TECHNICAL SPECIFICATION CONTROL SYSTEMS

TCC-TTS-SPEC-E009

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 Control Systems implemented on Townsville City Council sites.

1.2. Scope

This standard specifies the minimum requirements for Control Systems supplied to Townsville City Council including, but not limited to:

- Programmable Logic Controllers;
- Remote I/O drops;
- Supervisory Control and Data Acquisition systems;
- Control systems communications network;
- Testing of the Control Systems; and,
- Training of maintenance staff in the usage of the Control Systems.

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. Programmable Logic Controllers

2.1. PLC Panels

Main PLC panels shall be of similar construction, form and finish as any MCC panels provided as per the Job Specification. This should follow TCC-TTS-SPEC-E004.

They shall be free standing on a 75mm PFC plinth.

Surge protection shall be provided on all field signals.

The main PLC panels shall house the following equipment:

- 240Vac UPS load centre;
- Dual redundant 24Vdc power supplies;
- 24Vdc essential load centre;
- Process I/O terminal strips;
- Communications equipment; and,
- PLC controllers and process I/O modules.

The cabinet shall be separated into three segregated sections, one shall contain the 240V UPS load centre, one shall contain the 24Vdc supplies, distribution and I/O terminal strips and the last section shall contain the PLC and communications equipment.

Each segregated section shall be accessed by a separate door. A single panel light shall be mounted within each section wired to a door switch. The doors shall be stiffened as required and furnished with door stays at 90° and 120°. The PLC panel door shall have a foldout laptop bench installed at an ergonomic height.

All equipment shall be mounted on the rear equipment pan. No equipment is to be mounted on the side walls of panels.

All internal wiring shall be installed in accordance with the TCC-TTS-SPEC-E002 and shall be contained in PVC cable trunking.

240Vac wiring, terminals and equipment shall be segregated at all times from instrumentation and ELV control wiring. All 240V terminals shall be protected to IP2x with PVC shrouds and clearly labelled with the following warning:

DANGER

240V

A 240Vac GPO shall be supplied in the 240Vac side of the PLC Panel, behind any escutcheon or door panel.

The PLC panels shall be provided with active ventilation as required to meet the cooling requirements.

2.2. PLC Hardware

PLCs shall be module based.

Each rack shall incorporate:

- CPU module, The CPU shall have:
  - on-board watchdog timer,
  - real-time clock
  - and all other functionality required for correct operation
- I/O cards;
- Communications interface; and,
- Power supply.

All equipment shall be selected from the Preferred Equipment List or otherwise approved by the TCC Nominated Electrical Representative.

The Contractor shall design and implement the communications interfaces in order to make the most efficient use of the available bandwidth. Each PLC shall report to the SCADA servers by continuous polling or change of state with a proven response time of less than 1 second.

2.2.1. Processor

Each PLC processor module shall be selected from the Preferred Equipment List while ensuring that the intrinsic capabilities of the device satisfy the requirements of the application.

The Contractor shall verify that 50% memory shall remain spare following commissioning.

Each processor shall be configured to complete self-checks to identify and correct where possible any internal faults including memory, system or user program or communications faults.

The state of the PSU, CPU, Fault Condition and Battery Low functionality shall be available as LEDs incorporated on the PLC hardware.

It shall be possible to differentiate the following fault conditions using the programming unit diagnostic software:

- User program error;
- System program error;
- Memory fault;
- Bus fault;
- Watchdog timers;
- Power supply error; and,
- I/O configuration error.

2.2.2. Inputs and Outputs

Wherever possible, signals shall be allocated to input and output modules in a manner consistent with the plant equipment ensuring that the failure of any one module does not affect more than one item of plant or equipment.

The Contractor shall provide one or more spare modules of each I/O type in each PLC rack to ensure that a minimum of 20% spare I/O is provided in the installed racks. Spare IO modules shall be added, if required, to fulfil this requirement.

Similarly, the PLC rack shall be supplied with sufficient spare slots to accommodate at least two additional I/O modules in the future. Sufficient space in the terminal strips shall be provided for the future modules.

