

Master Specification

Part RD-ITS-S2

Roadside Electrical Switchboards

September 2024



Government of South Australia
Department for Infrastructure
and Transport

Build.
Move.
Connect.

Document Information

Document Information	
K Net Number:	13138259
Document Version:	1
Document Date:	30/09/2024

Document Amendment Record

Version	Change Description	Date
0	Initial issue	31/08/2023
1	Updated cover page	30/09/2024

Document Management

This document is the property of the Department and contains information that is confidential to the Department. It must not be copied or reproduced in any way without the written consent of the Department. This is a controlled document and it will be updated and reissued as approved changes are made.

Contents

Contents	3
RD-ITS-S2 Roadside Electrical Switchboards	4
1 General	4
2 Documentation	5
3 Equipment requirements	5
4 Minor roadside electrical switchboards	16
5 Design and manufacture	16
6 Switchboard enclosure installation	18
7 Verification requirements and records	18

RD-ITS-S2 Roadside Electrical Switchboards

1 General

- a) This Master Specification Part sets out the requirements for the supply and installation of roadside electrical switchboards for applications other than standalone road lighting or traffic signal installations, including:
 - i) the documentation requirements, as set out in section 2;
 - ii) the equipment requirements, as set out in section 3;
 - iii) the requirements for minor roadside electrical switchboards, as set out in section 4;
 - iv) the design and manufacturing requirements, as set out in section 5;
 - v) the switchboard enclosure installation requirements, as set out in section 6; and
 - vi) the verification requirements and records, as set out in section 7.
- b) This Master Specification Part:
 - i) applies only to the supply and installation of roadside electrical switchboards for applications other than road lighting and traffic signals which are located at grade; and
 - ii) does not apply to the supply and installation of electrical switchboards located within Tunnels.
- c) The supply and installation of roadside electrical switchboards for applications other than road lighting and traffic signals must comply with the Reference Documents, including:
 - i) AS 1768 Lightning protection;
 - ii) AS 4070 Recommended practices for protection of low-voltage electrical installations and equipment in MEN systems from transient overvoltages;
 - iii) AS 60529 Degrees of protection provided by enclosures (IP Code);
 - iv) AS/NZS 1170 Structural design actions;
 - v) AS/NZS 3000 Electrical installations (known as the Australian/New Zealand Wiring Rules);
 - vi) AS/NZS 3008 Electrical installations - Selection of cables;
 - vii) AS/NZS 3013 Electrical installations - Classification of the fire and mechanical performance of wiring system elements;
 - viii) AS/NZS 3085.1 Telecommunications installations - Administration of communications cabling systems, Part 1: Basic requirements;
 - ix) AS/NZS 3100 Approval and test specification - General requirements for electrical equipment;
 - x) AS/NZS 3111 Approval and test specification - Miniature overcurrent circuit-breakers;
 - xi) AS/NZS 3190 Approval and test specification - Residual current devices (current operated earth-leakage devices);
 - xii) AS/NZS 5000 Electrical cables - Polymeric insulated;
 - xiii) AS/NZS 61439 Low-voltage switchgear and control gear assemblies;
 - xiv) AS/NZS IEC 60947 Low-voltage switchgear and control gear; and
 - xv) AS/NZS ISO 9001 Quality management systems - Requirements.

2 Documentation

2.1 Design Documentation

In addition to the requirements of PC-EDM1 “Design Management”, the Design Documentation must include:

- a) design documentation applicable to the roadside electrical switchboards in accordance with the requirements of RD-ITS-D1 “Design for Intelligent Transport Systems (ITS)”;
- b) details of the mains switching, outgoing circuit switching, motor control and starters, protection, and auxiliary equipment relevant to the roadside electrical switchboards, as required by section 3.1d); and
- c) drawings, manufacturer’s specifications, and diagrams relevant to the roadside electrical switchboards.

2.2 O&M Manual

In addition to the requirements of PC-CN2 “Asset Handover”, the O&M Manuals (including the Operations Manuals and the Maintenance Manuals) must include all operations and maintenance information and documentation relevant to the roadside electrical switchboards as required by RD-ITS-S1 “General Requirements for the Supply of ITS Equipment”.

