TWEED SHIRE COUNCIL

ELECTRICAL DESIGN SPECIFICATION

EL15

LOW VOLTAGE SWITCHBOARDS

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1 CITATION

This document is named "Tweed Shire Council, Electrical Design Specification E15 – "Low Voltage Switchboards"

2 ORIGIN OF DOCUMENT, COPYRIGHT

3 VERSIONS

VERSION	AMENDMENT DETAILS	CLAUSES AMENDED	DATE ISSUED (The new version takes effect from this date)	Authorised by the Director of Engineering Services
1.1	Original version		1 November 2005	

4 STANDARDS

The equipment and materials supplied under this Specification must comply with the latest relevant Australian Standards, or, in their absence, with the latest relevant IEC Standards, together with the requirements of competent Authorities having jurisdiction over all or part of their manufacture, installation and operation.

5 GENERAL

The low voltage Switchboards must also comply with Standard Specification EL14 "General Switchboard Requirements."

The equipment must be designed and manufactured with an emphasis on safety, reliability and maintainability. Comprehensive diagnostic systems must be an integral part of the equipment design.

It is an objective of this Specification to specify items and equipment with similar technical requirements in order to minimise site inventory and reduce life cycle costs of all equipment, so far as the performance, reliability and durability of the 'Equipment' is not compromised. Any proposed departure from this Specification must be identified by the Tenderer and justified at the time of the Tender.

Door locks must comply with STD-ES-001. Gland plates must be constructed from brass.

6 DISTRIBUTION BOARDS

The small power distribution equipment may form part of an MCC (termed a "distribution section" (DS) or be a stand-alone dedicated cubicle (termed a "distribution board" (DB). The following details refer to both forms, with the only difference being the additional mechanical construction details pertaining to the cubicle form.

Low voltage distribution switchboards must have a hinged front door, behind which is a dead front escutcheon with circuit breaker toggles projecting through. The internal escutcheon must be hinged and lift off. A combined ammeter/MDI, voltmeter and phase selector switch must be installed on the incoming section. Larger distribution boards must be constructed to Form 4 of AS 3439.1, where specified.

Distribution boards including load centres must be constructed from metallic materials. Plastic and polycarbonate materials are not acceptable.

Switchboards must be free standing, but small distribution boards may be back mounted with four (4) external fixings.

General construction must be as follows:

- metalwork, layout constraints and mechanical construction to be as for the switchboards as appropriate, as described elsewhere in this Specification;
- overall construction to be Form 1 to AS 3439.1;
- main isolating device to be mechanically interlocked with escutcheon plate (inner door); outer door to have T-handles, inner escutcheon door to have handles requiring a special tool for opening. Refer to Standard Specification EL01 “General Requirements and Information”;
- Gland plates must be provided in the bottom of each tier. These must be 6 mm brass;
- Panels must be arranged such that no switch gear or control device is mounted higher than two metres or lower than 300 mm above floor level.
- Each distribution circuit breaker must be provided with a padlock facility, the padlock facility must be permanently attached to the escutcheon.

Electrical requirements are as follows:

- chassis assemblies must be a fully-dipped, colour-coded, insulated and type-tested (to AS 3439.1) busbar system;
- all unused busbar branches must be shrouded;
- the line side of the main isolating device must be fully shrouded;
- the inner escutcheon door must allow only circuit breaker bodies and activating arms to protrude through the cutouts such that there are no exposed 240/415 V AC terminals or surfaces with the escutcheon door closed;
- all DS/DBs must conform to AS 3439.1 and be suitable for use under "Normal Service Conditions" as defined in AS 3439.1;
- spare busbar branches must be set at 25% by useable number or as specified on the single line diagram;

- note is drawn to the requirement for double-pole breakers on all single-phase circuits supplying equipment within a hazardous zone;
- all lighting and GPO circuits must have 30 mA RCD protection;
- all circuit breakers with earth leakage (or RCD) protection must have an additional pole to switch the neutral;
- cable entry must be from the bottom only, with cable ducts provided to allow fastening and grouping of outgoing circuits in a neat and orderly manner;
- the incomer isolating device, as indicated on the single line diagram, must switch the neutral and all phases;
- there must be no neutral-to-earth connection within the distribution section/board.

7 MOTOR CONTROL CENTRES

7.1 General Arrangement

MCC's must be of the dead front freestanding type. All MCC's must be supplied with base frames for floor fixing.

Mild steel must have a minimum thickness of 2 mm. Structural panels must be suitably reinforced to prevent warping or buckling. Marine grade aluminium enclosures are also acceptable.

Starter cells for motors 150 kW and above and large feeder cells must be located at the bottom of the MCC and must be provided with a separate gland plate for the direct connection of the large power cables.

All back to back MCC's be centre fed with the larger drives grouped towards the centre incomer.

The PLC cabinets should be located such that the overhead busbar currents are minimal.

Outdoor MCC's must be completely constructed of 316 stainless steel number 4 linish finish or marine grade aluminium.

Weather-proof enclosures must have sloping roofs and guttering which direct water away from doors.

Unit cells must be of uniform width and depth and of a modular design, constructed such that all components are mounted on a removable equipment mounting plate which can be interchanged readily with other modules of the same size. All components must be able to be removed and installed on the equipment mounting plate without requiring removal of the mounting plate.

Unless otherwise specified motor control centres must be of modular compartment type, fully folded and welded construction, conforming with AS 3439.1, Form 4 segregation. The MCC required fault withstand capacity must be defined in the scope of works or by Council. The main incoming circuit breaker must be air break or moulded case type and withdrawable.

Detailed information supporting the MCC's compliance and the method of venting internal explosions to the atmosphere must be provided.

