

Specification

Rectifier Transformer Specification

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1 PURPOSE

The purpose of this specification is to specify the minimum requirements of rectifier transformers, 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 rectifier transformers. This specification does not apply retrospectively to existing rectifier transformers on the Yarra Trams network. However, this specification is applicable if an existing rectifier transformer is being altered, modified or replaced.

The equipment detailed in this specification shall be suitable for 600 V DC operation and shall allow for 750 V DC operation in the future.

This specification applies to any party who is involved in the design or construction of rectifier transformers for Yarra Trams.

3 COMPLIANCE

Any party who is involved in the design or construction of rectifier transformers 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 per the 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 rectifier transformer shall be indoor and may also be underground.
- 4.1.1.2 The operating conditions are 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 minimum requirements shall be as defined in Infrastructure – Network Power – Substation Design and Construction [CE-021-ST-0023]. The *Designer* shall detail additional storage requirements from this. Transport and storage information shall be contained in the equipment manuals, which are outlined in Table 6.

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].
- 4.1.3.2 The sound power level shall not exceed the Reduced Limit specified in AS 60076.10 and AS 60076.10.1.

4.1.4 Electromagnetic compatibility (EMC)

- 4.1.4.1 In accordance with clause 12 of AS 60076.1, rectifier transformers shall be considered as passive elements in respect to emission of, and immunity to, electromagnetic disturbances.
- 4.1.4.2 All other requirements are defined in Infrastructure – Network Power – Substation Design and Construction [CE-021-ST-0023] and Infrastructure – Network Power – Traction Power – Design and Construction [CE-021-ST-0037].



4.2 General requirements

4.2.1 General

4.2.1.1 The rectifier transformer shall be a vacuum-impregnated epoxy coil, cast-resin dry-type transformer complying with AS 60076.1 and AS 60076.11.

4.2.1.2 The rectifier transformer shall meet the following requirements:

Table 1: General requirements

Description	Requirement
Connection symbol	Dd0y11
Rated frequency	50 Hz
Primary: Configuration	Three-phase windings
Primary: Rated voltage	As defined in the <i>Scope of Works</i>
Secondary: Configuration	2 x three-phase windings (for 12-pulse rectification)
Secondary: Rated voltage	To be determined by the <i>Designer</i> NOTE: The rated voltage of the secondary windings shall be the AC voltage which produces the rated DC voltage at the output of the rectifier, when: - the rectifier is operating at its rated output current, - the rectifier transformer is at its centre tap position, and - the rectifier transformer supply voltage is the rated voltage.
Rated power	To be determined by the <i>Designer</i> NOTE: The rated power shall be designed given the rated power of the rectifier.
Duty class	Class VI (according to Table A.1 of EN 50329)
Tapping range	± 7.5 % in steps of ± 2.5 % (7 tap positions)
Tapping type	Off-load tap-changer
Tapping location	Installed on the primary windings
Short circuit impedance [%]	< 6% (HV/LV1&LV2 @ full power)
Coupling factor	K > 0.9
Type of cooling	AN (Air Natural) preferred ¹ however transformer shall be capable of operating under forced air ventilation
Climatic class	C1
Environmental class	As defined in the <i>Scope of Works</i>
Fire behaviour class	F0



Description	Requirement
Winding temperature-rise limits	Class H (according to Table 2 of AS 60076.11)
Earthed screen between primary and secondary windings	Yes
Design Life	Design life to be either 40 years or as specified in Infrastructure - Network Power – Substation – Design and Construction [CE-021-ST-0023]; whichever is greater.
¹ The <i>Designer</i> shall carefully consider section 4.1.3 prior to the selection of AF (Air Forced) equipment.	

4.2.1.3 The *Designer* is fully responsible for providing suitable ratings for the rectifier transformer and shall therefore verify the values in Table 1.

4.2.1.4 If the primary rated voltage is 6.6 kV, the design of the rectifier transformer shall allow the primary rated voltage to be increased to 11 kV at a later date. Yarra Trams acknowledges that this may require a different connection symbol, depending on the primary rated voltage.

4.2.1.5 If the primary rated voltage is 11 kV, the design of the rectifier transformer shall allow the primary rated voltage to be increased to 22 kV at a later date. Yarra Trams acknowledges that this may require a different connection symbol, depending on the primary rated voltage.