2.3 Quality Management Records

In addition to the requirements of PC-QA1 “Quality Management Requirements” or PC-QA2 “Quality Management Requirements for Major Projects” (as applicable), the Quality Management Records must include the verification records required by Table RD-ITS-S2 7-1.

3 Equipment requirements

3.1 General

- a) The Contractor must ensure that all supplied roadside electrical switchboard equipment is manufactured under a quality system certified to AS/NZS 9001 Quality management systems - Requirements.
- b) The Contractor must ensure that all supplied roadside electrical switchboards are contained within a dedicated, sealed enclosure that:
 - i) prevents contact with any live, low voltage surface; and
 - ii) complies with the requirements of:
 - A. RD-ITS-S3 “ITS Enclosures”; and
 - B. RD-ITS-D1 “Design for Intelligent Transport Systems (ITS)”.
- c) Where required by the Contract Documents, the Contractor must supply a finished and operational sample roadside electrical switchboard to the Principal for assessment and approval.
- d) The Contractor must ensure that comprehensive details of:
 - i) mains switching;
 - ii) outgoing circuit switching;
 - iii) motor control and starters; and
 - iv) protection and auxiliary equipment,as relevant to the roadside electrical switchboards is included in the Design Documentation.

- e) The Contractor must ensure that all circuit protection devices relevant to the roadside electrical switchboards are rated for:
 - i) full current of connected load, continuous duty; and
 - ii) starting currents of connected load, a duty equal to the load's rated number of starts per hour.
- f) The Contractor must ensure that the circuit protection devices relevant to the roadside electrical switchboards comply with the following requirements:
 - i) the make and break capacity of the circuit protection device must be equal to the calculated prospective short-circuit fault current of the installed loads, as a minimum; and
 - ii) the minimum utilisation category of the circuit protection devices must comply with the following:
 - A. for circuits with motor or other highly inductive loads, the minimum utilisation category must be AC-23, in accordance with the requirements of AS/NZS IEC 60947 Low-voltage switchgear and controlgear; and
 - B. for loads other than those required by 3.1f)ii)A, the minimum utilisation category must be AC-22, in accordance with the requirements of AS/NZS IEC 60947 Low-voltage switchgear and controlgear.

3.2 Electrical requirements

The Contractor must ensure that all supplied roadside electrical switchboards comply with the following electrical requirements:

- a) the roadside electrical switchboards must comply with the requirements of AS/NZS 3000 Electrical installations (known as the Australian/New Zealand Wiring Rules);
- b) all electrical components of the roadside electrical switchboards must be:
 - i) suitable for operation on a mains 230 V AC +10%/-6%, 50 Hz \pm 0.1 Hz system (or 3-phase equivalent as appropriate); and
 - ii) rated for the respective calculated, prospective fault current; and
- c) the switchboard equipment must be mounted on DIN rail which comply with the following:
 - i) the DIN rail must meet the requirements of AS/NZS 61439 Low-voltage switchgear and controlgear assemblies; and
 - ii) the DIN rail must be:
 - A. type TH35-7.5;
 - B. of a minimum length of 400 mm; and
 - C. fixed securely to prevent movement.

3.3 Identification and labelling

3.3.1 General

The Contractor must ensure that all roadside electrical switchboards are identified and labelled in accordance with the following requirements:

- a) permanent labels must be affixed to all roadside electrical switchboards and their contents, including:
 - i) instruments;
 - ii) controls;

- iii) circuit designations and ratings;
 - iv) circuit protection devices;
 - v) discrete devices;
 - vi) cabling; and
 - vii) warning notices; and
- b) all identification labels required by section 3.3.1a) must meet the requirements of:
- i) AS/NZS 61439 Low-voltage switchgear and control gear assemblies; and
 - ii) AS/NZS 3000 Electrical installations (known as the Australian/New Zealand Wiring Rules).

3.3.2 Electrical insulation

- a) The Contractor must ensure that live terminal blocks and switchboard components are protected to a minimum degree of IP2X in accordance with AS 60529 Degrees of protection provided by enclosures (IP Code).
- b) The Contractor must ensure that electrical insulation colours for wiring cores and busbars relevant to the electrical switchboards comply with the requirements of Table RD-ITS-S2 3-1.

