

Specification

Voltage Limiting Device Specification

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1 PURPOSE

The purpose of this specification is to specify the minimum requirements of voltage limiting devices, which are to be installed within DC traction substations on the Yarra Trams network.

The configuration, ratings and any other project specific equipment details shall be provided by Yarra Trams in the accompanying *Scope of Works* document.

2 SCOPE

The scope of this specification encompasses the design and construction requirements for all new voltage limiting devices. This specification does not apply retrospectively to existing voltage limiting devices on the Yarra Trams network. However, this specification is applicable if an existing voltage limiting device is being altered, modified or replaced.

This specification applies to any party who is involved in the design or construction of voltage limiting devices for Yarra Trams.

3 COMPLIANCE

Any party who is involved in the design or construction of voltage limiting devices for Yarra Trams shall fully comply with this specification. Deviation from this specification is only permitted when a deviation or waiver has been formally requested and approved as the per Yarra Trams Deviation from Standards procedure.

The Yarra Trams Engineering Change Management Procedure [CE-021-PR-0020] shall be followed in all circumstances where change is proposed to this specification.

The following definitions apply throughout the specification:

- 'Shall' statements are mandatory in the context of compliance with requirements stipulated in this specification.
- 'Should' statements are considerations in the context of compliance with requirements stipulated in this specification.
- 'Information' statements provide additional content for clarification purposes only and are not requirements in the context of compliance with this specification.
- 'So far as is reasonably practicable' statements must at a minimum result in the provision of a technical risk assessment including proposed list of design controls to demonstrate compliance to this specification.



4 REQUIREMENTS

4.1 Service conditions

4.1.1 Operating conditions

- 4.1.1.1 The voltage limiting device shall be indoor or underground.
- 4.1.1.2 The operating conditions shall be those defined in Infrastructure - Network Power – Substation - Design and Construction [CE-021-ST-0023].

4.1.2 Transport and storage conditions

- 4.1.2.1 The transport and storage conditions are defined in the Infrastructure - Network Power – Substation - Design and Construction [CE-021-ST-0023].
- 4.1.2.2 The *Designer* shall detail the minimum storage requirements. This information shall be contained in the equipment manuals, which are outlined in Table 3.

4.1.3 Noise

- 4.1.3.1 The permissible noise levels inside and outside the substation are defined in Infrastructure - Network Power – Substation - Design and Construction [CE-021-ST-0023].

4.1.4 Electromagnetic compatibility (EMC)

- 4.1.4.1 The electromagnetic compatibility requirements are defined in Infrastructure - Network Power – Substation - Design and Construction [CE-021-ST-0023].

4.2 General requirements

4.2.1 General

- 4.2.1.1 The voltage limiting device shall comply with the following:
 - EN 50526-2; and
 - EN 50122-1 (fulfilling the requirements of VLD-F and VLD-O).
- 4.2.1.2 The voltage limiting device shall ensure the voltage between earth and the return circuit does not exceed the maximum permissible effective touch voltages for long-term and short-term conditions in accordance with Infrastructure - Network Power – Traction Power – Design and Construction [CE-021-ST-0037].
- 4.2.1.3 The voltage limiting device shall meet the following requirements:



Table 1: General requirements

Description	Requirement
Class	Class 4.1 and 4.2
Input: Reliable auxiliary power supply	48 V DC
Recoverable or non-recoverable	Recoverable
Rated current, I_r [A]	To be determined by the <i>Designer</i>
Short time withstand current, I_w [A]	To be determined by the <i>Designer</i>
Making capacity	To be determined by the <i>Designer</i>

4.2.1.4 The *Designer* is fully responsible for providing suitable ratings for the voltage limiting device. The *Designer* shall at least consider the following scenarios when determining the ratings of the voltage limiting device:

- DC Traction short circuit current flowing through the VLD; and
- Stray current flowing through the VLD when the contactor is closed.

4.2.1.5 In accordance with section 5.6 of EN 50526-2, the voltage limiting device shall withstand the effects of lightning surges at the substation.

4.2.2 Insulation coordination

4.2.2.1 The insulation levels are defined in Infrastructure - Network Power – Substation - Design and Construction [CE-021-ST-0023].

4.2.3 Earthing and bonding

4.2.3.1 The metal frame of the voltage limiting device shall be connected to earth.

4.2.3.2 All other requirements are defined in the Infrastructure - Network Power – Substation - Design and Construction [CE-021-ST-0023].

4.2.4 Enclosure

4.2.4.1 The minimum degree of protection provided by the enclosure (according to AS 60529) shall be IP21.

4.2.5 Protection

General

4.2.5.1 The voltage limiting device shall include at least the following protection:

- Instantaneous overvoltage protection (utilising thyristors); and
- Overvoltage protection (utilising contactor).



