep FAS cables out of trackside verge; cross at 90°, maintain ≥300-500 mm separation; metal segregation in shared ducts.	5	1	6	BS EN 50121-2:2017: Railway applications. Electromagnetic compatibility - Emission of the whole railway system to the outside world	CLOSED	Dedicated 50x25mm fire alarm tray mounted on the soffit, 2850mm above platform level - Segregation at void area to be detailed at RIBA 5 - Add reference to drawing: 16012-ARC-BRY-CNY-D-EE-000007 & 16012-ARC-BRY-TRK-D-EE-000011.		
4	EMC	Transport for Greater Manchester (TfGM)	DC Traction System (OLE)	3 rd party radio and Police/Fire TETRA communication system	Nuisance to 3rd party telecommunications systems that are used for safety/public security purposes	Reputational Issues	PERFORMANCE / SAFETY		YES	3	4	7	Cable routing to be designed to prevent excessive noise as per the recommendations of the EMC Control Plan (16012-ARC-BRY-ZZZ-T-EC-000002). Equipment must show evidence of conformity to ensure emission levels are compliant to BS EN 50121-2:2017. Third party telecommunications towers and landlines to be identified as being at risk during surveys (RIBA 5)	3	3	6	BS EN 61000-6-2: Electromagnetic compatibility (EMC) - Generic standards. Immunity standard for industrial environments. BS EN 50121-2:2017: Railway applications. Electromagnetic compatibility - Emission of the whole railway system to the outside world	CLOSED	Theres no existing information on location of 3rd-party comms. Source is DC - Immunisation testing should've been carried out prior to Tramstop commission. Additional 3rd-party infrastructure should've been subjected to a full EMC assessment. TfGM to provide results from annual EMC Baseline Testing as well as any desktop survey's conducted as part of this assessment. Refer to Actions No.5 in the EMC HAZID Workshop Output Report: 16012-ARC-BRY-ZZ-T-EC-000005.		
5	E&B	Transport for Greater Manchester (TfGM)	DC Traction System (OLE)	Lineside Conductors (e.g. long fences)	Higher Induction levels to long (> 1km) conductors	Risk of Electric Shock	SAFETY		YES	3	2	5	E&B Design in accordance with ITS 3003 & BS EN 50122-1/2. Lengths of other conductors to be minimised as much as possible, using appropriate segregation	3	1	4	ITS 3003: Earthing & Bonding BS EN 50122-1: Fixed installations for railway applications. Electrical safety, earthing and the return circuit - Protective provisions against electric shock BS EN 50122-2: Railway applications. Fixed installations. Electrical safety, earthing and the return circuit - Provisions against the effects of stray currents caused by DC traction systems BS EN 61140: Protection against electric shock. Common aspects for installation and equipment.	CLOSED	End of platform gates/fence/handrail which are within the OCLZ and exceed small conductive parts dimensions shall be of non-conducting material. Earthing & Bonding implemented as in the Bury Interchange Earthing & Bonding Strategy: 16012-ARC-BRY-ZZZ-T-EP-000001.		
6	EMC	M&E - Bridge and Tramstop	LV Distribution	Rail Systems Comms and Rad-Rail Systems Communications	LV circuits interfere with rail system communication.	Noise in the communication system, may cause data change. However, it will not be a direct safety hazard.	PERFORMANCE	Existing cables are currently lying unsecured within the platform void, resting on the floor with no support. No surveys appear to have been undertaken to confirm their condition. This environment is already compromised from an EMC perspective.	YES	2	3	5	LV cables and communication cables are completely segregated. There are dedicated risers, cables trays with minimum separation according to BS 7671	2	2	4	BS EN 50121-4: Electromagnetic compatibility - Emission and immunity of the signalling and telecommunications apparatus	CLOSED	300x50 mm cable try for LV and 600x50 mm cable tray for Telecoms Services mounted to the front wall of the platform void with 100 mm clearance. See Bury Tram Stop Below Platform CMS: 16012-ARC-BRY-ZZZ-T-EP-000001.		

