



AUSTRALIAN RAIL TRACK CORPORATION LTD

This document has been adopted by the ARTC with the permission of the NSW Government and will continue to apply under the authority of the ARTC General Manager Infrastructure, Strategy & Performance until further notice

Discipline
Engineering Standard - NSW

Category
Electrical

Title
Common Requirements for Electric Power Equipment

Reference Number
PDS 12 - (RIC Standard: EP 00 00 00 15 SP)

Document Control

Status	Date	Prepared	Reviewed	Endorsed	Approved
Issue 1 Revision 2	Mar 05	Standards and Systems	Signalling Standards Engineer	GM Infrastructure Strategy & Performance	Safety Committee
		Refer to Reference Number	T Moore	M Owens	Refer to minutes of meeting 24/01/05

Disclaimer

Australian Rail Track Corporation has used its best endeavors to ensure that the content, layout and text of this document is accurate, complete and suitable for its stated purpose. It makes no warranties, express or implied, that compliance with the contents of this document shall be sufficient to ensure safe systems of work or operation. Australian Rail Track Corporation will not be liable to pay compensation in respect of the content or subsequent use of this document for any other purpose than its stated purpose or for any purpose other than that for which it was prepared except where it can be shown to have acted in bad faith or there has been willful default.

Document Approval

The technical content of this document has been approved by the relevant ARTC engineering authority and has also been endorsed by the ARTC Safety Committee.

Document Supply and Control

The Primary Version of this document is the electronic version that is available and accessible on the Australian Rail Track Corporation Internet and Intranet website.

It is the document user's sole responsibility to ensure that copies are checked for currency against the Primary Version prior to its use.

Copyright

The information in this document is Copyright protected. Apart from the reproduction without alteration of this document for personal use, non-profit purposes or for any fair dealing as permitted under the Copyright Act 1968, no part of this document may be reproduced, altered, stored or transmitted by any person without the prior written consent of ARTC.

About This Standard

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 ARTC's infrastructure. 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.

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

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.

Document History

Primary Source – RIC Standard EP 00 00 00 15 SP Version 1.0

List of Amendments –

ISSUE	DATE	CLAUSE	DESCRIPTION
1.1	05/01/2005		Reformatted to ARTC Standard
1.2	11/03/2005	Disclaimer	Minor editorial change

Contents

About This Standard	3
Document History	4
1 Scope and Application	7
2 Normative References	7
2.1 ARTC Engineering Standards	7
2.2 Standards	7
2.2.1 Australian Standards	7
2.2.2 International Standards	8
2.3 ARTC templates	8
3 Technical Requirements	8
3.1 Panels and Doors	8
3.2 Painting	8
3.2.1 Indoor Equipment	8
3.2.2 Outdoor Equipment	9
3.3 Cable Entry	9
3.4 Access	9
3.5 Lifting Points	9
3.6 Colour Convention for Controls and Indications	9
3.6.1 1500V and High Voltage Devices	9
3.6.2 Low Voltage Devices	10
3.7 Equipment Mounting	10
3.8 Labelling	10
3.8.1 Language	10
3.8.2 Equipment Labels	10
3.8.3 Terminal Strip Labels	11
3.8.4 Wire Identification & Numbering	11
3.9 Auxiliary Supply Voltage	11
3.9.1 Traction Substation – DC auxiliary supply	11
3.9.2 Traction Substation – AC auxiliary supply	11
3.9.3 DC auxiliary supply – other than traction substations	11
3.9.4 AC auxiliary supply – other than traction substations	11
3.10 Wiring	11
3.10.1 General	11
3.10.2 Termination	12
3.10.3 Minimum Wire Size and Wire Type	12
3.10.4 Wire Colours	12
3.11 Terminal Blocks	12

3.12	Earth terminal	12
3.13	Light	13
3.14	Auxiliary Relays, Push Buttons, and Selector Switches	13
3.14.1	Contacts	13
3.14.2	Relays	13
3.14.3	Suppression Diodes	13
3.15	Indicator Lights	13
3.16	Programmable Equipment	13
3.17	Current Transformers	13
3.18	Metering	14
3.19	Selection of Components and Equipment	14
3.20	Environmental	14
4	Maintenance Concept	14
5	Testing	15
5.1	Type Tests	15
5.2	Routine Tests	15
6	Data Set Associated With The Equipment	15
6.1	Drawings	15
6.1.1	Drawings Required	15
6.1.2	Manufacturers Standard Drawing	16
6.1.3	Project Drawings	16
6.1.3.1	CAD Drafting	16
6.1.3.2	Schematic Diagrams	17
6.2	Test Results	18
Appendix A	Schematic Diagram Identifiers	19
Appendix B	Request for Tender Checklist	23
B.1	Application	23
B.2	Information to be supplied to the Tenderer	23
B.3	Information to be submitted by the equipment supplier	24
B3.1	Label Schedule	24
B3.2	Inspection and Test Plan	25
B3.3	Drawings	25
Appendix C	AutoCAD to Microstation Specifications	26

1 Scope and Application

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 ARTC's infrastructure. 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.

