



AUSTRALIAN RAIL TRACK CORPORATION LTD

HEAVY HAUL INFRASTRUCTURE GUIDELINES

SIGNALS, COMMUNICATIONS AND ELECTRICAL

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Document Overview

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Applicability Hunter Valley Heavy Haul Network

Purpose: These guidelines are not intended to replace any ARTC standards, but are to be used as a supplement to deliver consistency in: design, systems provided, components installed, installation arrangements and deliverables applicable to the Heavy Haul requirements of the Hunter Valley.

Related Documents Heavy Haul Infrastructure Guidelines Track, Civil and Structures

Endorsed by: EGM Hunter Valley

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CONTENTS

1	GENERAL	5
2	SIGNALS	7
2.1	General	7
3	INTERLOCKING, CBI FIELD EQUIPMENT	8
3.1	General	8
3.2	Computer Based Interlocking (CBI)	8
4	FIELD EQUIPMENT: TRACK CIRCUITS, TRACKSIDE EQUIPMENT	9
4.1	Glued Insulated Joints (GIJs).....	9
4.2	Axle Counters	9
4.3	Audio Frequency (AF/Jointless) Track Circuits	10
4.4	Coded Track Circuits	10
4.5	Track Circuit Cabling and Bonding.....	10
5	POWER SUPPLY	11
5.1	Mains Power Supplies.....	11
5.2	Standby Power Plants	11
5.3	Solar Power Systems	11
5.4	No-Break Power Supply for 120/240 Volt Mains Supply.....	11
5.5	Bypass Arrangements for No-Break Supplies	12
5.6	Minimum Run Time for No-Break Supplies	12
5.7	Earth Leakage Detection	12
5.8	Surge Protection	12
5.9	Power System Compliance and Certification.....	13
6	POWER SYSTEM MONITORING AND ALARMS	14
6.1	General	14
6.2	Standby Power Plants	14
6.3	Solar Systems.....	14
6.4	UPS Systems	14
6.5	Earth Leakage Detectors	14
6.6	Level Crossing Equipment	14
7	ENCLOSURES	15
7.1	General	15
8	CABLE PITS, CABLE ROUTES AND CONDUITS	16
8.1	General	16
8.2	Trenching	16
8.3	Underbores	16
9	TURNOUT DRIVE SYSTEMS	17
9.1	General	17
9.2	Preferred Systems and Suppliers	17
9.3	New Functionality Points and Crossovers	17
9.4	EOL / ESML Cabinets and Manual/Emergency Operation (refer also to Appendix D).	18
10	TELEMETRY AND CONTROL SYSTEMS	19
10.1	General	19
11	LEVEL CROSSINGS	19
11.1	Lamps	19
11.2	Wiring	19
12	NEW CONNECTIONS, PRIVATE LOOPS AND SIDINGS	19
12.1	General	19

13 APPENDICIES	20
Appendix A Hunter Valley Authorised Infrastructure Representatives	20
Appendix B UPS Termination Diagram	21
Appendix C Surge Protection and Earthing Arrangements	22
Appendix D Switch Identification and ESML/EOL Signage	39

1 GENERAL

The objective of this document is to provide clear insight into the considerations required in designs, equipment types and configurations of infrastructure installed in the Hunter Valley Heavy Haul Network. These considerations are the core of the Hunter Valley Business Units' key performance criteria with the planned expansion of the coal throughput to the port of Newcastle, namely:

- Improvement of operational reliability (reduction of asset failures),
- Improvement of asset availability (reduction of maintenance possession time) and
- The need to achieve prudent capital expenditure taking into account maintainability and asset life cycle maintenance costs

1.1 Application to Works in the Corridor

1.1.1 These guidelines are applicable only to the Hunter Valley Heavy Haul network as defined by Figure 1 and/or Pricing Zones 1, 2, 3 and 4 of the Hunter Valley Coal Network Access Undertaking as amended from time to time.

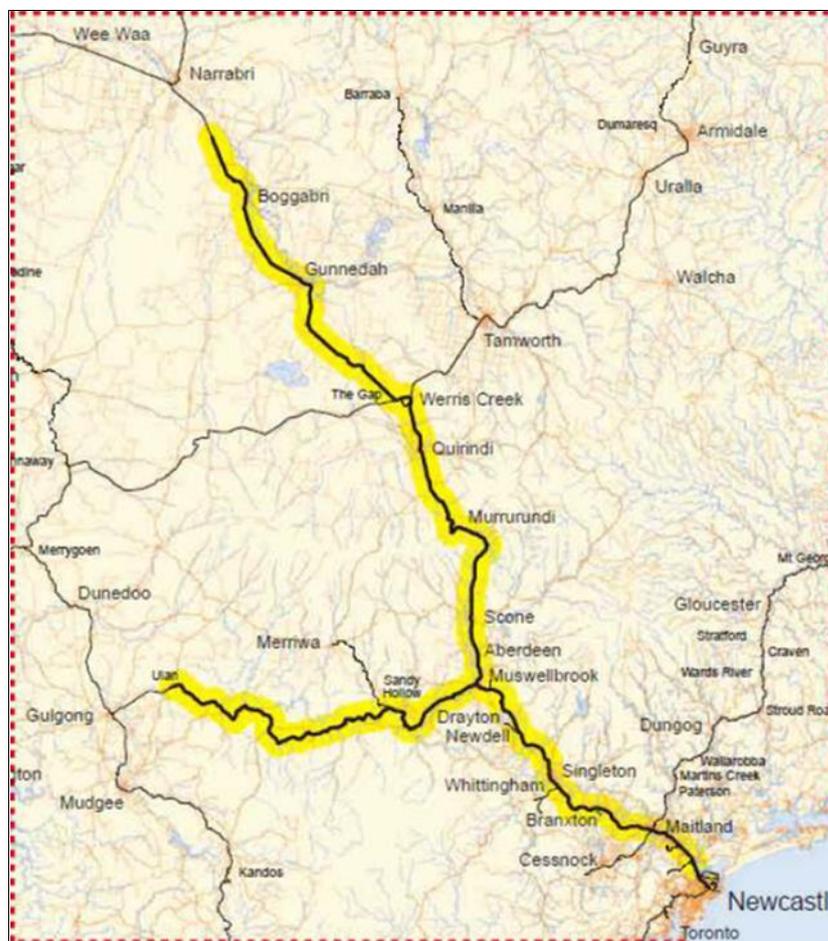


Figure 1.1 – Hunter Valley Heavy Haul Network

1.1.2 Projects with a budget less than \$100,000 will not be required to comply with this guideline as these projects are typically small repairs to existing infrastructure. In these circumstances the further scope required to comply with these guidelines may generate an unnecessary cost burden upon the project.

Therefore the applicability of this guideline to most RCRM, MPM works will be determined by the Manager Infrastructure and Planning (MIP) on a case-by-case basis during project scope development. The MIP will consider the scope of the project in context with the business unit objectives of the Hunter Valley.

- 1.1.3 Minor Capital, Major Capital and other projects with a budget of \$100,000 or greater will generally be expected to adhere to these guidelines as published
- 1.1.4 Any departures in the application of these guidelines must be declared and presented for endorsement by the Operational Steering Committee (OSC), prior to implementation.
Endorsement of these departures should be obtained from the Authorised Infrastructure Representative (AIR) - refer to Appendix A - prior to presentation at the OSC, however if this is not possible due to an impasse then a joint presentation to the OSC is required by the project owner and the AIR.

1.2 Interpretation of Guideline Clauses

- 1.2.1 Where clarification is required to these guidelines – including conflict with current ARTC standards (perceived or otherwise) – a technical query is to be forwarded to the Authorised Infrastructure Representative, or their nominated representative.

1.3 Innovative Solutions

- 1.3.1 To meet the business objectives of the Hunter Valley Business Unit, the investigation and use of new technological solutions in the field is encouraged. This document does not intend to restrict innovation in design or the introduction of new technology.

With respect to innovation, some sections of this document refer the reader to a preferred proprietary product or design solution – this is made in an attempt to avoid a situation where a variety of different spares, training requirement and equipment performance is experienced throughout the Heavy Haul.

However, the mention of a preferred proprietary product or design solution shall not preclude other equipment or solutions to be considered, investigated and recommended by the project team.

The recommendation of non-preferred products and solutions shall be considered a departure from the guidelines and are to be considered as per clause 1.1.4 above.

1.4 Design Concept, Review and Presentation

- 1.4.1 Final designs for recently commissioned Hunter Valley projects are to be used as a baseline model for projects with similar infrastructure configurations – this is to prevent starting from scratch and also capturing lessons learnt during design phases of previous projects.
- 1.4.2 Hunter Valley main line signalling headways are to be designed to meet forecast capacity requirements. For guidance on headways and other capacity requirements please refer to the current version of the Hunter Valley Corridor Capacity Strategy which is publically available on ARTC's website <www.artc.com.au>
- 1.4.3 All concept plans, proposal specifications, designs, installation and commissioning documentation are to be reviewed and accepted by the Authorised Infrastructure Representative (see Appendix A) before any work is progressed.
- 1.4.4 Signalling Infrastructure to be shown on any related Track and Civil IFC drawings including GPS coordinates.

2 SIGNALS

2.1 General

- 2.1.1 Fixed signals and other track side signalling equipment shall not be located or installed in cess drains and must comply with the detailed site survey plan, as agreed by the Authorised Infrastructure Representative (AIR)
- 2.1.2 Home, Starting and Shunt signals must not be placed on grades where there is a risk of wheel slip and resulting wheel burns.
- 2.1.3 Signals should be placed on straight sections to avoid the need of installing GIJs on curves. GIJs on curves represent a reliability risk and incur increased maintenance, refer to Section 4.
- 2.1.4 As a safety consideration, fixed ladders are to be fitted to all new fixed signals. This will have an additional benefit of more efficient maintenance with crews not required to carry portable ladders to access the signal head.
- 2.1.5 All weather access shall be provided to all track side signalling equipment. This may include stairs, access roads, ladders or walkways.

Such access will be developed in liaison with the Local Team Manager and is subject to the approval of the Operations Steering Committee. Refer also to the Heavy Haul Infrastructure Guidelines Track, Civil and Structures.

3 INTERLOCKING, CBI FIELD EQUIPMENT

3.1 General

- 3.1.1 Computer Based Interlocking (CBI) solutions are to be provided for all green-field sites. MicroLok II is the current preferred CBI solution, however the introduction of other CBI systems will be considered as per clause 1.3.1.
- 3.1.2 Expansion of existing relay based interlocking for brown-field sites will not normally be considered due to:
- High lifecycle costs
 - Industry phase out of this old technology (life time support is questionable)
 - Introducing complex and high risk interfaces
 - Reduced opportunity for extensive off site pre-commissioning testing

3.2 Computer Based Interlocking (CBI)

- 3.2.1 All auto signal indications are to be logged but not displayed on the Train Control System (currently Phoenix)
- 3.2.2 All CBI's are to be fitted with backup batteries for both signal lamp retaining and CBI backup. The designer needs to consider the load and duration, including maintenance response time, when calculating the number and size of the batteries. The nominal capacity shall be at least 4 hours.
- 3.2.3 All signal lamps supplied via a CBI lamp driver card shall be supplied from a type approved 12 volt power supply via a type approved 12 to 16 volt DC to DC converter. The power supply arrangement shall be duplicated (i.e. maximum two power supplies per busbar) as to provide redundancy. The maximum load should not be greater than the 75% of the maximum rated load of any single component in the supply arrangement.
- 3.2.4 All CBI communication designs shall be subject to the acceptance of the Senior Control Systems Engineer Hunter Valley or the nominated representative.
- 3.2.5 All CBI network switches / modems shall be installed in close proximity to the CBI within the signalling equipment room or enclosure.
- 3.2.6 Each CBI network switch / modem shall be fitted with a fault alarm facility which shall provide an approved indication of a fault condition. This shall comply with Hunter Valley alarm strategy and be submitted for the acceptance of the Senior Signals and Control Systems Engineer the nominated representative Hunter Valley
- 3.2.7 All CBI network switches / modems shall be configured to provide a remote interface for both diagnostics and log retrieval.
- 3.2.8 Currently the RuggedCom RS400 modem is provided throughout the Hunter Valley for vital CBI communications. This device also provides a remote interface to CBIs for both diagnostics and log retrieval. Alternatives may be considered subject to clause 1.3.1 so long as the alternative provides the same functionality as a minimum.
- 3.2.9 The main interlocking site shall be provided with a complete version of the master circuit book including; cover sheets and indexes for all locations controlled by the main interlocking, control sheets, control table, track plan and track insulation plan.
- 3.2.10 Each CBI interlocking site shall be provided with an extract version of the master circuit book applicable to the CBI interlocking, signals, track circuits, power supplies etc at that site. The extract circuit books shall include all circuit diagrams, applicable to the area covered by the location.

4 FIELD EQUIPMENT: TRACK CIRCUITS, TRACKSIDE EQUIPMENT

4.1 Glued Insulated Joints (GIJs)

Glue Insulated Joints are a high maintenance asset and an inherent weak spot in the track infrastructure. It is the strategic objective of the Hunter Valley to reduce/remove as many GIJs as possible due to their reliability issues generated with the failure of the joint or the thermic welds associated with their installation.