7	EMC	M&E - Bridge and Tramstop	LV Distribution	Station Fire Alarm System (FAS)	LV system interferes with fire alarm panels	Disrupt the signals, loss of data. Missed or delayed alarms if signals are corrupted.	PERFORMANCE / SAFETY	Fire Alarm cabling to run on its own dedicated cable tray before terminating at the proposed Fire Alarm Panel within the proposed Metrolink Electrical Room	YES	5	3	8	LV cables and fire circuits are segregated. Use dry contacts / voltage free contacts. Use approved and EMC compliant products (DoC)	5	2	7	BS EN 50121-4: Electromagnetic compatibility - Emission and immunity of the signalling and telecommunications apparatus	CLOSED	Dedicated 50x25mm fire alarm tray mounted on the soft 2850mm above platform level - Segregation at void area to be detailed at RIBA 5 - Add reference to drawing: 16012-ARC-BRY-CNY-D-EE-000010 & 16012-ARC-BRY-TRK-D-EE-000011. EMC Project File includes the EMC documentation for M&E equipment. Risk to calculated as per Gap Analysis scoring. M&E Fire Alarm Control System shows evidence of Dry Contact, ensuring no power is supplied by the switch . Allowing control circuits to be unaffected by LV- distribution circuit. See Bury Tram Stop Platform Fire Alarm Schematic: 16012-ARC-BRY-PFM-D-EE-000004.
8	EMC	M&E - Bridge and Tramstop	LV Distribution	Station SISS	LV system interferes with CCTV system	Loss of Service Lack of security coverage	PERFORMANCE / SAFETY	Passenger emergency call points will have a fire interface unit located in an IP-rated box positioned close to the individual PEC. From each fire interface unit, an individual cable will run back to the system	YES	5	3	8	Separation and segregation of cable routes. CCTV system is IP based, circuits surge protected. Cables are fully shielded CAT6 cable for CCTV and for IP network	5	1	6	BS EN 61000-6-4:Electromagnetic compatibility (EMC) - Generic standards. Emission standard for industrial environment BS EN 61000-6-2:Electromagnetic compatibility (EMC) - Generic standards. Immunity standard for industrial environments	CLOSED	PEC cable as part of the PHP is segregated from the LV distribution in segregated CMS. 2x20 mm conduit providing segregation for power and data cables. Reference from LV CMS layout 16012-ARC-BRY-TRK-D-EE-000011 & 16012-ARC-BRY-TRK-D-EE-000007. Network switch has integrated max power draw for each port (15W) as per UPS design. Current design scope does not include SPD due to assessment of LPS as the comms equipment is mounted on the canopy. Shielded twisted pair - especially for long range cabling. CAT 6A cables are being used in the telecoms system: Refer to Telecoms RIBA 4 Report: 16012-ARC-BRY-ZZZ-T-TC-400010
9	EMC	M&E - Bridge and Tramstop	LV Distribution	Station - AFILS	LV cable interfering with the hearing loop via Inductive/capacitive coupling & harmonic interference.	Affects PHP systems and Passengers with Hearing impairment using hearing aids Loss of service, noise in the systems. Safety risks: to be operational in emergency scenario	PERFORMANCE		YES	4	3	7	Separation and segregation of LV cables from the AFILS Use approved and EMC compliant products (DoC) Shielded cables where LV cables are in areas close to AFILS system.	4	2	6	BS EN IEC 60118-4: Electroacoustics. Hearing aids - Induction-loop systems for hearing aid purposes. System performance requirements	CLOSED	Separation and segregation of LV cables from the AFILS.2x20mm conduit providing segregation for power and data cables. Reference from LV CMS layout 16012-ARC-BRY-TRK-D-EE-000011 & 16012-ARC-BRY-TRK-D-EE-000007. EMC Project File:16012-ARC-BRY-ZZZ-T-EC-000003 includes the EMC documentation for Telecoms Equipment. Risk calculated as per Gap Analysis scoring. Telecoms uses shielded twisted pair cabling for added rust protection. Not Foil twisted pairs (FTP) for the CAT6A cabling. Refer to the Telecoms RIBA 4 report:16012-ARC-BRY-ZZZ-T-TC-400010
10	EMC	M&E - Bridge and Tramstop	LV Distribution	Station-PA	LV cables may interfere with comms circuits of the PA system	Loss of service, noise in the systems. Safety risks as the PA system to be operational in emergency scenario	PERFORMANCE / SAFETY		YES	4	3	7	Separation and segregation of cable routes. Use approved and EMC Compliant Equipment for PA system. 2 pairs of Copper Cable for the PA System	4	2	6	BS EN 50121-4: Electromagnetic compatibility - Emission and immunity of the signalling and telecommunications apparatus	CLOSED	2x20mm conduit providing segregation for power and data cables. Reference from LV CMS layout 16012-ARC-BRY-TRK-D-EE-000011 & 16012-ARC-BRY-TRK-D-EE-000007. EMC Project File:16012-ARC-BRY-ZZZ-T-EC-000003 includes the EMC documentation for Telecoms Equipment. Risk to calculated as per Gap Analysis scoring.
