

EP 00 00 00 15 SP

COMMON REQUIREMENTS FOR ELECTRIC POWER EQUIPMENT

Version 3.1

Issued February 2012

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Document control

Version	Date	Summary of change
3.0	May 2010	<ul style="list-style-type: none">• Application of TMA 400 format
3.1	February 2012	<ul style="list-style-type: none">• Section for Terminal Blocks has been expanded.• Screw clamp type terminals have been specified instead of spring-loaded tunnel type terminals• Minimum wiring size requirements for terminal has been added.• Australian Standard reference for colour convention for controls and indications has been updated• Australian Standard reference for wire colour has been updated

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1 Introduction

This document details the common requirements for electric power and control cubicles or assemblies forming part of switchgear, rectification equipment, transformers and similar equipment deployed in the Electric Power sub-system of RailCorp. It includes requirements relating to the equipment as a whole and components used in the equipment, to both hardware and software aspects and also the data set associated with the equipment.

It is intended that this document be called up in other documents and these requirements only apply when this document is referred to in the primary specification for the equipment.

2 Scope and Application

The requirements of this document apply to new power and control cubicles or assemblies as well as existing equipment that is modified or refurbished.

The standard RailCorp relay and circuit naming conventions are included at Appendix A.

The release of this document will not affect the operation or maintenance of existing power and control cubicles or assemblies in the RailCorp network.

3 Normative References

3.1 Code of Practice

The following documents contain provisions that, through reference in this text, constitute provisions of this specification.

At the time of publication, the editions indicated were valid.

3.2 International Standards

IEEE C.37.2 -1996 Standard electrical power system device function numbers and contact designations.

3.3 Australian Standards

The following Australian Standards are either referenced in this document or can provide further information.

AS 1042:1973	<i>Direct-acting Indicating Electrical Measuring Instruments and their Accessories. (Withdrawn)</i>
AS 1102:1997	<i>Graphical symbols for Electrotechnical Documentation</i>
AS 1675:1986	<i>Current Transformers - Measurement and Protection</i>
AS 60044.1:2007	<i>Instrument Transformers - Current Transformers.</i>
AS 1939 Supp 1:1990	<i>Degrees of protection provided by enclosures for electrical equipment (IP Code) – Wallchart 1</i>
AS 1939 Supp 2:1990	<i>Degrees of protection provided by enclosures for electrical equipment (IP Code) – Wallchart 2</i>
AS 2067:2008	<i>Substations and high voltage installations exceeding 1 kV a.c.</i>
AS 2700:2011	<i>Colour Standards for General Purposes.</i>

AS/NZS 3000:2007	<i>Electrical Installations (known as the Australian/New Zealand Wiring Rules)</i>
AS/NZS 3439.1:2002	<i>Low-voltage switchgear and controlgear assemblies – Type-tested and partially type-tested assemblies.</i>
AS/NZS 5000.1:2005	<i>Electric cables – Polymeric insulated – For working voltages up to and including 0.6 / 1 (1.2) kV</i>
AS/NZS 5000.2:2006	<i>Electric cables – Polymeric insulated – For working voltages up to and including 450/750 V</i>
AS/NZS 5000.3:2003	<i>Electric cables – Polymeric insulated – Multicore control cables</i>
AS 60038:2000	<i>Standard voltages</i>
AS 60529:2004	<i>Degrees of protection provided by enclosures (IP Code)</i>

3.4 RailCorp Documents

The following RailCorp documents are either referenced in this document or can provide further information.

EP 00 00 00 12 SP Electrical Power Equipment – Integrated Support Requirements
EP 00 00 00 13 SP Electrical Power Equipment – Design Ranges of Ambient Conditions
EP 19 00 00 02 SP Protection System Requirements for the High Voltage Network
ED 0022P CAD and Drafting Manual – All Design Areas
ED 0024P CAD and Drafting Manual – Electrical

3.5 RailCorp Templates

The following templates are provided for documentation:

Cable schedule Blank Cable schedule.xls

4 Technical Requirements

4.1 Panels and Doors

All panels, including doors, shall generally be constructed of mild steel sheet with robust steel framework sufficiently braced to prevent warping and twisting. The minimum sheet thickness shall be 1.2 mm for panels and 1.6 mm for doors. Other materials such as aluminium and stainless steel may be used subject to RailCorp approval.

The doors shall be fitted with removable-pin hinges and locking handles.

Opening doors shall have stops to prevent damage to doors or hinges from overswing.

4.2 Painting

4.2.1 Indoor Equipment

Where the supplier is able to provide a customised paint finish, outside surfaces of the cubicle shall be painted storm grey, colour No. N42 in accordance with AS 2700, in textured powder coat. The inside surfaces shall be painted white, colour No. N14 in accordance with AS 2700, in smooth powder coat. Cubicles that will be installed in corrosive environments shall be painted with a fit-for-purpose system rather than powder coat.

Where customised painting is not available, the supplier's standard paint system and colour may be accepted subject to approval. However, the preferred colour for inside surfaces is white, colour No. N14.