However, traditional track circuit designs utilising GIJs also provide an important benefit namely; the ability to identify potential broken rails (via a track circuit failure). Broken rail detection is something that the Hunter Valley wishes to maintain; therefore the installation of other track circuit technologies must consider how the risk of broken rail detection will be covered by the new technology.

The installation of GIJs is not a preferred option, however on a case-by-case basis, to retain broken rail detection and to easily integrate the scope into the existing interlocking GIJs may still be installed subject to the below clauses.

- 4.1.1 GIJs should not to be installed on curves due to:
 - Short life and poor reliability due to excessive curve rail wear
 - Rail head flow on gauge face
 - Higher risk of derailment if GIJ breaks in a curve situation.
- 4.1.2 Wherever possible, GIJs shall not be located on grades due to the potential for wheel burns caused by trains lifting heavy load on a grade (worst case scenario of wet conditions needs to be considered in any site assessment).
- 4.1.3 Placement of GIJs in turnouts to be determined on a 'site by site' basis to minimise GIJ wear and consequential failure (direction of most traffic and dynamic lateral forces need to be considered in any site assessment).

4.2 Axle Counters

- 4.2.1 Axle counters are a proven solution that may be used to support the strategy of minimising the number of GIJ's and the associated thermic welds. Installation of axle counter operated track circuits are the preferred at the following locations:
 - Turnouts
 - Plain track sections on non-passenger lines (within crossing loop boundaries only)
 - Within the Kooragang and Port Waratah Bulk Terminals
- 4.2.2 For standardisation Frausher axle counters are preferred, however variation may be permitted subject to clause 1.3.1.
- 4.2.3 Axle counter reset must comply with ARTC's cooperative sweep release and reset procedure issued as engineering waiver [HV-SG-0010](#) and standard design requirements as directed by the Signals Standards Engineer.
- 4.2.4 Frausher ACS 2000 Axle counters shall be configured in "isolation mode" only. As we migrate to Frausher's FADC digital axle counters they will be inherently "transmission mode".
- 4.2.5 All Frausher axle counters evaluator boards installed in the Hunter Valley Corridor must be model IMC006. This is to avoid miscounts previously experienced due to the smaller wheel on hi-rail based track machines.

Project managers should note due to changes in technology or manufactures specifications this may change without notice. Confirmation should be sought from the Signal Maintenance Engineer as to preferred evaluator board for the applicable application.
- 4.2.6 In areas where impulse track or other circuits are currently installed over points, Project Managers must seek advice from the Authorised Infrastructure Representative as to the train detection arrangements to be provided.
- 4.2.7 Consideration should be given to additional battery backup for axle counters installed at level crossings

4.3 Audio Frequency (AF/Jointless) Track Circuits

- 4.3.1 To be used at all locations where it is not proposed to utilise coded track circuits or axle counters.
- 4.3.2 UM71 or TI21 Digital type is preferred.
- 4.3.3 Capacitor compensated audio track circuits will only be considered for installation in exceptional circumstances.

4.4 Coded Track Circuits

- 4.4.1 Coded track circuits are preferred for medium to low density long block sections (typically beyond Muswellbrook) where it is cost prohibitive to install audio frequency track circuits and where axle counter technology is not acceptable.
- 4.4.2 Microtrax coded track circuits are preferred, although alternative coded track circuit products may be considered subject too clause 1.3.1

4.5 Track Circuit Cabling and Bonding

- 4.5.1 All track circuit cabling and bonding shall be securely anchored to prevent damage from mechanised track maintenance machinery as per example in Figure 4.1. Project Managers are to liaise with Signal Maintenance Engineers for an appropriate design solution for the application.



Figure 4.1 – CSEE cables protected by flat metal plates

5 POWER SUPPLY

5.1 Mains Power Supplies

- 5.1.1 Local energy provider to provide primary supply.
- 5.1.2 Redundancy is to be provided by a no-break supply backup to the signalling supply busbar, it will not be necessary to backup the points supply busbar.
- 5.1.3 Where power supplies are reticulated at 120 V or 415 V from a main power room for both local and external supplies (i.e. North and South or East and West) then the external and local supplies must be backed up by separate no-break supply units. The failure of a single no-break supply must not fail the whole station or interlocking.
- 5.1.4 At interlockings with power operated point motors, a motor generator (MG) plus a no-break supply for changeover is required. Consideration will be given to a no-break supply only arrangement in low train density situations.

5.2 Standby Power Plants

- 5.2.1 A suitable shelter or enclosure is to be provided for outdoor motor generators to prevent corrosion of the housing and water ingress into the control equipment.

5.3 Solar Power Systems

- 5.3.1 Solar Power systems may only be utilised where mains power is unavailable and as accepted by the Senior Signal and Control Systems Engineer or Signal Manager (Hunter Valley). Typically they may be used for distant, outer home, or in-section signal location in medium and low density traffic areas subject to ARTC's approval. It should not be assumed that solar systems will be approved even where solar power systems currently exist in the area.
- 5.3.2 Solar power installations must be designed by a power engineer experienced in solar power supply systems.
- 5.3.3 Solar battery systems must provide a minimum of 7 days capacity without charging based on a continuous maximum load.
- 5.3.4 Solar panels and batteries must be chemically etched "STOLEN FROM ARTC" and the manufacturer and serial number/s, where available, must be recorded on the history card.

5.4 No-Break Power Supply for 120/240 Volt Mains Supply

- 5.4.1 The preferred No-Break supply units for installation in the Hunter Valley are Eaton Powerware 9130 series and 9155 series.
- 5.4.2 No-break supplies shall be split to best service the load and power distribution.
- 5.4.3 Parallel no-break supply arrangements will not be approved by ARTC.
- 5.4.4 The maximum capacity of any single no-break supply which can be installed at a field location is 6KVA.
Subject to the approval of the Senior Signal and Control Systems Engineer Hunter Valley, larger capacity no-break power units may be considered at major interlockings provided:
 - (i) permanently connected reverse cycle air conditioning is installed or other effective passive cooling mechanism
- 5.4.5 Other equivalent No-Break Supplies may be considered as per clause 1.3.1, provided they are equivalent or better in performance and meet the following requirements;
 - Changeover between supplies to be less than 20ms.
 - The No-Break supply must have ethernet based monitoring capability.
 - All components of the No-Break supply must be 19 inch rack mountable.
 - Comply with sections 5.4.2 and 5.4.3

5.5 Bypass Arrangements for No-Break Supplies

- 5.5.1 A manual bypass switch shall be fitted to all no-break supply units installed.
- 5.5.2 The installed no-break supply shall be provided with a manufacturer's internal auto-bypass arrangement which is activated when a no-break supply internal fault is detected.
- 5.5.3 An additional external automatic bypass arrangement is to be installed to provide for failure of the no-break supply unit failing to go into the internal automatic bypass mode (see Appendix B for a contemporary wiring arrangement).

5.6 Minimum Run Time for No-Break Supplies

- 5.6.1 10 hours at full load capacity for auto/block sections where no standby power plant is provided.
- 5.6.2 15 minutes at full load or standard manufacturer's run time at full load, whichever is the greater, where a standby power plant is provided.

5.7 Earth Leakage Detection

- 5.7.1 Earth Leakage Detectors (ELDs – MRD AC/DC type) are to be fitted to all mains external and internal busbars including 12 V, 15 V, 24 V, 50 V, 120 V, and 415 V.
- 5.7.2 Preferred product is MRD AC/DC digital display model.
Other equivalent or compatible products may be considered as per 1.3.1, provided they are equivalent or better in performance and as a minimum offer:
 - no alarm raised on power interruption
 - alarm status retained following power interruption
 - minimum 3 days retention of time activation of alarm
 - display of earth leak value

5.8 Surge Protection

- 5.8.1 Surge protection systems must meet ARTC standards. Primary Rail Filter technology is to be used on all IVAP panels, alternative equivalent technologies will be considered for inclusion in the standard on a case by case basis.
- 5.8.2 Upgrading of earthing specifications are to meet current recommendations from ERICO.
- 5.8.3 Surge protection devices shall be installed in the Main Distribution board for protection of the "Consumers Mains".
- 5.8.4 The signalling location earth grid earth stakes shall be connected together by flat copper earth strap (not stainless steel wire) in accordance with current recommendations from ERICO.
- 5.8.5 Consumers, mains supplied equipment, mains supply and building earths shall be connected to a separate earth busbar to that of the Signalling Equipment earths and location earth grid. Both earth busbars shall be connected by a transient earth clamp.
- 5.8.6 Communications aerials, towers, etc, shall be connected to the signalling earth grid via a transient earth clamp.

5.9 Power System Compliance and Certification

5.9.1 Signalling power systems shall be designed to comply with the Australian Standard AS 3000 and ARTC Electrical Standards and Procedures. However, the current signalling specifications may not allow full compliance with Section 7.4 of AS3000 on “Separated Supplies”. Until the signalling specifications are revised, the following principles shall be adopted in the designs of signalling power systems:

- The signalling locations with 240V MEN supply from the local energy provider shall be provided with two independent earths – an MEN Earth and a Signalling Earth (Lightning Protection Earth);
- All exposed conducting surfaces associated with MEN and back up supplies shall be connected to the MEN Earth;
- All exposed conducting surfaces associated with the ‘separated supplies’ shall be connected to the Signalling Earth;
- Earth terminals of Surge Protection Devices shall be installed inside non-conducting enclosures;
- Protection against electric shock hazard (due to touch voltages) shall be achieved by placing the MEN supply equipment ‘out of reach’ of the systems and equipment associated with the separated supplies. Further protection can be achieved by using equipment enclosures made of non-conducting materials for the separated supply equipment.

However, in order to remove the shock hazard completely from the metal relay room buildings, the relay and power rooms must be physically separated and each building must be connected to the earths as follows – power room to the MEN Earth and relay room to the Signalling Earth;

- The signalling locations without a direct 240V MEN supply shall be provided with just one earth to avoid touch voltage problems; and
 - Signalling locations shall be located in such a way that they are well clear of high voltage (11kV) earth rods.
- 5.9.2 Installation of signalling power systems must be undertaken in accordance with AS 3000 and the NSW “The Electrical (Consumer Safety) Act 2004 and Electrical (Consumer Safety) Regulation 2006”. All work must be performed by installers holding a current NSW Electrical Supervisor’s Licence and ARTC Statement of Competency. This applies to all electrical equipment installation, repair, testing and certification activities on voltages equal and above 50V AC and 100V DC.
- 5.9.3 The installing contractor or contractors shall submit a Certificate of Compliance to the local supply authority in accordance with the NSW “The Electrical (Consumer Safety) Act 2004 and Electrical (Consumer Safety) Regulation 2006. Two copies of the Certificate of Compliance shall be provided to ARTC. One copy shall be included in the signalling commissioning work package (CWP) for the project and the other copy shall be forwarded to the Senior Signals and Control Systems Engineer Hunter Valley or the Hunter Valley electrical representative. This applies to all electrical equipment installation and modification activities on voltages equal and above of 50V AC and 100V DC.

6 POWER SYSTEM MONITORING AND ALARMS

6.1 General

- 6.1.1 The Hunter Valley power systems are remotely condition monitored and logged. Alarm and diagnostic events are captured and managed through ARTC's Hunter Valley Alarm Management System.
- 6.1.2 All equipment alarm and warning indications shall be available both locally and remotely, interfacing with remote diagnostic systems such as MOXA I/O logic Module (E2210) which provides an Ethernet with a TCP/IP interface to facilitate remote capture and logging of events and faults.
- 6.1.3 Power supply alarm (critical) status to be provided to the remote control centre for operator monitoring via the Phoenix train control system or other nominated monitoring system.
- 6.1.4 Power supply warning and alarm indications shall be captured by a MOXA I/O Logic Module (E2210) to facilitate remote capture and logging of events and faults.
- 6.1.5 All Power System monitoring and alarm devices must be capable of interfacing with ARTC's Hunter Valley and Corporate Alarm Management diagnostic and alarm management system.

6.2 Standby Power Plants

- 6.2.1 The standby power plant controller shall be able to log system events and faults for recall and diagnostics.
- 6.2.2 Standby power plant alarm and warning indications must include availability of mains supply, low fuel, low battery and plant failure.

6.3 Solar Systems

- 6.3.1 In addition to the standard alarms the system must provide logging and remote alarm indication capability when the solar panel is disconnected or removed (stolen).
- 6.3.2 Additional alarm indications shall be provided for battery condition when an excessive load is detected or the battery reaches a level of <50% the total battery capacity.

6.4 UPS Systems

- 6.4.1 The no-break supply alarms shall be captured by the manufacturers approved interface card which provides an Ethernet port with a TCP/IP interface to facilitate remote capture and logging of events and faults.

6.5 Earth Leakage Detectors

- 6.5.1 Alarms shall also be captured by a MOXA I/O Logic Module (E2210) which provides an Ethernet with a TCP/IP interface to facilitate remote capture and logging of events and faults.