11	EMC	M&E - Bridge and Tramstop	LV Distribution	Signalling-Signalling through circuit cables	LV cables may interfere with Signalling circuits, in the same trench with different conduits.	False operation of Train System causing Wrong Side or Right Side Failure affecting safety and reliability. Tram Delays	SAFETY	Hitachi signalling is engaged directly by TFGM. Meeting notes will need to be shared with TFGM so that they can pass them to Hitachi. Additional workshops may be required for hazards that cannot be mitigated or designed out at this stage. Full coordination with Hitachi will be needed once their involvement increases. The team currently has no detailed information on the existing signalling circuits, but this hazard will still be included in the Hazard Log. A question was raised about whether any LV trunking or	YES	5	3	8	Provide separation and segregation between LV and signalling according to BS 50121-4	5	2	7	BS EN 50121-4: Electromagnetic compatibility - Emission and immunity of the signalling and telecommunications apparatus	OPEN	600mm cable has been provided to support the signalling cables within the platform area. Signalling scope of works to incorporate the movement of signalling cables to the dedicated cable tray as part of RIBA 5 works. Risk to remain open until completion of works.
12	EMC	3rd Party/TIGM (Transport for Greater Manchester)	3 rd Party Equipment/Operations	Railway/Station Systems	"Malfunction of the railway and station equipment due to the operation of 3rd party systems such as: - Laboratories - Power systems - Airports - etc."	Maloperation of Equipment and Possible delays of Trams	PERFORMANCE		YES	3	3	6	Desktop study has been carried out to identify 3rd party potential sources of EMI, no 3rd party equipment has been identified Coordinate with asset owners where required. Follow EMC good practices and follow EMC standards, as set out in project EMC strategy	3	2	5	BS EN 61000-6-2:Electromagnetic compatibility (EMC) - Generic standards. Immunity standard for industrial environments. BS EN 61000-6-4:Electromagnetic compatibility (EMC) - Generic standards. Emission standard for industrial environments.	CLOSED	Theres no existing information on location of 3rd-party comms. Source is DC - Immunisation testing should've been carried out prior to Tramstop commission. Additional 3rd-party infrastructure should've been subjected to a full EMC assessment. TIGM to provide results from annual EMC Baseline Testing as well as any desktop survey's conducted as part of this assessment. Refer to Actions No.5 in the EMC HAZID Workshop Output Report: 16012-ARC-BRY-ZZ-T-EC-000005.

