TECHNICAL SPECIFICATION
MOTOR CONTROL CENTRES

TCC-TTS-SPEC-E007

Revision History

Revision	Status	Prepared by	Reviewed by	Approved by	Date
0	Issued for Use	D Philipson	L Eastlake	T Laveti	25/09/2025

Contents

1. Introduction

1.1. Purpose

This standard covers Motor Control Centres owned and operated by Townsville City Council.

1.2. Scope

This standard gives guidelines for the components of Motor Control Centres and the standard of workmanship for the construction of Motor Control Centres.

1.3. Electrical Specification Manual

This document forms part of the Electrical Installation section of the TCC Electrical Specification Manual (ESM) and shall be read in conjunction with other documents in the ESM and the Job Specification to determine the requirements for a particular project.

The intention of the ESM is to provide consistency in electrical design and installation requirements that will better enable council to fulfil its duties in the delivery and implementation of their electrical works.

Contractors shall comply with all requirements in this document and the documents referenced in TCC-TTS-SPEC-E001 Introduction to Technical Specifications, unless specified otherwise.

1.4. Exceptions and Feedback

Should the Contractor propose any exceptions, deviations or variations from this specification or referenced documents, such variations shall be submitted in writing to the TCC Nominated Electrical Representative for approval.

If there exists a requirement that is unclear or ambiguous, the Contractor shall contact the TCC Nominated Electrical Representative for clarification and feedback.

2. General

2.1. Operating Conditions

All equipment shall be suitable for operation in a tropical coastal environment.

Unless specified otherwise in the Job Specification the equipment will be required to operate in the environmental conditions defined in TCC-TTS-SPEC-E001 Clause 5.10.

3. Specific

Every motor supplied from a switchboard/MCC shall be provided with an automatic motor starter, with type 2 motor protection co-ordination.

The preferred type of starter is Direct On-Line (DOL) subject to DNSP starting current limitations and the requirements of the driven equipment. When starting current limitations or other operational issues require the use of reduced voltage starting then electronic soft starters shall be used. Variable speed drives shall only be used where there is a defined process requirement for speed control.

Refer to the Job Specification for details of motor starter requirements.

This specification should be read in conjunction with TCC-TTS-SPEC-E002 (Electrical Installation) and TCC-TTS-SPEC-E004 (Low Voltage Switchboards). MCC's may be incorporated within a single Distribution and MCC switchboard or as a standalone MCC, in either case TCC-TTS-SPEC-E004 will be used to define all ancillary equipment and arrangements within, and the testing of the MCC.

3.1. DOL Starters

DOL starters shall comprise a contactor and motor protection device. The starter shall be designed for utilisation category AC3 and an intermittent duty of up to 12 starts per hour.

Type 2 co-ordination with motor protection and short circuit protection devices shall be employed.

3.2. Electronic Starters

Electronic Starters includes soft starters and variable speed drives (VSD) (also known as variable frequency drives (VFD)).

The starter shall be mounted in accordance with manufacturer's instructions paying due attention to the spacing and cooling requirements. The operating temperature of the unit must be maintained within the manufacturer's specification, typically less than 40°C.

Electronic starters shall be protected by semi-conductor fuses in accordance with manufacturer's recommendations. Ensure that manufacturer's directions are followed with regard to control circuit voltages.

Where isolation transformers or control voltage transformers are required, these shall be installed in accordance with the manufacturer's recommendations.

The disturbance to the electricity supply system due to harmonics generated by the starter shall not exceed the limits specified in AS 61000 or the DNSP requirements. Radio interference (EMF) external to the starter shall not exceed the limits specified in CISPR 11. The Point of Common Coupling shall be the line side of the main switch of the switchboard that supplies the starter.

The chassis of the starter shall be bonded to earth as per manufacturer's instructions with a minimum earth conductor 20% larger than normal.

The supplier shall provide the anticipated harmonic voltages and currents and a conformance statement before construction.