6.6 Level Crossing Equipment

- 6.6.1 Level crossing "Alarm" and "Warning" condition indications shall be provided to the network controller NCCN Broadmeadow. The alarm and warning indications shall be provided for all level crossings in the Hunter Valley corridor. The indications shall be provided on the network controllers Phoenix screen adjacent to the position of the level crossing and on the alarm summary page.
- 6.6.2 Communications of these "Alarm" and "Warning" conditions to the Phoenix control system shall be direct via the field interlocking equipment or continuously on line telemetry system.
- 6.6.3 Where a telemetry system is utilised the state of the telemetry link shall be monitored for "Health". A failure of the telemetry link will raise the level crossing "Alarm" condition on the network controllers Phoenix screen for the affected level crossing.

7 ENCLOSURES

7.1 General

- 7.1.1 Walk-in locations shall be provided for housing axle counter and no-break supply equipment.
- 7.1.2 All signal enclosures and locations must be fully sealed as to prevent entry of moisture and rodents. This is to include sealing of cable ways, conduits including spares, fitting of PVC barrier in base of location cases, cable entry points, fitting of vermin proofing to air vents, and sealing of space between concrete slab and floor of free standing buildings.
- 7.1.3 All equipment enclosures should also be provided with an 'A3' size vermin and weather proof resealable enclosure for housing circuit books and maintenance history cards.
- 7.1.4 CBI interlocking locations cases shall also be provided with suitable vermin and weather proof resealable enclosure suitable for the housing of signalling and track insulation plans.
- 7.1.5 All non-air conditioned signalling equipment and power locations are to be fitted with ventilation including:
- Low easy maintenance filters and vermin proofing must be fitted to all vents. The filtering shall be such to prevent the ingress of dust but allow the free flow of air.
 - All location doors fitted with long life, low maintenance seals as to prevent the ingress of dust and vermin.
 - Removable dust filters must be fitted to all signal location vents. These filters must be manufactured for easy removal, cleaning and replacement of filter material
- 7.1.6 A laminated Terminal and Fuse analysis sheet shall be affixed to the inside of location case doors. In relay rooms and walk-in equipment housings this sheet shall be affixed adjacent to the Termination and Fuse racks.
- 7.1.7 Signalling equipment locations which house Electronic equipment such as no-break supplies, CBI, Axle Counter, Solar charging, switch mode power supplies, etc shall be temperature stabilised (preferably by passive means) to ensure the equipment operates within the manufactures recommended ambient specification. .
- 7.1.8 Bollards shall be installed adjacent to all signal locations and track side equipment to protect the location and equipment from being damaged by passing or reversing vehicles.
- 7.1.9 All signalling enclosures fitted with in a 19 inch rack shall be fitted with a slide out shelf and surface mount 120 V plug socket (within the 19 inch rack) to allow placement and connection of a laptop computer or other test equipment. This socket is to be protected with a 4A fuse.
- 7.1.10 The Contractor together with the Signals Maintenance Engineer shall determine the most suitable site for the positioning of each signalling equipment location case and building. This will be undertaken in conjunction with the Detailed Site Survey (DSS) and Site Interface Agreement (SIA) project walk through.
- 7.1.11 Due to increasing vandalism some signalling equipment locations may require additional security measures to be installed. This may include security fencing and security cameras.
This requirement is to be determined during the Site Integrity Agreement Inspection and associated documentation.

8 CABLE PITS, CABLE ROUTES AND CONDUITS

8.1 General

- 8.1.1 This section is to compliment ARTC Standard ESC-11-01 “Construction of Cable Route and associated civil works”. NOTE: all cable routes are to be re-enterable.
- 8.1.2 Cable runs where no metallic cables are installed shall have a continuous long-life conductor installed in the conduit which must pass through all cable pits in the route. Braided metallic tapes are not acceptable.
- 8.1.3 Flexible conduits shall be used for mechanical protection of electrical cables.
- 8.1.4 “Flexicon” brand flexible conduits and fittings is the only brand currently type approved for this application. Alternative brand components maybe considered subject to ARTC type approval, application suitability and durability. Project Managers shall seek advice from the Signal Maintenance Engineer Hunter Valley regarding alternative approved flexible conduits and fittings.
- 8.1.5 All conduits shall be sealed, but re-enterable, to prevent the entry of moisture and rodents. Sealing shall be performed where conduits enter cable pits, location cases, equipment rooms, power rooms, communication rooms, track side equipment, signal bases and where flexible conduits meet rigid conduits.
- Expanding foam filler is not to be used.
 - Weak sand and cement mix is to be used to seal the cable entry/conduit end/s with suitable wading to support the concrete mix and a wire piece to be imbedded to facilitate easy removal.

8.2 Trenching

- 8.2.1 All trenching must be compacted adequately to prevent water ingress and bearing failure of the trench.
- Trenching in areas such as top drains, at the base of embankments and along/through access roads have in the past been left uncompacted leading to top drain failures, embankment slips and maintenance vehicles becoming bogged.
- 8.2.2 Refer to Section 10.3 of Heavy Haul Infrastructure Guidelines: Track, Civil and Structures.

8.3 Underbores

- 8.3.1 Utility Services and Pipeline Underbores under are to comply with ETG 17-01 which in turn references AS 4799.
- The exception being that the minimum depth to the underbore obverts (highest point of the internal pipe surface) is to be 2 m below rail level.

9 TURNOUT DRIVE SYSTEMS

9.1 General

When designing points drive systems consideration to the harsh operating environment (including debris and water ingress) and the need for low maintenance equipment must be factored into the selection of drive solutions.

- 9.1.1 In-bearer point drive systems are required for most applications in the Hunter Valley. The Authorised Infrastructure Representative (Appendix A) is to be consulted in determining the need for in-bearer point drive systems. Reference should also be made to section 4 of the Infrastructure Guidelines Track, Civil and Structures.
- 9.1.2 The design of the in-bearer configuration should aim to maximise ease of maintenance.
- 9.1.3 All in-bearer point rodding arrangements shall be fitted with covers to prevent the entry of split coal or ballast.
- 9.1.4 All point bearers that house signalling equipment shall be securely anchored to the stock rails to prevent their movement during tamping operations.
- 9.1.5 Each point end and detector shall have a discrete detection input.
- 9.1.6 Back drive rodding should be installed on the straight leg of turnouts if possible.
- 9.1.7 It is preferred that point machines and separate detectors should be fitted with internal wiring terminated on a high impact non corrosive weatherproof (minimum IP56) electrical plug couplers to allow quick removal of cabling to components.
- 9.1.8 Utilisation of IP67 rated point drive motor machine housing in locations where high risk of water inundation or coal dust ingress is encountered, especially dump station departure is encouraged.
- 9.1.9 All termination boxes shall not impede the safe manual operation of or access by maintainers to point mechanisms. The termination box shall be placed no closer than 3 m from the nearest rail. Preference should be given to the installation of point machines in the “cess” rather than the “6 foot”.

Project managers shall liaise with Signal Maintenance Engineer Hunter Valley, to ensure appropriate installation arrangements are incorporated into their project scope.

9.2 Preferred Systems and Suppliers

- 9.2.1 Unless otherwise approved all new points and SNX drives installed shall be fitted with Spherolocks, applicable rodding and back drive system.
- 9.2.2 The preferred ‘In Bearer’ point mechanism for the operation of the Spherolock point locking system is the D84M ‘in-bearer’.
- 9.2.3 Cogifer MCEM91 integrated point machine and back drive system may also be acceptable subject the agreement of Signal Maintenance Engineer.
- 9.2.4 Alternative point machines may be considered subject to the approval of Signal Maintenance Engineer Hunter Valley. These may include Westinghouse D84M, Westinghouse M23A and Siemens S700K.

9.3 New Functionality Points and Crossovers

- 9.3.1 ARTC is currently developing new facilities to improve maintainability and availability for points and crossovers installed in multiple line areas.
 - (i) Facilities shall be provided to enable maintenance of individual point ends and SNX on each line without impacting other lines – the facility will be known as “Split Point Detection” (SPD).
 - (ii) Facilities shall be provided to operate the points and crossovers under power when the interlocking, remote control or dead locking track circuit fails. It will also be available to facilitate local control and power operation of the points during track possessions – this facility will be known as “Emergency Power Operation of Points” (EPOP)

- 9.3.2 Project Managers shall liaise with Signal Maintenance Engineer Hunter Valley as to the status of this new initiatives and functionality to ensure current strategies are incorporated into their project scope.

9.4 EOL / ESML Cabinets and Manual/Emergency Operation (refer also to Appendix D).

- 9.4.1 Manual operating mechanism is to comply with WH&S manual handling standards, especially in the area of loading when operating from a compromised ergonomic position.
- 9.4.2 The EOL box design must safely secure all the point clips, point handles and SL locks. The design must comply with the Hunter Valley design template and be approved by the Signal Maintenance Engineer Hunter Valley.
- 9.4.3 Point numbers, switch identification and EOL signage must be attached to points and SNXs in accordance with these guidelines. A plate shall also be fitted to all point and SNX stock rails indicating the correct positioning of emergency point clips – refer to Appendix D for further information and examples.

10 TELEMETRY AND CONTROL SYSTEMS

10.1 General

- 10.1.1 Control Systems and Telemetry system software (data) together with their communications designs shall be subject to the review and acceptance of the Senior Control Systems Engineer Hunter Valley
- 10.1.2 For standardisation purposes Kingfisher is the only acceptable product at this time. This is due to its proven performance, proven support, generic ARTC data design templates available, excellent logging and diagnostics capability together with ARTC's need to rationalise spares and minimise staff training. Alternative comparable and compatible products may be considered provided the system has the appropriate OEM or nominated Australian representative long term support. Consideration is subject to the acceptance of the Senior Control Systems Engineer Hunter Valley.
- 10.1.3 Phoenix is the standard control system adopted throughout the ARTC network including the Hunter Valley. All proposed modifications to the Phoenix systems including modifications the Network Controller's display shall be reviewed and approved by the Operations Manager Hunter Valley and subject to the acceptance of the Senior Control Systems Engineer Hunter Valley.

11 LEVEL CROSSINGS

11.1 Lamps

- 11.1.1 All Level Crossings shall be fitted with Alstom FLO3 type F highway lamps. Alternative comparable products be may considered provided they prove compatible with Cerberus level crossing monitoring system and are approved the Senior Signal and Control Systems Engineer Hunter Valley.

11.2 Wiring

- 11.2.1 All wiring to F type Highway Lamps from location building terminations shall have a minimum size of 16 mm².
- 11.2.2 Where Level crossing controls interface with CBI equipment provision shall be made to ensure that any failure of the CBI or CBI communications links does not affect the normal operation of the level crossing equipment (i.e. the crossing equipment shall detect all approaching rail traffic operating normally and correctly for the passage of all rail traffic).

12 NEW CONNECTIONS, PRIVATE LOOPS AND SIDINGS

12.1 General

- 12.1.1 All new sidings are to provide for turnout and siding capacity to facilitate the whole of train exiting the main line at 80 kph or otherwise agreed by the Hunter Valley Operations Manager or Operational Steering Committee via approval of the functional requirements.
- 12.1.2 Maintenance Isolating Switches are required to facilitate safe access for maintenance within the loop or siding.
Project Managers shall liaise with Signal Maintenance Engineer Hunter Valley as to the location and arrangement of these isolation switches for incorporation into their project scope.
- 12.1.3 Where the signalling in the private facility interfaces or is controlled or released by ARTC signalling control systems then the signalling in the private facility shall be designed, installed and maintained in accordance with ARTC Signalling Standards and Procedures and these guidelines.