13	EMC	M&E - Bridge	Lift Motors Drives	Station Systems	Lifts powered by electric motors controlled by variable frequency drives (VFDs) or inverters which can generate high levels of EMI, interfering with sensitive station equipment	Maloperation of Equipment and Possible delays of Trams	PERFORMANCE		YES	3	3	6	Ensure EMI filter is present in the motor drives to minimise conducted EMI.	3	2	5	BS EN 61000-6-3: Adjustable speed electrical power drive systems - EMC requirements and specific test methods for PDS and machine tools. BS EN 61000-6-2: Electromagnetic compatibility (EMC) - Generic standards. Immunity standard for industrial environments. BS EN 61000-6-4: Electromagnetic compatibility (EMC) - Generic standards. Emission standard for industrial environments.	OPEN	KONE lifts are designed to EN 12015 for electromagnetic Emissions & EN 12016 for electromagnetic immunity. Modern KONE drives such as the VSF25 utilise specific modules such as KN780180G01 which are designed to handle high-power filtration (up to 22 kV/ 40 A). These drives help to prevent HF noise generated by the VFDs from entering into the station systems via LV distribution network. There is currently no specification for the lift to be installed at Bury Interchange. Hazard to be closed out once available at RIBA 5.
14	EMC	M&E - Bridge	Lift power & control cables	Station Systems	Power and control cables can act as an antenna, radiating EMI that can disrupt the operation of station systems, greatly impacting those in the closest vicinity.	Maloperation of Equipment and Possible delays of Trams	PERFORMANCE		YES	3	3	6	Control and Power cables for the lift must be shielded and routed adequately as per BS 7671 & BS EN 50121-1.	3	2	5	BS 7671: Requirements for Electrical Installations. IET Wiring Regulations BS EN 50310: Telecommunications bonding networks for buildings and other structures BS EN 50121-4: Electromagnetic compatibility - Emission and immunity of the signalling and telecommunications apparatus BS EN 50121-2: Railway applications. Electromagnetic compatibility - Emission of the whole railway system to the outside world Tolerable	OPEN	An assumption has been made that the cables utilised for motor power (which contain HF noise from the VFD) are shielded. There is currently no specification for the lift to be installed at Bury Interchange. Whilst it is expected, it cannot be proven that lifts are designed to railway specific standards such as BS EN 50121-1 until Declaration of Conformity certification is made available. Hazard to be closed out once available at RIBA 5.
15	EMC	M&E - Bridge	Lift Control Systems	LV/Distribution	The lift control system, including the micro-processors and communication devices can emit EMI noise which can potentially induce coupling into the power supply cabling, leading to harmonic distortion and voltage irregularity.	Harmonic Distortion of Power Supply Voltage Fluctuations and Transients	PERFORMANCE		YES	2	3	5	Install harmonic filters for lift supplies as well as SPDs (Surge Protection Devices) for LV distribution.	2	2	4	BS EN 61543-11: Low-voltage surge protective devices - Surge protective devices connected to low-voltage power systems. Requirements and test methods. BS EN 61000-3-12: Electromagnetic compatibility (EMC) - Limits. Limits for harmonic currents produced by equipment connected to public low-voltage systems with input current > 16 A & ≤ 75 A per phase.	CLOSED	Transient Over-Voltage protection is provided in accordance with BS EN 62305-4. Consisting of a combination of Type 1 & 2 surge protection devices for Level III systems (Furse ESP415/III/TNS or equal, and Type 3 Devices for each Distribution Board. Refer to Clause 5.16.1 of the Electrical Particular Specification: 16012-FUT-BRY-XXX-T-BV-000007.