I/O modules shall be provided with detachable terminal strips to facilitate module exchange without interfering with the panel wiring. Each core shall be identified with corresponding IO, Slot and Rack number.

Minimum requirements are listed:

Part	Parameter	Requirement
General	Capacity	Sufficient to provide plant function plus 50%
	Labelling	Each input and output shall be clearly identified by function name on an adjacent ‘Trafolyte’ label
	Surge Withstand	Surge withstand capability of each input and output shall comply with IEEE 47274 (ANSI C37.90 1978)
	Isolation	Galvanic isolation shall be provided
	Short Circuit Protection	Each module shall have a dedicated fuse and shall include blown fuse indication and alarm initiation.

Analogue Inputs	Resolution	At least twelve (12) bit resolution over measured range
	Accuracy	At least 0.5% accuracy for digital to analogue conversion
	Isolation	Optical rated at 1500Vac for 1 minute (input to logic and input to ground)
Analogue Outputs	Resolution	At least twelve (12) bit resolution over measured range
	Accuracy	At least 0.5% accuracy for digital to analogue conversion
	Isolation	Optical rated at 1500Vac for 1 minute (input to logic and input to ground)
Digital Inputs	Interrogation Voltage	24Vdc
	Signal Conditioning	'Anti bounce' signal conditioning and noise filtering
	Indication	Status (on/off) of each input to be displayed by a LED
	Isolation	Optical rated at 1500Vac r.m.s for 1 minute (input to logic and input to ground)
	Operation	Energised for healthy / not alarm / safe condition (fail safe)
Digital Outputs	Type	Electronic rated at 0.5A/24Vdc or voltage free contacts rated at 2A/24Vdc
	Isolation	Optical Isolation, contact to coil and contact to ground isolation rated at 1500Vac r.m.s for 1 minute
	Indication	The status (on/off) of each output shall be displayed by a LED

2.2.3. Communications

Each PLC Controller shall have 10/100-BaseT Ethernet channels. The Ethernet system shall be suitable for connection on a ring topology through the nominated Preferred Equipment List, ethernet switches.

Processors and SCADA system shall be connected together on a Controller network via a minimum of 100-BaseT Ethernet ports, with a minimum of 1000-BaseF backbone connecting all network switches.

Critical applications will require redundant communications as directed in the Job Specification.

2.2.4. Power Supply

PLC Power supplies shall be 24Vdc.

Each PLC cabinet shall contain a dual redundant pair of 24Vdc supplies connected in parallel with the outputs decoupled.

A dedicated redundancy unit shall be used (ie: not a simple diode).

For essential I/O, these supplies shall be fed from a 240Vac UPS.

For MCC remote I/O drops (non-essential I/O) the power supply shall be mains fed.

Where both essential and non-essential I/O exist on one PLC, two sets of 24Vdc supplies shall be provided and maintained as separate systems.

Power supplies and redundancy modules shall have a digital output indicating a fault and be connected to the PLC system to provide alarms.

2.3. PLC Software

The Contractor shall provide each PLC processor fully programmed with the approved and tested PLC programs for each PLC.

The Contractor shall refer to the process functional description provided in the Job Specification for the details and parameters of the process control to be implemented.

The Contractor shall develop a PLC functional specification and submit it to the TCC Nominated Electrical Representative for approval prior to any programming works taking place.

This PLC functional specification shall detail all programming blocks, modes and processes proposed to implement the process functional description in plain English. Flow charts indicating an overview of execution are preferred.

2.3.1. Communications

The communication management shall incorporate block I/O transfer and other optimisation techniques to ensure rapid and efficient utilisation of the installed communication systems.

PLC modules shall communicate across the network via polling. An alarm shall be raised in the event of a communications failure (eg: watchdog).

All communications data transfers shall be documented in the functional specification.

2.3.2. Structure

The program shall be constructed in a logical manner to allow ease of understanding and maintenance.

All tags and I/O etc. shall be addressed by a logical functional name with naming based on P&ID device numbering.

Documentation shall consist of descriptive comments on each rung or functional block, fully detailing the code execution as a minimum. All description and comments are to be provided in English.