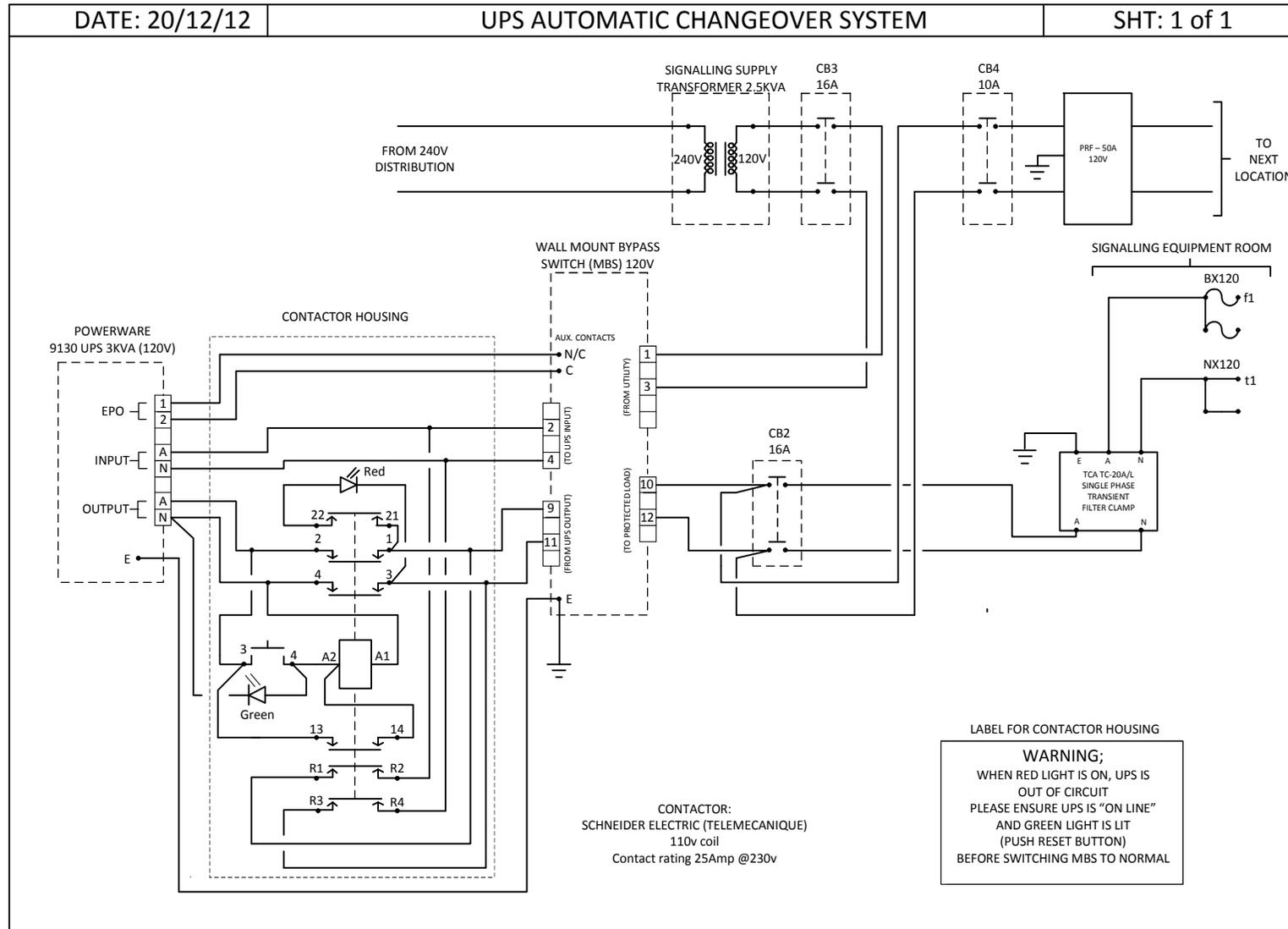
13 APPENDICIES

Appendix A Hunter Valley Authorised Infrastructure Representatives

For consistency in interpretation of these guidelines the following staff are authorised to provide guidance and advice to Project Managers within their respective area of responsibility.

Area of Responsibility	Authorised Infrastructure Representative	Incumbent
Civil Concept Design	Manager Infrastructure and Projects	Jay Jayakumar
Civil Earthworks Design	Manager Infrastructure and Projects	Jay Jayakumar
Civil Drainage Design	Manager Infrastructure and Projects	Jay Jayakumar
Rail Infrastructure	Manager Infrastructure and Projects	Jay Jayakumar
Signal Concept Design	Manager Signalling and Compliance	John Gifford
Signal Infrastructure	Senior Signal and Systems Engineer	Mark Blaik
Signalling Control Systems	Senior Signal and Systems Engineer	Mark Blaik
Communication/Telemetry Network	Senior Signal and Systems Engineer	Mark Blaik

Appendix B UPS Termination Diagram



Appendix C Surge Protection and Earthing Arrangements

C.1 General

The ARTC Signalling Construction Specifications, “Lightning and Surge Protection Requirements” ESC-09-02 and SCP-04 details ARTC performance specification for Lightning and Surge Protection requirements.

This document details installation practices to achieve the requirements.

Reference documents

- (i) Signalling Surge protection – Installation Guidelines, 20 November 2002, RAIL INFRASTRUCTURE CORPORATION
- (ii) Grounding Design Evolution Report, 12 March 2008, ARTC (prepared by Erico, Inc)

C.2 Separation From or Bonding to Other Earths

C2.1 Communications earths

Communications earths must be direct bonded to the power earth as per ACA rules therefore the installation of signalling earths only needs to consider the low voltage and high voltage power earths.

C2.2 High voltage earths

ARTC Electrical Systems Requirements document “Co-ordination of Signalling and power Systems – Earth Potential Rise” EP 90 10 00 04 SP details the requirements for the management of the High Voltage and Signalling earths.

Fundamentally, the aim is to achieve as great a separation as practicable between signalling and high voltage earths. Depending on the distance achievable between the signalling earth and the high voltage earth then different design and installation practices are used.

Criteria	Typical Distance between earths*	Installation requirement
Signalling earth inside the 800 volt Earth Potential Rise (EPR) gradient of High voltage earth	<5 metres	Use isolation transformers rated for 2500 V isolation to ensure galvanic isolation for paths to remote earths
Signalling earth outside the 800 volt Earth Potential Rise (EPR) gradient of High voltage earth	>5 metres	Use surge protection equipment that can handle 800v EPR <i>The new IVAP surge panels (also called PRF, from 2001 on) are rated for 800 volt EPR and therefore need a separation distance of >5 metres</i>
Signalling earth outside the 430 Potential Rise (EPR) gradient of High voltage earth	>15 metres	Use surge protection equipment that can handle 430v EPR. <i>The original IVAP, VAP and IDP surge panels (pre 2001) are only rated to 400 volt EPR and therefore need a separation distance of >17 metres</i>

* The actual distances can vary greatly from the typical distance due to variations in soil resistivity.

C.3 Earth Wiring Guidelines

Single 4mm² earth wires for surge protection must not be more than 0.5m long.

Single 16mm² earth wires for surge protection must not be more than 0.5m long.

Paired 16mm² earth wires for surge protection within equipment locations must be separated by 15mm, and must not be more than 1m long when used in equipment locations.

Earth bars should be extended if earth wires will otherwise exceed the limits or braid wiring of equivalent size used.

Connections between the subsidiary earth bars and the main earth bar can exceed the distance limits.

C.4 Wiring Separation Guidelines

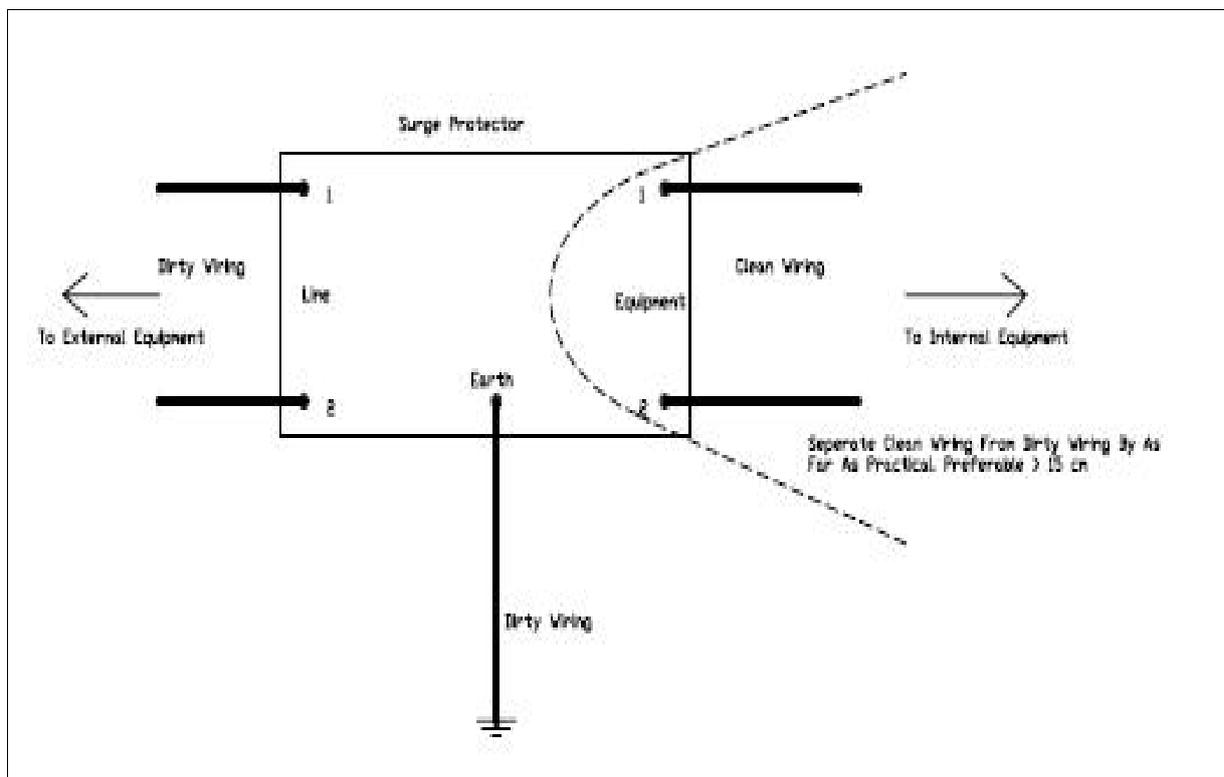
C4.1 General

Surge protected wiring must be physically separated from non-surge protected wiring.

The separation criteria are given in sections 8.2 and 8.3. If the separation cannot be achieved then a barrier consisting of an earthed piece of metal work is an acceptable solution to provide the separation.

If surge protected wiring must cross non-surge protected wiring then it must cross at right angles. Earth wires from surge protectors must be treated as per the unprotected wiring.

Always consider what is happening in the cable routes, as this is where considerable parallelism between cables can occur. Figure C1 illustrates the concept of separation.



FigureC1 – Concept of Separation

C4.2 Absolute separation (includes wiring crossing at right angles)

Separation Distance	Internal Wiring	Zone A wiring	Zone B wiring	Zone C wiring
Internal wiring	0mm	5mm	15mm	30mm
Zone A wiring	5mm	0mm	5mm	15mm
Zone B wiring	15mm	5mm	0mm	15mm
Zone C wiring	30mm	15mm	15mm	0mm

C4.3 Separation for more than 1 metre of parallelism

Separation Distance	Internal Wiring	Zone A wiring	Zone B wiring	Zone C wiring
Internal wiring	0mm	50mm	150mm	300mm
Zone A wiring	50mm	0mm	50mm	150mm
Zone B wiring	150mm	50mm	0mm	150mm
Zone C wiring	300mm	150mm	150mm	0mm

Zone A - Circuits from other equipment rooms.

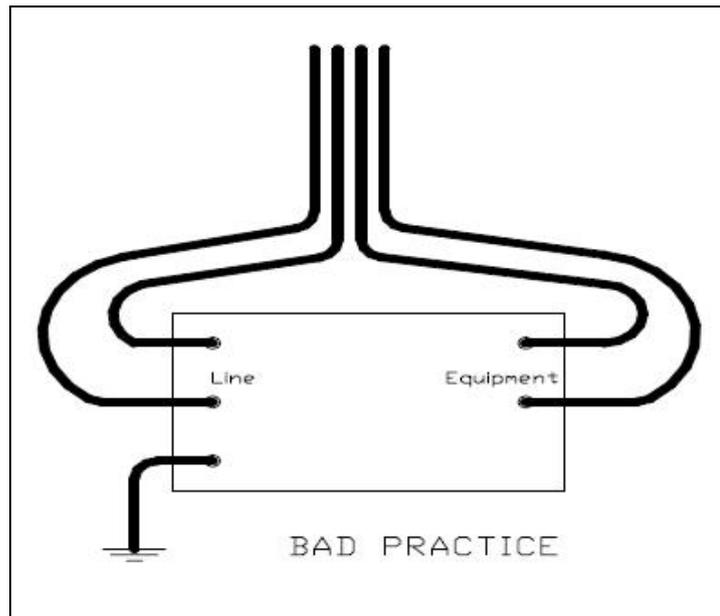
Zone B - Circuits from external cables

Zone C - Circuits from overhead power lines or pole route.

C.5 Examples of Good and Bad Wiring Practice

C5.1 Surge Protection

If the surge protector is installed as per Figure C2 then the surge can couple between the wiring and bypass the surge protector. This is bad practice and needs to be avoided.



FigureC2 – Bad Wiring Practice for Surge Protection

If the surge protector is installed as per Figure C3 then due to the separation of the wiring on the line and equipment side the surge is unable to bypass the surge protector. This is good practice.