4.2.1.6 In accordance with clause 7 of AS 60076.11, the rectifier transformer shall fulfil the requirements in AS 60076.5 regarding its ability to withstand short circuits. A test is required to demonstrate this fulfilment. Note for rectifier transformers, as outlined in clause 4.2.1.4 and 4.2.1.5, the short circuit withstand shall be evaluated at the highest fault level.

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 In accordance with Clause 4.1 of EN 50329, the neutral point of a secondary star winding feeding a converter shall not be earthed and does not need to be brought out.

4.2.3.2 If the rectifier transformer has an enclosure, the enclosure shall be earthed.

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

4.2.4 Enclosure

General

When considering the enclosure requirements, there are three possible rectifier transformer installation types:

- Indoor, where the transformer is located in a separate dedicated room;
- Indoor, where the transformer is not located in a separate dedicated room, and the transformer shall have its own protected enclosure; and
- Outdoor in a suitably protected enclosure.

4.2.4.1 The general enclosure requirements for each rectifier transformer installation type are outlined in Table 2. These requirements are to prevent contact with live conductors.

Table 2: Enclosure – General requirements

Installation type	Is an enclosure required?	Minimum degree of protection provided by the enclosure (according to AS 60529)
Indoor, where the transformer is located in a separate dedicated room	No	IP00
Indoor, where the transformer is not located in a separate dedicated room	Yes	IP21
Outdoor	Yes	IP54

4.2.4.2 Indoor rectifier transformer enclosures shall be metallic and sufficiently ventilated to allow natural or forced cooling to be effective.

4.2.4.3 Interlocking requirements are outlined in section 4.2.6 as well as Infrastructure - Network Power – Substation Design and Construction [CE-021-ST-0023].

4.2.4.4 If the rectifier transformer is located in a separate dedicated interlocked room, no equipment separate to the transformer requiring inspection or frequent maintenance shall be located in the room. Examples of such equipment include control panels, air filters, fans, and fire extinguishers.

Dimensions

4.2.4.5 The rectifier transformer enclosure shall be designed to minimise its overall size, weight, (and subsequently the physical size of the substation) while meeting the requirements of specifications and standards.



Covers and doors

- 4.2.4.6 The covers and doors which are part of the enclosure shall be metallic. When they are closed, they shall provide the same degree of protection as specified for the enclosure.
- 4.2.4.7 Covers and doors shall not be made of woven wire mesh, expanded metal or similar designs that may allow metallic conductors or items to breach the enclosure. Top of enclosures shall be waterproof.

Ventilating openings

- 4.2.4.8 Ventilation openings and vent outlets shall be arranged or shielded so that they provide the same degree of protection as specified for the enclosure. Such openings may make use of wire mesh or the like provided that it is of suitable mechanical strength.

4.2.5 Protection

General

- 4.2.5.1 The rectifier transformer shall include at least the following protection:
- Thermal protection (Temperature alarm and Temperature fault)
 - Rectifier Transformer Thermal Protection Relays
 - Enclosure access protection
 - Surge protection

Table 3: Summary of protection

Protection description	Rectifier HVCB Trip	Rectifier DCCB Trip	Lockout	Indication on control panel	Indication to SCADA system	Notes
Rectifier Thermal Protection relay						
Temperature alarm [ALARM]				✓	✓	Thermal protection
Temperature fault [FAULT]	✓	✓		✓	✓	Thermal protection
Enclosure access protection [FAULT]	✓	✓		✓	✓	



Thermal protection

4.2.5.2 The rectifier transformer shall have temperature sensors on its windings. The thermal protection system shall provide two levels:

- Temperature alarm: The first level shall operate the ventilation fans (for air-forced rectifier transformers only). An indication of the temperature alarm shall be provided to a local indicator and to the SCADA system; and
- Temperature fault: The second level shall cause the protection to operate, as shown in Table 3. An indication of the failure shall be provided to a local indicator and to the SCADA system.

4.2.5.3 Once the temperature has fallen below the temperature fault level, the rectifier HVCB and DCCB may be closed (the temperature fault shall not lockout devices). However, the local indication shall remain set to indicate that the thermal protection has operated. This local indication shall be manually reset.