4.2.2 Outdoor Equipment

Where external surfaces of outdoor equipment are to be painted, an approved paint system suitable for extended outdoor service shall be used. The paint system shall address:

- Surface preparation, including protection of threads and other vulnerable features, and treatment of difficult access parts.
- Masking of items that must be kept paint free.
- Timing, including time between surface preparation and the application of the first coat of paint, and the time between coats.
- Details of each coat to be applied including the type of coating, the method of application and the required dry film thickness.
- The repair scheme for minor damage.
- The applicable QA provisions.

4.3 Cable Entry

Floor mounted equipment shall be configured to accommodate cabling from both above and below.

Cable entries shall be designed for glanding of all control cables. Sufficient space in gland plates etc. shall be provided for the installation of at least two additional control cables in the future, and to accommodate cables with at least 15% spare cores.

4.4 Access

All controls, alarms, and indications shall be mounted for ready Operator access at the front of the cubicle.

Access to equipment, terminal strips and wiring for maintenance shall be unimpeded.

4.5 Lifting Points

Where appropriate, equipment shall be provided with lifting points suitable for slinging the equipment complete with all components installed.

4.6 Fixing Points

Fixing and mounting holes shall be welded or drilled and painted in the supplier's works at locations to be shown on the general arrangement drawings.

All fixing and mounting holes shall be positioned to allow comfortable use of the appropriate tool during installation at site.

4.7 Colour Convention for Controls and Indications

4.7.1 1500V and High Voltage Devices

A red indication shall indicate that the switch is closed.

A green indication shall indicate that the switch is open.

A red control shall cause the switch to close.

A green control shall cause the switch to open.

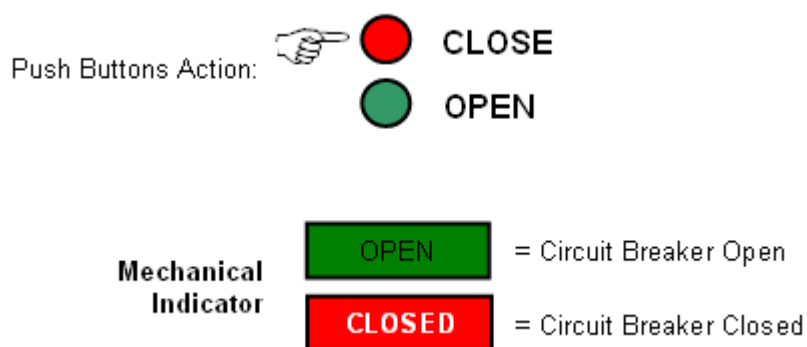


Figure 1

4.7.2 Low Voltage Devices

A red indication shall indicate that the switch is closed.

A green indication shall indicate that the switch is open.

A green control shall cause the switch to close.

A red control shall cause the switch to open.

4.8 Equipment Mounting

All control equipment and circuitry shall be mounted so that it is easily removable for maintenance. This may be achieved by the use of plug-in modules or an equivalent method.

4.9 Labelling

4.9.1 Language

All labelling shall be in the English language only.

4.9.2 Equipment Labels

All individual components and items of equipment shall be labelled by “Traffolyte” or similar material which shall remain legible over the life of the equipment when subjected to all reasonable mechanical wear and abrasion conditions.

Lettering shall be black letters on white background.

Labels shall be mounted on a fixed portion of the cubicle or compartment and not on the actual components, equipment or duct covers. Labels shall be positioned to remain visible after wiring and cabling are completed and so that components and equipment are not blocked from view.

Components and equipment mounted inside the cubicle or compartment shall be labelled with the schematic designation (eg “52OP”) in lettering of not less than 3 mm in height. Operator controls and equipment on the front panel shall be labelled with the device function (eg “Open ACCB”, “DCCB Closed”) in lettering not less than 4 mm in height. Stand-alone cubicles shall also be fitted with a main label inscribed with the name (e.g. “No. 1 Rectifier Control Cubicle”) in lettering of not less than 15 mm in height.

Specific labelling requirements for protection equipment are detailed in *EP 19 00 00 02 SP Protection System Requirements for the High Voltage Network*.

4.9.3 Terminal Strip Labels

All terminals shall be clearly and indelibly labelled with the terminal number shown on the schematic diagram using proprietary labels from the terminal supplier.

4.9.4 Wire Identification & Numbering

All control and protection wires shall have a unique number and shall be identified at each end by white number ferrules inscribed in black characters with the wire number shown on the schematic diagram. Ferrules shall be a proprietary, interlocking type of size to match the wire diameter.