Control logic shall be designed to optimise the use of the selected PLC architecture by:

- Minimising program steps necessary to achieve the desired purpose;
- Making the code easily traceable;
- Modularising code sections for reuse in multiple PLC’s;
- Making maximum use of manufacturer standard functions and subroutines; and,
- Segregating PLC routines by functional equipment (eg: Drives, Valves, etc.).

Prefabricated blocks with superfluous tags shall not be acceptable.

Sequential Function Chart and Structured Text to be used only upon approval by the TCC Nominated Electrical Representative.

The software must be stable and able to cycle indefinitely with no compilation or runtime errors.

2.3.3. PLC Programming Software

The software shall facilitate all necessary operations to allow successful ongoing use of the PLC including:

- Programming;
- Editing;
- Diagnostics;
- Monitoring PLC operations;
- Monitoring program operation;
- ‘Forcing' inputs and outputs;

- Program documentation;
- Setting of the real time clock; and,
- Communications with the operator interface.

Programs shall be developed on a PC running the latest version of Windows.

All process control shall be performed by the PLC programs. Under no circumstances will Cicode, VB, scripts or other embedded programming languages, executing on the SCADA or HMI be an acceptable method of programming process control.

The Contractor irrevocably assigns to the TCC ownership of intellectual property rights including all existing and future copyright in relation to the PLC, SCADA and RTU software specifically developed and/or customised for the TCC. The Contractor warrants that it will not breach the intellectual property rights of any third party.

2.3.4. Licensing

The Contractor shall provide a licensed copy of all software necessary to maintain and re-program the system, registered in the name of Townsville City Council.

The Contractor shall provide evidence of valid licensing (e.g. license keys, certificates or proof of purchase) as part of the project documentation.

Licensing of SCADA packages will allow for 20% expansion (eg: 20% more tags or data points than used).

2.4. PLC Uninterruptible Power Supply (UPS)

The main PLC modules shall be supplied by a 240V UPS which shall be installed adjacent to the main PLC cabinet. External MCCs with on-board main PLC modules shall house the UPS within the MCC itself in a segregated and separately ventilated section.

The UPS shall be permanently online and not rely on switching from mains to inverter supply.

The UPS shall provide alarms as required by AS 3011.2. The following are the minimum number of alarms to be sent to the PLC:

- Mains Failure;
- UPS Failure; and,
- Battery Low Voltage.

The batteries shall comprise 5 year rated cells and shall be sized to allow the UPS to provide 100% output at its specified voltage and frequency limits for 2 hours or the nominated time, whichever is the greater.

The UPS shall be able to fully recharge the backup batteries from flat within 24 hours.

The battery cubicle shall be a separate enclosure to the UPS and shall be ventilated in compliance with the requirements of AS 3011.2.

Each UPS shall be provided with a lockable external bypass switch to allow the UPS to be removed without losing power.

Each UPS shall provide power for critical process I/O, PLC controllers, communications equipment and SCADA equipment (where installed).

PLC’s shall NOT be fed by RCD’s.

The 24Vdc supplies for process I/O shall be furnished by dual redundant 24Vdc power supplies fed from the UPS. The outputs of these power supplies shall be connected in parallel and decoupled.

2.5. Communications Equipment

Each PLC panel shall house the communications equipment required to implement the topology detailed on the functional description.

Where fibre optics are used:

- All trunk fibres within the bundle shall terminate directly to a FOBOT at each node. All fibres shall be patched across the node unless required at that node and labelled clearly;
- Ethernet switches will provide all interconnection of devices and to fibre backbones; and,
- Single mode optic fibres shall be used throughout the installation.

3. Telemetry Systems

3.1. General

Much of the requirements for the telemetry systems have been incorporated into the TCC-TTS-SPEC-E004 Low Voltage Switchboard and TCC-TTS-SPEC-E002 Electrical Installation documents as most of the switchboards have a telemetry component.

3.2. Equipment

The main TCC Telemetry System is based around Schneider Electric SCADAPacks coupled to a GeoSCADA SCADA system. Some ancillary point to point connections may use Elpro RTUs.