4.2.5.4 The thermal protection limits shall be adjustable as a percentage of the maximum allowable temperature.

4.2.5.5 Thermal Protection relay

- A thermal protection relay system shall be provided for the Rectifier Transformer by a suitably calibrated thermal device. The system shall be a two level thermal sensing system. The first level shall provide an over temperature alarm to the SCADA System, operate an indicator on the Rectifier Circuit Breaker panel and shall operate the ventilation fan contactors. The second level shall trip the Rectifier ac Circuit Breaker, give a temperature trip indication to the SCADA System, and operate a local flag indication on the Rectifier Circuit Breaker panel.
- The thermal protection shall have an adjustable differential temperature setting such that the drop out temperature can be set as a percentage of the selected maximum temperature.
- Reliable analogue type devices are preferred over electronic types unless the Contractor can demonstrate reliability through service life.
- An automatic reset facility shall be provided to operate upon the return to normal temperature conditions. The local flag shall remain set to indicate that the over-temperature protection has operated. This flag shall be manually reset on the rectifier panel.

4.2.5.6 The temperature sensors and their measurement leads shall meet the electromagnetic compatibility requirements defined in section 4.1.4 and shall be suitably insulated from the high voltage windings.

Information: The thermal protection may be provided using a device on the rectifier transformer itself or may be incorporated into the HV AC switchgear protection relay. Yarra Trams have accepted both solutions in past installations.

Enclosure access protection

4.2.5.7 In the event of the failure of the interlocking system, opening of the rectifier transformer enclosure (or separate dedicated room) without performing the correct switching operations as outlined in 4.2.6, shall cause the protection to operate, as shown in Table 3.



If applicable, the protection shall also isolate the associated auxiliary transformer which is connected to the rectifier transformer.

Surge protection

4.2.5.8 In accordance with clause 2.3 of EN 50329, care shall be taken to avoid transmission of inadmissible voltage surges between primary and secondary windings and vice versa. This may be achieved by selecting suitable insulation or by careful selection of surge protection devices.

4.2.6 Interlocking

4.2.6.1 The definitions of interlocking are defined in Infrastructure - Network Power – Substation Design and Construction [CE-021-ST-0023].

4.2.6.2 The rectifier transformer shall include at least the interlocking outlined in Table 4.

4.2.6.3 The *Designer* shall provide a detailed enclosure access procedure on the rectifier transformer enclosure.

Table 4: Summary of interlocking

Interlocking description	Interlocking type	Prerequisite conditions ¹	Notes
Rectifier transformer enclosure (or separate dedicated room) access ²	Mechanical	All of the following: • Relevant HV AC rectifier circuit breaker earth switch is closed; • Relevant 600 V DC rectifier circuit breaker short-circuiting switch is closed; • Relevant negative isolator is closed; and • If an auxiliary transformer is connected to the star secondary winding of the rectifier transformer/converter, then the auxiliary transformer shall be isolated at its fuse links.	
¹ The order of the prerequisite conditions does not necessarily represent the order of switching operations. ² In addition to the interlocking requirements, electrical enclosure access protection shall be provided and is outlined in section 4.2.5.			

4.2.6.4 All electrical apparatus shall accommodate appropriate padlocking system in order to provide safe work environment and to provide safeguards against accidental or unexpected activations of traction power equipment, related circuits.



4.2.6.5 Yarra Trams Isolation and Lockout Tagout procedures (IN-022-PR-0010) and Work Instruction (IN-022-WI-0017) shall be followed for lockout and tagout of electrical apparatus work on or near electrical infrastructure.

4.2.7 Control panel

4.2.7.1 If the rectifier transformer has a control panel, the control panel shall be located in an area which can be accessed without any switching operations.

4.2.8 Equipment interfaces

SCADA

4.2.8.1 The rectifier transformer shall include at least the SCADA points outlined in Table 5. Each point shall be brought to the SCADA cubicle. The interpretation of Table 5 and additional SCADA requirements shall be in accordance with Infrastructure - Network Power – Substation Design and Construction [CE-021-ST-0023].