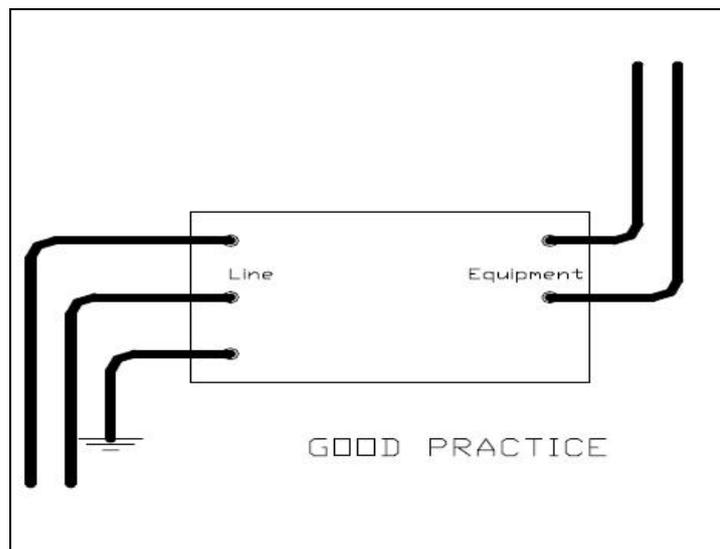


Figure C3 –Good Wiring Practice for Surge Protection

C5.2 Earthing

Very high currents flow through the earth wiring with very fast rates of change during surge events. As a result currents in one wire affect the current flowing in other wires.

Wires that run in close proximity increases the effect between wires and as a result the surge current effectively treats the pair of wires as one wire. Bad wiring practice puts the wires close together as per Figure C4.

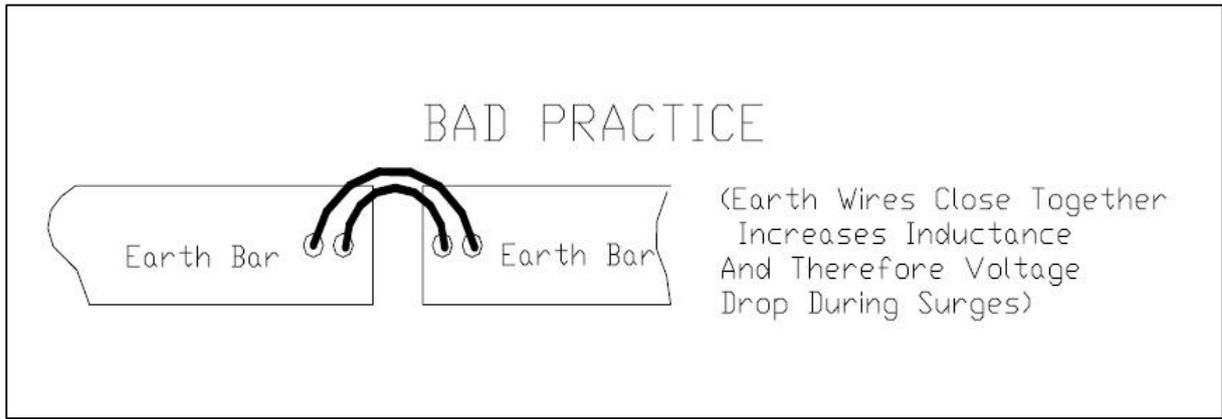


Figure C4 –Bad Practice for Earthing Connections

Separation of wires decreases the affect between wires and as a result the surge current effectively treats the pair of wires as individual wires. Good practice keeps the wires apart as per Figure C5.

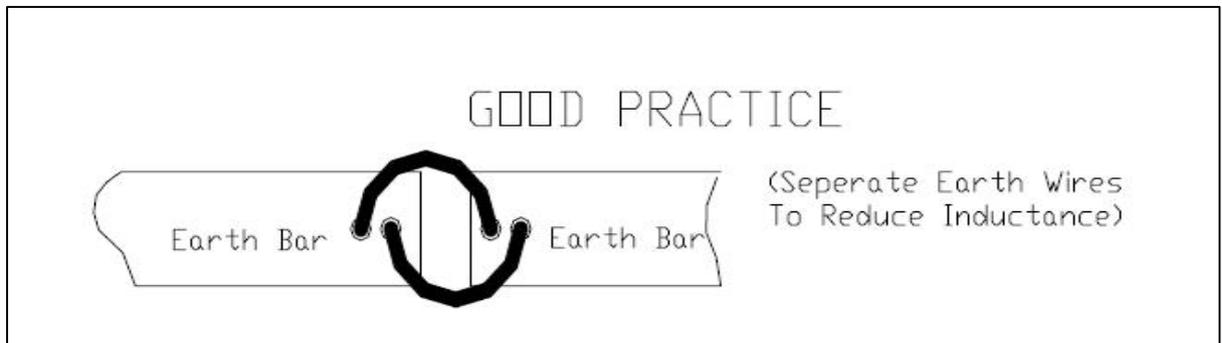


Figure C5 –Good Wiring Practice for Earthing Connections

Coils and bends in the earth wire as per Figure C6 increases its length and inductance and as a result reduces the effectiveness of the surge protector, this is considered bad wiring practice.

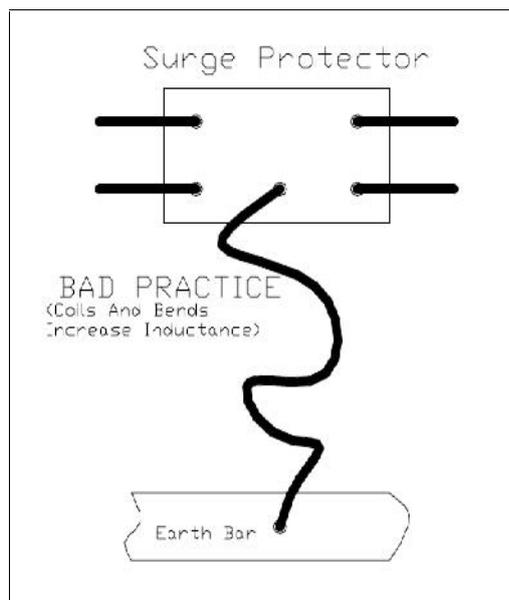


Figure C6 –Bad Practice for Earthing Connections

Minimum length on earth wire results in the best possible performance of the surge protector as per Figure C7

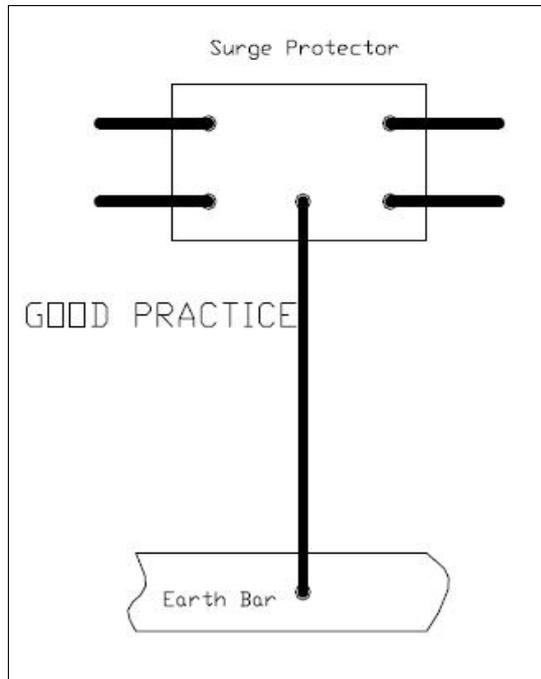


Figure C7 –Good Wiring Practice for Earthing Connections

C5.2 Wiring Proximity

Wiring in close proximity will cause common mode surge currents to have a higher self-inductance.

Therefore it is best to make sure that power cables are kept in close proximity by binding them together prior to connection to the surge protector to increase their inductance to common mode surge. This practice is illustrated in Figure C8.

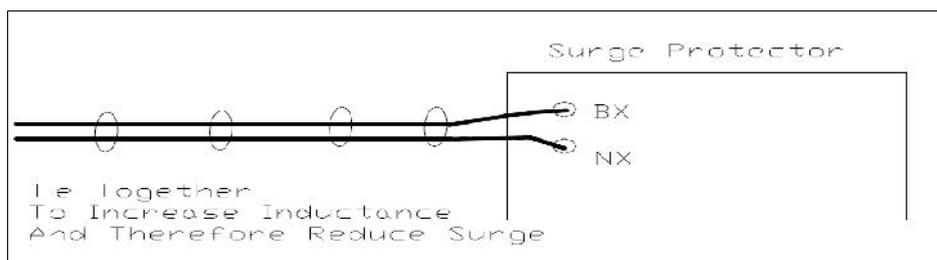


Figure C8 –Good Wiring Practice for Earthing Connections

Cabling that has not had proper surge protection should not be put in close proximity to the signalling cables as it can couple surges into other cables as would occur if installed as per Figure C9. If placed in the same trench then it must have a physical separation of greater than 150 mm.

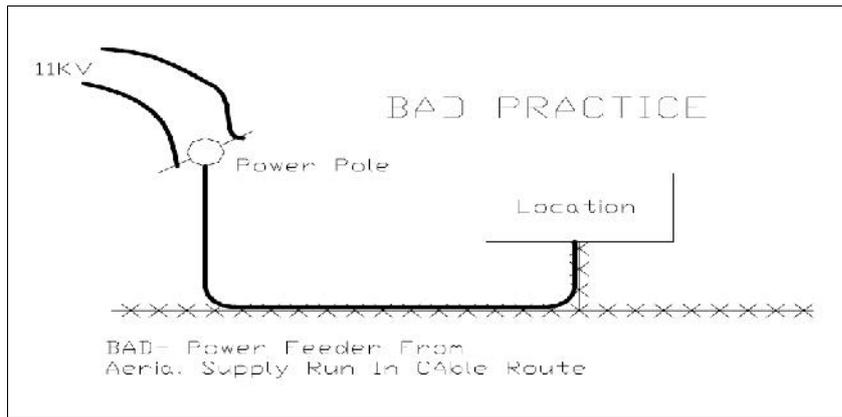


Figure C9 –Bad Practice for 11kV/120V Transformer on Power Pole

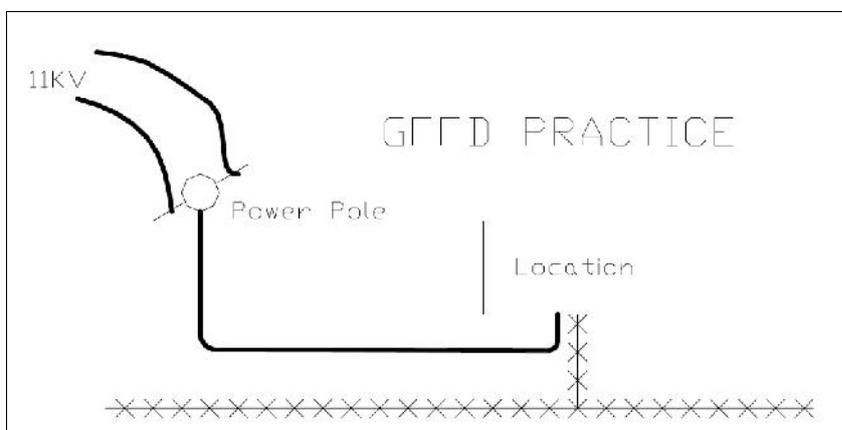


Figure C10 –Good Practice for 11kV/120V Transformer on Power Pole

If wires have to cross, then it is acceptable practice to cross at right angles, with no parallelism as shown in Figure C11. In these cases if the wiring is from an above ground source then a piece of earthed metal or additional insulation should be placed between the crossing wires.

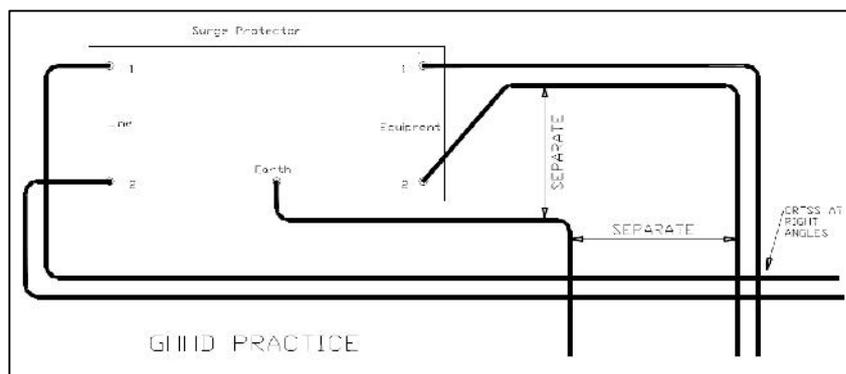


Figure C11 –Good Separation and Crossing Practices

C.6 Preferred Practice for Wiring

C6.1 Wiring of Main Surge Protection Panels

Figure C11 shows the preferred method of wiring main surge protection panels.

