TECHNICAL SPECIFICATION PUMPSTATION ELECTRICAL DESIGN SPECIFICATION

TCC-TTS-SPEC-E011

Revision History

Revision	Status	Prepared by	Reviewed by	Approved by	Date
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Contents

1. Introduction

1.1. Purpose

This document outlines the technical requirements for a standard design of a Townsville City Council pumpstation.

1.2. Scope

This standard is provided with the intent to:

- Standardise pumpstation design;
- Increase efficiency and maintainability via design reuse; and,
- Complement other specifications and provide extra clarity to Contractors when delivering pumpstation designs.

Much of the requirements for a pumpstation is detailed in other parts of the ESM, with this section only detailing specifics about pumpstations.

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. Pumpstation Equipment

2.1. General

2.1.1. Telemetry

Where telemetry equipment is specified in the Job Specification then it shall be supplied, installed and wired by the Contractor.

Note that telemetry is required on every pumpstation switchboard.

Unless otherwise specified, TCC technicians will carry out the software configuration and integration into the SCADA system.

TCC technicians require a minimum of six (6) weeks of notice prior to commissioning to allow for scheduling of tasks into their works program.

A listing of approved telemetry equipment is provided in the preferred equipment list refer to TCC-TTS-SPEC-E013. Note that certain equipment is mandatory, and no alternatives will be accepted. Possible suppliers are also listed but this does not imply they are the only suppliers that can be used.

When telemetry equipment is to be mounted in a remote cubicle the required signals shall be wired to a segregated section of the field cables terminal strip.

TCC-TTS-SPEC-E013 contains tables showing the minimum required I/O signals and address assignment for a typical pumpstation telemetry RTU. These assignments are not to be varied without written permission from the TCC Nominated Electrical Representative.

For other telemetry installations the I/O signals and address assignment shall be detailed in the Job Specification.

Refer to TCC-TTS-SPEC-E013 for a typical telemetry schematic for a pumpstation.

Note that for pumpstations incorporating more than three pumps or of a critical nature, dual RTUs may be required - Refer to Job Specification.

2.1.2. HMI Screen

The Job Specification will contain full details of the HMI if it is required.

2.1.3. PLC

PLC equipment shall only be used where complex control functions warrant it with the approval of the TCC Nominated Electrical Representative.

Pump control logic should be incorporated into RTU’s as much as possible.

2.1.4. Plug/Socket Motor Connection

Plug/socket connection of motors shall only be provided when specifically detailed in the Job Specification. It is typically employed at remote sites or for equipment that requires frequent disconnection or relocation for operational purposes. The purpose of plug/socket connection is to allow disconnection of motors by non-electrical personnel.

The sockets shall be a decontactor type such as Marechal or approved equivalent. Matching plug tops shall be supplied for fitting to the motor’s cables. The materials of the socket and plug shall be suitable for the environment in which they are to be installed.

The pump well conduits must be of sufficient diameter to allow the decontactor plug top to be pulled though.

For sites where the switchboard is located remote from the pump well, the decontactors may be housed in the disconnection pillar.

2.1.5. Disconnection Pillar

Disconnection pillars shall only be provided when specifically detailed in the Job Specification.

Where the pumpstation switchboard is located remotely from the pump, disconnection pillars shall be installed at the pump to provide a local termination point for the pump cables thus facilitate easier removal of equipment.

The disconnection pillar will be fabricated from 316 stainless steel and comply with TCC-TTS-SPEC-E002. The pillar will typically have two sections. The lower section will be a cable zone and will be fully segregated and sealed from the upper section. A gland plate shall be provided between the lower and upper sections and all cabling that passes between these sections shall be securely glanded. The transmission of sewer gases between sections must be prevented. The upper section shall accommodate the cable terminals and any other equipment that may need to be housed locally, e.g., pump protection relay.

A separate pillar shall be provided for each motor. Local instrumentation may be housed within a common pillar. The lower section of the pillar shall be of sufficient dimensions to permit the termination of cables and have the upper section at a comfortable working height.

The cables will typically be terminated on to terminal strips or link bars in the upper section. Where plug/socket connection has been specified, the decontactor sockets would be housed in the lower section.