Thermal protection relay and its functions are outlined in 4.2.5.5

Table 5: Summary of SCADA points

Point description - 'Plant'	Point description - 'Designation'	Point description - 'Quantity'	Analogue, Status or Command	Hardwired or Digital	Details	Conditions or Controls
Transformer	X ¹	Temperature Alarm	Status	Digital	1 Bit	0 = Alarm 1 = Normal [Normal]
Transformer	X ¹	Temperature Fault	Status	Hardwired	1 Bit	0 = Fault 1 = Normal [Normal]

¹The designation shall be determined by the *Designer*. Depending on project specific details, this may be “+T01” or “+T02” etc.

4.2.8.2 Yarra Trams understands that the SCADA points outlined in Table 5 are only a minimum requirement. The *Designer* shall include additional SCADA points, where required for the effective operation and diagnostics of the equipment.

4.2.8.3 If the *Designer* is planning to include additional SCADA points or deviate from the points outlined in Table 5, this information shall be provided to Yarra Trams in accordance with Infrastructure - Network Power – Substation - Design and Construction [CE-021-ST-0023].

Cables

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

4.2.8.5 Control wiring shall meet the electromagnetic compatibility requirements defined in section 4.1.4 and shall be suitably insulated from high voltage windings.



LV distribution

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

HV AC switchgear

4.2.8.7 Interfaces with the HV AC Switchgear system are given in the HV Switchgear and Control Specification [IN-021-ST-0012] and the *Scope of Works*.

4.2.9 Labelling and identification

Warning labels

4.2.9.1 In accordance with AS 2067, warning labels shall be provided on the enclosure and on the rectifier transformer coils to warn personnel of the presence of high voltage.

4.2.9.2 The procedure for accessing the rectifier transformer shall be labelled on the enclosure in accordance with the switching operations described in section 4.2.6. Coils of the transformers shall be labled with warning against contact.

Cubicle identification

4.2.9.3 Cubicle identification shall be in accordance with IEC 60445.

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

Nameplate

4.2.9.5 The rectifier transformer shall be fitted with a nameplate identifying the entries as per clause 9.1 of AS 60076.11. In addition to the mandatory entries, the nameplate shall include the following:

- Indoor/outdoor;
- The standards the rectifier transformer is compliant with;
- Duty class;
- Arrangement of tap settings and instructions required for tap changing;
- No load current;
- Inrush current (peak and time constant); and
- Service conditions which differ from standard conditions (e.g. -5°C to 50°C).



4.2.9.6 The nameplate shall be mounted in accordance with clause 9.2 of AS 60076.11.

4.2.10 Efficiency and losses

4.2.10.1 In accordance with clause 4.2.1 of EN 50329, the losses shall be guaranteed at rated service current. The losses shall produce an efficiency of > 98% at the rated service current.

4.3 Testing

4.3.1.1 The tests defined below shall be compliant with the relevant parts of AS 60076.1 and AS 60076.11.

4.3.1.2 It should be noted that some tests of the rectifier converter can only be done with the rectifier transformer as a test of the whole rectification system.

4.3.1.3 Testing shall at least comprise the items outlined in Table 6.

Table 6: Summary of tests

Test	Type test ¹	Routine test	Special test	Commissioning test
Measurement of winding resistance		M		M
Measurement of voltage ratio and check of phase displacement		M		M
Measurement of short circuit impedance and load loss		M		
Measurement of no-load loss and current		M		
Separate-source AC withstand voltage test		M		M
Induced AC withstand voltage test		M		O
Lightning impulse test	M			
Partial discharge measurement		M	O	
Temperature-rise test	M			
Measurement of sound level			M	
Short circuit test			O	
Environmental test			O	
Climatic test			O	
Fire behaviour test			O	
Determination of transient voltage transfer characteristics			O	
Measurement of the harmonics of the no-load current			O	
Check thermal protection device(s) and threshold settings				M



Type test of complete transformer and rectifier assembly in situ to confirm the system meets the specified requirements for temperature rise	M			
M: Mandatory O: Optional. The <i>Scope of Works</i> shall detail if any of these tests are required. ¹ Type tests shall be performed for all rectifier transformers not having a type test certificate.				