Instantaneous overvoltage protection (utilising thyristors)

4.2.5.2 The protection shall utilise the thyristors to ensure a fast closing of the circuit, working in parallel to the contactor.

Overvoltage protection (utilising contactor)

4.2.5.3 If the voltage exceeds a set value and remains there longer than the set time delay, the protection shall operate. The voltage tripping threshold and time delay shall be programmable.

4.2.6 Control panel

4.2.6.1 The voltage limiting device shall contain the local control characteristics and measuring indications outlined in section 5.7.1 of EN 50526-2.

4.2.7 Equipment interfaces

SCADA

4.2.7.1 The voltage limiting device shall include at least the SCADA points outlined in Table 2. Each point shall be brought to the SCADA cubicle. The interpretation of Table 2 and additional SCADA requirements shall be in accordance with the Infrastructure - Network Power – Substation - Design and Construction [CE-021-ST-0023].

Table 2: Summary of SCADA points

Point description - 'Plant'	Point description - 'Designation'	Point description - 'Quantity'	Analogue, Status or Command	Hardwired or Digital	Details	Conditions or Controls
Voltage limiting device	Contactor	State	Status	Hardwired	2 Bit	00 = Disconnected 01 = Closed 10 = Open [Normal] 11 = Indeterminate
Voltage limiting device	VLD	Fault	Status	Hardwired	2 Bit	00 = Disconnected 01 = Normal [Normal] 10 = Fault 11 = Indeterminate
Voltage limiting device	VLD	Blocked	Status	Hardwired	1 Bit	0 = Blocked 1 = Normal [Normal]
Voltage limiting device	VLD	DC Voltage ¹	Analogue	Digital	16 Bit Units: Voltage [V]	



Voltage limiting device	VLD	DC Current ²	Analogue	Digital	16 Bit Units: Current [A]	
¹This is the instantaneous d.c. voltage across the terminals of the VLD. In accordance with section 5.7.1 of EN 50526-2, the voltage is the voltage on the rails relative to earth. This means that if the rail potential is positive the figure displayed is positive. ²This is the instantaneous d.c. current flowing through the device.						

4.2.7.2 Yarra Trams understands that the SCADA points outlined in Table 2 are only a minimum requirement. The *Designer* shall include additional SCADA points, where required for the effective operation and diagnostics of the equipment.

4.2.7.3 If the *Designer* is planning to include additional SCADA points or deviate from the points outlined in Table 2, this information shall be provided to Yarra Trams in accordance with the Infrastructure - Network Power – Substation - Design and Construction [CE-021-ST-0023].

Cables

4.2.7.4 Requirements for the cables are given in the Cable Specification [IN-021-ST-0003].

LV distribution

4.2.7.5 Interfaces with the LV distribution are given in the LV Switchboards Specification [IN-021-ST-0009].

4.2.8 Labelling and identification

Cubicle identification

4.2.8.1 Cubicle identification shall be in accordance with IEC 60445.

4.2.8.2 Additionally, the equipment designation (e.g. +VLD), which is defined in the *Scope of Works*, shall be clearly marked on the enclosure.

4.3 Testing

4.3.1.1 Testing shall be compliant with section 6 and section 7 of EN 50526-2.

4.3.1.2 Type tests shall be performed for all voltage limiting devices not having a type test certificate.

4.4 Reliability, Availability, Maintainability and Safety (RAMS)

4.4.1.1 The RAMS requirements are defined in the Infrastructure - Network Power – Substation - Design and Construction [CE-021-ST-0023].



4.5 Documentation

4.5.1.1 Submitted documentation shall at least comprise the items outlined in Table 3. This documentation shall be provided for the voltage limiting device throughout the procedure outlined in EMS Design Acceptance Standard [CE-023-ST-0020].

Table 3: Documentation

Documentation	Step 1: System Design Specifications (SDS)	Step 2: Acceptance Test Criteria	Step 3: Preliminary Design	Step 4: Detailed Design	Step 5: Production	Step 6: Installation/Site Assembly	Project completion
Statement of compliance			✓				
Technical specification			✓				
Single-line diagram of main circuit			✓				
General layout			✓				
Detailed drawings of electrical circuits (main and auxiliary)				✓	✓	✓	✓ ¹
Detailed drawings of mechanisms				✓	✓	✓	✓ ¹
Detailed drawings of mechanical arrangement, including cable boxes				✓	✓	✓	✓ ¹
Connection guide (conductors, earthing, auxiliary circuits, etc)			✓	✓	✓	✓	✓ ¹
Bill of materials				✓	✓	✓	✓ ¹
Detailed drawing of nameplate					✓	✓	✓ ¹
Type test certificates					✓	✓	✓
Test reports					✓	✓	✓
Installation manual(s)			✓ ²		✓	✓	✓
Operation manual(s)			✓ ²		✓	✓	✓
Maintenance manual(s)			✓ ²		✓	✓	✓
List of recommended spare parts and their availabilities			✓ ²		✓	✓	✓
¹ Drawings shall be submitted into PTV's Drawing Management System Compliant library according to the requirements of clause 4.5.1.2. ² Only typical non-project specific documentation required.							