3.2.1. Soft Starters

Soft starters shall be specifically designed for the control of induction motors operating on a three phase 400/415V 50Hz supply. They shall have a continuous rating of not less than the maximum input rating of the driven equipment after allowing for motor efficiency. Soft starters shall be selected for 3-wire connection only, utilisation category AC-53b and 12 starts per hour as a minimum duty. It may be necessary to de-rate the soft starter to meet this requirement, e.g., select an oversized unit.

Starters shall have two modes of starting, standard soft start and a current limiting soft start. In standard mode the terminal voltage shall be increased gradually over the selected ramp time-That is, the peak motor starting current is a function of ramp time. In current limiting mode the peak current shall not exceed a user defined value.

The starters shall have provision for soft stop. Adjustable controls shall be provided for ramp time, acceleration, deceleration, current limit and stalled current.

The starter shall include protection for internal fault, phase loss, motor disconnected, controller temperature, and locked rotor. Motor protection features shall include thermistor, undercurrent, and overcurrent. The starter is to include three CTs for accurate motor current measurement. An auxiliary trip input shall be provided to allow connection of external protection devices such as seal failure. Relay outputs shall be provided for run, fault and top of ramp. It shall be possible to reset a fault trip either via a local reset pushbutton or from a remote reset pushbutton. An analogue output shall be provided when specified in the Job Specification.

The starter shall have a display panel that can be remotely mounted on the escutcheon door. The panel is to include LED's indicating motor status, starter status, trip status and output relay status. The panel shall also include pushbuttons for local motor control and parameter programming. The starter shall be suitable for local or remote control as selected via a control input.

Soft starters shall be wired via a line contactor to provide positive line isolation.

A bypass contactor shall be provided integral to the starter or be wired externally, to operate when the motor is up to speed.

Particular attention is to be paid to the current and voltage ratings of the starter's control relays. Use interposing relays, RC snubber circuit or diodes for inductive loads as recommended by the manufacturer.

In certain applications the use of less featured soft starters may be considered. Written approval from the TCC Nominated Electrical Representative is required for the use of such equipment.

3.2.2. Variable Speed Drives (VSD)

Variable speed drives shall be of the solid-state electronic type suitable for use with squirrel cage induction motors. VSD's shall be suitable for operation from a 240/415V 50Hz mains supply. VSD's must comply with AS/NZS 61800 and AS/NZS 61000 in terms of electromagnetic compatibility and harmonic performance.

The VSD shall offer selectable control methods including V/Hz, sensorless vector control or field-oriented control.

The drive shall have the ability to model the thermal capacity of the motor in order to calculate the motor temperature, but also have thermistor or RTD inputs.

The VSD shall have all necessary certifications for sale and use within Australia. EMC filters shall be integral to the drive and be in accordance with AS 61800. Unless otherwise specified the VSD shall comply with the limits specified for installation in the First Environment as per AS 61800.3.

Harmonics shall be limited to the levels specified in AS 61000. Special attention is required to applications where regeneration will occur. The use of active front ends or similar may be required.

Output chokes shall be used on installations where motor cable length exceeds the drive manufacturer's recommendation.

The drive shall have a keypad for display of status information, fault messages, parameter programming, drive control and monitoring.

Where the VSD is mounted internally, the keypad shall be remotely mounted on the escutcheon or panel door such that access to the VSD is not required to use the keypad.

It shall be possible to control the drive either locally from the keypad or remotely from a PLC, comms network, operator station or the like. The drive shall also have an integral status display visible when the keypad is removed.

Switching to/from local to remote shall be via an external, panel mounted rotary switch.

Switching to/from local and remote shall be bumpless.

The drive shall have, as a minimum the same I/O as the VSD's nominated in the preferred supplier list.

It shall be possible to add internal expansion cards to increase the I/O of any type above the minimum requirements. Analogue I/O shall generate an alarm for loss of signal or signal outside of range.

The VSD shall include comprehensive fault monitoring and protective functions. This shall include, but not limited to:

- Hardware fault;
- Software fault;
- Phase failure;
- Over current;
- Over voltage;
- Over temperature;
- Cooling fan failure;
- Motor overload; and,
- Motor over temperature.

A fault history shall record the last eight faults with a log detailing the operational status at the time of each fault. It shall be possible to reset fault conditions either locally or remotely.