MCCs must be preferably back connected. Where front connected, the cabling zone must be at least 370 mm in width. The arrangement of equipment and components must reduce, to an economic minimum, the number of different component parts.

Horizontal wireways must be provided at the top and bottom of each tier, to provide a complete wiring duct the entire length of the switchboard. In addition, each cubicle must have a vertical cabling space connecting into the horizontal wireway.

Modules up to and including 110kW must be withdrawable of the plug in busbar type. Modules above 110 kW must be direct connect to the busbar.

Equipment must only be mounted on the gear tray or door.

The main disconnecting device for motors and feeders must be either a combined fuse switch (CFS) or a circuit breaker depending on what is shown on the detailed design drawings. The types and sizes must be as required by the detailed design drawings.

All main disconnecting devices for motors and feeders must have the operating handle external to the compartment (door mounted). All handles must point in the same direction when in the isolated or "O" position. Similarly, all must point in the same direction when in the closed or "I" position..

The operating handle for the main disconnecting devices of motors and feeders must be padlockable in the "off" position only, with a 8 mm hasp padlock - padlocks to be supplied by Others. The appropriate proprietary accessory (excluding the padlock) must be provided for each motor/feeder for this purpose. The handle must be mechanically interlocked with the compartment door, allowing the door to be opened only when the disconnecting device is open.

7.2 Motor Starter Types

The following forms of motor starter may be used:

- direct on line;
- solid state (soft start or variable frequency). Where a motor is 12.5kW or greater and is fixed speed it shall use soft starting.

All starters must be sized for six (6) equally spaced starts per hour.

7.3 Motor Starter Unit Cells

7.3.1 General

Motor starter cells must include the following equipment where required, and as shown on the detailed design drawings.

- Motor Short Circuit Protector/Isolator;
- Contactor with 240 Volt AC coil;
- Auxiliary Relay with 24 Volt DC coil;

- Ammeter for all drives rated 5.5 kW and above;
- 2400 Volt AC Control Miniature Circuit Breakers and links;
- Protection Current Transformers;
- Metering Current Transformers;
- Thermal Overload Protective Device with Electrical Reset or;
- Electronic Motor Protection Relay;
- Toroidal Current Transformer;
- Earth Leakage Relay;
- “Run” Lamp;
- “Fault” Lamp;
- “Ready” Lamp;
- Control Terminal Blocks, located in the cable zone;
- Internal Wiring;
- Current Transducer for all Drives 45 kW and above.

The following sections are specific requirements of some motor control circuits.

7.3.2 Motors up to 4.0 kW

- Direct connect ammeter (where required).

7.3.3 Motor larger than 4.0 kW to 37 kW

- C.T. operated ammeter with 5A secondary.

7.3.4 Motors larger than 37 kW

- electronic overload relay;
- ammeter either by 5A C.T. or integral to electronic overload;
- 4-20 mA current signal;
- thermistor protection.

7.3.5 Solid State Drives

Variable speed drives must also comply with Standard Specification EL09 - Variable Speed Drive Systems.

Due to the large heat dissipation the cubicle must be adequately ventilated and fan force cooled.

Thermistors must be installed in the motor to prevent overheating at slow speeds, unless otherwise specified.

Solid state drives less than 110 kW, where required, must be mounted internally to the MCC. It is preferable that the associated starter circuit power devices be mounted adjacent to the Solid State Drive within the same tier. Control circuit wiring may be terminated directly to the Solid State Drive internal terminal strip.

The minimum acceptable Solid State Drive housing protection rating must be IP2X to AS 1939.

Cooling system design of the solid state drive tier must be determined by the Contractor. The Tenderer must clearly state any degradation of overall MCC IP rating due to this cooling system.

Minimal IP degradation is preferred. Where door-mounted fan-forced ventilation is utilised, the filtration system must be suitable for exclusion of entry of fine coal dust and must be of a design to allow ready removal and replacement of the filter media. Where the solid state drives do not incorporate an integral cooling fan, a dedicated internal tier fan is recommended for the contractor's consideration. The use of cooling system equipment requiring greater than 120 V AC is unacceptable.

Preference is for solid state drives 110 kW or greater to exhaust air outside the VSD enclosure.

Unless otherwise specified, the solid state drives must be supplied by the Contractor.

7.3.6 Solid State Soft Starters

Soft starters must meet the requirements of AS 3947.4.2.

SCR's must be protected against voltage spikes.

Soft starters must be continuously rated for at least 440V at a motor full load current (FLC), 300% FLC for 60 seconds, and 500% FLC for 30 seconds. They must be rated to perform a minimum of ten starts at five times full load current in a period of one hour.

The solid state soft starter for each drive must be fitted with a control system capable of providing all of the following:

- An open loop step / ramp voltage control with initial supply voltage adjustment of 0% to 50% volts, acceleration adjustment of 0 – 30 seconds, and current limit adjustment of 150% to 600% full load amps. Constant current control is not acceptable.
- A closed loop tacho-feedback control of linear speed ramp control with shaft encoder or other type of motor shaft speed input.
- Common control and firing printed circuit boards for all sizes of starters in the range.
- Soft starters must be protected from phase failure and, where specified, phase reversal.
- Soft starters must each be equipped with a shorting or bypass contactor, rated the same as the main contactor, operated by an auxiliary relay when the motor has reached full speed.
- The controller must have a LED display, or approved equivalent, for fault diagnostics, and contacts for remote fault monitoring.

8 SMALL STARTER PANELS

These panels must be typically used at remote pumping stations or in association with small self contained package equipment.

The equipment must be arranged to Form 1 segregation in accordance with AS 3439.1. The control equipment must be separated within each starter in a logical and accessible manner.