2.1.6. Actuated Valves

The Job Specification will contain full details of the valve, actuator and control philosophy to suit the specific installation.

As a minimum requirement the I/O signals listed below shall be connected between the telemetry RTU and the actuator:

Digital Inputs:

- Actuator available in remote
- Actuator Healthy
- Actuator mid-torque trip
- Valve in open position
- Valve in closed position

An energised input shall indicate the condition named.

Digital Outputs:

- Valve open command
- Valve close command

The RTU outputs shall be wired via interposing relays. The RTU output shall energise the relay to affect the command.

Other I/O signals may be specified dependant on the make/model of the actuator and the control functions required.

2.1.7. Mobile Generator Connections

TCC has two different sized mobile generators for the purpose of providing emergency power at facilities during times of extended power outages.

Where the Job Specification calls for the installation of a generator connection then:

- For sites with a maximum demand of less than 110kVA and greater than 65KVA (with due consideration to motor starting requirements) a 150A decontactor type inlet socket is to be provided either fitted to the switchboard (for an external board) or, where the switchboard is located inside a building, mounted in an accessible, external location. The socket is to be a Marechal DS9-3198017, Cutler Hammer CH9A3NE01 or Proconect 3PS9A3NE01 and is to be mounted in a suitable wall box and fitted with an inlet cap;

- For sites with a maximum demand of less than 65kVA (with due consideration to motor starting requirements) a 90A decontactor type inlet socket is to be provided either fitted to the switchboard (for an external board) or, where the switchboard is located inside a building, mounted in an accessible, external location. The socket is to be a Marechal DS6-3168017, Cutler Hammer CH6A3NE01 or Proconect 3PS6A3NE01 and is to be mounted in a suitable wall box and fitted with an inlet cap;
- For facilities where a permanent standby generator is not installed and the total demand is in excess of 110kVA (with due consideration to motor starting requirements) or when specified in the Job Specification, generator connection links are to be provided. The purpose of the links is to permit the quick and easy connection of a transportable generator via a trailing cable. For an outdoor switchboard the connection links are to be housed in a dedicated section of the switchboard. For an indoor switchboard the connection links are to be housed in an IP65 stainless steel enclosure mounted in an accessible, external location; and,
- The generator connection link shall be designed so that the cable termination is adequately protected and supported and all doors, covers and the like can be closed and secured with the trailing cable connected.

3. Specific Equipment Requirements

3.1. Sewerage Pump Stations

All sewerage pumpstations are to be fitted with a hydrostatic level sensor as per TCC-TTS-ELEC-E008. The housing shall be stainless steel with a capacitive ceramic sensor element and stainless-steel diaphragm.

Unless otherwise specified, the sensor shall be ranged 0-10m. The sensor shall be supplied with a minimum 27m of cable and a strain clamp for suspension in the pump well. The sensor shall be suspended so it is not affected by turbulence. If turbulence is a factor, then additional measures such as a stilling tube or suspended weight may be necessary for a satisfactory installation.

All level measurements shall be displayed on a HMI or 4-20mA display located at the switchboard front panel or escutcheon.

A float switch (Type I) as per TCC-TTS-ELEC-E008 shall be utilised as a redundant backup high level switch should the hydrostatic transmitter fail.

3.1.1. Pumpstation Ventilation Fans

The ventilation fans in pumpstation buildings shall have an Auto / Off / Manual selector switch.

In Manual they shall operate continuously. In Auto they shall be controlled via a 24-hour time clock such that they operate for a 30minute period twice a day, once at 6AM and once at 6PM.

3.1.2. Odour Control Unit

If an odour control unit (OCU) is to be installed the Job Specification will provide full details of the unit and the control and monitoring requirements to suit the specific installation.

Odour control units shall comply with TCC-WW-SPEC-M001.

As a minimum requirement a digital signal shall be connected the telemetry to indicate if the OCU is healthy or not. An energised input shall be the healthy state and de-energised input shall indicate the unit has faulted. The Job Specification may require additional signals for any given installation.

All digital signals will be inputs into the telemetry system.