Table RD-ITS-S2 3-1 Electrical insulation colours

Wiring core	Multiphase installation (colour)	Single phase installations (colour)
Active	Red, white, or blue	Red
Neutral	Black	Black
Earth	Green and yellow	Green and yellow
LV control	White, with numbered ferrules	White, with numbered ferrules
ELV control	Purple, with numbered ferrules	Purple, with numbered ferrules

3.3.3 Labelling requirements

The Contractor must ensure that all labels required by this section 3 comply with the following requirements:

- a) labels must be affixed by screws adjacent to the roadside electrical switchboard or the relevant roadside electrical switchboard components (as applicable);
- b) in areas accessible to the public, the screws used for affixing the labels, in accordance with section 3.3.3a), must be of a vandal-resistant design;
- c) labels must be located such that they cannot be mistaken as referring to another asset, component, or device;
- d) labels must not be affixed to the actual roadside electrical switchboard or the roadside electrical switchboard components;
- e) labels must:
 - i) be laminated plastic or brushed aluminium; and
 - ii) be coloured as follows:
 - A. warning notices: white letters on red background;
 - B. essential circuits: red lettering on white background; and
 - C. labels other than warning notices or essential circuits: black lettering on white background; and
- f) label lettering must comply with the label lettering heights outlined in Table RD-ITS-S2 3-2.

Table RD-ITS-S2 3-2 Label lettering heights

Label	Lettering height (mm)
Main switchboard	25
Name of other switchboards	15
Main switch	15
Switchboard feeder control switches	10
Name of switchboard panel	6
Equipment labels	4
Warning notices	4
Essential circuits	4

3.3.4 Labelling of circuit protection devices

- a) The Contractor must ensure that circuit protection devices that protect roadside electrical switchboard feeders are labelled in a manner consistent with the following example:
 - i) number of the circuit protection device: Qxx [or] Fxx;
 - ii) name of the connected sub-board: SB 1 - General Light & Power;
 - iii) setting / rating of the circuit protection device: 315 A / 400 A; and
 - iv) connected cable size and type: 4 x 1 C 300 mm² Cu/PVC/PVC.
- b) The Contractor must ensure that circuit protection devices that protect roadside electrical switchboard circuits (other than feeders required by section 3.3.4a)) are labelled in a manner consistent with the following example:
 - i) number of the circuit protection device: Qxx [or] Fxx; and
 - ii) name of the final sub-circuit: L1 - S/L North 1.

3.3.5 Schedule cards

- a) The Contractor must:
 - i) prepare circuit schedule cards which describe the final sub-circuits for the switchboard; and
 - ii) mount each circuit schedule card in a purpose-built holder affixed inside the door of the enclosure housing the circuit protection devices.
- b) The Contractor must ensure that the circuit schedule cards required by section 3.3.5a) comply with the following requirements:
 - i) each circuit schedule card must be at least 200 mm (height) x 150 mm (width) in size and contain easily legible computer-printed text showing:
 - A. the number of the circuit protection device;
 - B. the sub-main or sub-circuit name;
 - C. the destination area (where applicable); and
 - D. connected cable rating, type, and length; and
 - ii) each circuit schedule card must be protected by a transparent plastic cover.

3.4 Neutral earth

- a) The Contractor must ensure that all:
 - i) enclosures housing electrical switchboards; and
 - ii) electrical switchboards,

are bonded to earth in accordance with the requirements of AS/NZS 3000 Electrical installations (known as the Australian/New Zealand Wiring Rules).

- b) The Contractor must provide:
 - i) clearly numbered terminals for all neutral and earth conductors, including the MEN link;
 - ii) spare terminals for future circuits in each of the neutral and earth bars; and
 - iii) stud connections for all cables with a cross sectional area of 16 mm² or larger.
- c) For the purposes of section 3.4b)ii), the number of spare terminals must be equal to the greater of:
 - i) 10% of initial connected terminals; or
 - ii) 6 terminals.

