Christchurch City Council

CITY WATER & WASTE

PRO-FORMA
GENERIC ELECTRICAL AND AUTOMATION SPECIFICATION ISSUE 5.1

TRIM File Ref: 25/2335203 Feb-26

CONTENTS

1. INTRODUCTION

(a) This specification is intended to be used by CCC staff and External Consultants for project scoping and design, and by Contractors for construction (and design where specifically required).

(b) This document is structured as detailed below. While the listed parties are the main intended audience of each section, all users are required to comply with this document in its entirety. The guidance below does not relieve any party from being compliant with all sections of this specification.

- Section 1: Introduction
- Section 2: Design Requirements (for Designers)
- Section 3: Equipment Requirements (for Designers and Suppliers)
- Section 4: Installation Requirements (for Contractors)
- Section 5: System Integration (for Integrators)
- Section 6: Testing and Commissioning (for Contractors, Integrators and Commissioning Engineers)
- Section 7: Communications and Radios (for Contractors and Integrators)
- Section 8: As-Built Documentation (for Contractors)

(c) Designers and Contractors are required to request relevant reference designs for each project from the EICA Engineer. The reference designs are provided subject to detailed design and review as CCC standards continue to evolve.

(d) It is the user's responsibility to obtain the latest version of this document from the CCC website for design specifications.

(e) Labelling and identification of equipment shall be in accordance with the Master Tagging system (TRIM File Ref: ELEC06/6074 - CCC Tagging Convention) through all phases of work (design, construction, integration, commissioning, documentation etc.).

(f) Feedback and suggested improvements to this document may be submitted to a CCC EICA Asset Engineer.

(g) All project communications shall be addressed to the CCC Project Manager or relevant communication channels as per the agreed contract.

1.1 PREFERRED SUPPLIERS AND EQUIPMENT LIST

(a) All Designers, Suppliers, Contractors and Subcontractors shall be suitably qualified and competent for the work they are doing. CVs shall be provided when requested by CCC.

(b) Suppliers and Subcontractors shall be from the preferred suppliers list in Appendix A.

(c) Equipment shall be from the preferred equipment list in Appendix B.

(d) **Alternatives** to the preferred equipment list may be submitted by the Contractor, or Designer to CCC PM for EICA Engineer approval.

(e) The EICA Engineer will review the shop drawings for the equipment which deviates from the original specification only after the Contractor provides written explanation that each substitution complies with at least one of the following criteria:

i. The specified equipment is no longer available or is not available in a timely manner.

ii. The proposed alternative equipment has advanced technical characteristics than the specified equipment and it will be provided without significant cost increase.

iii. The proposed alternative equipment has the same technical characteristics as the specified equipment but brings significant cost savings.

(f) The alternate submission shall provide sufficient information to enable the EICA Engineer to determine whether the alternate is acceptable or unacceptable. Any additional information requested by the EICA Engineer that they deem necessary to verify the conformance of a proposed alternative shall be provided.

(g) Provide complete information on required revisions to other work and products to accommodate each alternate product. The Contractor shall provide adjustments to the drawings as deemed necessary by the Designer to accommodate an alternative material or product.

(h) The Contractor assumes full responsibility when providing alternative products or materials that all space, weight, connections, performance, power and wiring requirements etc. are considered. Any costs that will be incurred for alternative components, changes to other services, structural or space requirements, layouts and plans, etc. shall be clearly presented to CCC by the Contractor.

(i) The EICA Engineer may reject an alternative without needing to provide justification.

(j) Provide to the EICA Engineer documentary proof of equality, and delivery dates, in the form of certified quotations from suppliers of both specified items and proposed substitutions.

1.2 GLOSSARY OF TERMS

Historian	Data warehouse to provide general access to SCADA data.
HMI	Touchscreen, interface at field site location.
Packaged Equipment	Any OEM assembly (skid-mounted or shipped in parts) complete with interconnecting piping and connections for external interfacing to be procured and installed by the Contractor as part of the project and integrated into the balance of plant of the project.
User Requirement Specifications (URS)	A document setting out the requirements of the Operators to run the plant, provided by CCC to guide the design. The URS shall be read in conjunction with the SoW and this document to capture the requirements of the design.
Scope of Works (SoW)	Document outlining the project requirements during design phase.
Specification	This document, the CCC City Water and Waste Pro-Forma Generic Electrical and Automation Specification.
SCADA	Software and hardware that is used for monitoring and control of OT.
CCC	Principal to the project, Owner.

Project Manager	CCC Project Manager has overall management responsibility for the delivery of the project and liaises with the wider group of CCC stakeholders. All project communications shall be via CCC PM or relevant channels.
EICA Engineer	CCC Electrical, Instrumentation, Control and Automation Engineer, Asset Management representative.
I&EC Network Operations	CCC I&EC Team leader or representative, has overall responsibility for maintenance of CCC control systems and SCADA.
Network Operations	Have overall responsibility for day to day operation of CCC control systems.
Discipline Leads	CCC Electrical, Control, Civil etc. discipline leads for the project.
Operations and Maintenance Representative	CCC Operations and Maintenance representative, has overall responsibility for the plant.
Commissioning Engineer	CCC Commissioning Engineer leads the commissioning team. They are responsible for the commissioning process and provide an interface between the Contractor, Engineer and the CCC Service Delivery team.
Engineer to Contract	Contract Engineer representative, Consultant.
Designer	Design Engineers and Consultants engaged by CCC, or the Contractor when specifically required e.g. Design and Construct projects.
Contractor	Responsible for construction.
Integrator, including SCADA Integrator	Responsible for integration of system controls into PLC and SCADA.
Supplier	Equipment Supplier or Switchboard manufacturer, Vendor.

