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Earthing & Bonding for Heavy Rail

Electrical Technical Forum



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Greetings

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Agenda

- ❑ **Current relevant standards**
- ❑ **Impending standards and guidelines**
- ❑ **Quick overview of DC Bonding**
 - Bonding issues
 - The typical solutions
- ❑ **Complications at Stations**
- ❑ **Complications at Maintenance Facilities**
- ❑ **Considerations for adjacent public infrastructure**
- ❑ **HV Earthing issues**

Raising Awareness of Guidance

ASA standards & guidelines on dealing with 1500VDC bonding issues:

The following documents give requirements and practical guidance on the issues of 1500VDC bonding:

- EP 12 00 00 01 SP High Voltage and 1500 System Earthing References and Definitions
- EP 12 00 00 02 SP Low Voltage Distribution and Installations Earthing References
- EP 12 10 00 13 SP 1500 V Traction System Earthings
- EP 12 10 00 21 SP Low Voltage Installations Earthings
- EP 12 20 00 01 SP Bonding of Overhead Wiring Structures to Rail
- EP 00 00 00 08 SP Safe Limits Of DC Voltages
- T HR EL 12002 GU Electrolysis from stray DC currents
- T HR EL 08001 ST Safety Screens and Barriers for 1500 V OHW Equipment
- EP 19 00 00 01 SP DCCB and delta I relay setting method
- TN016 Overbridges and footbridges earthing and bonding requirements
- Guideline on earthing and bonding at railway stations

All of the above and more are available at <http://www.asa.transport.nsw.gov.au/asa-standards>

International standards & guidelines:

The principles in the documents above are based on experience which is consistent with international standards such as EN 50122 Parts 1-3 (also known as IEC 62128 Parts 1-3) and industry best practices. Standards are available at <https://www.saiglobal.com>

Impending Standards

Updates on the way...

- LV distribution & installation earthing standards
- Updates to the guideline Electrolysis from stray DC currents

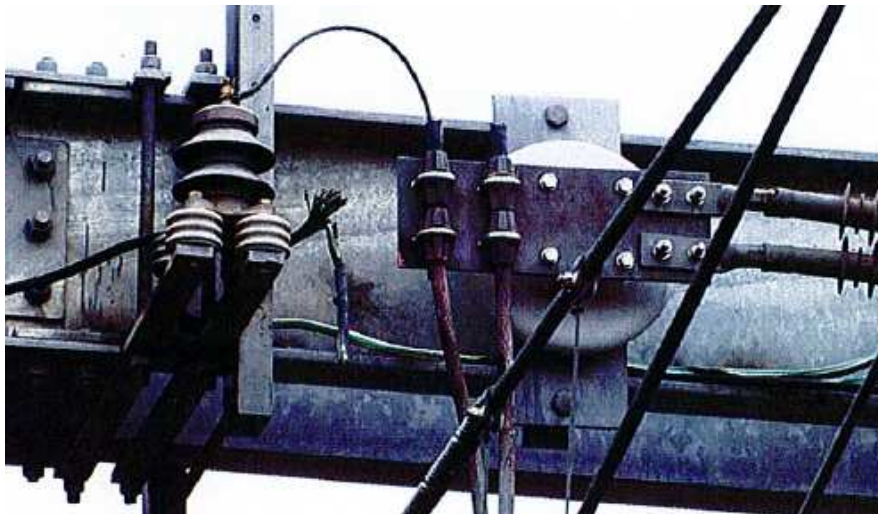
New...

- 1500V DC Bonding standard

1500VDC Hazards

Possible sources of 1500VDC faults:

- OHW fitting/insulator failure (flashover)
- OHW failure (fallen/broken wire)
- Contact with OHW (chains, tin roof)
- Pantograph malfunction



Practical Solutions

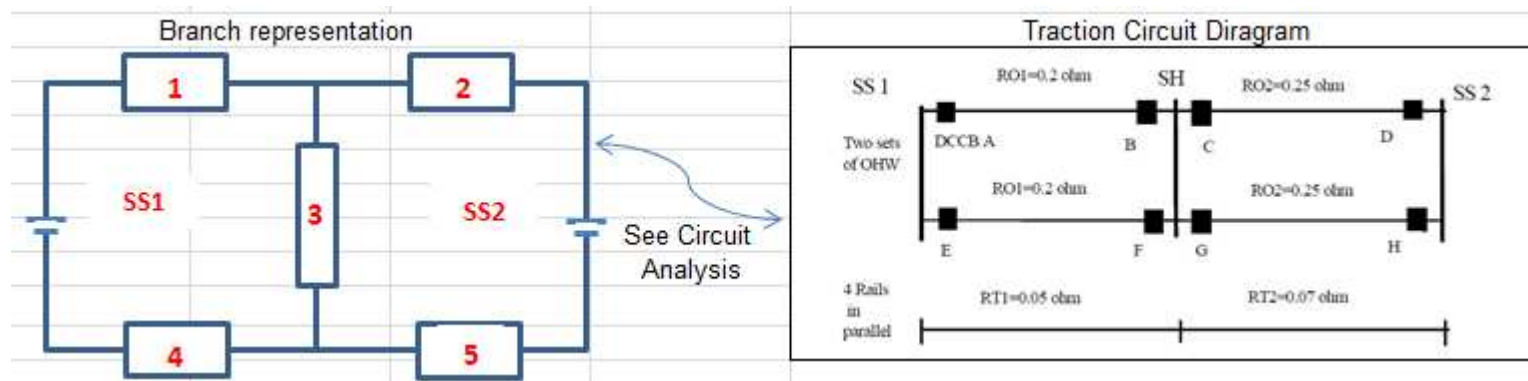
May consist of:

- Spark gap bonding circuit
- Physical clearances, barriers and insulation
- Equipotential bonding
- Secondary / Tertiary OHW insulation



The Impacts of Bonding Circuits

Calculation of DCCB protection clearance is a mandatory aspect of bond circuit design.