3.5 Switchboard wiring

- a) The Contractor must ensure that all roadside electrical switchboard wiring complies with the following requirements:
 - i) the roadside electrical switchboard wiring must have a minimum cross-sectional area of:
 - A. 2.5 mm² (7/0.67) for power supply wiring; and
 - B. 1.0 mm² (32/0.2) for control and indication wiring;
 - ii) the roadside electrical switchboard wiring must:
 - A. comply with the requirements of AS/NZS 5000 Electrical cables - Polymeric insulated; and
 - B. be de-rated in accordance with the requirements of AS/NZS 3008 Electrical installations - Selection of cables;
 - iii) the roadside electrical switchboard wiring must be sized to suit the rated current of the particular circuit, including any requirement for additional or spare capacity as specified in:
 - A. RD-ITS-D1 "Design of Intelligent Transport Systems (ITS)"; or
 - B. the Contract Documents;
 - iv) only one wire is to be connected to each terminal;
 - v) proprietary bonding links must be used for parallel connections between adjacent terminals;
 - vi) all roadside electrical switchboard wiring must use 0.6/1 V V-75 Cu/PVC cables that comply with the requirements of AS/NZS 5000 Electrical cables - Polymeric insulated;
 - vii) essential circuits as specified in the Contract Documents must utilise a wiring system that complies with fire performance rating WS52 as required by AS/NZS 3013 Electrical installations - Classification of the fire and mechanical performance of wiring system elements; and
 - viii) protective insulated flashing must be provided where wiring or cables required for the roadside electrical switchboards pass through cut-outs or other sharp edges.
- b) The Contractor must ensure that wiring ducts are utilised within the roadside electrical switchboard.
- c) Where the use of wiring ducts for wiring within parts of the roadside electrical switchboards, as required by section 3.5b), is impractical due to space limitations, the Contractor must ensure that the wiring exiting the wiring duct is bundled and supported with PVC ties or strips so as to:

- i) remain neat, functional and prevent excessive sagging; and
- ii) avoid interference with maintenance activities within the enclosure.

3.6 Terminations

3.6.1 Terminals

- a) The Contractor must ensure that each roadside electrical switchboard wiring terminal is clearly and indelibly identified.
- b) The Contractor must ensure that each roadside electrical switchboard terminal assembly is arranged so that:
 - i) the connecting cables can be formed in a neat manner; and
 - ii) all conductors can be connected or disconnected without disturbing other connections.
- c) The Contractor must ensure that all roadside electrical switchboard wiring terminals comply with the following requirements:
 - i) the wiring terminal must use stud-type terminals (minimum 5 mm diameter) with wiring connections for cross sectional areas greater than 25.0 mm²;
 - ii) only one lug is to be installed per mounting stud;
 - iii) tunnel-type terminal blocks must be DIN rail mounted as follows:
 - A. wire cross sectional areas 10.0 mm² to 25.0 mm² (inclusive) must be DIN rail mounted with compression screws; and
 - B. wire cross sectional areas less than 10.0 mm² must be DIN rail mounted with:
 - I. compression screws; or
 - II. spring-type; and
 - iv) each tunnel-type terminal must only have one conductor connected to each end of the tunnel.

3.6.2 Lugs

The Contractor must ensure that:

- a) wiring relevant to the roadside electrical switchboards is terminated using compression type lugs or pins that are compatible with the terminals; and
- b) the lugs or pins required by section 3.6.2a) must be crimped in accordance with the manufacturer's instructions.

3.6.3 Arrangement

The Contractor must ensure that:

- a) all roadside electrical switchboard internal wiring is terminated on one side of the terminal block;
- b) wiring that exits the roadside electrical switchboard enclosure is terminated on the other side;
- c) roadside electrical switchboard control terminals are grouped for each circuit with each group physically segregated; and
- d) DIN rails relevant to the electrical switchboards provide 25% spare capacity for future circuits.