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 ARTC 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 ARTC network.

2 Normative References

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.

2.1 ARTC Engineering Standards

The following ARTC Engineering Standards are either referenced in this document or can provide further information:

POP 01	Electrical Power Equipment - Integrated Support Requirements
PDS 11	Electrical Power Equipment - Design Ranges of Ambient Conditions
EP 00 00 00 00 MP	Electric Power Technical Maintenance Plan (RailCorp publication)

2.2 Standards

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

2.2.1 Australian Standards

AS 1042	1973	Direct-acting Indicating Electrical Measuring Instruments and their Accessories (Withdrawn)
AS 1002	1997	Graphical symbols for Electrotechnical Documentation
AS 60044.1	2003	Instrument Transformers - Current Transformers
AS 1939	1990	Degrees of protection provided by enclosure for electrical equipment (IP Code)

AS 2067	1984	Switchgear assemblies and ancillary equipment for alternating voltages above 1 kV
AS 2700	1996	Colour Standards for General Purposes
AS/NZS 3000	2000	Electrical Installations (known as the Australian/New Zealand Wiring Rules)
AS/NZS 3493.1	2002	Low-voltage switchgear and controlgear assemblies - Type-tested and partially type-tested assemblies.
AS/NZS 5000.1	2003	Electric cables - Polymeric insulated - For working voltages - up to and including 0.6 / 1 (1.2) kV

2.2.2 International Standards

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

2.3 ARTC templates

The following templates are provided for documentation:

Use	Filename
Cable schedule	Blank Cable schedule.xls

3 Technical Requirements

3.1 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 1.6 mm for panels and 2 mm for doors. Other materials such as aluminium and stainless steel may be used subject to ARTC 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.

3.2 Painting

3.2.1 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.

3.2.2 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.

3.3 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.

3.4 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.

3.5 Lifting Points

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

3.6 Colour Convention for Controls and Indications

3.6.1 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.

Note: *This colour requirement is the opposite of the convention as defined in Table 7.1 of AS 2067.*

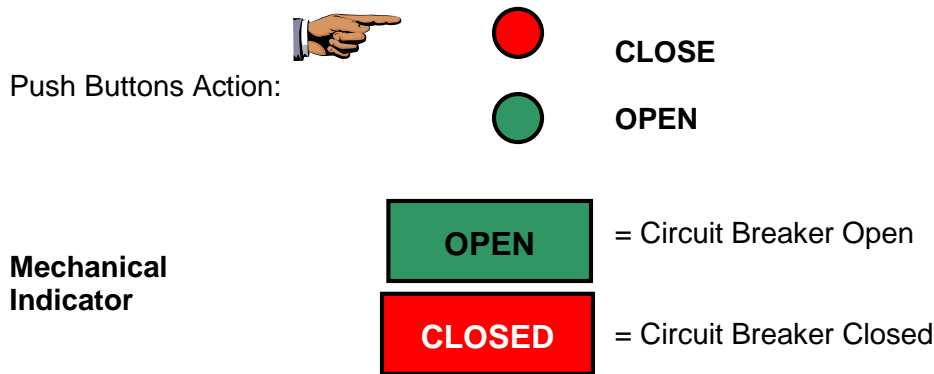


Figure 1

3.6.2 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.

3.7 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.

3.8 Labelling

3.8.1 Language

All labelling shall be in the English language only.

3.8.2 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 and equipment.

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 (eg “No. 1 Rectifier Control Cubicle”) in lettering of not less than 15 mm in height.

3.8.3 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.

3.8.4 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.

3.9 Auxiliary Supply Voltage

3.9.1 Traction Substation – DC auxiliary supply

Traction substations have dc auxiliary supply. For new and upgraded traction substations the nominal voltage is 120Vdc.

Equipment supplied at 120Vdc shall be designed to operate satisfactorily with the auxiliary voltage in the range -10% to +15% of this nominal voltage. All connected loads shall operate within this voltage range under ambient conditions as specified in 3.20 Environmental 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 PDS 09, Protection System Requirements for the High Voltage Network.

3.9.2 Traction Substation – AC auxiliary supply

Traction substations have ac auxiliary supply. For new and upgraded traction substations the nominal voltage is 240 Vac.

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

3.9.3 DC auxiliary supply – other than traction substations

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

3.9.4 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.

3.10 Wiring

3.10.1 General

All wiring shall be installed to the requirements of AS 3000.

All 120 Vdc wiring (other than control wiring installed on 1500Vdc 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 ARTC 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 PDS 09 Protection System Requirements for the High Voltage Network.

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.

3.10.2 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.

3.10.3 Minimum Wire Size and Wire Type

Small wiring shall generally be stranded copper 0.6/1 kV V105 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).

3.10.4 Wire Colours

Colours for dc control wiring shall be brown for positives, light blue for negatives and grey for all mid-wires.

Colours for ac and dc power wiring shall be in accordance with AS 2067.

CT and other protection wiring shall be as specified in PDS 09 Protection System Requirements for the High Voltage Network.