4.9.5 Cable identification codes for schematics, cable schedule and drawings

The identification codes for cables are to be used on all drawings, schedules and labelling are detailed in the table below:

ID	Category	Example application
CM	COMMUNICATION	OPTICAL FIBRE, COPPER SERIAL LINKS, PILOT CABLES, TELEPHONE, DATA
C	CONTROL	CONTROL CABLES BETWEEN PANELS.
FL	FRAME LEAKAGE (RECT & DCCB)	DCCB FRAME TO FRAME LEAKAGE RELAY BAR, RECTIFIER TO RECTIFIER FRAME LEAKAGE RELAY.
E	EARTHING	EQUIPMENT EARTHS, EARTH GRID CONNECTIONS, HV CABLE SCREEN EARTHS
IA	INSTRUMENTATION (ANALOGUE 0-20MA)	VOLTAGE & CURRENT TRANSDUCER OUTPUT CABLES, AMMETER & VOLTMETER CABLES

ID	Category	Example application
S	SUPERVISORY	SUPERVISORY INDICATION & CONTROL
AC	<= 600V	RECTIFIER TRANSFORMER 600V CABLES, AUXILIARY TRANSFORMER 600V CABLES, 415/240V POWER, 240V LIGHT
DC	<= 120V	BATTERY SUBMAINS
HV	> 600V AC	2KV, 11KV, 33KV & 66KV
TP	1500V POSITIVE	RECTIFIER 1500V POSITIVES, OHW FEEDER POSITIVES,
TN	1500V NEGATIVE	RECTIFIER 1500V NEGATIVES, REACTOR TO TRACKSIDE BAR NEGATIVES, 1500V LINK RAIL CONNECTIONS, 1500V NEGATIVE LINK
TC	TRACTION CONTROL	REC, DCCB NEGATIVES, 1500V SURGE DIVERTERS , HARMONIC FILTER
CT	CURRENT TRANSFORMER SECONDARY CABLES	CT CABLES FROM OUTDOOR SWITCHGEAR TO PROTECTION PANELS
VT	VOLTAGE TRANSFORMER SECONDARY CABLES	VT CABLES FROM OUTDOOR VOLTAGE TRANSFORMER TO PROTECTION PANELS
PW	Pilot Wire	Pilot Wire

4.10 Auxiliary Supply Voltage

4.10.1 Traction Substation – DC auxiliary supply

Traction substations have dc auxiliary supply. For new and upgraded traction substations the nominal voltage is 125Vdc.

Equipment supplied at 125Vdc shall be designed to operate satisfactorily with the auxiliary voltage in the range 96 to 135V. All connected loads shall operate within this voltage range under ambient conditions as specified in Section 4.20 and derating for enclosures as necessary.

Strategic traction substations have two independent dc auxiliary supplies. Criteria determining which substations have two dc supplies is specified in *EP 19 00 00 02 SP Protection System Requirements for the High Voltage Network*.

4.10.2 Traction Substation – AC auxiliary supply

Traction substations have an ac auxiliary supply. For new and upgraded traction substations the nominal voltage is 3-phase 415/240 Vac.

Equipment supplied at 415/240 Vac shall be designed to operate satisfactorily with the auxiliary voltage in the range -20% to +20% of this nominal voltage.

4.10.3 DC auxiliary supply – other than traction substations

DC auxiliary supply for equipment in sectioning huts, HV AC switching substations and other locations can be 125 or 48 Vdc nominal. At locations with 48V dc, equipment must be designed to operate satisfactorily with the auxiliary voltage in the range 43 to 58 Vdc.

4.10.4 AC auxiliary supply – other than traction substations

Requirements for equipment operating in sectioning huts, HV AC switching substations and other locations requiring ac auxiliary supplies will be provided in future versions of this standard.

4.11 Wiring

4.11.1 General

All wiring shall be installed to the requirements of *AS 3000* and equipment supplier specifications.

All 125 Vdc wiring (other than control wiring installed on 1500 Vdc equipment) shall be able to withstand a 1 minute test voltage of 1.5 kV rms to earth.

Requirements for control wiring installed on 1500 Vdc equipment such as DCCB's and rectifiers are detailed in the respective RailCorp equipment specifications.

DC control wiring and the AC auxiliary supply wiring shall be segregated.

The requirements of this section need not apply to special purpose signal and electronic wires.

On terminal blocks, intermeshing of cores of different field cables will not be accepted.

Current and voltage transformer wiring shall be as specified in *EP 19 00 00 02 SP Protection System Requirements for the High Voltage Network*

Wiring to swing-frames and doors shall be suitably formed to sustain the flexing imposed and properly protected from damage.

4.11.2 Termination

All wires shall be terminated using proprietary crimp lugs (not bootlaces) of correct size for the conductor. Lugs shall be the insulated barrel type. Termination of protection wiring at the relay shall be by screwed connections using 'ring' type crimp lugs as recommended by the relay manufacturer.

Not more than two wires shall be terminated in any tunnel-type terminal.

4.11.3 Minimum Wire Size and Wire Type

Small wiring shall generally be stranded copper 0.6/1 kV or 0.45/0.75 kV V-90HT PVC insulated. Unless noted otherwise on the schematic diagrams, DC control wiring shall be 1.5 mm² cross-section, flexible, multi-strand copper (30/0.25).

4.11.4 Wire Colours

Colours for dc control wiring shall be brown for positives, light blue for negatives and grey for all mid-wires. "Mid-wires" means all wires that are more than one device away from the positive and negative rails of the control circuit, where a "device" is a relay or switch contact, coil, indicating light etc.

Colours for ac and dc power wiring shall be in accordance with AS 3000.

CT and other protection wiring shall be as specified in *EP 19 00 00 02 SP Protection System Requirements for the High Voltage Network*.