3.7 Switch-isolator and fuse switch units

The Contractor must ensure that all switch-isolator and fuse-switch units relevant to the roadside electrical switchboards comply with the following requirements:

- a) the switch-isolator and fuse-switch units must comply with the requirements of AS/NZS IEC 60947 Low-voltage switchgear and controlgear; and
- b) the switch-isolator and fuse-switch units must:
 - i) allow manual operation with an integral on-off indicator;
 - ii) a facility to lock the device in the off position;
 - iii) be totally enclosed; and
 - iv) incorporate:
 - A. arc-control devices; and
 - B. shrouded stationary contacts.

3.8 Fuses and circuit breakers

- a) The Contractor must ensure that roadside electrical switchboard fuses comply with the following requirements:
 - i) fuses must be of an enclosed, high rupturing capacity type;
 - ii) fuses must be installed in fuse-holders that allow a blown fuse to be identified while the fuse is installed in the service position;
 - iii) fuse-holders must insulate all live parts when a fuse is withdrawn;
 - iv) a fuse insertion and extraction device must be provided with each electrical switchboard to safely remove and insert fuses; and
 - v) the fuse insertion and extraction device required by section 3.8a)iv) must be mounted on retention clips within the enclosure housing the electrical switchboard.
- b) The Contractor must:
 - i) provide 3 spare fuses for each size of fuse used in each roadside electrical switchboard; and
 - ii) mount the spare fuses required by section 3.8b)i) in holders within the enclosure housing the roadside electrical switchboard, adjacent to the fuse insertion and extraction device required by section 3.8a)iv).
- c) The Contractor must ensure that:
 - i) fuse-holders are arranged such that the fuse may be extracted directly towards maintenance personnel and not towards live parts;
 - ii) circuit breakers are arranged so that the breaker operation status and current rating indications are clearly visible while the switchboard panel cover or escutcheon plate is in position;
 - iii) where a preformed roadside electrical switchboard enclosure is used, it must be capable of housing:
 - A. single width miniature circuit breakers;
 - B. double width miniature circuit breakers;
 - C. triple width miniature circuit breakers; and
 - D. their related preformed busbars; and
 - iv) proprietary pole fillers are provided in all unused portions of the clip tray within the roadside electrical switchboard enclosure.
- d) The Contractor must ensure that roadside electrical switchboard circuit breakers comply with the following requirements:

- i) moulded case circuit breakers and miniature circuit breakers with fault capacities of 10 kA or more must comply with the requirements of AS/NZS IEC 60947 Low-voltage switchgear and controlgear;
- ii) miniature circuit breakers with fault capacities less than 10 kA and a current rating of up to 100 A must comply with the requirements of AS/NZS 3111 Approval and test specification - Miniature overcurrent circuit-breakers;
- iii) all circuit breakers must be able to be locked in the off position; and
- iv) moulded case circuit breakers with alternate mounting arrangement capability do not need to be mounted on DIN rail.

3.9 Residual current devices

- a) The Contractor must ensure that RCDs relevant to the roadside electrical switchboards comply with the following requirements:
 - i) the RCDs must meet the requirements of:
 - A. AS/NZS 3190 Approval and test specification - Residual current devices (current operated earth-leakage devices); and
 - B. AS/NZS 3111 Approval and test specification - Miniature overcurrent circuit-breakers; and
 - ii) the RCD must have a tripping current of 30 mA.
- b) Where RCD protection is provided on a circuit protected by a miniature circuit breaker, the Contractor must ensure that the RCD is integral with the miniature circuit breaker.

3.10 Protection against electrical transients and over-voltage

3.10.1 General

- a) The Contractor must ensure that the electrical switchboards comply with the following requirements:
 - i) the switchboard must incorporate protection against:
 - A. electrical transients; and
 - B. over-voltage; and
 - ii) the Contractor must ensure compliance with:
 - A. the recommended practices for the MEN system, as specified in AS 4070 Recommended practices for protection of low-voltage electrical installations and equipment in MEN systems from transient overvoltages; and
 - B. the guidelines for the protection of persons and property from hazards arising from exposure to lightning as set out in AS 1768 Lightning protection.
- b) The Contractor must ensure that the roadside electrical switchboards include all necessary devices to protect all equipment being housed in the enclosures from:
 - i) electrical transients; and
 - ii) over-voltage.