4.5.1.2 The documentation shall be compliant with the requirements defined in Infrastructure - Network Power – Substation - Design and Construction [CE-021-ST-0023].

5 RELATED LEGISLATION & DOCUMENTS

5.1.1.1 The design and construction of voltage limiting devices shall be consistent with the best engineering practices and shall comply with all of the referenced documents listed in this section. These referenced documents shall be read in conjunction with this specification.

5.1.1.2 All referenced documents shall refer to the most recent published versions of them at the time of invitation to tender.

5.1.1.3 Wherever a conflict exists in the requirements of these documents, the order of precedence shall be observed as defined in Infrastructure - Network Power – Substation - Design and Construction [CE-021-ST-0023].

Table 4: Referenced documents

Name	Document number
Yarra Trams	
EMS Design Acceptance Standard	CE-023-ST-0020
Infrastructure - Network Power – Substation - Design and Construction	CE-021-ST-0023
Infrastructure - Network Power – Traction Power – Design and Construction	CE-021-ST-0037
Cable Specification	IN-021-ST-0003
LV Switchboards Specification	IN-021-ST-0009
Public Transport of Victoria	
PTV Infrastructure Drafting Standards	
Regulations & other legislative documents	
As defined in the Infrastructure - Network Power – Substation - Design and Construction [CE-021-ST-0023]	
Industry codes of practice, guidelines, policies, and rules	
As defined in the Infrastructure - Network Power – Substation - Design and Construction [CE-021-ST-0023]	
Australian Standards	
Degrees of protection provided by enclosures (IP Code)	AS 60529
International Standards	
Railway applications – Fixed installations – Electrical safety, earthing and the return circuit – Part 1: Protective provisions against electric shock	EN 50122-1
Railway applications – Fixed installations – D.C. surge arresters and voltage limiting devices – Part 2: Voltage limiting devices	EN 50526-2



Basic And safety principles for man-machine interface, marking and identification – Identification of equipment terminals, conductor terminations and conductors	IEC 60445
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DOCUMENT VERSION CONTROL

Table 5: Document version control

Version History	Date	Detail
1.0	30/07/2021	Original approved issue
1.01	2/09/2021	Minor typing errors corrected
1.07	13/05/2025	Periodic review.
1.08	10/03/2026	Updated the Author
1.09	30/06/2026	Changed from a Standard to a Specification. Document number changed from CE-019-ST-0049 to CE-019-SP-0049. Logo updated to YJM.

DEFINITIONS & ABBREVIATIONS

Table 6: Glossary - Words

Word	Definition
Scope of Works	The Scope of Works is a key document that defines the specific project-related requirements such as the configuration and rating of equipment to be installed. It prevails over all the specifications.
Designer	The party who is fully responsible for the suitability and compliance of the design of the DC traction substation and all its equipment and subsystems.

Table 7: Glossary - Abbreviations

Abbreviation	Definition
AC	Alternating Current
DC	Direct Current
EMC	Electromagnetic Compatibility
EMS	Engineering Management System (internal Yarra Trams abbreviation)
FAT	Factory Acceptance Test
HV	“High Voltage” means a nominal voltage exceeding 1000 V AC or exceeding 1500 V DC
LV	“Low Voltage” means nominal voltage exceeding 50 V AC / 120 V DC but not exceeding 1000 V AC / 1500 V DC
PTV	Public Transport of Victoria



Abbreviation	Definition
RAMS	Reliability, Availability, Maintainability and Safety
RMS	Root Mean Square
SCADA	Supervisory Control and Data Acquisition
VLD	Voltage Limiting Device

APPENDIX B – TENDER REQUIREMENTS

Table 8 summarises the information which shall be defined by Yarra Trams in the *Scope of Works* at the time of tender.

Table 8: Summary of information to be defined in the Scope of Works

Description	Requirement
Equipment designation	

Statement of compliance

The *Designer* shall return a statement of compliance to this specification. The Yarra Trams statement of compliance template and deviation procedure for specifications is provided within Infrastructure - Network Power – Substation - Design and Construction [CE-021-ST-0023].

Equipment selection principles

The equipment selection principles are defined in Infrastructure - Network Power – Substation - Design and Construction [CE-021-ST-0023].