16	EMC	M&E - Bridge	Lift Control System	DNO Supplies	The VFDs (Variable Frequency Drives) in the Lift motor control can generate high levels of harmonic distortion which at a significant level can reduce the power quality of items of equipment connected to the DNO. This can lead to overheating of transformers and conductors. The Earthing and Bonding system can also be impacted by the induction of currents in the earthing system leading to the formation of ground loops, increase of touch and step voltages.	Harmonic Distortion of Power Supply Voltage Fluctuations and Transients	PERFORMANCE	Confirm and record the authority or approval basis for using the same LV source for both primary and secondary lift supplies. Ensure DNO interface and duct routes are fully documented. Assess whether any additional mitigation is needed for harmonic distortion and earthing impacts.	YES	2	3	5	The lifts must be equipped with harmonic filters to mitigate against the generation of harmonic filters. The basic EMC guidelines and separation distances as described in section 8 of the EMC Control Plan must be followed in line with BS IEC 61000-5-2, BS EN 50310 & BS EN 50174-2 & BS 7671. Where practicable, the lift control system should be supplied from a separate and dedicated power circuit to be isolated from the main DNO supply – Although it is noted this is luxury requirement.	2	2	4	BS IEC 61000-5-2: Electromagnetic compatibility (EMC). Installation and mitigation guidelines - Earthing and cabling BS EN 50310: Telecommunications Bonding Networks for buildings and other structures BS EN 50174-2: Information technology. Cabling installation - Installation planning and practices inside buildings BS 7671: Requirements for Electrical Installations. IET Wiring Regulations BS EN 81-76: Safety rules for the construction and installation of lifts. Particular applications for passenger and goods passenger lifts - Part 76. Evacuation of persons with disabilities using lifts BS EN 81-72: Safety rules for the construction and installation of lifts. Particular applications for passenger and goods passenger lifts - Firefighters lifts	CLOSED	Transient Over-Voltage protection is provided in accordance with BS EN 62305-4. Consisting of a combination of Type 1 & 2 surge protection devices for Level III systems (Furse ESP415/III/TNS or equal, and Type 3 Devices for each Distribution Board. Refer to Clause 5.16.1 of the Electrical Particular Specification: 16012-FUT-BRY-XXX-T-BV-000007. For lifts used for evacuation purposes, a separately fused circuit from the main switchboard is intended primary power supply shall be derived from the main switchboard whilst the secondary supply is taken from the live side of the main switchboard. Refer to clause 5.15 of the Electrical Particular Specification: 16012-FUT-BRY-XXX-T-BV-000007. The lifts considered for the design (at RIBA 4) are confirmed to be Class A lifts (refer to the Bury Interchange Fire Strategy.) which as per BS EN 81-76 do not require a secondary supply or a dedicated secondary supply. Should a Class B lift used as a fire fighter lift, the secondary supply must be independent to mitigate against common mode failure as per clause A.4 of BS EN 81-72.
17	EMC	Transport for Greater Manchester (TIGM)	Handheld Radios	Railway Systems	Radiated RF interference, particularly when used close to vulnerable devices	Maloperation of Equipment and Possible delays of Trams	PERFORMANCE	Confirm whether any RF restricted zones currently exist on the system. Verify compliance with EN 50401 and include evidence in the EMC project file. Assess whether any additional RF protection (gasketing, mesh, restricted areas) is required for vulnerable cabinets.	YES	1	3	4	Determine distance from handheld radios where fields levels of BS EN 50401 are met. Compliance of Metrolink tram detection & signalling systems with EN 50121-4 Mark restricted zones; fit additional RF gasketing/mesh to vulnerable cabinets; brief staff and contractors. Measurements and tests, or alternatively documentary evidence to be provided (EMC Project File) from equipment suppliers and/or from other UK projects.	1	2	3	BS EN 50401: Product standard to demonstrate the compliance of base station equipment with radiofrequency electromagnetic field exposure limits (110 MHz - 100 GHz), when put into service EN 50121-4: Railway applications. Electromagnetic compatibility - Emission and immunity of the signalling and telecommunications apparatus	CLOSED	Current mitigation involves investigating existing handheld radios currently operational at Bury Tramstop. An assumption has been made that the existing radios used by staff are compliant. This does not need to be evidenced unless EMC historical issue has been logged previously. If still open then EMC documentation will need to be reviewed to understand level of compliance/non-compliance.
18	EMC	Transport for Greater Manchester (TIGM) - Rolling Stock Operator	Train borne Radio Transmitters	Railway Systems	Radiated RF interference can cause maloperation of Railway Handheld Radios, which can impact on railway systems such as signalling, Train Detection	Maloperation of Equipment and Possible delays of Trams	PERFORMANCE	Identify O & M lead responsible for RF management on the project. Confirm whether existing RF control measures or restricted zones are in place for train-borne systems. Verify transmitter compliance with licence requirements. Update the EMC file accordingly.	YES	1	3	4	Use radio transmitters within their license requirements Mark restricted zones; fit additional RF gasketing/mesh to vulnerable cabinets; brief staff and contractors.	2	1	3	BS EN 50121-3-1: Railway applications. Electromagnetic compatibility - Rolling stock. Train and complete vehicle BS EN 50121-4: Railway applications. Electromagnetic compatibility - Emission and immunity of the signalling and telecommunications apparatus	CLOSED	Current mitigation involves investigating existing on board tram radio transmitters currently operational at Bury Tramstop. An assumption has been made that the existing radios used by staff are compliant. This does not need to be evidenced unless EMC historical issue has been logged previously. If still open then EMC documentation will need to be reviewed to understand level of compliance/non-compliance.