4.12 Terminal Blocks

4.12.1 General

Small wiring field terminals shall generally be the rail-mounted screw clamp type and suitable for 2.5mm² wiring. Terminals shall be grouped according to function and voltage and groups shall be segregated by proprietary barriers.

Terminal numbers shall be allocated on the schematic diagrams so that all the cores of each field cable can be terminated on consecutive terminals.

The terminal block shall include 15% spare terminals, or a minimum of one (1), whichever is the larger, for each cable to be terminated.

4.12.2 Terminal Blocks For D.C. Auxiliary Supply

The terminal blocks for 125V/48V d.c. auxiliary supplies shall be suitable for 6mm² wiring.

Rectifier DCCB d.c. auxiliary supply terminals shall be suitable for 16mm² wiring.

4.12.3 Terminal Blocks For A.C. Auxiliary Supply

Terminals energised at 415/240 Va.c. shall be shrouded and denoted as hazardous by warning labels.

The terminal blocks for 415V/240V a.c. auxiliary supplies shall be suitable for 2.5mm² wiring.

4.12.4 Terminal Blocks For CT and VT

CT and VT secondary wiring terminals shall be as specified in *EP 19 00 00 02 SP Protection System Requirements for the High Voltage Network*.

4.13 Earth terminal

Equipment intended to be located in substations shall be provided with an earth terminal suitable for connection of an earth cable of a minimum size of 70 mm² or lug with M10 hole.

4.14 Light

An appropriate 240 Vac light fitting shall be installed in the cubicle or assembly to illuminate areas containing equipment and terminal strips where the design is such that this equipment will not be directly illuminated by external lighting. The light shall be activated by a switch on the front panel, or automatically when the door is opened.

4.15 Auxiliary Relays, Push Buttons, and Selector Switches

4.15.1 Contacts

Contacts of auxiliary relays, push buttons, and selector switches used at ELV, low current shall be designed for such duty. Particular attention shall be given to ensuring contact wetting by means of gold plated contacts, wiping contacts or other suitable means.

4.15.2 Relays

All relays shall have clear and ready visual indication of the state of the relay, either by direct observation of the mechanism (flag) or by means of a LED.

Plug-in relays are preferred.

All plug-in relays shall be positively retained in their bases.

4.15.3 Suppression Diodes

Suppression diodes shall be provided across DC coils where appropriate to limit back EMF in order to protect contacts and/or reduce EMR.

4.15.4 Trip Circuit Supervision

Where Trip Circuit Supervision is employed, continuity of the circuit shall be monitored as well as availability of the power supply.

The Trip Circuit Supervision (TCS) relay shall be connected, physically, to the end point of the wires in the trip circuit. i.e. The tripping circuit is to be made by looping all wires right onto the terminals of each tripping contact, with the TCS relay furthest from the supply fuses or circuit breaker. In this way, a break in the wiring of this circuit will be detected.

The TCS relay shall drop out (providing indication to SCADA) before the voltage measured at the end point of the circuit wiring falls to the minimum operating level of the control relays. (SCADA indication is required based on the control relays' capabilities). It is acceptable that the indicating LED's have stated minimum operating voltages different to this threshold.

Refer to *EP 19 00 00 02 SP Protection System Requirements for the High Voltage Network* for details of approved TCS relays.

4.15.5 Indicator Lights

All indicator lights shall be LED types.

The colour of indicating lights shall be identified on schematics by placing an appropriate letter adjacent to the LED: G – green, R – red, W – white.

4.16 Programmable Equipment

Programmable controllers used in Electric Power Equipment shall be the product of a recognised supplier and be purpose-built to carry out the functions specified. Programming shall be carried out using non-proprietary, commonly available and inexpensive equipment. It shall be possible to download the software from a storage medium or entry via keypad and display unit mounted on the front of the cubicle or compartment.

Operator control and interrogation shall be possible via the keypad and display unit. Access to keypad control functions and programming shall be restricted by password. Indications of status shall be continuous and immediately apparent without the need to use the keypad.

The controller shall include means of retaining programming for one year in the event of loss of auxiliary power.

4.17 Current Transformers

Current transformers shall be as detailed in *EP 19 00 00 02 SP Protection System Requirements for the High Voltage Network*.

4.18 Metering

Where required, analogue display meters for indication purposes shall be between 96 mm and 144 mm square and comply with AS 1042 with an accuracy class of 2.5.

Meters shall be mounted with the bottom not lower than 500 mm above floor level and the top not higher than 2000 mm above floor level.

4.19 Selection of Components and Equipment

The make and model of components and equipment used shall generally be as nominated on the schematic diagrams. However, approved equivalents may be used provided that these are readily available items from recognised suppliers.

4.20 Environmental

The ambient temperature rating and degree of protection to AS 60529 shall be as required by RailCorp Standard *EP 00 00 00 13 SP Electrical Power Equipment – Design Ranges of Ambient Conditions*. The equipment supplier shall make due allowance for the temperature rise that can occur within a panel or assembly when specifying the ambient rating of components used in that panel or equipment assembly.