The VSD shall have communications capability and support the following protocols:

- Modbus TCP;
- Profibus DP; and,
- Ethernet IP.

The use of an internally mounted option card would be acceptable if the protocol is not included in the basic unit.

It shall be possible to program the drive from a PC via suitable software and connection lead (USB connection preferred over serial). It is preferred that the software does not require the use of a software licence token or dongle.

If the software is not available for free download, then a licensed copy shall be provided.

A connecting lead shall also be supplied with the drive.

The software shall provide the ability to upload, download, modify, store and print a full parameter list and be capable of full monitoring and control of the drive.

The software must be backwards compatible with earlier versions of the drive firmware. Any updated firmware must be supplied with the drive.

In a switchroom type environment, VSD's shall generally be mounted separate from the switchboard cubicle. The IP rating of the VSD enclosure is to be suitable for the environment but shall not be lower than IP44. Smaller drives (e.g., ≤ 7.5kW) may be installed within a segregated, screened compartment of the switchboard provided generous space provisions are made and an effective cooling system is installed.

Where it is not possible to install drives in a switchroom type environment they shall be enclosed within a cubicle constructed as per TCC-TTS-SPEC-E004 with suitable ventilation requirements. It is generally expected that such cubicles will be fitted with an air-conditioner unit.

Variable speed drives are not to be installed in any external cubicles that may be subject to direct sunlight, without prior written approval of the TCC Nominated Electrical Representative.

Care shall be taken to segregate power, control and motor cables. Motor cables for VSD's shall be of the screened type, designed for use with variable frequency motors and be terminated using correct gland types. Screened cables shall be continuous from the motor terminals to the VSD terminals. All wiring and termination are to strictly comply with the manufacturer's recommendations.

Where VSD's are used to control sewage pumps, the initial start shall be at 100% speed to assist with moving potential blockages. After a 30s time delay the VSD shall ramp to the required control point as dictated by the control logic.

Integral motor/VSD packages shall not be accepted without prior approval of the TCC Nominated Electrical Representative.

3.3. Autotransformer Starters

Written approval from the TCC Nominated Electrical Representative is required for the use of autotransformer starters.

3.4. Motor Protection

Non-electronic starters up to 45kW shall be protected by a thermal overload relay (TOL). The TOL shall provide single phasing protection as well as overload protection. The full load current of the protected motor shall be between 30-80% of the current range of the TOL. The TOL shall be ambient temperature compensated, have both N/O and N/C auxiliary contacts and shall be capable of both manual and automatic reset.

Electronic starters (eg: VSD's, Softstarters) shall be protected by integral electronic thermal overload protection.

On motors fitted with a soft starter, a TOL shall remain in circuit when the starter is bypassed.

Motors with a rating of 45kW or greater shall be protected by an electronic motor protection relay unless stated otherwise in the Job Specification. The MPR shall provide protection for thermal overload, thermistor, single phasing and asymmetry or a required in the Job Specification.

The MPR shall have N/O and N/C auxiliary contacts, LED indication and be capable of both manual and automatic reset.

All motors shall be provided with over-temperature protection via sensors embedded in the motor windings, e.g., thermistors. The sensors shall be wired to a monitoring relay. The monitoring relay shall have N/O and N/C auxiliary alarm contacts and be capable of both manual and automatic reset.

The monitoring relay shall incorporate a time delay function to mitigate unreliable operation on power up.

For motors with an electronic starter, separate monitoring relays need not be provided if the starter incorporates suitable inputs and monitoring functionality.

Where equipment is supplied with integral protection devices (e.g., thermal switches, moisture switches, insulation monitors etc.) these devices are to be wired into the motor protection circuit as recommended by the equipment manufacturer.

All motor protection sensors are to be wired on ELV circuits.

Dry mounted submersible pumps of 17kW or greater shall be provided with a means of detecting failure of the mechanical seal and/or ingress of moisture. This protection shall stop/inhibit pump operation via the motor fault circuit. A separate fault indication lamp and telemetry input shall be provided. Wet mounted submersible pumps shall only have seal failure monitoring when specifically called in the Job Specification or it is a requirement to maintain the pump supplier's warranty.