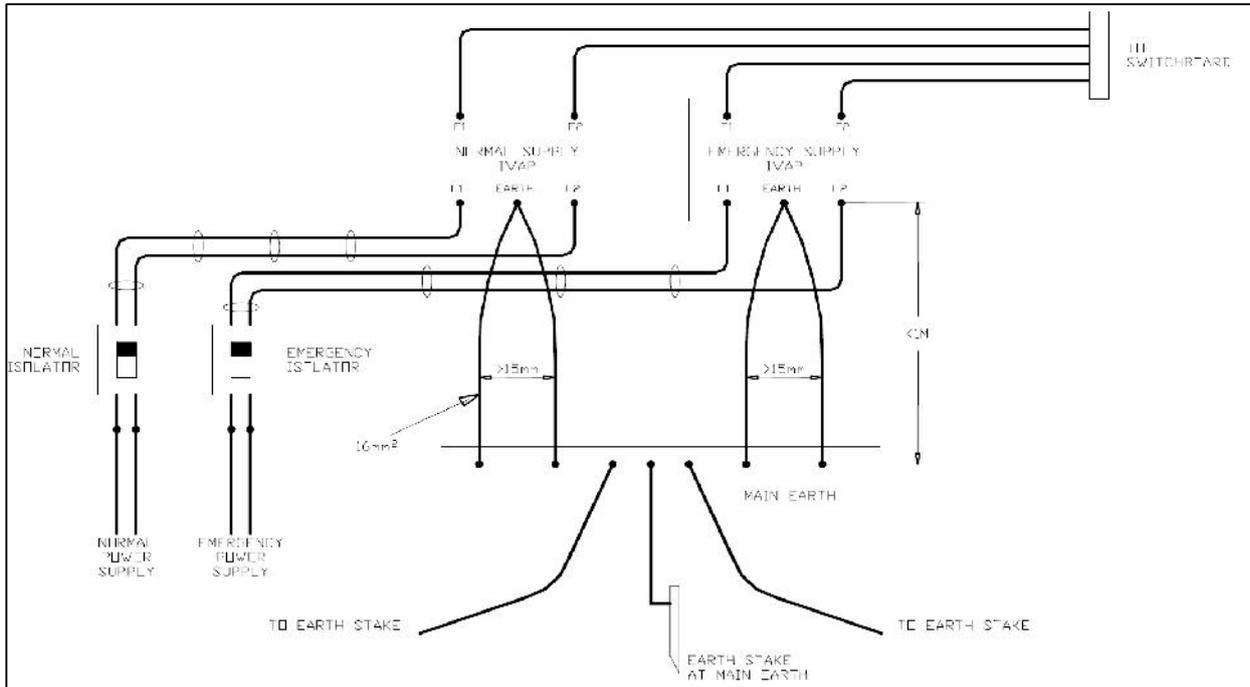


Figure C11 –Preferred Method for Wiring Main Surge Protection Panels

C6.2 Mounting and Earthing of Rail Mounted Equipment for Retrofitting Existing Locations

Figure C12 shows the improved retrofitting earthing practice into existing location cases.

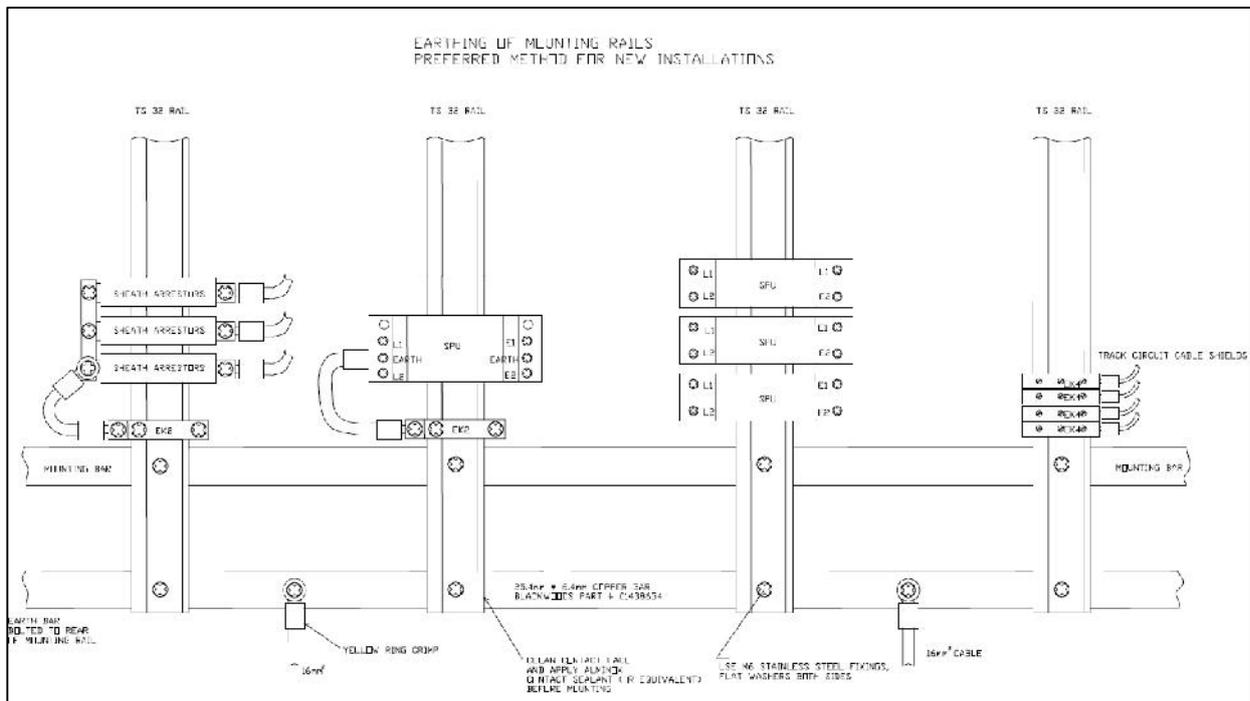


Figure C12 –Preferred Method for Mounting and Earthing in Retrofitted Locations

C6.2 Mounting and Earthing of Rail Mounted Equipment for New Locations

Figure C13 shows the improved retrofitting earthing practice into existing location cases.

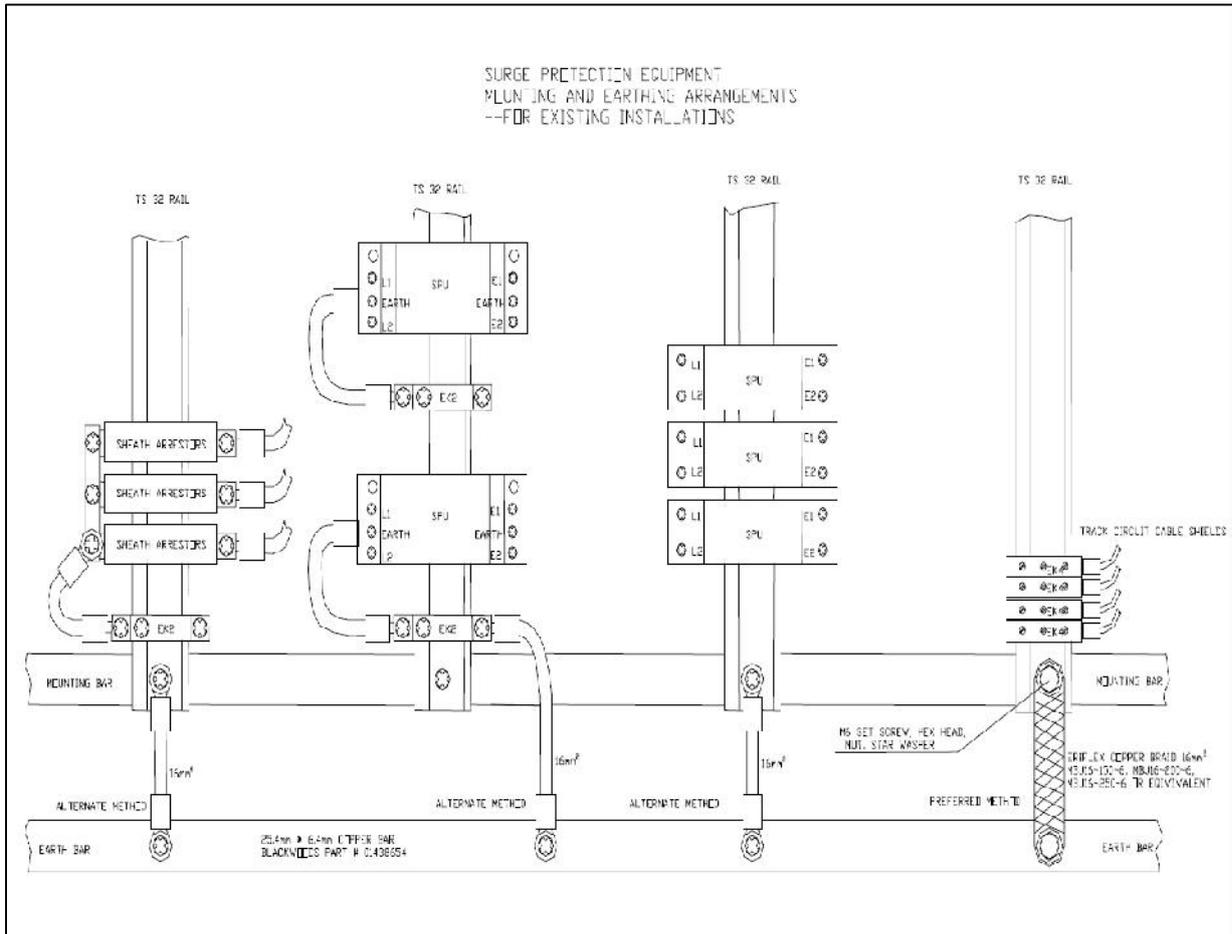


Figure C13 –Preferred Method for Mounting and Earthing in New Locations

C6.2 Separation of Wiring Ducts

Figure C14 details the preferred method to separation clean and dirty wiring by the use of separate wiring ducts.

C.7 Location Layout Example

Attached drawing CB:477 Sheet X27 Part 1 of 2 shows a Power Supply location layout. Cable entry is from the bottom of the location.

This drawing shows:

- The earth bars being bonded in series because the length of the bond is short.
- The earth bars being bonded to the location metalwork.
- The dotted shading area around the IVAP surge panels indicates the area where the non-surge protected wiring is to be run and surge protected wiring must not be run.
- The IVAP surge panels have been mounted low in the location to reduce the length earth wires to the earth bar.
- The IVAP surge panel 2 has been turned around to allow separation of the protected and un-protected wiring.
- The IVAP surge panel 3 is mounted higher in the location because of physical constraints and panels 1, and 2 are the primary power supply surge protection.

C.8 Earthing Plan Example

Attached drawing CB:477 sheet Y48 HR134 Earth Connections shows the earth connections for a Power supply location with SSI type CBI equipment.

A High voltage earth exists near the location but is separated from the signalling earth by more than 17 metres.

A Council MEN earth exists near the location but is separated from the signalling earth by more than 2 m.

These earths are not shown on the drawing because they meet the separation requirements. If they did not meet the separation requirements then they would be shown on the plan.

The drawing shows:

- The earth bars installed
- How the earth bars are interconnected.
- Where the equipment earths are connected.
- The earth stakes installed, where they are located, and how they are connected.

C.9 AC Power Supply Circuit Example

Attached drawing CB:477 sheet U14 shows the circuit for wiring to the emergency Change-over contactor.

The drawing shows:

- Notes indicating the unprotected wiring that must be separated from surge protected wiring.
- Notes indicating the wiring that must be cable tied together to improve surge protection performance. The cable ties are not necessary if a twin or twisted pair cable is used.
- Notes detailing the limits for the length of the IVAP earth connections.
- A surge protector at Council supply metre box to limit surges in cabling to location.

C.10 Examples of Good and Poor Installation Practice

C10.1 Poor Earthing Installation

The photograph in Figure C16 shows poor earth wiring practice because the wiring:

- Is not as short as practical,
- Has bends which are un-necessary,
- Is mixed with surge protected wiring.

The DKU48 surge protectors are also mounted at the top of the middle “G Rail” which maximises the length of the earth wires instead of minimising the length of earth wires.