5 Maintenance Concept

The equipment supplied must be suitable for operation with only limited periodic routine maintenance comprising tasks falling into the following categories as applicable:

- Testing of functionality
- Injection testing of any protection relays
- Cleaning
- Lubrication of locks and hinges.
- Replacement of circuit breaker contacts.
- Calibration
- Checking of gas pressure
- Oil sampling

These tasks shall be Level 1 (on system). Level 2 (off system) tasks are generally not acceptable for periodic routine maintenance. Where it is not practical to undertake major corrective tasks on system, a level 2 off system approach will be acceptable.

6 Testing

6.1 Type Tests

All protection relays, electronic modules and controllers shall be type tested in accordance with the relevant standards.

6.2 Routine Tests

Routine factory tests shall include the following as applicable to the equipment concerned:

- Inspection in accordance with AS 3439.1 Section 8.3.1.
- Continuity (point-to-point) test of all wiring.
- Dielectric test at power frequency in accordance with AS 3439.1 Section 8.3.2 or AS 2067 Section 9 as appropriate.
- Function test of all logic and interlocks.
- Secondary injection testing of protection relays and metering.
- Polarity (flick) test of CTs and VTs.
- Group primary injections of CT's.
- Phasing of power circuits.

Copies of final inspection and equipment routine test reports shall be provided and comply with *EP 00 00 00 12 SP Electrical Power Equipment – Integrated Support Requirements*.

7 Data Set Associated With The Equipment

The following data shall be provided when relevant by the equipment supplier and maintained for the life of the equipment. This data shall remain the property of RailCorp.

7.1 Drawings

7.1.1 Drawings Required

- General arrangements, giving cubicle dimensions and showing the location of all relays, operator controls, terminal blocks and other devices along with the entry points of all cables. General arrangement views to include front, floor plan and end. Sheet metal fabrication details of cabinets showing material type and thickness, surface preparation and paint finish details shall be provided.
- Single line diagram.
- Functional block diagram.
- Schematic diagrams of all circuitry, including a legend sheet listing all device identifiers with their full description and giving their locations on the schematics.
- Component schedule listing the device schematic identifier, description, supplier, model number, ratings if relevant and the location on the schematic diagram. (This may be integrated with the schematic diagrams legend sheet).
- Cable / termination schedule giving cable number, core number, wire number, origin and destination, origin and destination terminal numbers, function of each core, number of cores in cable, conductor material and cross-section, insulation grade, screen type if applicable, insulation and sheath material and any relevant comments. RailCorp template in excel format is available and is the preferred method of documentation. See Section 3.5.
- Cabling block diagram.
- Terminal block layout.
- Where programmable controllers are included, provide full functional specification of the control logic, fully annotated logic diagrams, factory and site acceptance tests and, if available, source code for any custom-built software.
- SCADA I/O list

7.1.2 Manufacturers Standard Drawings

The manufacturer's standard drawings for an item of equipment will be acceptable where they :

- Accurately represent the equipment supplied
- Provide all required information
- Are presented on sheets not larger than A1
- Are provided in the English language
- Use symbols in accordance with AS 1102.

7.1.3 Project Drawings

7.1.3.1 CAD Drafting

All drawings shall be produced in accordance with the RailCorp Specification *ED 0024P, CAD and Drafting Manual – Electrical*.

The sheet size shall not be larger than A1.

All drawings will be stored within the RailCorp drawing system in Microstation format, the preferred format for drawings being Microstation Version 8, however RailCorp will accept drawings produced in AutoCAD Version 2009.

To minimise the complications arising from conversion from AutoCAD to micro station & vice versa the following shall be observed:

- Copy & rename suitable size RailCorp provided border sheet. Border sheets for sizes A1 to A3 with scales of 1:100, 1:50, 1:20 & 1:1 are available.
- use the renamed file to draw and annotate.
- For linework, draw in modelspace at 1:1 scale, units are in mm.
- For annotation, draw in modelspace at 100 times (e.g. to get a printed text size of 2.5mm, draw at text size of 250mm).
- Do not attach xref's. If you do, merge them & detach xref's.
- Do not use paperspace.
- Do not use viewports.
- Use one scale only in one drawing. Xref's and viewports should not be used.
- Use isocp3.shx as font file with width factor of 1.05
- Do not use shared cells.

The border sheet has elements on level 60. Do not draw anything on this level; do not delete anything from this level (if needed please consult RailCorp). Do not move the border area. The final printed size is determined by the master drawing sheet, which can be A1, A2, A3 or A4 dependent upon content. For additional information see Appendix C.

7.1.3.2 Schematic Diagrams

Symbols used in drafting schematic diagrams shall be in accordance with *AS 1102*.

Components on the schematic and other drawings must be designated according to the RailCorp identifiers tabled in Appendix A. Where there is no RailCorp identifier for a particular device, it shall be designated according to *IEEE standard C.37.2*.

Schematics shall employ a column reference system for locating devices. The location of each relay contact and device auxiliary contact shall be shown near the relay or device on all schematics.

Every connecting line or group of lines in a control or protection circuit shall be identified with a wire number on the schematic. The numbering system used shall conform to that given in Appendix D of *AS 2067* except that positive rails shall be designated BP# (for battery positive 1, 2, 3 etc) and negative rails shall be designated BN#.