A listing of approved telemetry equipment is provided in the Preferred Equipment List. Note that certain equipment is mandatory, and no alternatives will be accepted. This is particularly so for RTU's and Radio Equipment as it must interface with the existing system at large.

3.3. Communications

The main TCC Telemetry network is based on a UHF radio network which utilizes repeaters located at various strategic alleviated locations. The system is largely based on DNP3 communication protocol though some legacy protocols are still in use.

The Contractor is expressly forbidden from integrating equipment with the existing radio networks.

TCC shall perform the DNP3 communication integration between RTUs and SCADA.

TCC shall program radios operating in the UHF band used for the main TCC telemetry System.

4. SCADA

4.1. Servers

SCADA servers shall be connected to the Controller Network via a minimum of 100baseT Ethernet network.

The servers shall be constructed according to the minimum requirements set out within the Job Specification.

The servers should be rack mounted with monitor / console switches provided as specified, with an appropriate area and furnishings to allow personnel to program and diagnose the equipment.

4.2. Local Terminals

The SCADA terminals shall be the sole on-site method of interrogating and manually controlling the process and field equipment.

The SCADA terminals shall be accessed by individual operators using an individual login and password unique to each operator. Permissions and access authority shall be configured within each login profile.

TCC shall provide the Contractor with a list of operators and permission levels upon application for the purposes of configuring the access logins.

4.3. Remote Terminals

The Contractor shall provide remote monitoring facilities to enable authorised offsite staff to monitor the status, trending displays and history of the process, field equipment and electrical distribution system.

Access to the SCADA for remote monitoring shall be password protected.

It is important that alarms may be acknowledged remotely; however, it is equally important to protect the system against unauthorised access. This shall not be achieved using password protection alone.

4.4. Hardware and Software

The SCADA system hardware shall be supplied TCC IT department only.

Additional software for a standard operating environment (SOE) shall be supplied by the TCC IT Department. The Contractor shall supply all specialised software for operation and maintenance of the control system.

4.5. SCADA Operation

4.5.1. General

All automatic control shall be performed within the PLC system. No control shall be performed within the SCADA servers, which shall manage the user interface, alarming and mass storage of historic and trending data only.

When the status of any PLC input changes, the PLC shall report that change of status to the SCADA server for appropriate action.

The SCADA installation shall be implemented in GeoSCADA with graphically mimics similar to those already installed on other TCC facilities.

The TCC Nominated Electrical Representative will provide copies of graphics. The Contractor shall familiarise themselves with other TCC installations such that the form and function of other TCC SCADA systems to allow operators to smoothly transition between plants.

TCC SCADA O+M Manuals shall be made available to the Contractor for this purpose.

4.5.2. Configuration

The SCADA system shall be the primary source of all plant status and operator control actions.

As such it shall be designed and installed to provide an intuitive interface between the operators and the plant. It shall perform the following functions:

- Monitor the condition of the power distribution system;
- Monitor the condition of the emergency generators;
- Monitor the process plant (i.e., all automated drives, valves, and instruments);
- Monitor process alarms;
- Control alarm paging;
- Monitor system events; and,
- Store trend information.

Design of the SCADA system shall be undertaken by the Contractor and shall include but not be limited to:

- Database configuration;
- Screen layout and arrangement;
- Screen navigation (including menu page);
- Pop-up screen arrangements;
- Alarms configuration;
- Alarm paging;
- Trending; and,
- Generation of reports.

The Contractor shall provide SCADA mimics for equipment supplied as package plants including the HV electrical system.

TCC shall supply an ethernet IP address schedule to be used for all TCP/IP connected equipment.

4.6. SCADA / HMI

The specifications detailed below are given to align the SCADA package with that installed across all TCC sites. Therefore, deviations shall not be accepted, and the Contractor shall confirm all design against the provided reference TCC SCADA O+M Manual to ensure identical set-up, layout, nomenclature, programming, colour schemes, mimic and template setup.