Unless otherwise specified, conductivity type sensors such as Water In Oil (WIO) are to be used as a warning indication only. Refer to Job Specification.

Where pump monitoring relays are used, they shall be mounted so that the indicating lights are visible and controls are accessible without the need to open escutcheon doors and expose live parts.

All motor protection circuits shall be arranged for fail-safe operation. Generally, the protective devices will be wired in series to a common, maintained fault relay. Should any device trip, the fault relay would be de-energised and signal a fault condition. The motor would be unavailable for further operation until reset. The protective devices would generally be set for automatic reset, but the fault relay shall require manual resetting by the operator. A reset pushbutton shall be provided on the escutcheon door. In addition to the reset pushbutton, it shall also be possible to reset motor faults remotely via an output from the telemetry unit.

All circuits shall reset automatically after a power failure unless there is a persistent fault present.

For certain installations additional protection may be required for water void, undercurrent etc. Refer to Job Specification and consult with the suppliers of mechanical equipment to ensure all control and protection elements required for equipment warranty are incorporated.

Motor control circuits shall incorporate a timer function to prevent excessive, frequent starting of the motor. The time delay between successive start attempts shall be based on the duty rating of the motor (i.e., number of starts per hour). Where the motor is normally controlled via logic within the telemetry unit or PLC (i.e., system mode) this timer function will be provided by the control software. The start delay timer shall not function in manual control mode.

Each motor shall be provided with an available status relay which shall be energised when all protective devices are healthy, supply circuit breaker and motor isolator switch are closed, and all process and operational interlocks are not active.

3.5. Isolation transformers

Isolation transformers are to be used when pumps are supplying swimming pools.

3.6. Motor Control Circuits

For an MCC style switchboard, Form 3 or Form 4, each motor shall have an independent control circuit that operates at ELV, typically 24VDC All ELV wiring shall have appropriate segregation from all LV cabling with particular consideration of interference from VSD output cabling.

Circuits that interface to telemetry or PLC systems shall operate at 24Vdc

All interfacing wiring to telemetry of PLC systems shall be wired via a terminal strip located within the cable galleries, so that wiring is not routed through other MCC or Distribution Modules to access the control system I/O modules.

Circuits that include equipment mounted in wet environments, such as float switches, flow switches etc., shall operate at ELV, typically 24Vdc

A typical motor control circuit shall consist of:

- Duty or Mode selector switch;
- Auto/off/manual selector switch (where required);
- Manual pushbuttons for start, stop and reset;
- Indicator lights for run and common fault;
- Manually reset fault relay;
- Motor available indication relay;
- Hours run meter (where required in the Job Specification);
- Ammeter reading current in each phase (where required in the Job Specification); and,
- Motor isolator (padlockable).

3.7. General Construction

Motor Control Centres shall be constructed to the requirements of TCC-TTS-SPEC-E004 Electrical Switchboards, with the following additional requirements.

Motor Control Centres shall be designed with a form of internal separation to suit the application, location, fault level, load current, method of operation and maintainability requirements. The form of separation shall be in accordance with AS/NZS 61439. The Job Specification will state the requirements.

3.7.1. Arc Fault Containment

As defined in TCC-TTS-SPEC-E001.

3.7.2. Demountable Functional Units

Preference shall be given to a motor control centre having all functional units demountable.

The following requirements shall be met for all demountable functional units:

- Vacant cells shall be fitted with a blank equipment mounting pan identical to that used for similarly sized active and spare cells; and,
- Commonly sized cell modules shall be manufactured in a common jig to guarantee interchangeability.

3.7.3. Accessibility of Equipment

All equipment shall be readily accessible. The height from the floor to the bottom of any item of equipment, except autotransformers, shall not be less than 300 mm. The height from the floor to the top of any item of equipment shall not exceed 2000 mm.

Control terminals shall be mounted to the front of cable ways, in front of power cables, where they can be easily accessed.

3.8. Testing

As defined in TCC-TTS-SPEC-E004.

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