3.10.2 Surge diverter

- a) Surge diverters must be supplied and installed by the Contractor in the roadside electrical switchboards to provide protection against multiple impulses caused by lightning or other transient disturbances.

- b) The Contractor must ensure that the surge diverters supplied and installed pursuant to section 3.10.2a) are connected on the load side of the electrical switchboard's main switch between the following terminals:
- i) phase and neutral;
 - ii) phase and earth; and
 - iii) phase to phase (at multi-phase installations).
- c) The Contractor must ensure that the surge diverters supplied and installed in the roadside electrical switchboards:
- i) satisfy the requirements of AS 4070 Recommended practices for protection of low-voltage electrical installations and equipment in MEN systems from transient overvoltages;
 - ii) have a minimum phase-to-neutral single shot 8/20 μ s rating of 80 kA;
 - iii) are suitably rated to withstand multiple impulses as defined by location category C in AS 1768 Lightning protection;
 - iv) are based on metal oxide varistor technology, with each metal oxide varistor:
 - A. rated at no less than 40 kA for an 8/20 μ s pulse; and
 - B. internally fused such that they are disconnected if the unit experiences a surge that exceeds its rating;
 - v) have visual indication of metal oxide varistor fuse:
 - A. operation;
 - B. loss of power; and
 - C. thermal overload;
 - vi) are such that, in the event of a thermal overload, the surge protection remains in circuit;
 - vii) have voltage free changeover contact (alarm output) which activates upon any:
 - A. metal oxide varistor failure;
 - B. power failure; and
 - C. thermal overload condition;
 - viii) the changeover contact required by section 3.10.2c)vii) must be isolated to 4 kV to all active circuitry;
 - ix) are rated for:
 - A. a nominal operating phase voltage of 230 V; and
 - B. a maximum operating voltage of at least 275 V rms; and
 - x) have a let through voltage (residual voltage) for a 6 kV 1.2/50 μ s, 3 kA 8/20 μ s impulse of less than 900 V when measured at the surge diverter terminals.

3.10.3 Surge filters

- a) A surge filter must be supplied and installed by the Contractor in the roadside electrical switchboards on:
- i) the load side of the surge diverter;
 - ii) the line side of sub-circuits supplying electronic equipment; and
 - iii) the line side of switched outlet sub-circuits.

- b) The Contractor must ensure that the surge filters supplied and installed in the roadside electrical switchboards comply with the following requirements:
- i) the surge filter must provide protection against multiple impulses caused by lightning and other transient disturbances and interferences; and
 - ii) the surge filter must be connected between phase and neutral in accordance with the requirements of AS 4070 Recommended practices for protection of low-voltage electrical installations and equipment in MEN systems from transient overvoltages.
- c) The surge filter must:
- i) have a minimum load current rating of 10 A per phase;
 - ii) have a single shot 8/20 μ s rating of 16 kA per mode;
 - iii) be suitably rated to withstand multiple impulses as defined by location category B in accordance with AS 1768 Lightning protection;
 - iv) be based upon metal oxide varistor technology with the line side of metal oxide varistors being internally fused such that they are disconnected if the unit experiences a surge that exceeds its rating;
 - v) remain in circuit in the event of a thermal overload;
 - vi) be rated for a nominal operating phase voltage of 230 V;
 - vii) be rated for a maximum operating voltage of at least 275 V rms;
 - viii) have a let through voltage (residual voltage) for a 6 kV 1/2/50 μ s, 3 kA 8/20 μ s impulse of less than 600 V when measured at the surge filter terminals;
 - ix) have visual tags and LED indicating "power" and "status" for each phase which comply with the following requirements:
 - A. the power LED must extinguish when power to the unit is lost; and
 - B. the status visual tags and LEDs must extinguish when:
 - I. the metal oxide varistor fuse operates;
 - II. power to the unit is lost; and
 - III. the unit experiences a thermal overload; and
 - x) have a voltage free changeover contact (alarm output) which:
 - A. activates upon any:
 - I. metal oxide varistor failure;
 - II. power failure; and
 - III. temperature overload condition; and
 - B. must be isolated to 4 kV to all active circuitry.