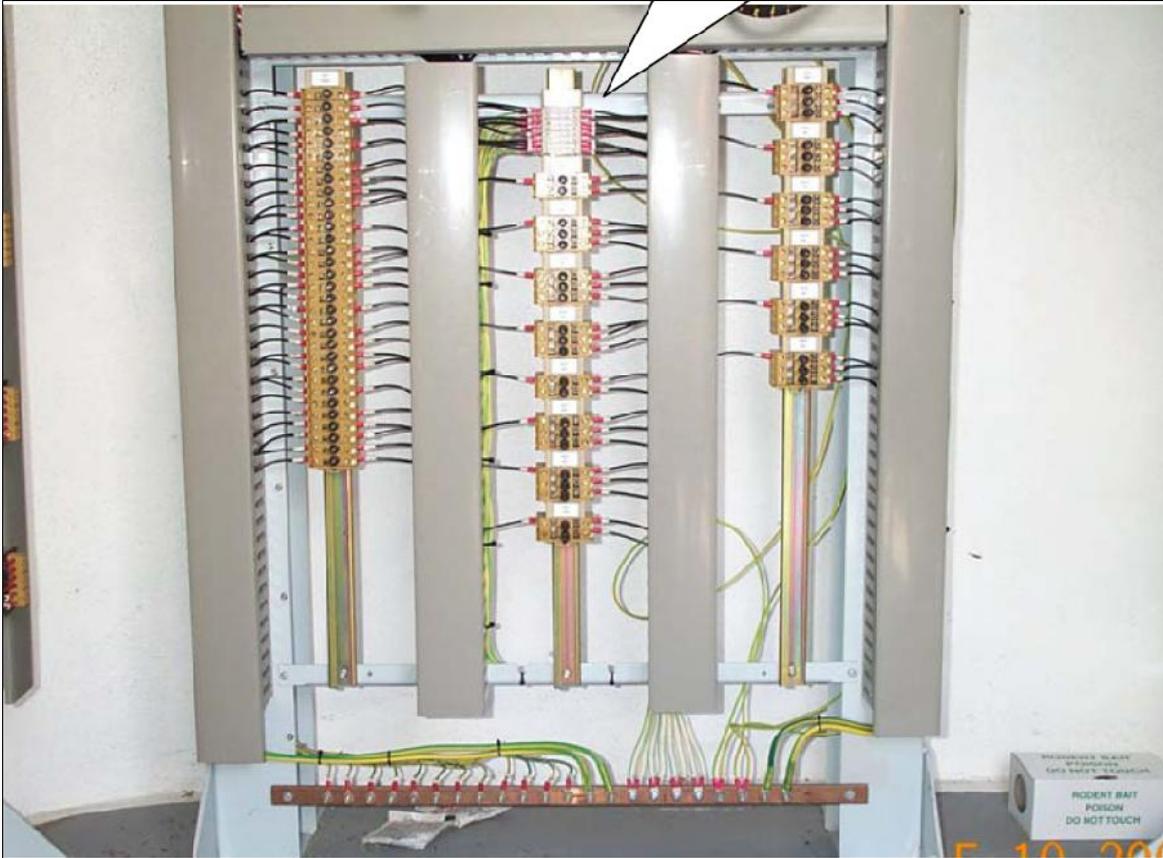


Figure C16 –Poor Example of Earthing Installation

C10.2 Good Earthing Installation

The photograph in Figure C17 shows good earth wiring practice, as the earth wire is as short and as direct as possible with no bends, or coils, and separated from other.

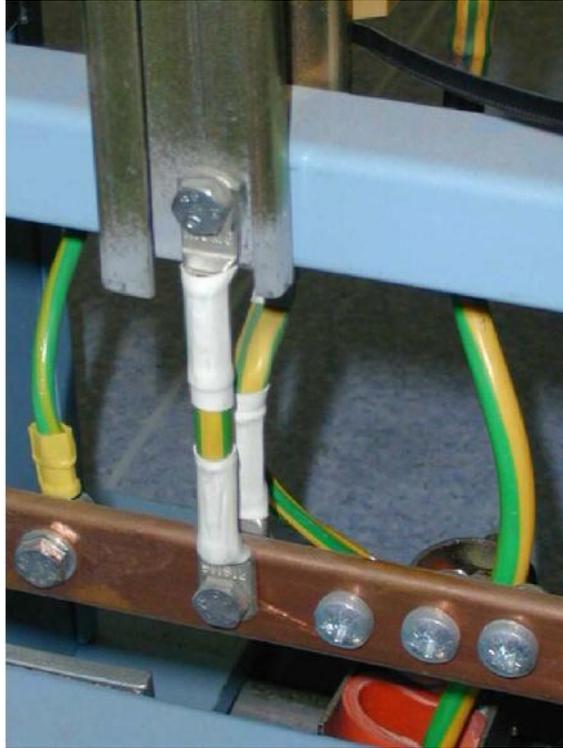


Figure C17 –Good Example of Earthing Installation

C10.3 Poor Surge Protection Installation

Figure C18 shows that the surge protected wiring from the surge panel on the right hand side is in close proximity to the unprotected wiring for the left hand surge protection panel.

This is poor practice, as a lightning surge will be coupled into the protected wiring.

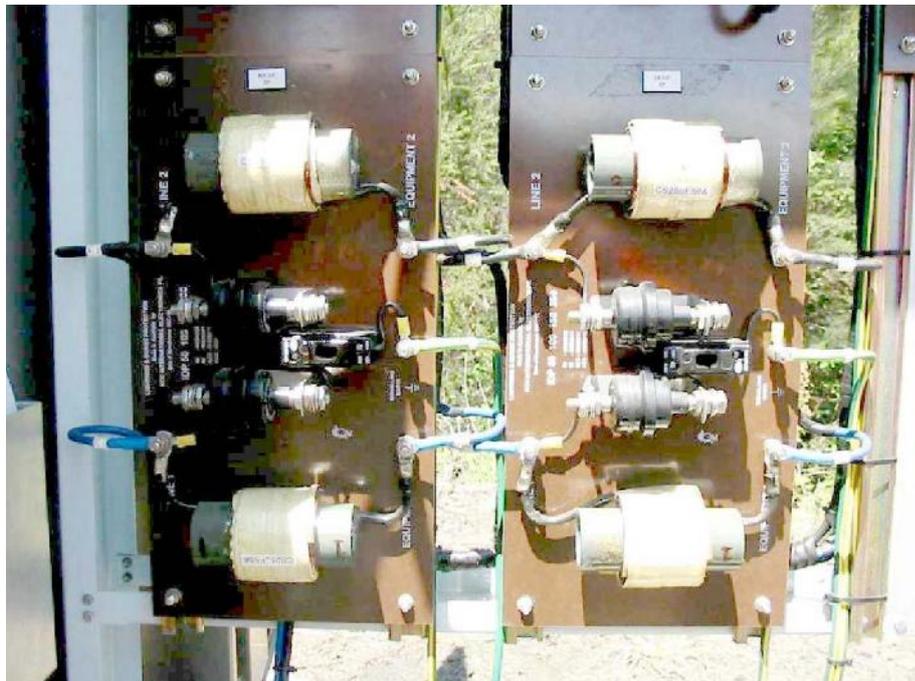
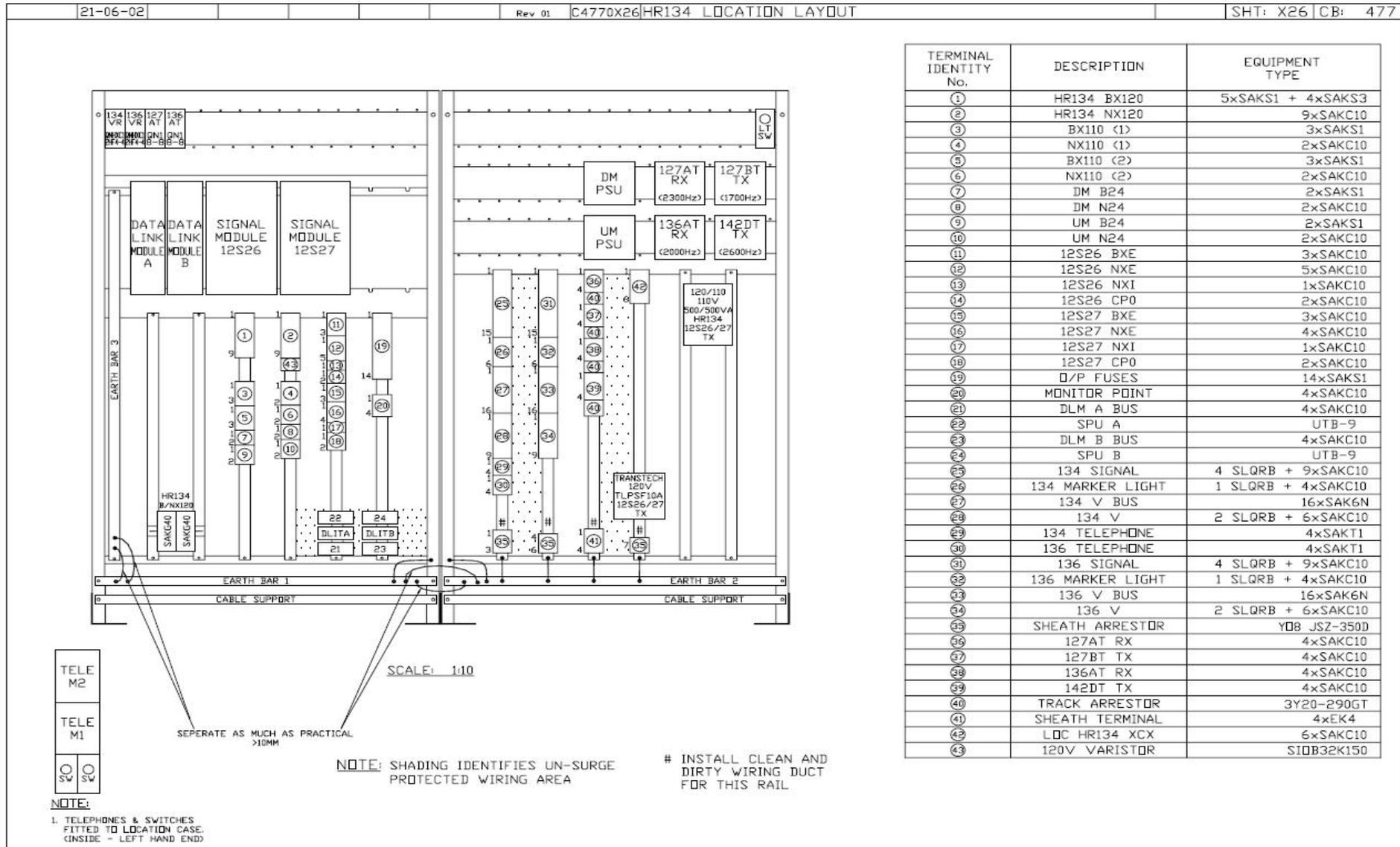


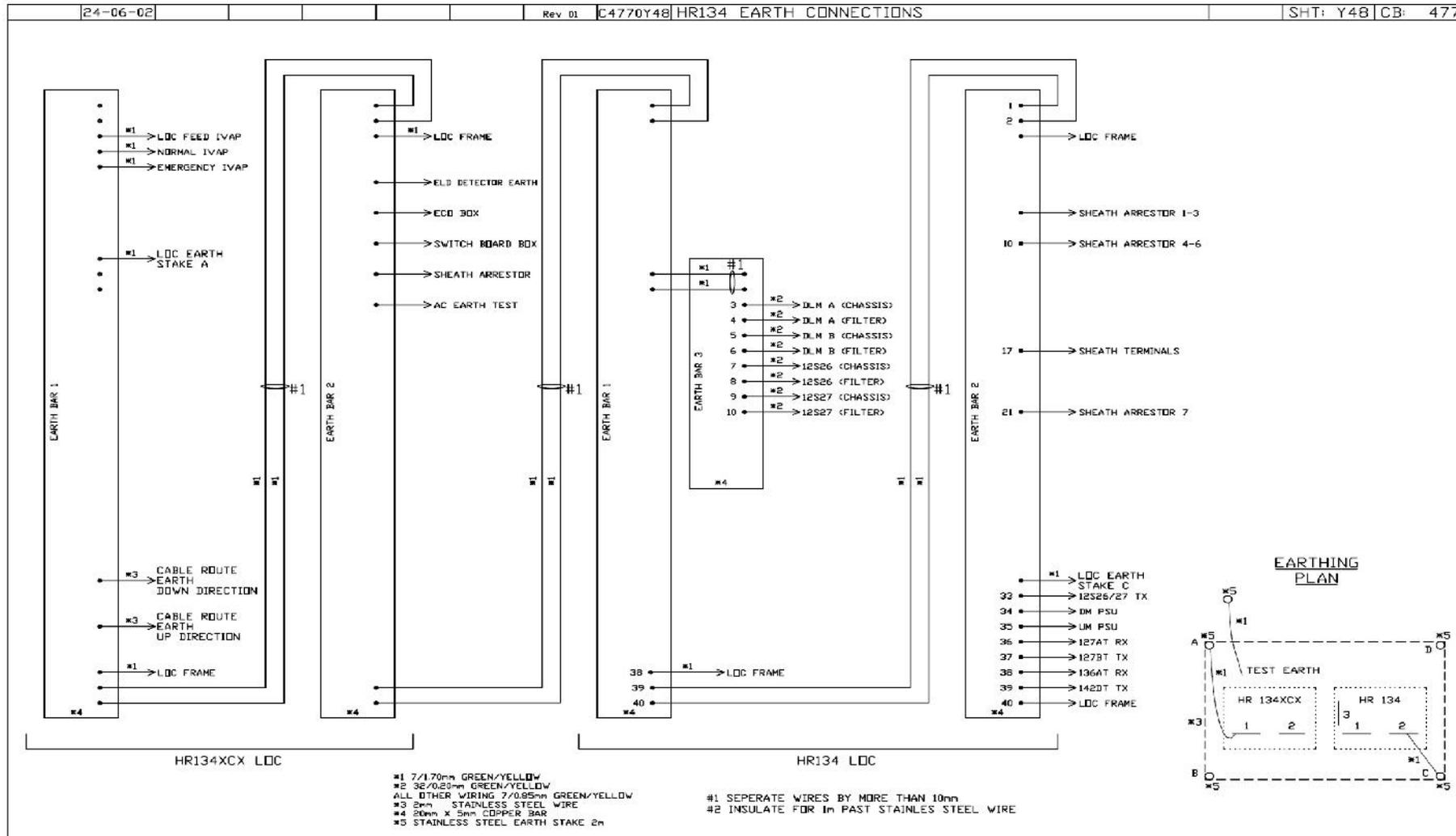
Figure C18 –Poor Example of Surge Protection Installation



24-06-02

Rev 01 C4770Y48 HRI34 EARTH CONNECTIONS

SHT: Y48 | CB: 477



Appendix D Switch Identification and ESML/EOL Signage

D1.1 Switch Identification

- D1.1.1 All points and swing nose crossings shall be identified with a point end ID plate (e.g. 201A, 201B etc.) fixed to the point motor cover.
- D1.1.2 The ID plate shall comply with the requirements stipulated in SPS 03 Section 1. Lettering shall be 100mm high reflective white/silver on black background similar to that provided on signalling equipment buildings (see example in below Figure D1.1).