4.4 Reliability, Availability, Maintainability and Safety (RAMS)

- 4.4.1.1 Taps shall be accessible for maintenance activities including cleaning and adjustment.
- 4.4.1.2 All other 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 7. This documentation shall be provided for the rectifier transformer throughout the procedure outlined in EMS Design Acceptance Standard [CE-023-ST-0020].

Table 7: 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 mechanical arrangement, including cable boxes				✓	✓	✓	✓ ¹
Connection guide (conductors, earthing, auxiliary circuits, etc)			✓	✓	✓	✓	✓ ¹
Bill of materials				✓	✓	✓	✓ ¹
Detailed drawing of nameplate					✓	✓	✓ ¹
Tap connections diagram					✓	✓	✓ ¹



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
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 DIAGRAMS AND GUIDANCE

5.1 Typical installations

Refer to Infrastructure - Network Power – Substation – Design and Construction [CE-021-ST-0023] for typical installation diagrams. Any diagrams shown here are as an example only.

TBC
<i>Figure 1: Typical installations – Rectifier transformer at Elsternwick Substation (IP21)</i>

TBC
<i>Figure 2: Typical installations – Rectifier transformer at TBC Substation (IP00)</i>

TBC
<i>Figure 3: Typical installations – Interlocking enclosure access procedure</i>



6 RELATED LEGISLATION & DOCUMENTS

- 6.1.1.1 The design and construction of rectifier transformers 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.
- 6.1.1.2 All referenced documents shall refer to the most recent published versions of them at the time of invitation to tender.
- 6.1.1.3 Wherever a conflict exists in the requirements of these documents, the order of precedence shall be observed as defined in the Infrastructure - Network Power – Substation - Design and Construction [CE-021-ST-0023].

Table 8: 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
HV AC Switchgear and Controlgear Specification	IN-021-ST-0012
Rectifier Converter Specification	IN-021-ST-0018
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	
Infrastructure - Network Power – Substation - Design and Construction [CE-021-ST-0023]	
Industry codes of practice, guidelines, policies, and rules	
Infrastructure - Network Power – Substation - Design and Construction [CE-021-ST-0023]	
Australian Standards	
Substations and high voltage installations exceeding 1 kV a.c.	AS 2067
Power transformers – General	AS 60076.1
Power transformers – Ability to withstand short circuit	AS 60076.5
Power transformers – Determination of sound levels	AS 60076.10
Power transformers – Determination of sound levels – Application guide	AS 60076.10.1
Power transformers – Dry-type transformers	AS 60076.11



Degrees of protection provided by enclosures (IP Code)	AS 60529
International Standards	
Railway applications – Fixed installations – Harmonisation of the rated values for converter groups and tests on converter groups	EN 50327
Railway applications – Fixed installations – Traction transformers	EN 50329
Basic And safety principles for man-machine interface, marking and identification – Identification of equipment terminals, conductor terminations and conductors	IEC 60445

DOCUMENT VERSION CONTROL

Table 9: Document version control

Version History	Date	Detail
1.01	30/07/2021	Original approved issue
1.02	23/12/2021	Minor update
1.03	27/06/2023	Periodic review. No change
1.04	28/07/2023	Periodic review. No change
1.05	06/11/2023	Periodic review. No change
1.06	15/11/2023	Periodic review. No change
1.07	13/05/2025	Authoriser update.
1.08	10/03/2026	Periodic review. No change
1.09	24/06/2026	Changed from ST to SP and Updated the YJM logo



APPENDIX A – DEFINITIONS & ABBREVIATIONS

Table 10: 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 11: Glossary - Abbreviations

Abbreviation	Definition
AC	Alternating Current
CB	Circuit Breaker
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
NSS	Negative Shorting Switch
PTV	Public Transport of Victoria
RAMS	Reliability, Availability, Maintainability and Safety
RMS	Root Mean Square
SCADA	Supervisory Control and Data Acquisition



APPENDIX B – TENDER REQUIREMENTS

Table 12 summarises the information which shall be defined by Yarra Trams in the *Scope of Works* at the time of tender.

Table 12: Summary of information to be defined in the *Scope of Works*

Description	Requirement
Equipment designation	
Primary: Rated voltage	
Environmental class	
Enclosure requirement	
List of special tests which are required	

Statement of compliance

The *Designer* shall return a clause by clause 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].