3.11 Switches and push buttons

- a) The Contractor must ensure that control and test switches and push buttons forming part of the roadside electrical switchboards:
- i) comply with the requirements of AS/NZS IEC 60947 Low-voltage switchgear and controlgear;
 - ii) have a minimum rating of 6 A at 230 VAC at utilisation category AC-22 in accordance with AS/NZS IEC 60947 Low-voltage switchgear and controlgear; and
 - iii) are IP56 rated (control and test switches only) in accordance with the requirements of AS 60529 Degrees of protection provided by enclosures (IP Code).

- b) The Contractor must ensure that push buttons forming part of the roadside electrical switchboards are colour coded according to the following functions:
 - i) green push buttons must be used for:
 - A. start;
 - B. on; and
 - C. close;
 - ii) red push buttons must be used for:
 - A. stop;
 - B. off; and
 - C. open; and
 - iii) black push buttons must be used for:
 - A. reset; and
 - B. acknowledge.

3.12 Control relays

- a) With respect to roadside electrical switchboard control relays, the Contractor must ensure:
 - i) that the control relays are suitable for continuous operation for the application;
 - ii) that all control relays comply with the requirements of AS/NZS IEC 60947 Low-voltage switchgear and controlgear;
 - iii) that only one voltage is used on the contacts of each control relay; and
 - iv) that control relays are:
 - A. plug-in type; and
 - B. held in the socket base by a captive clip that can be operated without the use of tools.
- b) The Contractor must ensure that:
 - i) the contacts have a minimum rating of 5 A at 230 VAC;
 - ii) the contacts are electrically isolated double break silver alloy non-welding contacts;
 - iii) control relay assemblies:
 - A. are provided with a minimum of 4 contacts; and
 - B. allow expansion to 8 contacts in the same assembly; and
 - iv) contact blocks are readily convertible in the field to either:
 - A. normally open; or
 - B. normally closed contacts.

3.12.2 Time delay relays

The Contractor must ensure that time delay relays:

- a) are adjustable over the full timing range; and
- b) are accurate within 12.5% of the nominal setting.

3.12.3 Phase failure relays

- a) The Contractor must ensure that phase failure relays are solid-state with field adjustable trigger level.
- b) The Contractor must ensure that the sensing circuit:
 - i) rejects frequencies other than 50 Hz; and
 - ii) is provided with surge filters.

3.13 Power socket outlet panels

The Contractor must provide a minimum of one switched double power socket outlet in each roadside electrical switchboard enclosure which is easily accessible from the front of the enclosure (or the rear of the enclosure where rear access is provided).

4 Minor roadside electrical switchboards

- a) For the purposes of this section 4, minor roadside electrical switchboards refer to smaller switchboards (sub boards) which would typically be fed from a major roadside electrical switchboard, but located within another cabinet, such as a VMS cabinet or a separate cabinet located remotely from the main switchboard.
- b) The Contractor must ensure that minor roadside electrical switchboards incorporate the following at a minimum:
 - i) one single pole, DIN rail mount, miniature 250 V, 32 A fused mains isolating switch;
 - ii) one single pole, DIN rail mount, 250 V, suitably sized, miniature circuit breaker for the surge diverter;
 - iii) surge diverter and surge filter as specified in sections 3.10.2 and 3.10.3;
 - iv) one 250 V, 10 A circuit breaker feeding the remainder of the minor electrical switchboard;
 - v) 2 x 250 V, 6 A miniature residual current circuit breaker with overload protection (RCBO) for separate cabinet lighting and fan circuits;
 - vi) a 250 V, 6 A miniature RCBO for the socket outlet panel described in section 3.13;
 - vii) neutral bar and cover, with a capacity suitable for the circuit requirements of the enclosure;
 - viii) earth bar, with a capacity suitable for the circuit requirements of the enclosure; and
 - ix) provision for an earth - neutral link.