4.6.1. Functions

The SCADA user interface shall provide at least the following functions:

- A user friendly, intrinsic operator interface for monitoring, control and system management purposes;
- Display and control of all analogue and digital points. Display will be in real time on graphic images of the plant and tabular form for common items (e.g., hours run data). The maximum response time between an operator action and confirmation that the action has taken place shall not exceed 1 second;
- Alteration of parameter values, e.g., set points, alarm limits;
- Annunciation of alarms on both occurrence and alarm priority basis. Alarms to be provided on all analogue data and failure of equipment to operate correctly;
- Alarm/event/operator action history collection for the generation of logs and customised reports;
- Incorporate consequential alarm suppression whereby secondary alarms will not be raised from systems which have failed or are programmed to be off;
- The ability to tag messages of at least 100 characters to any alarm to provide instruction to the operator for action to be taken;

- Provision of an alarm paging system (eg: SMS) and communications as detailed in the Job Specification; and,
- Automatic synchronisation of project information and databases between the redundant servers and the clients.

The SCADA shall include the capability for producing schematics of the systems and displaying dynamic data, in real time, at appropriate locations in the graphic.

All pages shall include clear and consistent navigation buttons for selection of each display function outlined.

All operations shall be mouse or menu driven. It shall not be necessary for the operator to remember text strings to type in commands.

4.6.2. Mimic Displays

Provide the following colour, graphical, mimic displays as separate pages (minimum).

1. HV Electrical Distribution System;
2. LV Electrical Distribution System including Standby Generators;
3. Plant Mimics based on the individual P&ID's; and,
4. Communications Mimic.

The Run/Stop/Fault status of each item of plant shall be indicated by the colour of the graphical symbol for that plant.

Colour scheme to be provided by the TCC Nominated Electrical Representative. This shall; however, generally be Red for running, Green for stopped and Amber for fault.

When the operator mouse clicks on an item of plant the SCADA shall bring up a popup window, which allows the operator to manually control that item, disable alarms, acknowledge alarms or alter set points. In general, there shall be five types of objects within the popup menus:

1. **Option Buttons (Radio Buttons).** These allow an operator to make a selection between a number of options. In general, only one option can be selected at any time. For example, a pump can be manually controlled or placed in Automatic Control by selecting one of the Run, Stop or Auto Option Buttons.
   Some Option buttons work across two plant items. For example, duty/standby pumps shall have an option in each popup to determine which pump is the duty pump. The SCADA shall generally only permit one to be the duty, except where two duty devices are called up. Refer to the plant functional description for these items.
2. **Buttons.** These are momentary action buttons for such functions as acknowledging alarms.
3. **Values.** These are text boxes which allow analogue values such as timers and set points to be entered.
4. **Messages**. These are text messages indicating the exact nature of a fault. Most items of plant are part of automatic sequences or are normally under PLC control. This automatic control shall be disabled by:
   - Commanding the plant to run in SCADA manual mode from the SCADA
   - Commanding the plant to stop in SCADA manual mode from the SCADA
   - Switching the plant to Manual at the MCC.
5. **Labels**. Labels on SCADA mimics shall include the P+ID tag name and a descriptive name.

If automatic control of an item of plant has been disabled, its colour is to be changed to grey.

When an item of plant goes into alarm, the SCADA shall indicate this via an alarm window with an additional alarm summary page.

Where there are multiple alarms display the highest priority alarms first.

To acknowledge the alarm the operator shall mouse click on the plant symbol. This shall bring up the pop-up window. In addition to the other controls relevant to this plant the window shall contain a message indicating the source of the fault, whether this be TOL trip, Lanyard, No flow etc. The operator acknowledges the alarm by pressing the Acknowledge Button.

The graphic displays shall only show the process lines which have remote operator controls and/ or indications. Subsidiary manual bypasses without remote indications shall not be shown. Process line widths shall be based on their importance to the process displayed, and not on physical pipe sizes

4.6.3. Electrical Distribution Mimic

The SCADA system shall incorporate mimic diagrams of the HV and LV Electrical Distribution systems in a configuration similar to that shown on the Single Line Diagrams.