19	EMC	Transport for Greater Manchester (TIGM) - Rolling Stock Operator	Train borne Radio Transmitters	Station Equipment	Radiated RF interference can cause maloperation of Railway Handheld Radios, which can impact station equipment	Maloperation of Equipment and Possible delays of Trams	PERFORMANCE		YES	1	3	4	Maloperation of Equipment and Possible delays of Trams Determine distance from handheld radios where fields levels of BS EN 50401 are met. Compliance of Metrolink tram detection & signalling systems with EN 50121-4. Re-site sensitive equipment away from the platform edge; RF sealing; signage for separation. Measurements and tests, or alternatively documentary evidence to be provided (EMC Project File) from equipment suppliers and/or from other UK projects.	2	1	3	BS EN 50401: Product standard to demonstrate the compliance of base station equipment with radiofrequency electromagnetic field exposure limits (110 MHz - 100 GHz), when put into service EN 50121-4: Railway applications. Electromagnetic compatibility - Emission and immunity of the signalling and telecommunications apparatus BS EN 61000-6-2: Electromagnetic compatibility (EMC) - Generic standards. Immunity standard for industrial environments. BS EN 61000-6-4: Electromagnetic compatibility (EMC) - Generic standards. Emission standard for industrial environments.	CLOSED	Current mitigation involves investigating existing on board tram radio transmitters currently operational at Bury Tramstop. An assumption has been made that the existing radios used by staff are compliant. This does not need to be evidenced unless EMC historical issue has been logged previously. If still open then EMC documentation will need to be reviewed to understand level of compliance/non-compliance.
20	EMC	Transport for Greater Manchester (TIGM)	Rolling Stock	Signalling Equipment	Train interference induced onto S&T cables cause Right Side Failure of Lineside systems. Sources from the rolling stock such as traction transformers, auxiliaries & inverters/converters generate magnetic leakage, harmonics, transients and HF power supply noise.	False operation of Train System causing Wrong Side or Right Side Failure affecting safety and reliability. Tram Delays	SAFETY	Hitachi signalling is engaged directly by TFGM. Meeting notes will need to be shared with TFGM so that they can pass them to Hitachi. Additional workshops may be required for hazards that cannot be mitigated or designed out at this stage. Full coordination with Hitachi will be needed once their involvement increases.	YES	5	2	7	Moderate Confirm compliance with specific signalling design standards/specifications. Signalling system to follow immunity limits specified in BS EN 50121-4 Use of Optic Fibre for telecoms and apply EMC Good practices	5	1	6	EN 50121-4: Railway applications. Electromagnetic compatibility - Emission and immunity of the signalling and telecommunications apparatus BS EN 50121-3-1: Railway applications. Electromagnetic compatibility - Rolling stock. Train and complete vehicle BS EN 50238-3: Railway applications. Compatibility between rolling stock and train detection systems - Compatibility with axle counters	OPEN	Hazard to remain open as there is no record of existing or proposed redesign of signalling assets.