3.1.3. Pump Control Relay

For installations where a pump control relay is required refer to TCC-TTS-SPEC-E004.

3.1.4. Level Control Relay (Electrode Type)

In certain applications, such as sump pump control, electrode type level sensors shall be used in conjunction with an electrode relay to control the starting and stopping of the pump.

The Job Specification will contain full details of the instrument and the monitoring signals required.

This arrangement will not be used as the primary level control method.

3.1.5. Well Flooded Alarm

The well flooded alarm is intended to provide early warning that the pumpstation level is approaching the overflow. All sewerage pumpstations are to be fitted with a well flooded alarm. For other facilities it shall only be provided when specifically detailed in the Job Specification.

The well flooded alarm shall be provided by a float switch suspended below the pumpstation overflow pipe- the exact distance will be detailed in the Job Specification.

The float switch contact shall be closed when the well level is healthy and shall open when the flooded level is reached.

The float switch will be a digital input into the telemetry system.

3.1.6. Penstock Flooded Alarm

The penstock flooded alarm is intended to give warning that the zero manhole at a pumpstation has an abnormally high level. It shall only be installed when specifically detailed in the Job Specification.

The penstock flooded alarm shall be provided by a float switch suspended in the zero manhole at the height nominated in the Job Specification. The float switch contact shall be closed when the well level is healthy and shall open when the flooded level is reached. The float switch will be a digital input into the telemetry system.

4. Pump Control

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.

4.1. General

A four-position selector switch shall be used to select between System / Off / Local Manual / Local Auto. This switch is to be of a distinct colour or have a distinctively coloured escutcheon plate so that it is readily identifiable to operations staff.

When System is selected the motors would be controlled via logic within the telemetry unit. The logic would monitor the well level analogue signal and start or stop the motors by energising digital outputs. The selection of motor duty and level set points would be via remote SCADA system.

All motor starter functions, and motor protection functions will be incorporated in the System mode control circuit. Faults would be reset by either an escutcheon mounted reset pushbutton or remotely via the SCADA system.

System would be the normal operating mode for a pumpstation.

When Local Manual is selected the motors will be under local manual control via escutcheon mounted start and stop pushbuttons. There will be no automatic or remote control in this mode however remote monitoring via telemetry would be active.

All motor starter functions, and motor protection functions will be incorporated in the Local Manual control circuit. Faults would be reset via an escutcheon mounted reset pushbutton. It is intended that this mode of control would only be used during maintenance activities or if there was a critical failure of the telemetry or the auto control equipment.

When Local Auto is selected, pump operation shall be controlled by a Pump Control Relay (Refer to TCC-TTS-SPEC-E004).

Starting and stopping of pumps would be determined by the set points in the pump control relay. The pump control relay will energise interposing relays to operate in the pump control circuits.

All motor starter functions, and motor protection functions will be incorporated in the Local Auto control circuit. Faults would be reset via an escutcheon mounted reset pushbutton.

Duty selection would be via an escutcheon mounted selector. The duty selector is to have an adjacent label stating that it is only for use in the Local Auto mode. There will be no remote control in this mode however remote monitoring via telemetry would be active.

The duty selector, pump control relay outputs and associated control relays will only be active when the selector switch is in the Local Auto position.

A time delay is to be incorporated in the Local Auto mode to ensure that pump available relays and other circuitry has operated before the control mode becomes active.

It is only intended that this mode of control is used if there is a critical failure of the telemetry equipment.

Programming of RTU logic and remote SCADA system would be carried out by TCC unless otherwise specified in the Job Specification.

4.2. Sewerage Pump Control Strategy

Unless otherwise specified in the Job Specification, these strategies should be used to control pumps at sewerage pumpstations.

4.2.1. Pump Operation Method 1

Pump Operation Method 1 is for duty/assist operation. Typically, the two pumps would be the same size.

Duty selection is affected via SCADA in System Mode or by an escutcheon mounted selector switch in Local Auto Mode.

When the level in the pump well rises to the duty start level, the duty pump will start and pump down to the stop level. If the level continues to rise and reaches the standby start level, the standby pump will start after a pre-set time and both pumps will operate in parallel until the stop level is reached. If the duty pump becomes unavailable, then the standby pump will be enabled to operate off the duty start level.