1.3 ABBREVIATIONS

Abbreviation	Description
316SS	Stainless Steel – Grade 316
ACB	Air Circuit Breaker
ACR	Automation Change Request

Abbreviation	Description
AFDD	Arc Flash Detection Device
AFFL	Above Finished Floor Level
AHr	Ampere-hour (battery capacity)
AI	Analog Input
AMF	Auto Mains Fail
AO	Analog Output
API	Application Programming Interface
AREP	Auxiliary Winding Excitation (Alt. to PMG)
AS/NZS	Australian/New Zealand Standard
CAD	Computer-Aided Design
CAT	Council As-built Template
CB	Circuit Breaker
CCC	Christchurch City Council
CCS	Construction Specification Standard
CMCA	Construction Monitoring & Contract Administration
COC	Certificate of Compliance
CPEng	Chartered Professional Engineer
CT	Current Transformer
CVs	Curricula Vitae (documents outlining a person's professional and educational history)
CWTP	Christchurch Wastewater Treatment Plant
DI	Digital Input
DNP3	Distributed Network Protocol v3

Abbreviation	Description
DO	Digital Output
DOL	Direct-On-Line starter
DP	Display Point
DWG	AutoCAD Drawing format
ECAN	Environment Canterbury
ECP	Electrical Code of Practice
EICA	Electrical, Instrumentation, Control and Automation
ELV	Extra Low Voltage
EMC	Electromagnetic Compatibility
ESC	Electrical Safety Certificate
EWRB	Electrical Workers Registration Board
FAC	Free Available Chlorine
FACE	Free Available Chlorine Equivalent
FAT	Factory Acceptance Test
FDS	Functional Design Specification
GOOSE	Generic Object Oriented Substation Event (IEC 61850 protocol)
GPL	General Purpose Library (software templates)
GPO	General Purpose Outlet
GPS	Global Positioning System
GSM	Global System for Mobile communications
H2S	Hydrogen sulphide (corrosive gas)
HART	Highway Addressable Remote Transducer

Abbreviation	Description
HMI	Human Machine Interface
HOA	Hand Off Auto
HV	High Voltage
HVAC	Heating, Ventilation, and Air Conditioning
ICA	Instrumentation, Control, Automation
IDS	Infrastructure Design Standard
IE3	International Efficiency class 3 (motors)
IFC	Issued for Construction
IFT	Issued for Tender
IL3/IL4	Importance Level 3 / 4 (NZ Building Code)
IP	Ingress Protection rating (e.g., IP20, IP21, IP54, IP56, IP65, IP67, IP68)
ISO	International Organisation for Standardisation
IT	Information Technology
ITP	Inspection & Test Plan
JB	Junction Box
KVM	Keyboard, Video, and Mouse
L1FD	Level 1 Functional Description (Process Narrative)
L2FD	Level 2 Functional Description
LCD	Liquid Crystal Display
LED	Light Emitting Diode
LV	Low Voltage
MCB	Miniature Circuit Breaker

Abbreviation	Description
MCCB	Moulded Case Circuit Breaker
O&M	Operation and Maintenance
OC	Over Current
OEM	Original Equipment Manufacturer
ORN	Orion reference number (lines company application)
OT	Operational Technology
POU	Program Organisational Unit
P&ID	Piping & Instrumentation Diagram
PDF	Portable Document Format
PE	Protective Earth
PID	Proportional–Integral–Derivative
PIR	Passive Infrared
PLC	Programmable Logic Controller
PMG	Permanent Magnet Generator (excitation)
PPE	Personal Protective Equipment
PS1	Producer Statement – Design
PS3	Producer Statement – Construction
PS4	Producer Statement – Construction Review
PTLIH	Polaris PTLIH type (LV bushing termination)
RAM	Random Access Memory (relay diagnostics)
RCD	Residual Current Device
RF	Radio Frequency

Abbreviation	Description
RFI	Radio Frequency Interference
RJ45	Registered Jack 45 (Ethernet connector)
RMU	Ring Main Unit
RPZ	Reduced Pressure Zone (backflow)
RTU	Remote Telemetry Unit (for remote outstations, integral with PLC)
SAT	Site Acceptance Test
SCADA	Supervisory Control and Data Acquisition
SDDS	Software Detailed Design Specification
SFAT	Software Functional Acceptance Testing
SNR	Signal to Noise Ratio
SS	Soft Starters
STP	Software Test Plan
SoW	Scope of Work
TCP/IP	Transmission Control Protocol / Internet Protocol
TRIM	CCC document/file reference system
TSD	Technical Services and Design
UHF	Ultra High Frequency
URS	User Requirement Specifications
UV	Ultraviolet
UVA	Ultraviolet Absorbance
UVT	Ultraviolet Transmittance
UTP	Unshielded Twisted Pair

Abbreviation	Description
VSD	Variable Speed Drive
VT	Voltage Transformer
WWTP	Wastewater Treatment Plant
uPVC	Unplasticized Polyvinyl Chloride

(a) Where abbreviations of cable types are given, they shall have the following meanings:

Al	Aluminium conductor
Cu	Copper conductor
PVC/PVC	Polyvinyl chloride insulated and sheathed.
TPS	Polyvinyl chloride insulated, tough plastic sheathed, to AS/NZS 5000
XLPE/PVC	Cross-linked polyethylene insulated, PVC sheathed, to AS/NZS 5000
SWA	Steel wire armoured
COAX	Coaxial cable
FLEX	Flexible cord or cable
NS	Neutral screened cable

1.4 STANDARDS AND REGULATIONS

(a) This Specification shall be read in conjunction with the latest edition of the following Standards or Regulations, which are deemed to form a part of this Specification. In the event of this Specification being at variance with any provision of these Standards, the documents are read in the following precedence:

i. Electricity (Safety) Regulations

ii. The more onerous of the requirements of this Specification and the Standards.