21	EMC	Transport for Greater Manchester (TIGM)	Rolling Stock	Station Fire Alarm Systems	PWM edges and braking events radiate wideband noise; vehicle antenna/RF systems raise local field strength; Near-field H-fields inductively couple to the loop wiring along platform edge.	False Alarms due to induced voltages/noise Missed or delayed alarms if signals are corrupted.	SAFETY	Identify all locations where fire alarm circuits run parallel to the track. Confirm the length of each parallel section. Assess whether further separation or shielding measures are needed. Update EMC file and drawings accordingly.	YES	5	2	7	Keep FAS loops back-of-shelter; minimize parallelism with track; use twisted, shielded Low Smoke Zero Halogen cables; correct shield termination.	5	1	6	BS EN 50121-3-1: Railway applications. Electromagnetic compatibility - Rolling stock. Train and complete vehicle EN 50121-4: Railway applications. Electromagnetic compatibility - Emission and immunity of the signalling and telecommunications apparatus	OPEN	All Rolling Stock EMC hazards to remain open until confirmation from TIGM that hazards have been reviewed with TIGM Rolling Stock Lead, as per EMC Actions ID No.10 in the EMC HAZID Workshop Output Report: 16012-ARC-BRY-ZZ-T-EC-000005.

22	EMC	Transport for Greater Manchester (TGM)	Rolling Stock	Lineside Equipment	Train Harmonics on feed current (including transients due to pantograph contact fluctuation)	Maloperation of Equipment and Possible delays of Trams	PERFORMANCE	Engage with Neil Sewell to validate rolling stock EMC assumptions and confirm whether any light rail specific adjustments are needed. Share all rolling stock related hazards with him for review. Update hazard records if additional nuances are identified.	YES	4	3	7	Compliance with EN 50121-3-1 and immunity below 150 kHz. Design to be performed as per BS EN 50388 section 10 (harmonics criteria) and BS EN 50317 (interaction between pantograph and overhead contact line). Apply EMC Good practices, follow the applicable standards: Improve cabinet shielding	4	2	6	EN 50121-3: Railway applications. Electromagnetic compatibility - Rolling stock. Train and complete vehicle BS EN 50388-1: Railway Applications. Fixed installations and rolling stock. Technical criteria for the coordination between electric traction power supply systems and rolling stock to achieve interoperability - General BS EN 50317: Railway applications. Current collection systems. Requirements for and validation of measurements of the dynamic interaction between pantograph and overhead contact line BS EN 50121-5: Railway applications. Electromagnetic compatibility - Emission and immunity of fixed power supply installations and apparatus EN 50121-4: Railway applications. Electromagnetic compatibility - Emission and immunity of the signalling and telecommunications apparatus	OPEN	All Rolling Stock EMC hazards to remain open until confirmation from TGM that hazards have been reviewed with TGM Rolling Stock Lead, as per EMC Actions ID No.10 in the EMC HAZID Workshop Output Report: 16012-ARC-BRY-ZZ-T-EC-000005.
23	EMC	Transport for Greater Manchester (TGM)	Rolling Stock	Station Equipment	Train Harmonics on feed current (including transients due to pantograph contact fluctuation)	Maloperation of Equipment and Possible delays of Trams	PERFORMANCE		YES	4	3	7	Compliance with EN 50121-3-1 and immunity below 150 kHz. Design to be performed as per BS EN 50388 section 10 (harmonics criteria) and BS EN 50317 (interaction between pantograph and overhead contact line). Apply EMC Good practices, follow the applicable standards.	4	2	6	EN 50121-3: Railway applications. Electromagnetic compatibility - Rolling stock. Train and complete vehicle BS EN 50388-1: Railway Applications. Fixed installations and rolling stock. Technical criteria for the coordination between electric traction power supply systems and rolling stock to achieve interoperability - Generals BS EN 50317: Railway applications. Current collection systems. Requirements for and validation of measurements of the dynamic interaction between pantograph and overhead contact line BS EN 61000-6-2: Electromagnetic compatibility (EMC) - Generic standards. Immunity standard for industrial environments. BS EN 61000-6-4: Electromagnetic compatibility (EMC) - Generic standards. Emission standard for industrial environments.	OPEN	All Rolling Stock EMC hazards to remain open until confirmation from TGM that hazards have been reviewed with TGM Rolling Stock Lead, as per EMC Actions ID No.10 in the EMC HAZID Workshop Output Report: 16012-ARC-BRY-ZZ-T-EC-000005.