The diagrams shall be displayed on multiple pages and shall include clear indication of current switch position at each switchboard or MCC where these are monitored.

Switch/Circuit Breaker positions be indicated using a semaphore of the required colour. The line width of the semaphore shall be greater than the adjacent connections.

The mimic shall include a digital display, within a box, adjacent to each digital meter showing the average phase thermal current and the average phase voltage. By mouse clicking on a digital meter more detailed display of that location shall be displayed showing:

- Individual phase and line volts;
- Individual phase instantaneous currents;
- Average power factor;
- Total kVA; and,
- Total kW.

By double clicking on any parameter, a display will appear which provides a trend display for that parameter. This display shall allow trend data of the parameter to be displayed.

4.6.4. Plant Mimic

Provide as many mimics as required to cover the entire plant. These mimics shall be based on the P&ID's but shall be simplified to only include:

- Major pipes and tanks;
- Plant which is under PLC control, or which is monitored by the PLC system;
- Analogue sensors/transmitters e.g., Flow meters; and,
- Other plant which is necessary to clearly show the plant configuration.

The information required to be displayed for each item of plant are broadly described in the plant functional description. Provide the specified controls together with any others, which may be specified herein or are necessary to facilitate control or monitoring of the plant.

The following additional mimics shall be provided for each zone or area:

- Set points page; and,
- Drives auxiliary page.

Each motor pop-up shall be provided with an interlocks button to display the status of any interlocks or permissives acting on that drive.

4.6.5. Communications Mimic

A set of Mimics shall be developed to show the status and operation of the plant communications systems.

The SCADA shall store communications error counts and alarm if the error persists as a LOW level alarm.

If communication is lost for more than five minutes a HIGH level alarm shall be raised.

Display Communications nodes with LOW level communication alarms in yellow and with HIGH level communications alarms in red.

4.6.6. Time Synchronisation

The duty SCADA server shall automatically synchronise the standby server, RTU and PLC real time clocks with its own once daily.

Clocks of PLCs and RTUS connected to SCADA shall synchronise once daily.

4.6.7. Process Alarms

The SCADA shall maintain a table describing each process alarm input as a graphical screen at the SCADA Terminal. This table shall enable the operator to view the status of the alarms or to alter the values as follows:

- Alarm Identifier;
- Alarm Inhibit; and,
- Status Indicator: Green = OK, Red = Alarm, Yellow = Inhibited, Grey = Not available (or communications with RTU/PLC not available).

Alarming on analogue values shall not be performed within the SCADA. Instead, these shall be processed within the PLC.

Alarm priorities shall be defined in the Job Specification.

4.6.8. Trends

The Contractor shall provide trends for all analogue data and digital datapoints with variable time bases appropriate to the value being measured.

Ensure data is displayed in engineering terms (eg: °C or Kw).

Data from trends shall be stored indefinitely until archived or until the disk space is required for new trend data.

Trends for a particular point shall be viewed by mouse clicking on the digital display of that value.

Provide a configurable trending page, which allows multiple analogue values to be displayed on the one trend and the display of multiple trends.

A pop-up trend shall be available directly from each data point, accessible from the primary menu.

4.6.9. Data Logging

Maintain a database within the SCADA Servers of at least the last seven (7) year's operation of all sequence of events and all archive analogue values.

Sequence of events to have resolution down to one second with all PLC's / RTU's regularly synchronising to ensure uniform time stamping.

Provide software to download data, including trending data, from the SCADA to removable mass storage and then clear the database of any entries older than 7 years.

The Contractor shall implement an automatic backup function using an external HDD or directly to the corporate back-up system if such link becomes available.

4.7. Uninterruptible Power Supplies

4.7.1. Plant UPS Systems

At relevant MCC's, the main PLC 240Vac UPS load centre shall provide a CB to power two off twin 10A red socket outlets clearly marked with the following warning:

"UPS power for SCADA equipment only"

The SCADA equipment shall be powered from these protected socket outlets only. The UPS shall provide a hardwired shutdown contact to the SCADA terminals and standby SCADA server to initiate a controlled system shutdown prior to the UPS failing. The threshold voltage of this contact shall be higher than the minimum input voltage to the SCADA equipment.