(b) References to Standards and Regulations refers to the latest version, including any amendments or substitutions made after publication.

(c) All materials, equipment and workmanship shall comply with the following Standards or Regulations to the extent that they are applicable:

AS 1939 (IEC529)	Ingress Protection (IP)
AS 60529	Degrees of protection provided by enclosures (IP Code)
AS/CA S008:2020	Requirements for customer cabling products.
AS/CA S009:2020	Installation Requirements for customer Cabling (Wiring Rules)
AS/NZS 1158	Lighting for roads and public spaces
AS/NZS 1260	PVC-U pipes and fittings for drain, waste and vent applications
AS/NZS 1680 Part 2.4	Interior lighting - Industrial tasks and processes
AS/NZS 1768	Lightning Protection
AS/NZS 2053	Conduits and fittings for electrical installations - Rigid plain conduits and fittings of insulating material
AS/NZS 2293	Emergency evacuation lighting for buildings
AS/NZS 2373	Electric cables - Twisted pair for control and protection circuits
AS/NZS 3000	Electrical installations - Known as the Australian/New Zealand Wiring Rules
AS/NZS 3008.1.2	Electrical installations - Selection of cables - Cables for alternating voltages up to and including 0.6/1 kV
AS/NZS 3010	Electrical installations – Generating sets
AS/NZS 3100	Approval and test specification – General Equipment requirements for electrical equipment

AS/NZS 3112	Approval and test specification – Plugs and socket-outlets
AS/NZS 3760	In-service safety inspection and testing of electrical equipment and RCDs
AS/NZS 4836	Safe working on or near low-voltage and extra-low voltage electrical installations and equipment
AS/NZS 5000.1	Electric cables - Polymeric insulated - For working voltages up to and including 0.6/1 kV
AS/NZS 5000.2	Electric cables - Polymeric insulated - For working voltages up to and including 450/750 V
AS/NZS 60079	Electrical apparatus for explosive gas atmospheres
AS/NZS 60947	Low-voltage switchgear & controlgear
AS/NZS 61439	Low-voltage switchgear & control assemblies
CSS: Part 1-7	Christchurch City Council Construction Standard Specification
NZECP 34	New Zealand Electrical Code of Practice for Electrical Safe Distances
NZECP 35	New Zealand Electrical Code of Practice for Power Systems Earthing
NZECP 36	New Zealand Electrical Code of Practice for Harmonic Levels
NZS 1170.0	Structural Design actions – General Principles (includes determination of Importance Levels)
NZS 1170.5	Structural Design actions – Earthquake actions
NZS 4219:2009	Seismic performance of engineering systems in buildings
NZS 5807	Code of Practice for Identification by Colour, Wording and other coding.
NZS 7649	Unplasticized PVC sewer and drain pipe and fittings
IEC 61000	Electromagnetic compatibility (EMC)
IEC 61086	Conformal Coating
IEC 61300-3-35	NZ Electrical Codes of Practice

ISA/IEC 62443	Industrial communication networks – Network and system security – Series
-	NZ Electricity Act
-	NZ Health and Safety at Work Act
-	NZ Health and Safety at Work Regulations
Engineering New Zealand Practice Note 19	Seismic Resistance of Pressure Equipment and its Supports

(d) Standards or Regulations other than those listed above may also be applicable. In any case all materials and equipment shall comply with an appropriate national (preferably AS/NZS or NZS) or international Standard, and wiring practices shall comply with all applicable New Zealand Acts, Standards, Regulations, Codes, etc.

In no circumstances shall products or fabricated equipment be installed that is not manufactured to acceptable standard types as quoted in the New Zealand Electricity Regulations and AS/NZS 3000.

1.5 RATINGS

1.5.1 Low Voltage Equipment

(a) Equipment supplied shall deliver rated output under the stated service conditions.

i. Rated voltage, 230VAC / 400VAC +10% to -6%

ii. Insulation voltage, 0.6 / 1kV

iii. Frequency, 47.5 - 52.5Hz

iv. Impulse withstands voltage (wave 1.2/50ms), 6.0kV

(b) Such equipment shall be suitable for connection to any of the following supplies:

i. 400VAC, 3 phase, 3 wire, 50Hz.

ii. 400VAC, 3 phase, 4 wire, 50Hz.

iii. 230VAC, 1 phase, 2 wire, 50 Hz.

iv. 24VDC

1.5.2 11kV High Voltage Equipment

(a) Refer to APPENDIX F – CWTP HIGH VOLTAGE REQUIREMENTS.

1.6 ENVIRONMENTAL CONDITIONS

(a) In the absence of other site-specific information specification, design, and supply of equipment shall allow for the following environmental conditions at the site without any equipment exceeding manufacturers recommended environmental specifications.

i. Maximum Temperature 45ºC

ii. Minimum Temperature -4ºC

iii. Relative Humidity Range 67-90%

1.7 UNITS

(a) The following units shall be used through design, construction and commissioning:

(b) For anything not defined below, SI units shall be used. Use of other units not expressly defined above shall be approved by the EICA Engineer.