Connecting lines that pass between separate equipment cubicles shall be drawn dashed to highlight that they are "field" connections. Terminal symbols shall be in accordance with Figure 2 and shall be shown at the ends of each such line.









	RECTIFIER CONTROL CUBICLE TERMINAL
	ACCB TERMINAL
	DCCB PLUG PIN/SOCKET
	DCCB TERMINAL BOX CONNECTOR
	RECTIFIER TRANSFORMER TERMINAL
	RECTIFIER TERMINAL
	DC REACTOR TERMINAL
	FIELD CABLE CORE

Figure 2 - Drawing Terminal Symbols

All terminals shall be designated with a prefix letter consistent with the broad function of the circuit, followed by a two or three digit number. The prefixes to be used are “C” for DC control and protection, “CT” for current transformer secondaries and “S” for connections to SCADA.

7.2 Test Results

The results of all tests, including Routine, Type and corrective maintenance tests, shall be recorded and maintained.

Routine test certificates showing the results of each test performed shall be supplied in duplicate and electronically, in English, and maintained for the life of the equipment.

Type test certificates for each protection relay and electronic module shall be supplied in duplicate, in English, and maintained for the life of the equipment.

Appendix A Schematic Diagram Identifiers

Device numbers and functions shall generally be in accordance with *IEEE C.37.2*. The detailed implementation shall be as set out below.

Relay Identifier	Description	Typical Location
8LX	Auxiliary CB Trip Relay	
33-1	Negative Isolator Accessed Switch	Rectifier
43	Local/Supervisory Changeover Switch (L - Local S - Supervisory)	Rectifier CC
43A	Local/Remote Changeover Switch ACCB	ACCB
50A	Instantaneous Overcurrent Relay (A phase)	Rectifier CC
50C	Instantaneous Overcurrent Relay (C phase)	Rectifier CC
51A	Inverse Time Overcurrent Relay (A phase)	Rectifier CC
51C	Inverse Time Overcurrent Relay (C phase)	Rectifier CC
51A2	Overcurrent Breaker Fail Relay (A phase)	Rectifier CC
51B2	Overcurrent Breaker Fail Relay (B phase)	Rectifier CC
51C2	Overcurrent Breaker Fail Relay (C phase)	Rectifier CC
51AX	Auxiliary Overcurrent Relay (A phase)	
51CX	Auxiliary Overcurrent Relay (A phase)	
51X	Auxiliary Relay for Rectifier Breaker Fail Protection	Rectifier CC
52	ACCB	ACCB
52C	ACCB Closing Contactor	ACCB
52CC	ACCB Closing Coil	ACCB
52H	ACCB Heater Control Switch	ACCB
52M	ACCB Closing Motor	ACCB
52M	ACCB Closing Springs Charge Motor	ACCB
52MC	Spring Charging Limit Switch	ACCB
52OP	ACCB Open Auxiliary Relay	Rectifier CC
52R	ACCB Heater Coil	ACCB
52SO	Solid State Open Device	ACCB
52T	ACCB Trip Coil	ACCB
52t	ACCB Heater Thermostat	ACCB
52 Close	ACCB Close Push Button	Rectifier CC
52 Open	ACCB Open Push Button	Rectifier CC
54	DCCB	DCCB
54A	DCCB Auxiliary Relay	
54a	DCCB Operating Auxiliary Switch	DCCB
54C	DCCB Closing Coil	DCCB
54D	Auxiliary Relay for Reverse Current Trip	DCCB
54ES	DCCB Closing Motor Limit Switch	DCCB
54H	DCCB Holding Coil	DCCB

Relay Identifier	Description	Typical Location
54M	DCCB Closing Motor	DCCB
54R	DCCB Reverse Current Trip Indication Relay	DCCB
54S	DCCB Stabilising Coil	DCCB
54T	DCCB Delayed Closing Relay	
54US	Mechanically Interlocked Limit Switch	DCCB
54UV	DCCB Undervoltage Coil	DCCB
54X	DCCB Closing Coil Contactor	DCCB
54XX	Auxiliary Relay for Closing Coil	
54Y	DCCB Auxiliary Relay for De-energising Closing Coil	DCCB
54Z	DCCB Auxiliary Relay	
54 Close	DCCB Close Push Button	Rectifier CC
54 Open	DCCB Open Push Button	Rectifier CC
63-1	Buchholz Gas Contact	Rect. Transf.
63-2	Buchholz Oil Contact	Rect. Transf.
63RX	DC Reactor Overpressure Follower Relay	DC Reactor Overpress Pnl
63RY	DC Reactor Overpressure Auxiliary Relay	Rectifier CC
63X	Auxiliary Relay for Buchholz Oil	Rectifier CC
63Y	Auxiliary Relay for Buchholz Gas	Rectifier CC
64	Instantaneous Earth Fault Relay	Rectifier CC
64-2	Earth Fault Breaker Fail Relay	Rectifier CC
64E	Rectifier Frame Leakage Relay	Rectifier
64EX	Auxiliary Relay for Rectifier Frame Leakage	Rectifier CC
71	Rectifier Cell Fail Relay	Rectifier CC
75	DCCB Door Switch Interlock	DCCB
77CAP	Rectifier Transformer Primary Current Transducer	Rectifier CC
77CD	Rectifier Output Current Transducer	Rectifier
77TI	Rectifier Inlet Air Temperature Transducer	Rectifier
77TO	Rectifier Outlet Air Temperature Transducer	Rectifier
77VD	Rectifier Output Voltage Transducer	Rectifier
84-1	Tap Change In Progress Signal Contact	Rect. Transf. Tapchanger
84-2	Tapchanger Fault	Rect. Transf. Tapchanger
84Y	Tap Change In Progress Auxiliary Relay	Rectifier CC
86	Rectifier Lockout Relay	Rectifier CC
86A	DCCB Frame Leakage Relay.	Rectifier CC
86AX	DCCB Frame Leakage Auxiliary Relay	Rectifier CC
86PB	Rectifier Lockout Relay Reset Push Button	Rectifier CC
89	Air Break Switch	