The Contractor shall ensure that these UPS units are sized to incorporate these SCADA loads in addition to those set out in the PLC technical specification.

4.7.2. Control Room UPS Systems

The control room SCADA, communications and critical equipment shall be supplied from a dedicated 240Vac UPS matching those provided for the PLC's but sized for the control room loads.

The UPS shall feed a dedicated essential serviced load centre or distribution board. All circuits fed from the UPS shall be hardwired except for SCADA equipment which shall use red twin 10A socket outlets clearly labelled as above.

The UPS shall be permanently online and not rely on switching from mains to inverter supply.

The UPS shall provide alarms as required by AS 3011.2. The Contractor shall provide a serial link between the control room UPS and the SCADA equipment for transmission of UPS status and alarms. The following are the minimum number of alarms to be sent to the SCADA equipment:

- Mains Failure;
- UPS Failure; and,
- Battery Low Voltage.

The batteries shall comprise 5 year rated cells and shall be sized to allow the UPS to provide 100% output at its specified voltage and frequency limits for 2 hours or the nominated time, whichever is the greater.

The UPS shall be able to fully recharge the backup batteries from flat within 24 hours. The battery cubicle shall be a separate enclosure to the UPS and shall be ventilated in compliance with the requirements of AS 3011.2.

4.8. Communications Equipment

Communications between the PLCs and the SCADA terminals shall be managed by the SCADA servers over the Ethernet ring. All communications shall be constantly monitored, and any communications failures shall be raised as an alarm.

The Contractor shall provide the LAN network ethernet switches, media converters, paging systems and all other communications equipment required to effect the installation.

All equipment shall be sourced from the Preferred Equipment List where possible.

All essential communications systems shall be powered from the SCADA UPS systems.

5. Testing

The Contractor shall provide comprehensive test documentation for the FAT and the SAT.

All automatic and manual operation from SCADA shall be proven and witnessed prior to the system being signed off. This includes dial out alarms, remote access, and any other ancillary operation required to successfully control and monitor the plant.

5.1. Factory Acceptance Testing

Control Systems shall be subject to Factory Acceptance Testing (FAT) at the programmer's facility prior to installation in switchboards or transport to site. All equipment and personnel necessary for carrying out the tests shall be provided by the Contractor.

5.1.1. SCADA & PLC FAT

The following requirements are a minimum for PLC Factory Acceptance Testing:

- SCADA servers and a client in a fully programmed and functioning manner for the tests;
- Validate PLC code by Simulation of I/O within the program and Monitoring the SCADA interface for correct indication and response. Alarm logs, trending and report functions shall also be demonstrated; and,
- Server swapping on failure or power loss shall also be demonstrated.

The Contractor shall issue the proposed inspection and test plans for approval and shall provide the TCC Nominated Electrical Representative with 1 week of notice of intention to conduct the FAT once the ITP has been approved.

The TCC Nominated Representative shall be provided the opportunity to witness all tests.

Should any items of the Control Systems not test satisfactorily, the Contractor shall rectify the defects and shall nominate a date for final testing of the Control Systems. Rectifications shall not be undertaken during the testing period.

The Contractor shall provide the completed ITP and the completed set of FATs, signed immediately after the tests have been completed to TCC within three days of successful completion of the FATs.

5.2. Site Acceptance Testing

Following successful completion of the FAT, the control system equipment may be installed on site.

The Contractor shall complete all installation relating to the control system and provide 1 week of notice of intention to conduct the SAT.

The SAT shall consist of 3 stages:

- Dry commissioning;
- Wet commissioning; and,
- Performance Testing.

The Contractor shall prepare and submit a commissioning plan detailing all sequential commissioning works and tests to be performed as part of commissioning works two weeks prior to the nominated date for commissioning. This plan shall be provided as part of the As-Constructed documentation as the Commissioning verification sheet, dated and signed by the Contractor against each test.

Commissioning shall only commence once the commissioning plan has been approved in writing by the TCC Nominated Electrical Representative.