It shall not be possible for both pumps to start simultaneously, e.g., after a power fail when well level may be high. That is, a timer shall be used to stagger the starts, should both pumps are called to run at the same time.

In some circumstances it is not desirable to have the pumps operate in parallel. In these cases, the duty pump would be stopped at the standby level and after a short time delay the standby pump would start. If the standby pump becomes unavailable, then the duty pump would be re-enabled.

The Job Specification will detail if parallel operation is required or not.

4.2.2. Pump Operation Method 2

Pump Operation Method 2 is for duty/standby (interlocked) operation. This method applies to stations where pumps are different sizes. Typically, one pump would be sized for 2 x ADWF (Average Dry Weather Flow) and would be the duty pump. The second, standby pump would be sized for 5 x ADWF and would only run during high flow periods (e.g., rainfall events).

Duty selection is affected via SCADA in System Mode or by an escutcheon mounted selector switch in Local Auto Mode. In normal operation the smaller pump is selected as the duty pump.

Normal operation is with the smaller pump selected for duty. When the level in well rises to the duty start level, the duty pump will start and pump down to the stop level. If the inflow is greater than duty pumps capacity and the level continues to rise to the standby level, the duty pump will stop and after a short time delay the standby pump will start. The standby pump will pump down to the stop level and turn off. When the level next rises, the duty pump will resume normal operation. Should the standby pump fail after operation has initiated then the duty pump must be re-enabled and start operation immediately. If the duty pump becomes unavailable, then the standby will operate off the standby level.

It shall not be possible for both pumps to start simultaneously, e.g., after a power fail when well level may be high. That is, a timer shall be used to stagger the starts, should both pumps are called to run at the same time.

The larger pump can be selected as duty for exercise and will start during an Automatic flush routine in System Mode.

When the larger pump is selected for duty, the smaller pump will not run under normal conditions. In this instance, the larger pump will operate off the duty level. Should the larger pump become unavailable then the smaller pump must be enabled to operate off the duty start level.

4.3. Water Pump Control Strategy

Unless otherwise specified in the Job Specification, these strategies should be used to control pumps for reservoirs and booster pump stations.

4.3.1. Reservoir Pump Operation

Reservoir Pump operation is duty/assist operation for reservoir filling. Typically, the two pumps would be the same size.

Duty selection is affected via SCADA in System Mode or by an escutcheon mounted selector switch in Local Auto Mode.

When the level in the reservoir falls to the duty start level, the duty pump will start and pump to the stop level. If the level continues to fall and reaches the standby start level, the standby pump will start after a pre-set time and both pumps will operate in parallel until the stop level is reached. If the duty pump becomes unavailable, then the standby pump will be enabled to operate off the duty start level.

It shall not be possible for both pumps to start simultaneously, e.g., after a power fail when well level may be high. That is, a timer shall be used to stagger the starts, should both pumps are called to run at the same time.

In some circumstances it is not desirable to have the pumps operate in parallel. In these cases, the duty pump would be stopped at the standby level and after a short time delay the standby pump would start. If the standby pump becomes unavailable, then the duty pump would be re-enabled.

The Job Specification will detail if parallel operation is required or not.

4.3.2. Testing Booster Pump Operation

Booster Pump operation is for duty/assist operation for pressure control with VSD pumps. Typically, the two pumps would be the same size.

Duty selection is affected via SCADA in System Mode or by an escutcheon mounted selector switch in Local Auto Mode.

Under normal operation the duty pump will run continuously under PID control to maintain the water pressure. Should the pressure not be reached under maximum speed, the standby pump shall start after a pre-set time period. The standby pump shall operate until pressure can again be maintained by the duty pump.

The standby pump shall have a minimum run time to reduce the number of starts below the manufacturer's recommendation.

Starting of the standby pump shall be as "bumpless" as possible so as not to over-pressure the system (eg: using ramped speed start).

Specific pump speeds shall be avoided where cavitation my arise.

The Job Specification will detail if parallel operation is required or not.

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