24	EMC	Transport for Greater Manchester (TGM)	DNO Supplies	Telecoms, Radio base stations, Train Detection Systems & other signalling systems	Excessive interference on DNO supplies causes equipment malfunction	Maloperation of Equipment and Possible delays of Trams	PERFORMANCE		YES	2	2	4	Provide back-up power supply to most critical systems. Implement adequate maintenance processes to ensure back-up power sources will operate as required on demand (e.g. that diesel is always available for diesel generators). Ensure adequate bonding to prevent high fault current and voltages.	2	1	3	EN A REEC G5/B: Harmonic voltage distortion and the connection of harmonic sources and/or resonant plant to transmission systems and distribution networks in the United Kingdom BS EN 61643-11: Low-voltage surge protective devices - Surge protective devices connected to low-voltage power systems. Requirements and test methods BS EN IEC 61000-3-12: Electromagnetic compatibility (EMC) - Limits. Limits for harmonic currents produced by equipment connected to public low-voltage systems with input current >16 A and ≤ 75 A per phase	OPEN	Telecoms utilises UPS as primary power supply to the racks via bypass panel. The secondary power supply comes from the LV distribution board within the SER. Refer to the LV Distribution schematic: 16012-ARC-BRY-FFM-D-EE-000001. Currently a 10 kW existing UPS which will be maintained as usual by the current O&M routine.
25	EMC	Transport for Greater Manchester (TGM)	Lightning Strikes	Railway Systems	Railway System(s) equipment damage due to lightning strikes	Maloperation of Equipment and Possible delays of Trams	PERFORMANCE / SAFETY	Confirmed that for the railway systems within this phase of the project, only Type 1 and Type 2 SPDs are required. Type 3 SPDs will not be applicable in this scope because there are no sub boards feeding downstream areas, and the assessment is limited to railway systems only.	YES	4	2	6	Risk assessment to be performed at RIBA 4-5 stages. SPD to be installed at DB feeding critical equipment. Type 1/2 SPDs coordinated; bonded per 50122-1; route sensitive cables away from strike-prone paths; ensure shield bonding.	4	1	5	BS EN 50122-1:2022+A1:2025: Fixed installations for railway applications. Electrical safety, earthing and the return circuit - Protective provisions against electric shock BS EN IEC 62305-1:2024: Protection against lightning - General principles BS EN IEC 61643-11: Low-voltage surge protective devices - Part 11: Surge protective devices connected to AC low-voltage power systems – Requirements and test methods IEC 61643-21: Low voltage surge protective devices - Surge protective devices connected to telecommunications and signalling networks. Performance requirements and testing methods	CLOSED	Transient Over-Voltage protection is provided in accordance with BS EN 62305-4. Consisting of a combination of Type 1&2 surge protection devices for Level III systems (Furse ESP415/III/TNS or equal, and Type 3 Devices for each Distribution Board. Refer to Clause 5.16.1 of the Electrical Particular Specification: 16012-FUT-BRY-XXX-T-BV-000007.
26	EMC	Transport for Greater Manchester (TGM)	Bus Station EV Chargers	Tramstop Railway Systems (Metrolink Signalling,Comms, etc)	HF EMI from power electronics could couple into adjacent station system cabling or equipment (comms, signalling, etc)	Maloperation of Equipment and Possible delays of Trams	PERFORMANCE / SAFETY	Confirmed that for the railway systems within this phase of the project, only Type 1 and Type 2 SPDs are required. Type 3 SPDs will not be applicable in this scope because there are no sub boards feeding downstream areas, and the assessment is limited to railway systems only.	YES	3	3	6	Mitigation through design, no shared infrastructure/equipment. Both the Bus Station and the Tramstop have separate electrical power supplies. Physical separation from the systems is ensured.	3	1	4	BS EN IEC 61851-21-2: Electric vehicle conductive charging system - Electric vehicle requirements for conductive connection to an AC/DC supply. EMC requirements for off board electric vehicle charging systems BS EN IEC 61000-6-4:2019: Electromagnetic compatibility (EMC) - Generic standards. Emission standard for industrial environments	CLOSED	Closure due to mitigation by design. Bus Interchange & Tramstop are to be segregated as part of tramstop upgrade.

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