Process flows	m³/h [instantaneous]
Totalised flows	m³
Chemical dosing flows	L/h
Analyser sample flows	L/h
Concentrations	mg/L
Pressure	kPa
Level	%, mRL
Temperature	˚C
Volume	m³
Current	A
Pump speed	Hz
Pump power / Electrical Demand	kW
Consumed Power	kWh
Turbidity	NTU
pH	pH
FAC/FACE	ppm
UVT	%
UVA	mW/cm^2

(c) Measurements are to apply the use of a dynamic decimal point to always achieve a display of 4 or 5 numerical characters. E.g. Flow 10.15 m³/h

1.7.1 Flow

(a) Flow shall be displayed in m³/h with an option for L/s.

(b) Totalised flow shall be displayed in m³.

(c) Chemical dosing and sampling flows shall be displayed in L/h.

(d) Conversion factor: 1L/s = 3.6m³/h

(e) Format: ##### m³/h
m³
###.# L/s (Dynamic decimal point)
###.# L/h (Dynamic decimal point)

1.7.2 Pressure

(a) Pressure shall be displayed in kPa with an option for metres head.

(b) Conversion factor: 1kPa = 0.10197 m.head

(c) Format: ##### kPa
###.# m

1.7.3 Level

(a) Level shall be displayed in %

(b) Conversion factor: none

(c) Format: ### %
##.## m
##.## mRL

(d) Level shall be displayed in meters relative to the floor level. CCC Datum (mRL) shall be displayed only on overview screen and Zone (P&ID) drawings.

1.7.4 Temperature

(a) Temperature shall be displayed in ˚C.

(b) Conversion factor: none

(c) Format: ###.## ˚C

1.7.5 Volume

(a) Volume shall be displayed in m³. The use of L (litres) shall be by approval only.

(b) Conversion factor: 1000L = 1.0m³

(c) Format: ##### m³

1.7.6 Current

(a) Electrical Current shall be displayed in A (Ampere).

(b) Conversion factor: none

(d) Format: ###.## A

1.7.7 Speed

(a) Speed shall be displayed in Hz, % of motor-rated speed or rpm. Confirm which option is to be used with the EICA Engineer.

(b) Conversion factor: as required

(c) Format: ##.# Hz
%
rpm

1.7.8 Energy & Demand

(a) Electrical Energy shall be displayed in kWh.

(b) Electrical Demand shall be displayed in kW (preferred for individual pump station) or MW for aggregate totals.

(c) Format: ##### kWh
kW

1.7.9 Turbidity

(a) Turbidity shall be displayed in NTU.

(b) Conversion factor: none

(c) Format: ##.## NTU

1.7.10 pH

(a) pH shall be displayed in pH.

(b) Conversion factor: none

(c) Format: pH##.##

1.7.11 FAC/FACE

(a) FAC - Free available chlorine, FACE – Free available chlorine equivalent shall be displayed in ppm. FACE is required only when UV equipment is installed.

(b) Conversion factor: none

(c) Format: ##.## ppm

1.7.12 UV Analyser

(a) UVT – Ultraviolet transmittance is measure in %

(b) Conversion factor: none

(c) Format: ##.## %

(d) UVA – Ultraviolet absorbance is measure in mW/cm^2

(e) Conversion factor: none

(f) Format: ##.## mW/cm^2

2 DESIGN REQUIREMENTS

2.1 GENERAL

(a) Unless specifically modified by the SoW document, EICA Design Documentation shall capture the details of the Electrical equipment, including but are not limited to;

i. Switchroom sizes and layout

ii. Doors and access

iii. HV switchgear and transformers

iv. Switchboards, distribution boards, motor load centres

v. Harmonic Filters

vi. Control panels, marshalling panels, junction boxes

vii. Control PLC, RTUs and HMIs

viii. Cables and cable support systems

ix. Earthing and Equipotential Bonding, as per AS/NZS 3000 and site-specific requirements

x. Lighting

xi. General power outlets

xii. Instruments

xiii. Solar panels, generators and power supplies

xiv. Radio and other communication equipment

xv. HVAC and ventilation

xvi. Module dip switch settings

xvii. Site layout

xviii. Equipment general arrangement

xix. I/O list

xx. Electrical ratings and protection settings

xxi. Schematics and wiring diagrams, termination details

2.1.1 Basis of Design

(a) CCC will endeavour to provide accurate record documentation, however, it is the responsibility of the Designer to confirm all relevant and necessary information. A site visit should be undertaken if required.

(b) CCC have developed standard electrical drawing sets, functional descriptions and tagging spreadsheets for both Water & Wastewater Pumping stations. These are to assist designers in their development of the design and to drive standardisation, listed below:

Note: Many of these standard documents are still in development.

- FOLDER25/528 Electrical and Automation Standards - Three Waters – Standard CAD Files
- FOLDER25/448 Electrical and Automation Standards - Three Waters – Standard Software Blocks
- FOLDER25/371 Electrical and Automation Standards - Wastewater – Standard Two Pump Waste Station
- FOLDERXX/XXX Electrical and Automation Standards - Wastewater – Standard Three/Four Pump Transfer Station
- FOLDER25/370 Electrical and Automation Standards - Water Supply - Standard Potable Water Booster Station
- FOLDERXX/XXX Electrical and Automation Standards - Three Waters – Standard Permanent Generator
- FOLDER25/698 Electrical and Automation Standards - Water Supply – Standard Water Wells and Suction Tanks
- FOLDER25/603 Electrical and Automation Standards - Water Supply – Standard Potable Water Treatment Plant

2.1.2 Standard Designs and Deliverables

(a) CCC design standards are continuously evolving. Request the latest drawing set for a related site type from the EICA Engineer before undertaking a design. Designs shall follow these details as appropriate for the project. Details of any differences shall be reviewed prior to tender or construction design issue.