Relay Identifier	Description	Typical Location
89G	Negative Isolator	Rectifier
89G-1, -2	Negative Isolator Limit Switch	Rectifier
89GR	Negative Isolator Auxiliary Relay	Rectifier CC
94	ACCB Anti-pumping Relay	ACCB
94D	DCCB Anti pumping Relay	DCCB
97	Sequence Timing Relay	Rectifier CC
97X	Auxiliary Relay for Reverse Current Trip	Rectifier CC
305A	ACCB Supervisory Close Relay	ACCB
306A	ACCB Supervisory Open Relay	ACCB
FS	DCCB 1500 V 3 A Fuse	DCCB
ILS	Indicating Light Switch	Rectifier CC
LCS1	ACCB Local Control Switch (T – Trip N – Normal C – Close)	ACCB
MTA	Multi Trip Auto Reset Relay (Follows 51A2, 51B2, 51C2 & 64-2 and trips all 33 kV ACCBs – all sources of power)	Rectifier CC
TBK1, 2	Test Block	Rectifier CC
TCS	Trip Circuit Supervisory Relay	Rectifier CC
TL	DCCB Test Link	DCCB
TM	Charge Motor Timer	
Xn	Link Terminal	

The colour of indicating lights shall be identified on schematics by placing an appropriate letter adjacent to the LED: G – green, R – red, W – white.

Appendix B Request for Tender Checklist

Application

The following material is for guidance in the preparation of a Request for Tender (RFT) for this type of equipment. This checklist itself is not intended to directly form part of any contract.

Information to be supplied to the Tenderer

Where this document is used as the basis for procurement of equipment for a particular location, in addition to the general requirements in this standard the following information related to the particular site will need to be supplied:

- A full list of deliverables required under the contract including:
 - Number of sets of equipment required.
 - Support Equipment and Tooling.
 - Number of sets of Documentation required.
 - Training Required.
- DC auxiliary voltage.
- AC auxiliary voltage.
- Any site specific limitations on size or arrangement.
- Any site specific corrosion protection requirements such as suitability for coastal installation.
- Colour requirements for outdoor equipment as might be required to match existing equipment or meet requirements of a local authority.
- Limitations due to access or transport.
- Details of interfacing equipment supplied by RailCorp, including schematic diagrams, general arrangement drawings and manufacturer's data.
- The pricing methodology to be applied for selection of equipment. This must be made on the basis of minimising the whole-of-life cost. The following factors must be considered in determining this:
 - Cost of changes to the Technical Maintenance Plan & Service Schedules or the creation of new manuals & schedules.
 - Initial purchase price.
 - Cost of installation.
 - Cost of inventory spares.
 - Cost of maintenance.
 - Cost of manuals.
 - Cost of modifications to other parts of the installation.
 - Cost of replacement parts.
 - Cost of special tools.
 - Cost of staff training.
 - Electrical losses.
 - Environmental costs.
 - Reliability and cost of consequential damage after failure.
 - Cost of decommissioning and disposal.
 - Discount rate.
 - Lifetime of equipment.
- Tenderers should be advised that the cable / termination schedule and cabling block diagram specified at Section 7.1.1 are not required for contracts including only supply of equipment.

- The tenderers should be advised that at the time of publication of this document, the editions of reference standards indicated were valid. All standards and specifications are subject to revision, and parties to agreements based on this specification are encouraged to investigate the possibility of applying the most recent editions of the reference standards.

The RFT document shall have a section on preparation of equipment for shipment. The main points are:

- All equipment shall be suitably packed for protection against damage during loading, transport, storage and unloading.
- Equipment subject to damage due to vibration such as plug-in relays, printed circuit boards and the like shall be removed and separately packed in clearly marked containers.
- Equipment packed separately or sectionalised for installation shall be provided with all assembly fittings, accessories and instructions.

Information to be provided by equipment suppliers

Type Test certificates for evaluation, QA management certificates, sample ITP and ITC, tentative manufacture and delivery programme, typical GA drawing, data sheets and pamphlets, information listed in B2 that is required for estimation of whole-of-life cost.