3.11 Terminal Blocks

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.

3.12 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.

3.13 Light

An appropriate 240V ac 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.

3.14 Auxiliary Relays, Push Buttons, and Selector Switches

3.14.1 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.

3.14.2 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.

3.14.3 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.

3.15 Indicator Lights

All indicator lights shall be LED types.

3.16 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 and software and shall be possible by downloading from storage medium or entering 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.

3.17 Current Transformers

Current transformers shall be as detailed in PDS 09 Protection System

Requirements for the High Voltage Network

3.18 Metering

Where required, analogue display meters for indication purposes shall be between 100 mm and 150 mm square and comply with AS 1042 with an accuracy class of 2.5.

Meters shall be mounted with their bottoms not lower than 500 mm above floor level and their tops not higher than 2000 mm above floor level.

3.19 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.

3.20 Environmental

The ambient temperature rating and degree of protection to AS 1939 shall be as required by ARTC Standard PDS 11 “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.

4 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.

For more detail see RailCorp publication EP 00 00 00 00 MP – Electric Power Technical Maintenance Plan.

5 Testing

5.1 Type Tests

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

5.2 Routine Tests

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

- Inspection in accordance with AS 3439.1 Clause 8.3.1.
- Continuity (point-to-point) test of all wiring.
- Dielectric test at power frequency in accordance with AS 3439.1. Clause 8.3.2 or AS 2067 Clause 11.3.1 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 POP 01.

6 Data Set Associated With The Equipment

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

6.1 Drawings

6.1.1 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 cross-section, insulation grade and any relevant comments. ARTC template in excel format is available and is the preferred method of documentation. See 2.3 ARTC templates.
- 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

6.1.2 Manufacturers Standard Drawing

The manufacturers 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.

6.1.3 Project Drawings

6.1.3.1 CAD Drafting

All drawings shall be produced in accordance with the ARTC CAD Manual. The sheet size shall not be larger than A1.

All drawings will be stored within the ARTC drawing system in Microstation format, the preferred format for drawings being Microstation Version 8, however ARTC will accept drawings produced in AutoCAD Version 2000.

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

- Copy & rename suitable size ARTC 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 (eg. 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 ARTC). 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.

6.1.3.2 Schematic Diagrams

Symbols used in drafting schematic diagrams shall be in accordance with AS 1102-1997

Components on the schematic and other drawings must be designated according to the ARTC identifiers tabled in Appendix A. Where there is no ARTC identifier for a particular device, it shall be designated according to IEEE standard C.37.2 – 1996.

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 – 1984 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.

6.2 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
51 A	Inverse Time Overcurrent Relay (A phase)	Rectifier CC
51 C	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
51 C2	Overcurrent Breaker Fail Relay (C phase)	Rectifier CC
51AX	Auxiliary Overcurrent Relay (A phase)	
51 CX	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	
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
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	

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	
97	Sequence Timing Relay	
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 51 A2, 51 B2, 51 C2 & 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 LEDs and 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

B.1 Application

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

B.2 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 ARTC, 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 6.1.1 Drawings Required 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.

B.3 Information to be submitted by the equipment supplier

B3.1 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.

B3.2 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.

B3.3 Drawings

Each revision of every drawing during design and manufacture shall be submitted for review by ARTC. One print marked with any necessary comments will be returned to the equipment supplier within fifteen (15) working days of receipt by ARTC. 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 ARTC 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 6.1.1) shall be subject to approval by ARTC.

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	ROMAN	WHITE	-	CONTINUOUS	59	137	0	1	0
GENERAL TEXT 2.5mm	8	ROMAN	WHITE	-	CONTINUOUS	8	138	0	1	0
GENERAL TEXT 3.5mm	8	ROMAN	RED	-	CONTINUOUS	8	138	3	2	0
GENERAL TEXT 5.0mm	8	ROMAN	GREEN	-	CONTINUOUS	8	137	2	3	0
EQUIPMENT/HARDWARE	1	-	WHITE	-	CONTINUOUS	1	-	0	1	0
EQUIPMENT/HARDWARE	3	-	MAGENT	-	DASHED	3	-	5	0	2
EQUIPMENT/HARDWARE	4	-	MAGENT	-	CENTRE	4	-	5	0	4
MAJOR EQUIPMENT/MAJOR	5	-	RED	-	CONTINUOUS	5	-	3	2	0
	5	-	RED	-	DASHED	5	-	3	2	2
CABLES, CONDUITS AND	12	-	SEE	-	SEE TABLES	12	-	VARIOUS	VARIOUS	VARIOUS
BUILDING	20	-	SEE	-	SEE TABLES	20	-	VARIOUS	VARIOUS	VARIOUS
TEXT/LINEWORK FOR BILL OF	21	ROMAN	WHITE	-	CONTINUOUS	21	138	0	1	0
EARTHWORK & OTHER	22	-	SEE	-	SEE TABLES	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	AutoCAD	MICROSTATION
LTSCALE IS RELEVANT IN 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