Figure D1 – Example of switch identification signage

D1.2 Switch Position

- D1.2.1 All points and swing nose crossings are to be provided with a switch position indicator.
- D1.2.2 Claw-lock and Spherolock arrangements shall be provide with a pointer which indicates when the switch blade is fully reverse or normal as applicable and fully locked. (see Figures D2 and D3).



Figure D2 – Example of claw-lock signage



Figure D3 – Example of Spherolock signage

- D1.2.3 For all other point end arrangements the letter “R” shall be placed in the “4-foot” adjacent to the reverse switch. The letter “N” shall be placed in the “4 foot” adjacent to the normal switch.
- D1.2.4 For swing-nose crossing arrangements the letter “R” shall be placed in the “4-foot” adjacent to the reverse switch position. The letter “N” shall be placed in the “4 foot” adjacent to the normal switch position.
- D1.2.5 The switch position plate shall comply with the requirements stipulated in SPS 03 Section 1; lettering shall be 100mm high reflective white/silver on black background similar to that provided on signalling equipment buildings.

D1.3 EOL/ESML Signage

To assist rail personnel know how many point ends they will need to manually operate, the following signage is to be provided on the inside of the ESML or EOL cabinet door. Note that only one of the following signs are required depending on the points arrangement.

- D1.3.1 Two point ends with two fixed-nosed crossings (i.e. traditional v-crossings)



Figure D4 – Example of signage for D1.3.1.

- D1.3.2 One (1) point end and one (1) swing-nosed crossing.

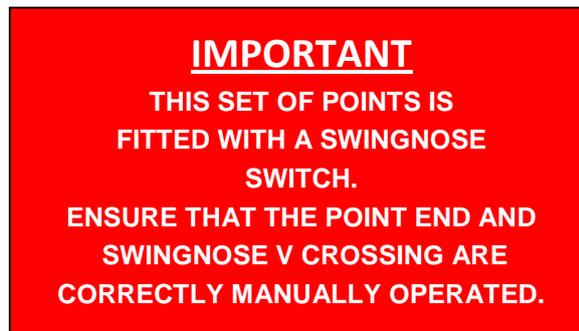


Figure D5 – Example of signage for D1.3.2.

- D1.3.3 Two (2) point ends and two (2) swing-nosed crossings

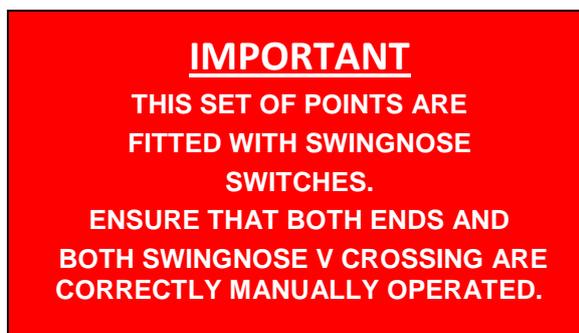


Figure D6 – Example of signage for D1.3.3.

D1.3.4 Two (2) point ends and one (1) swing-nosed crossing

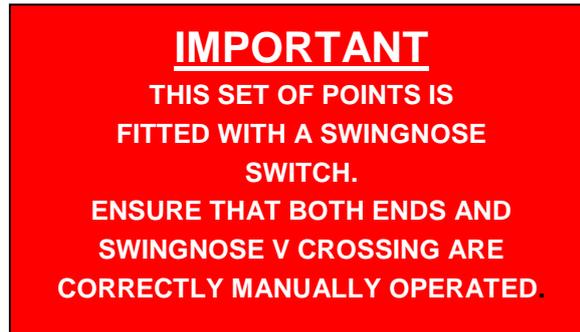


Figure D7 – Example of signage for D1.3.4.

D1.4 Point Manual Operation Handles

Also see SDS 14, SCP 22, ESC-07-03 and ESC-07-01

- D1.4.1 Where loose handles for the manual operation of power worked points are provided these handles shall be housed in the EOL / ESML cabinet. Each handle in the cabinet shall be securely attached to its companion EOL key by a stainless steel lanyard.
- D1.4.2 Each EOL key shall be fixed to a corresponding tag and handle all of which shall be inscribed as detailed in SDS 14. (ie Key, Tag and Handle)
- D1.4.3 Handles, point clips and SL locks shall be secured in the EOL / ESML cabinet in a manner which prevents them from falling out – see Figure D8
- D1.4.4 Where there is insufficient space to hold the point clips in the EOL / ESML cabinet an additional cabinet shall be provided. This cabinet shall be mounted adjacent to the EOL / ESML cabinet for the points for which the point clips are provided. The cabinet shall be fitted with a name plate inscribed “XXX (insert points id) POINT CLIPS”



Figure D8 – Typical EOL cabinet for Siemens S700 and Vossloh Cogifer point motors.



Figure D9 – Typical EOL cabinet for Siemens S700 and Vossloh Cogifer point motors.

D1.5 Points Manual Operation Warning Notice

- D1.5.1 In an effort to assist track staff manually operating points for traffic movements a warning notice shall be fixed to each point machine.
- D1.5.2 This warning notice shall follow the key shown in Figure D10 to generate the appropriate wording for each situation. Figures D11 and D12 are examples of installed signage.
- D1.5.3 Fixing of this signage shall be by permanent means such as screws, rivets or other mechanical fixings and located in a clearly visible position on the points machine.
- D1.5.4 Lettering and numerals and letter and numeral spacing shall be in accordance with AS1744. The notice shall be in the form of black text on white background with the word “WARNING” in blue text. See figure 8
- D1.5.5 Warning plates shall be made from aluminium alloy sheet 1.6mm thick sheet (5052 H36 or H38; 5251 H36 or H38) or extrusion, Alloys (6063 T5 or T6; 6061 T6)
- D1.5.6 Finishes, weather paints, films or other coating materials shall be compatible and adhere securely to the aluminium plate or extrusion and have an equivalent or better service life of greater than 10 years in and external environment.

WARNING

FOR THE MANUAL OPERATION OF <A>, , <C>
POINT MACHINES MUST BE OPERATED.

THEY ARE <D>.

YOU ARE NOW AT MACHINE <E>.

ENSURE ALL POINTS <F> ARE IN THE CORRECT
POSITION BEFORE CLIPPING AND LOCKING.

<A> - INSERT NAME OF TURNOUT OR CROSSOVER

 - TURNOUT / CROSSOVER (select applicable)

<C> - ONE (1)/TWO (2)/THREE (3)/FOUR (4) (select applicable)

<D> - INSERT POINT ID NUMBERS (ie 215A, 215B, 215C, 215D as applicable)

<E> - INSERT POINT ID NUMBER

F - <AND SWINGNOSE CROSSINGS (delete if not required)>

Figure D10 – Points Machine Manual Operation Signage Key

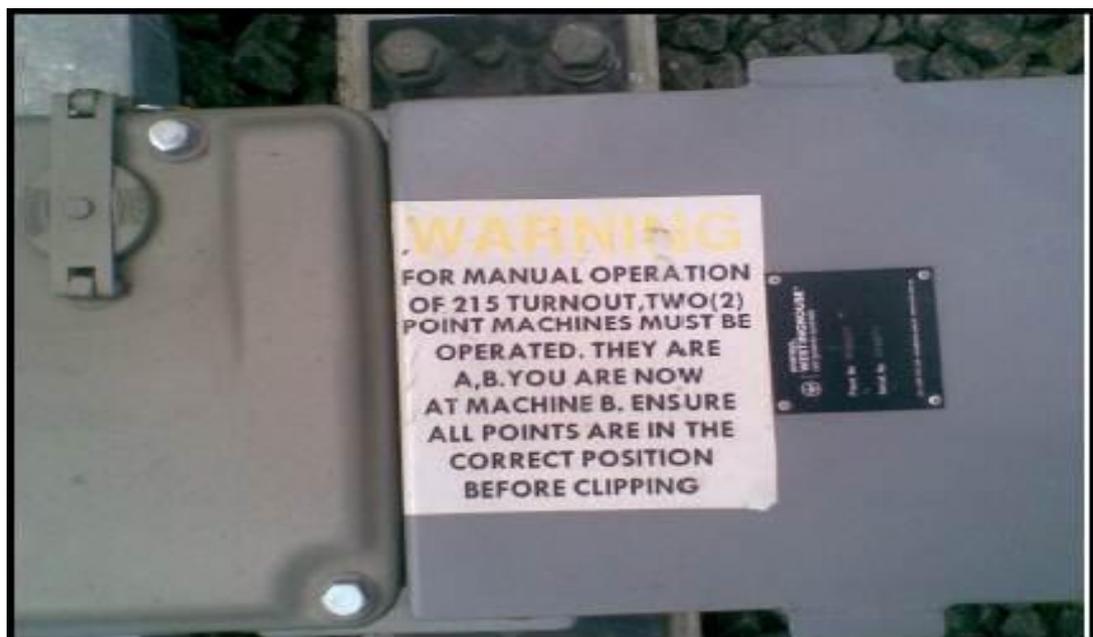


Figure D11 – Location of Points Manual Operation Warning Notice (note WARNING lettering incorrectly yellow).



Figure D12 – Location of Points Manual Operation Warning Notice on D84M motor.

D1.6 Points Clip Signage

All points and swing nose crossings shall be fitted with a plate which identifies the location which the point clip shall be placed for securing the switch blade against the point or swing nose stock rail – see Figure D13.

D1.6.1 Inscription “POINTS CLIP THIS BAY”

D1.6.2 The point clip location plate shall be made from aluminium alloy sheet 1.6 mm thick sheet (5052 H36 or H38; 5251 H36 or H38) or extrusion, Alloys (6063 T5 or T6; 6061 T6)

D1.6.3 Finishes, weather paints, films or other coating materials shall be compatible and adhere securely to the aluminium plate or extrusion and have an equivalent or better service life of greater than 10 years in and external environment.

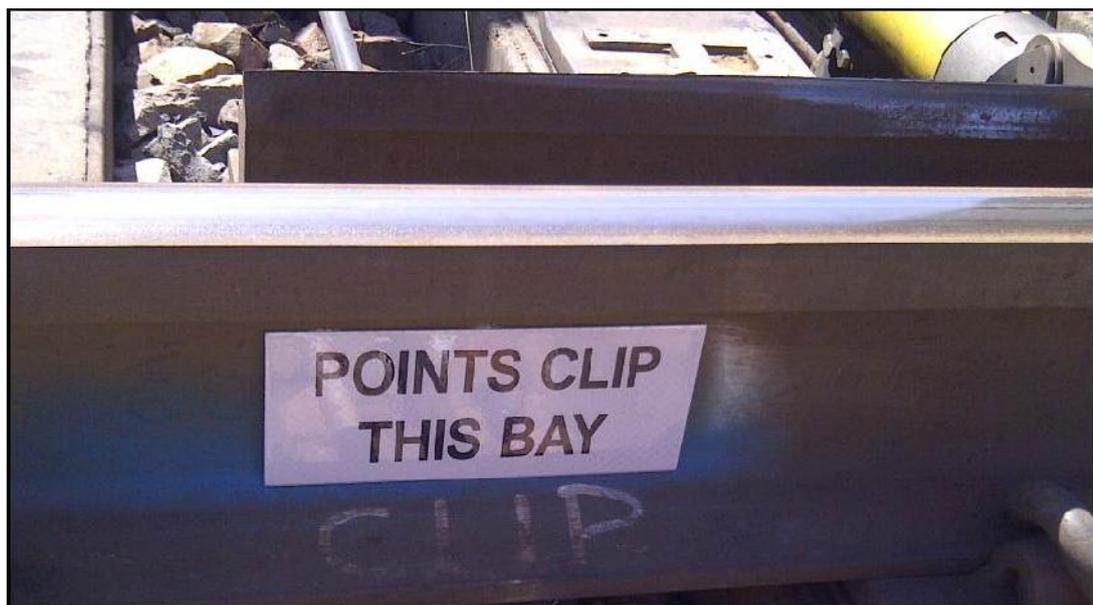


Figure D13 – Location of Points Manual Operation Warning Notice on D84M motor.