(b) The Design Documentation shall include pre-populated CAT sheets from the project Bill of Materials, for the Contractor to complete during construction. Refer to IDS requirements and template from the CCC website for as-built data requirements.

(c) The design documents shall be supported by a design compliance statement. The Designer shall ensure compliance with the CCC standards, legislative requirements and that the desired performance requirements are met.

(d) Design shall be completed such as to ensure that the requirements for project quality control and quality assurance are met. Project specific quality plan and calculations shall be provided when requested by CCC.

2.1.3 Filetype and CAD Requirements

(a) Design drawings shall be submitted in PDF. Issued For Construction sets shall also include the designers native AutoCAD DWG digital files, with accompanying database and metadata files.

(b) All red-pen construction drawing markups shall be incorporated into the CAD files and issued as updated AutoCAD DWGs and matching PDFS for handover.

(c) All as-built shop drawings including as-built panel drawings shall be provided in DWG format. This should be incorporated into the as-built DWG and matching PDFS for handover.

(d) All tables and schedules must be provided as text-searchable content within the PDF. Tables and schedules must be positioned and oriented so they can be read easily without rotating the document.

2.1.4 Approvals

(a) All EICA Design Documentation (including Functional Design Specification) shall be approved by the EICA Engineer at the following milestones:

i. for Tender

ii. for Construction

(b) Approval shall be recorded by way of an Electronic Stamp applied by CCC to each document.

2.1.5 Seismic Requirements

(a) Design of seismic restraint systems and equipment, hold downs, including but not limited to, switchboards, cabinets, generators, diesel engines, fuel tanks, cable support and protection systems, etc shall be in accordance with AS / NZS 4219, NZS 1170.5 and the relevant material Standards for the specific bracing systems being proposed.

(b) The responsibility for the design, including the design of the interfaces such as hold down anchors and brackets, shall be assigned to the party identified in the project-specific Scope of Works (SoW).

(c) In the absence of a specific assignment within the Scope of Works, the responsibility for the design of such equipment fixing connections shall default to the Contractor. The Contractor shall be deemed accountable for ensuring that all such designs are appropriately coordinated, structurally adequate, and compliant with all relevant statutory and contractual obligations.

(d) The Designer shall document in the design documents details of the supporting structure/building that the equipment is to be installed into.

(e) The seismic design for manufactured equipment shall be designed by the equipment manufacturer/supplier and provided by the Contractor for submission to Engineer. Where no information is available, seismic design shall be provided by the Contractor.

(f) The design and certification of seismic restraint systems shall be done by the Contractor. Load calculations shall be based on the equipment specifications, weights and configuration provided by the Manufacturer/Supplier of the equipment in the first instance, otherwise by the Contractor.

(g) The Contractor shall submit the proposed design for review by the EICA Engineer.

(h) The Contractor shall provide a PS1 design producer statement, signed by a NZ Chartered Engineer (CPEng), with the design documentation for the seismic restraint design of the equipment.

(i) Design is to be minimum importance Level 3 (IL3), as per AS/NZS 1170.0, unless specified by the design documentation/drawings to be importance level, IL4.

(j) The components of the engineering system are to be classified P6, unless specified as P7 in the contract design documentation/drawings, as per table 2 Cl. 3.2.2 of NZS 4219.

(k) All anchors to concrete to be seismically qualified in accordance with NZS3101.

(l) Design life of seismic bracing systems and their post-installed fixings shall match or exceed the equipment design life.

(m) All horizontal electrical linear systems shall be provided with flexible joints across seismic joints. The required movement allowance shall be coordinated with the Structural Engineer for the main structure.

(n) All vertical electrical linear systems spanning between different floors shall allow for inter-storey movement through flexible joints. The required movement allowance shall be coordinated with the Structural Engineer for the main structure.

(o) All proprietary bracing systems, including their proprietary connections shall be seismic qualified. Testing data shall be made available by the manufacturer upon Engineer request. The Engineer might request the Contractor to propose an alternative proprietary bracing system if this does not meet the project specifications and National Standards.

2.1.6 Noise Levels

(a) Acoustic performance of the entire installation shall be considered with respect to compliance with the Christchurch District Plan and Environment Canterbury noise control standards.

(b) If the project is subject to a resource consent then the Designer shall ensure the design complies with any noise requirements of the consent.

(c) Acoustic analysis shall include all noise sources including:

i. Diesel Generator

ii. Pumps

iii. VSDs

iv. Active Harmonic Filters

v. Sine Filters

vi. HVAC, cooling

2.1.7 Power Supply to Site

(a) The designer shall provide load calculations and if required by the SoW; engage the Lines Company (Orion) to confirm power supply to site.

(b) Where required, lodge an application through the Lines Company online portal, receive an ORN number and ensure it is passed to the Contractor on the construction drawings.

i. Pass correspondence regarding any Lines Company upgrades necessary to the EICA Engineer.

(c) The Designer or Contractor shall provide a Lines Company approved design (if required). The Contractor shall facilitate the mains supply to the project.

(d) The design shall comply with all Lines Company requirements for the connection of supply, and the requirements of Section 2.2.

(e) The Designer shall coordinate with the CCC Energy team (through the Project Manager) to agree on a suitable tariff and account code to pass onto the Contractor. Details shall be captured on the drawings.

2.2 MAINS SUPPLY

(a) The electrical design shall clearly show the point from which the electrical supply is obtained.

(b) At minimum, the design drawings shall show the following details for the mains (or submains):

i. Location of power supply (if known)

ii. Metering details (if applicable)

iii. Cable routes and installation details (trench section)

iv. Conductor size and material

v. Conductor arrangement

vi. Insulation material and temperature rating

vii. Conduit size (if applicable).