Label Schedule

Attention must be drawn to the requirement for the equipment supplier to provide a Label Schedule. The Label Schedule shall list all labels required and shall detail wording, letter size and label size.

Inspection and Test Plan

Attention must be drawn to the requirement for the equipment supplier to provide an Inspection and Test Plan (ITP) and associated Inspection and Test Checklist (ITC). This must include the time after the placement of the order by which the draft ITP and ITC must be submitted for approval.

The ITP must nominate hold points for witness tests and inspections. The amount of notice required regarding the approach of each such hold point must be stated.

Drawings

Each revision of every drawing during design and manufacture shall be submitted for review by RailCorp. One print marked with any necessary comments will be returned to the equipment supplier within fifteen (15) working days of receipt by RailCorp. The comments shall be considered by the equipment supplier and incorporated in the next revision of the drawing. The required timing for the initial submissions of each drawing must be stated in the RFT.

“As-Built” versions of each drawing shall be submitted no later than the time of delivery of the equipment.

Each drawing revision forwarded to RailCorp shall be submitted in the following forms:

- Three (3) full-size paper prints
- Electronic copy in Microstation Version 8 or AutoCAD Version 2000 format.
- Electronic copy of each approved drawing in TIFF MSB, Monolithic CCIT Group IV file format, non colour drawings - resolution 300dpi in both X & Y directions.

All submissions shall be accompanied by a transmittal form listing all drawings being forwarded and stating the drawing revisions. The transmittal shall be signed and dated by a responsible representative of the Contractor.

The Component Schedule (refer Section 7.1.1) shall be subject to approval by RailCorp.

Appendix C AutoCAD to Microstation Specifications

	AutoCAD					MICROSTATION				
	LAYER	FONT	COLOR	WEIGHT	LINESTYLE	LEVEL	FONT	COLOR	WEIGHT	LINE CODE
BORDER TEXT & LINE WORK	60					60				
TITLE TEXT	59	ROMANC	WHITE	-	CONTINUOUS	59	137	0	1	0
GENERAL TEXT 2.5mm	8	ROMANS	WHITE	-	CONTINUOUS	8	138	0	1	0
GENERAL TEXT 3.5mm	8	ROMANS	RED	-	CONTINUOUS	8	138	3	2	0
GENERAL TEXT 5.0mm	8	ROMANC	GREEN	-	CONTINUOUS	8	137	2	3	0
EQUIPMENT/HARDWARE LINEWORK SOLID	1	-	WHITE	-	CONTINUOUS	1	-	0	1	0
EQUIPMENT/HARDWARE LINEWORK DASHED	3	-	MAGENTA	-	DASHED	3	-	5	0	2
EQUIPMENT/HARDWARE LINEWORK CENTRE	4	-	MAGENTA	-	CENTRE	4	-	5	0	4
MAJOR EQUIPMENT/MAJOR HARDWARE LINEWORK BOLD e.g. OUTLINE OF TRANSFORMER	5	-	RED	-	CONTINUOUS	5	-	3	2	0
	5	-	RED	-	DASHED	5	-	3	2	2
CABLES, CONDUITS AND ANYTHING WHICH CONNECTS EQUIPMENT	12	-	SEE TABLE'S BELOW	-	SEE TABLES BELOW	12	-	VARIOUS	VARIOUS	VARIOUS
BUILDING WALLS/PARTITONS/DOORS ETC.	20	-	SEE TABLE'S BELOW	-	SEE TABLES BELOW	20	-	VARIOUS	VARIOUS	VARIOUS
TEXT/LINEWORK FOR BILL OF MATERIALS	21	ROMANS	WHITE	-	CONTINUOUS	21	138	0	1	0
EARTHWORK & OTHER LINEWORK OUTLINE BUILDINGS	22	-	SEE TABLE'S BELOW	-	SEE TABLES BELOW	22	-	VARIOUS	VARIOUS	VARIOUS

FONT MAPPING BETWEEN AutoCAD & MICROSTATION	AutoCAD	MICROSTATION
	ROMANS	139
	ROMAND	138
	ROMANC	137
LINE STYLES MAPPING BETWEEN ACAD & MICROSTATION. LTSACLE TO SUIT AutoCAD. LTSCALE IS IRRELEVANT IN MICROSTATION	AutoCAD	MICROSTATION
	CONTINUOUS	0
	DASHED2	1
	DASHED	2
	DASHEDX2	3
	CENTRE	4
	HIDDEN	5
	PHANTOM	6

COLOR MAPPING BETWEEN AutoCAD & MICROSTATION. PLEASE SEE THAT CHOOSING A COLOR IN AutoCAD AFFECTS BOTH COLOR & WEIGHT AT THE SAME TIME	AutoCAD		MICROSTATION	
	COLOUR	PEN THICKNESS	COLOUR	WEIGHT
	RED (1)	0.35	3	2
	YELLOW (2)		4	-
	GREEN (3)	0.50	2	3
	CYAN (4)		1	-
	DARK BLUE (5)	0.70	9	4
	MAGENTA (6)	0.18	5	0
	WHITE (7)	0.25	0	1