The Contractor shall provide all personnel and equipment necessary to conduct the SAT.

The TCC Nominated Electrical Representative shall witness all tests.

Should any items of equipment or sections of code not successfully pass the tests, the Contractor shall rectify the defects and nominate a date for completion of the SAT. Rectification works shall not be undertaken during the SAT period.

5.2.1. Dry Commissioning

Dry Commissioning at a minimum shall:

- Completely demonstrate the full functionality of all I/O;
- The PLC code shall be verified using direct injection of field I/O at the most distant terminals. Where possible Field devices should be operated to ensure the correct operation;
- Complete functional test of all communications links, redundant fail over operation and alarming;
- Bump testing of all motors;
- Direction testing, failure mode testing for all valves; and,
- Functional testing of all equipment.

It is noted that it may not be possible to demonstrate some functionality without the full process being available, for example PID control loops, but the contractor should demonstrate that functionality as far a practical and note limitations that are stopping any further function testing.

Water shall be applied to processes requiring fluids (eg: pumps) only after full hydraulic testing has been completed and signed off by the relevant supervisors.

These noted limitations should be highlighted for completion during commissioning.

5.2.2. Wet Commissioning

Wet Commissioning at a minimum shall:

- Completely demonstrate the full functionality and control actions available to the operator and for all process monitoring.

All tests shall be conducted without simulation of process set points or data. Rectification of all faults shall be undertaken by the Contractor. The Contractor shall maintain a database of set points developed during testing and commissioning and include the same in the As-Constructed documentation.

The Contractor shall conduct all third-party liaison (including with the Distribution Network Service Provider) and provide all equipment, temporary power supplies, personnel, protective equipment, testing fluids, calibration devices and all other equipment necessary to complete the commissioning of the plant.

The Contractor shall demonstrate the functionality of all installed equipment including interfacing with existing equipment.

The Contractor shall liaise with the TCC Nominated Representative to demonstrate remote dial in and alarm (SMS) functions.

5.2.3. Performance Testing

Performance testing shall be dictated in the Job Specification and Project Contract where required.

Performance testing shall prove the operation of the automation to meet specified performance requirements.

Final completion shall not be issued until full performance testing has been completed.

6. Spares

Nominated spares to be supplied by the Contractor shall be included in the Job Specification.

Any recommended spares not listed in the Job Specification shall be documented and provided to the TCC Nominated Electrical Representative detailing the manufacture, local supplier and relevant part or catalogue numbers to facilitate future ordering.

7. Training

The Contractor shall provide training with all the necessary equipment, manuals, videos and notes using trained and experienced staff.

Prior to final inspection and after all commissioning tests have been completed, the operation of each of the systems is to be demonstrated to not less than five (5) persons nominated by the TCC Nominated Representative.

These demonstrations shall cover all aspects of use, programming and operation of the plant and equipment and of maintenance procedures. They shall relate closely to the Operational and Maintenance Manuals.

7.1. Training Courses

If required in the Job Specification, the Contractor shall provide OEM training courses for first line service, systems operation and use of the SCADA and PLC programming software.

Not less than four (4) weeks of notice of the intention to commence training courses shall be submitted to the TCC Nominated Representative and the actual dates of the course shall be by mutual agreement between the TCC Nominated Representative and the Contractor.

Training courses shall be conducted in Townsville and the Contractor shall provide course notes in addition to the maintenance manuals, which shall be submitted, to the TCC Nominated Representative for preview by course participant not less than two weeks before commencement of the training course.

Training course shall be segmented into three levels as follows:

1. An initial introductory day. Content will be self-contained and provide an overview/block diagram schematic stage for engineers and operators;
2. A first line servicing course conducted for a minimum of six staff over a minimum two working day period shall be structured for electricians involved in the maintenance of the equipment;
3. A comprehensive course for engineers in the use of the PLC and SCADA programming software is to be carry out; and,
4. An operator training course detailing system use, navigation, trending functions, generation of reports and alarm functionality.

7.2. On Site Training

The Contractor shall work with nominated staff during installation and commissioning solely for the purpose of on-site training.

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