2.2.1 Harmonics and Power Factor

(a) A harmonic impact assessment shall be carried out, and the installation approach shall follow Lines Company requirements and ECP 36.

(b) For VSDs and other active devices this shall include Active Harmonic Filters or Low Harmonic (Active Front End) drives.

(c) The designer shall consider Power Factor Correction requirements to maintain or achieve a Power Factor of 0.95 lagging minimum.

(d) For motors and other lagging devices, Power Factor Correction requirements shall be considered. In general, Power Factor Correction is required for pumps above 3kW.

2.3 IDENTIFICATION AND LABELLING

(a) The design drawings shall show the equipment label identifying the below information for all equipment:

i. Description of equipment

ii. Its “Tag name”

and shall meet the requirements as specified herein.

(b) Switchboard and electrical enclosure labels shall have 5mm lettering for the Description and 3mm lettering for Tag name. Font shall be Helvetica. Site identification such as pump station name shall be 10mm Helvetica.

(c) An example is provided below:

(d) Field device labels shall be stainless steel and have 5mm lettering.

(e) Labels shall follow the below colour scheme:

i. General labels: White / Black / White

ii. Danger / Warning Labels: Red / White / Red

2.4 SWITCHROOMS

2.4.1 General Arrangements

(a) Switchroom equipment general arrangement drawings shall be produced prior to confirmation of the building layout, size, and structural details. Submit switchroom general arrangement drawings at Concept Design for acceptance by CCC. Switchboards and control panels shall be in a dedicated electrical switchroom away from any process equipment. Switchboards shall not be housed in process areas.

(b) The general arrangement drawings shall include all electrical equipment to be installed in the room including:

i. Switchboards – sizing based on site specific load lists

ii. HMI - located as close as practical to the personnel entry door

iii. Starters – Soft Start and Variable Speed Drives

a. Shall be grouped together, not with each pump (if space allows)

b. Shall be numbered left to right (if space allows)

iv. Starter Control Panels (HOA Panels)

v. Control System RTU Cabinet (SCADA Cabinet)

vi. Lectern / Shelves for site documentation

vii. Harmonic Filtering equipment

viii. Generator inlet point – where a plug inlet or terminal box is used

ix. Cable Trenches, cable trays and cable ladders

x. Spare space for any identified future provision

xi. Spare space, 15% of the usable wall space

xii. Any other equipment required in the room.

(c) General arrangement drawings shall show the required spaces in front of major equipment for opening doors and maintenance, as well as clearance distances demonstrating compliance with the standards for egress.

2.4.2 Doors

(a) Switchroom doors shall be 200mm higher than the maximum height of any switchboard or item of electrical equipment. Minimum heights are:

i. Single door, 2200mm

ii. Double door, 2550mm

(b) Switchroom doors shall have an opening no less than 900mm in width.

(c) Two entries shall be provided for switchrooms with switchboards rated >800Amps as required in AS/NZS 3000.

2.4.3 Switchroom Instrumentation

(a) Switchrooms shall include:

i. Analogue temperature sensor, mounted in a location to avoid unrepresentative readings. Wire to an analogue input of the PLC with a high temperature alarm. See Section 2.4.4.

ii. Smoke detectors above all switchroom switchboards, wired in series where more than one is installed. The activation of the smoke detector shall disable forced ventilation if installed. Smoke detectors shall be 24VDC and monitored by the RTU. Smoke detectors are not required for outdoor kiosks.

2.4.4 Temperature Control

(a) HVAC is generally not required, CCC will monitor the temperature post construction and decide if HVAC is required.

(b) Designer to advise EICA Engineer if the temperature cannot be kept within 35 ^{o}C limits and additional ventilation and/or cooling arrangements will be required, prior to commencing the design.

(c) The temperature shall be monitored by SCADA and alarms shall be configured for:

i. Alarm at 45 ºC,

ii. Persistence delay of 5 minutes,

iii. Deadband of 5 ºC to avoid multiple re-alarming

(d) The switchroom shall be provided with temperature monitoring as per Section 2.4.3. Heat pump HVAC will be installed as required following continuous switchroom temperature monitoring.

2.5 EMERGENCY GENERATOR INLET CONNECTION

2.5.1 General

(a) The generator inlet plug, where the inlet pins are exposed, shall have the neutral pin disconnected from the main neutral by means of switching through a 4-pole generator breaker.

(b) Provide a trapped key interlock between the generator and mains breaker.

(c) Fit all stations that do not have permanently installed generators with a three-phase generator inlet connection. Plugs shall generally be mounted on the switchboard.

(d) In general, for pump stations, the generator inlet should be sized to the capacity of the site. The **minimum** capacity of the generator connection shall be sufficient to run one pump (the largest pump).

(e) For other sites, the capacity shall be agreed with the EICA Engineer.

(f) Single phase sites shall be provided with the same connection as three phase sites, with only one phase active.

(g) Generator inlet connection is not required for sites that do not run pumps or valves, such as level and pressure monitoring stations. At these locations, backup batteries are sufficient to maintain site operation for a limited duration in the event of a power outage.

2.5.2 Large Sites (Mains Supply >125Amps)

(a) Generator inlet MCCB with approved Powerlock-style connectors mounted through the front of the switchboard.

2.5.3 Smaller sites (mains supply <=125A)

(a) Use an approved 125A or 63A 5-pin plug.