Excessive bonding circuits will reduce prospective fault levels and may compromise DCCB operation or result restricting the DCCB settings.

The Impacts of Bonding Circuits

Minimum fault level for typical bonding circuits

Fault circuit	Minimum fault level for typical bonding circuits					
	OHWS	OHWS (5m)		Footbridge (35m)	Daisy chain OHWS / Flyover (50m)	
	Dead short	Copper	Steel	Copper	Steel	Copper
Fault between substations.	100%	99%	88%	75%	40%	90%

Further considerations:

- Falling voltage shall be considered for calculation of FAR DCCB tripping (EP 04 01 00 01 SP section 6.2.3)
- Redundancy shall be considered when designing bonding circuits (such as using loops)
- Commissioning testing shall be done confirm installation meets requirements

1500VDC Bonding & Electrolysis

Stations and bridges

- EP12100021SP & EP12100020SP are guiding documents on stations and other LV installations with LV earthing in close proximity to 1500VDC infrastructure.
- TN016 is the guiding document on Overbridges and really Bridges in general.
- Guideline on earthing and bonding at Railway Stations
- Applications of the above to existing installations.

1500VDC Bonding & Electrolysis Issues

Complications at stations

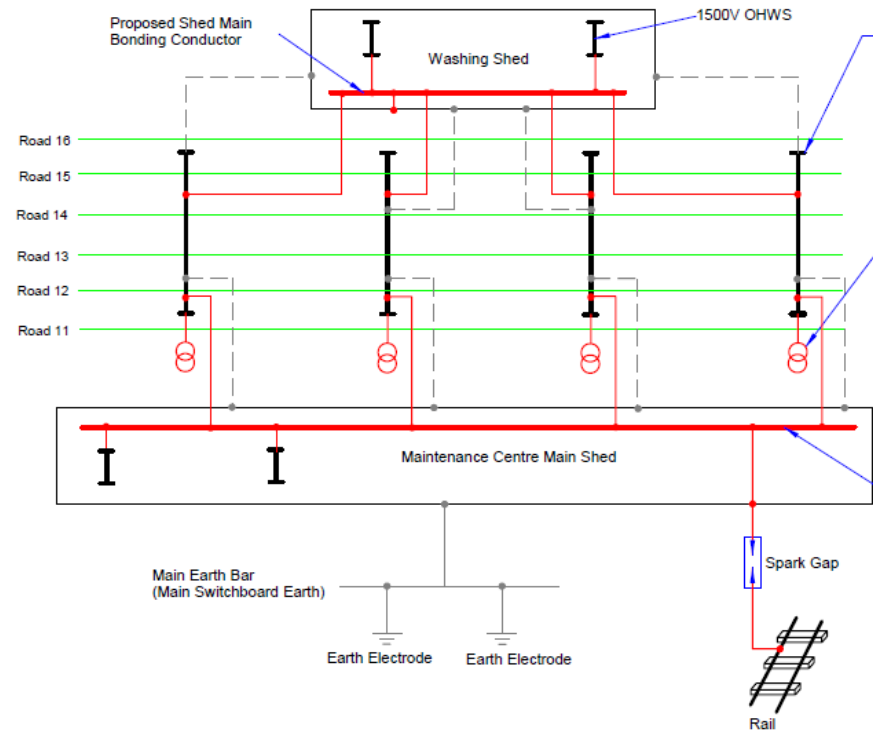
- Aerial lines over buildings and structures (refer to T HR EL 00004 ST)
- As built information for existing bonding arrangements
- Isolation barriers
- Understanding of bonding strategy and exclusion zones
- Testing complications



1500VDC Bonding & Electrolysis Issues

Complications at Maintenance Facilities

- Excessively large and well earth structures
- Grading of VLD devices and spark gap bonding circuits
- Isolation barriers
- Testing complications
- ROCR



1500VDC Bonding & Electrolysis Issues

Considerations for adjacent public infrastructure

- Electrolysis
- Extending HV earthing systems
- Use of minimisation techniques
- Assessment of design against baseline signature
- Use the 'near to' definition with caution.

HV Earthing Issues

Difference in approaches between AS2067, (EG0) and ETN11/02

- ETN11/02 Is still a valid document
- Probabilistic analysis can still be undertake as part of SFAIRP approach should compliance with ETN11/02 be proved not reasonably practicable.
- HV earthing documents are on the way to address this.

Construction and installation of Earthing Systems

- Use of C crimps
- Installation of Insulated fence panels
- Excessive equipotential bonding at Substations



Questions ?