5 Design and manufacture

5.1 General design

The Contractor must ensure that the design and manufacture of roadside electrical switchboards complies with the following:

- a) switchboards and control panels less than 100 A per phase with the prospective fault current being less than 5 kA must be designed and constructed to comply with the requirements of AS/NZS 3000 Electrical installations (known as the Australian/New Zealand Wiring Rules);
- b) manufactured switchgear assemblies, other than those required by section 5.1a), must be designed and constructed to comply with the requirements of AS/NZS 61439 Low-voltage switchgear and control gear assemblies;

- c) the switchboard must be of type Form 2B as specified in AS/NZS 61439 Low-voltage switchgear and control gear assemblies; and
- d) roadside electrical switchboards are designed with:
 - i) a load capacity of 140% of the design calculated maximum demand;
 - ii) a 40% spare capacity of poles;
 - iii) a minimum of 300 mm gap at the bottom of each cabinet to allow for cable management;
 - iv) finger ducts for internal cable management, designed to be maximum 50% full on completion of cable installation;
 - v) a document pocket included on the door for document storage as required by RD-ITS-S3 "ITS Enclosures"; and
 - vi) equipment layout within roadside electrical switchboards must follow a logical design, and allow for adequate electrical segregation, ventilation or air movement between and around equipment, supported by heat load calculations per cabinet.

5.2 External design

The Contractor must ensure that roadside electrical switchboard enclosures, panels, doors and related external components are designed and constructed:

- a) in accordance with the requirements of AS/NZS 61439 Low-voltage switchgear and controlgear assemblies; and
- b) to provide the specified segregation and degree of protection stipulated in AS 60529 Degrees of protection provided by enclosures (IP Code).

5.3 Supporting structure

- a) The Contractor must ensure that the roadside electrical switchboard supporting frames are fabricated from:
 - i) rolled and cold-formed; or
 - ii) extruded metal sections; and
 - iii) have all joints fully welded and ground smooth.
- b) The Contractor must ensure that concealed fixings or brackets are located to allow the roadside electrical switchboard to be mounted and fixed in the specified location without the removal of equipment.

5.4 Panels

The Contractor must ensure that panels forming part of the roadside electrical switchboards, or their enclosures, satisfy the following requirements:

- a) sheet metal angles, corners and edges must be machine folded with a minimum return of:
 - i) 25 mm around the edges of the front and rear panels; and
 - ii) 13 mm edge around doors; and
- b) where necessary, panels and doors must be provided with stiffening to prevent distortion or drumming.

5.5 Equipment fixing

The Contractor must ensure that DIN rails and other equipment relevant to the roadside electrical switchboards are mounted on equipment mounting panels that are:

- a) fixed to threaded metal inserts; and

- b) located towards the rear of the enclosure.

5.6 Escutcheon plates

- a) The Contractor must provide escutcheon plates that comply with the following:
 - i) the escutcheon plates must be removable and hinged; and
 - ii) the escutcheon plates must have neat cut-outs as required for circuit breaker handles and other protrusions associated with the electrical switchboards.
- b) The Contractor must ensure that:
 - i) each escutcheon plate is fitted with lifting handles and captive fixings that can be operated without the use of tools;
 - ii) sufficient clearance around equipment is provided to allow for easy removal of the escutcheon plates;
 - iii) the escutcheon plates are transparent; and
 - iv) a continuous support frame is provided for the fixing of each escutcheon plate and to prevent panel distortion.

6 Switchboard enclosure installation

With respect to the roadside electrical switchboard cabinets, the Contractor must ensure that:

- a) they are installed in accordance with the requirements of AS/NZS 3000 Electrical installations (known as the Australian/New Zealand Wiring Rules);
- b) they are affixed in accordance with the requirements of AS/NZS 1170 Structural design actions;
- c) masonry anchors are used as appropriate;
- d) they are plumb, level, and fixed rigidly into position by at least 4 fixing points; and
- e) for ground mounted roadside electrical switchboards, the installation must comply with the requirements of RD-ITS-C1 "Installation and Integration of ITS Equipment".

7 Verification requirements and records

The Contractor must supply written verification as part of the Quality Management Records that the requirements listed in Table RD-ITS-S2 7-1 have been complied with.

Table RD-ITS-S2 7-1 Verification records

Document reference	Subject	Record to be provided
RD-ITS-S1 "General Requirements for Supply of ITS Equipment"	Testing	Test records