2.5.4 Generator Cable Entrance

(a) For sites with the switchboard in a building, provide a 150mm diameter wall penetration and access box on the station wall for the entry of portable generator cables. Access box to be polycarbonate for secure locations or metal (galvanised steel or 316SS as appropriate) for locations accessible to the public. Box to be fitted with CCC lock.

(b) For outdoor kiosk installations, provide matching cutouts in the bottom door lip and bottom return to allow the door to close when the temporary generator cables are in place.

(c) All cable entries must be provided with removable covers to stop rodents entering the switchboard.

2.6 CABLES

(a) The design shall not require cables to be installed in locations where they may be subject to damage due to subsequent work (such as nailing of linings and the like).

2.6.1 Cable Labelling

(a) Cables shall be tagged according to the CWW Tagging Convention (TRIM:ELEC 06/6074) and shall follow CCC sample drawing, summarised as follows:

i. Data Cables DJ###

ii. Signal Cables SJ###

iii. Power Cables EJ###

(b) Cable labels shall be PVC and shall comply with Section 4.3.2 requirements.

(c) A cable schedule shall be provided with the contract documents for use by the Contractor under Section 4.3.2.

2.6.2 Conductors

(a) All conductors shall be copper. Exceptions may be granted for the mains cable at potable water sites (with written approval from EICA Engineer).

(b) Unless otherwise stated all power cable conductors shall be plain annealed stranded copper.

(c) The minimum size for conductors shall be 1.5mm^2 for lighting circuits and 2.5mm^2 for socket outlets.

(d) The minimum size for conductors of cables for any other circuits (except for instrumentation or data circuits) shall be 2.5mm^2.

(e) All conductors of 1.5mm^2 and above shall be stranded.

(f) Flat TPS wiring shall not be used.

(g) Analogue and digital data cables and ELV cables shall be physically segregated from all AC power and control cables.

(h) The use of parallel cables shall be considered for circuits >150mm^2.

(i) Cabling to generators, motors, mechanical plant, or crossing seismic joints shall allow for vibration and movement by providing cable slack or loops. The fixed cabling shall be terminated in a junction box and the final connections shall be completed with a flexible cable.

2.6.3 Colours

(a) Phase, neutral and earth conductor insulation colours shall be per AS / NZS 3000.

(b) Other cable colours shall be in accordance with the below tables:

i. Copper:

3Ph/1Ph	Red/White/Blue
230VAC control	White Appliance wire
Neutral	Black
Earth	Green/Yellow
PLC Digital Inputs	Orange
PLC Digital Outputs	Purple
12VDC Pos	Red
12VDC Neg	Grey
24VDC Pos	Pink

24VDC neg	Grey-common with 12V Neg
4-20mA AI Pos	White/red
4-20mA AI Neg	Black
4-20mA AO Pos	White/black
4-20mA AO Neg	Black
Ethernet (Cat 5 or 6)	Biege
Fibre	Orange

ii. Fibre Patch Leads:

SCADA and Ethernet HMI's	Yellow
PLC to PLC (Peer to Peer)	Black
PLC and RTU (I/O connection)	Blue
Camera (Voice/Video)	Green
Data (Administration)	Beige
Management (iLo)	Grey
Crossover	Red
Wireless	Purple
KVM Extenders	White

2.6.4 Instrument Cables

(a) Analogue and digital signals shall not be together in a mixed cable.

(b) Instrument cables shall be minimum 0.5 mm^2 twisted pair overall screened.

(c) Multi-pair analogue signal cables shall be element screened and overall screened.

(d) Instrument cables include all extra low voltage devices cabling.

(e) Instrument cable shields shall be electrically continuous. When two lengths of shielded cable are connected (at a terminal block(s)) an additional terminal block shall be used for connecting the shields. Shields shall be isolated and insulated except at their selected grounding point. At any point of termination, the shield shall not be stripped back any further than necessary. Shields shall not be used as part of the signal circuit.

(f) Analogue signal circuits shall be grounded at one common point, closest to the PLC.

(g) Digital signal circuits shall be grounded only at the power supply source.

2.6.5 Communication cables

(a) Local Area Networks (LAN), and general data and communication systems are to be installed with Category 6, unshielded twisted pair cable (UTP).

(a) Fieldbus data network cable shall comply with the Control System hardware manufacturers' requirements.

2.6.6 Reticulation

(a) The design shall allow the installation to be carried out in accordance with Section 4.4.

2.6.7 VSD Cables, Screens and Glands

(a) VSD cables shall be installed per Section 4.3.6.

(b) Motor cable earthing conductors shall be connected to the equipment dedicated earth terminal at both ends of the cable by use of a lug.

2.6.8 Cable Jointing

(a) The design shall only include cable joints (in any location) with the prior written approval of the EICA Engineer.

(b) Underground cable joints shall be avoided wherever possible. Where unavoidable, underground cable joints shall be permitted only with the prior written approval of the EICA Engineer.

(c) Where cable joints are approved, they shall be designed to facilitate the installation requirements in Section 4.3.7 and documented in accordance with Section 8.3.1.

(d) Cable joints shall comply with AS/NZS 3879 and shall be watertight.

2.6.9 Cable Terminations

(a) Aluminium conductors shall be terminated using only proprietary bimetallic lugs or links.

(b) Must comply with Section 4.3.8.

2.7 CABLE SUPPORT AND PROTECTION SYSTEMS

2.7.1 General

(a) Cables shall not be direct buried in the ground. Provide conduits or ducts for all underground cables.

(b) At potable water sites cable trenches are the preferred method of cable routing in electrical switchroom and plant rooms. At wastewater sites, ducts are preferred.

(c) Cable tray or ladder shall be used where four or more conduits would otherwise be run or where the additional support provided by ladder is necessary.

(d) Conduit/ducts may be used where cable trays or ladder are not required.

(e) Exposed unsupported cable is permitted for the final connection to devices with a length no longer than 150 mm for instrument cable or 500 mm for power cable.

(f) For cables that are installed outside, the design shall include provision for physical protection from mechanical damage, UV and vandalism. Where exposed to the public, this shall be with steel conduit.

(g) Refer to AS/NZ 3000 wiring rules and seismic requirements Section 2.1.5 for cable support design requirements.

(h) All trays and ladders shall be perforated or slotted to permit airflow and drainage of liquids.

2.7.2 Sizing

(a) Preferred conduit/ducts size is 50mm for control cables and 100mm for buried power cables, 150mm for mains power cables.

(b) Unless otherwise specified all conduits/ducts shall be one size larger than required by regulation for the number of conductors to be drawn in.

2.7.3 Catenary Wires

(a) Catenary wiring shall only be used in a false ceiling.

(b) Catenary wires may be used for mains voltage electrical cables but shall not share a catenary wire with communications cables. Where used, separate catenary wires shall be employed for mains services and for communications (telecommunication, signalling, or data) cables.

(c) Catenary wires shall be plastic coated galvanised steel of 2.5 mm diameter (minimum).

2.7.4 Cable Ducts/Conduits

(a) Conduit and conduit fittings shall comply with AS/NZS 61386.1:2015

(b) Conduit shall be cast into the roof of tanks to remove any trip hazards. At wastewater pump stations, provide at least three 100mm conduits – two for Power and one for Instrumentation – between the kiosk and the wet well.

(c) Flexible conduit shall only be used in short lengths where rigid conduit is unsuitable. At the conduit termination an appropriate cable gland shall be used, and a length of heat shrink applied covering the end of the flexible conduit and the gland. Flexible conduits and fittings shall be "Black Technoflex" or equivalent and be a minimum IP56. Flexible conduit and fittings shall comply with AS/NZS 2053.1 and AS/NZS 2053.4.

(d) Where accessible to public steel or rubber coated flexible steel conduit to be fitted.

(e) Conduit runs in areas accessible to the public shall be galvanized steel or 316SS as appropriate.

(f) Cable ducts shall be un-plasticized orange PVC electrical duct (Marley or equivalent) and complying with AS/NZS 1260.

(g) All cable ducts that are open at both ends shall be sealed as close to switchboard as possible with a removeable firestop plug.

(h) Conduit runs on or surrounding water reservoirs and suction tanks shall be galvanized steel or 316SS as appropriate. All pipe joints shall utilise quick-clamp fittings or similar to ensure a weld-free and screw-free installation. No welded or threaded joints will be accepted.

2.7.5 Underground Cabling

(a) Cables shall be laid in compliance with the requirements of the AS/NZS 3000 Wiring Rules.

   i. Cables entering Orion kiosks shall also meet the requirements of Orion Network Code - Technical requirements for connections to Orion's electricity distribution network NW70.00.15.

(b) Cables shall be bedded in clean sand with minimum depth of bedding of 50 mm below the cable and minimum cover of sand of 50 mm above the cable. The minimum depth of cable shall mean the perpendicular depth from final finished surface level to the top of the buried cables.

(c) An orange PVC cable marker strip shall be placed (during backfilling) along the full-buried length of cables at the depth shown on the Drawings (if specified) or in the Standards.

2.7.6 Cable Tray and Ladder

(a) At Wastewater sites either Al or 316SS cable trays must be used.

(b) At Potable Water sites materials of cable trays and cable ladders are unrestricted (Al, 316SS or galvanised steel).

2.8 LIGHTING

2.8.1 General

(a) Provide lighting to AS/NZS 1680 – for switchboards, and for plant rooms and process plant with occasional manual intervention.

(b) The Designer shall confirm the below requirements with the latest version of AS / NZS 1680

i. Switchboards: 160 lux on vertical face

ii. Plant rooms: 80 lux

(c) All luminaires shall be LED.

(d) Switching of all station indoor lighting shall be integrated with site security for automatic light switching when entering and leaving the station. Switching of switchroom lighting also requires an HOA lighting override switch mounted on the front SCADA panel to allow operation if RTU fails.

(e) Switching of outdoor flood lighting is via a switch mounted on the front SCADA panel, outdoor lighting is also integrated with site security to turn off lights if left on when leaving the station.

(f) Where outdoor luminaires are controlled from a PIR sensor, an indoor switch with flap is also required, this is mounted on the side of the switchboard.

(g) Where a PIR sensor is used at a site with a generator, the PIR must be self-resetting.

(h) All luminaires' locations must be selected to allow future maintenance of the fittings.

(i) Where emergency lighting is not installed then glow-in-the-dark exit signs shall be provided.

(j) The locations of all outdoor luminaires shall be selected and installed to prevent nuisance and spill lighting to neighbours.

2.8.2 Luminaires

(a) Luminaries shall confirm to AS/NZS 1680 set (as applicable) and AS/NZS 1158 set (as applicable)

(b) Luminaries in plant areas shall be suitable for IP56 rating.

(c) Exterior fittings shall be vandal resistant.

(d) Luminaries shall be suitable for the adverse environment conditions and shall be resistant to atmospheric corrosion.

(e) All lighting equipment shall be suitable for the ambient temperature it is operating in.

(f) Luminaires shall be cast aluminium, plastic, or polycarbonate. No fitting to be installed outside shall be of ferrous material.

2.8.3 Pump Station Flood Lighting

(a) Specify an LED light rated at a minimum 4000 lumens, cool white and housed in a security cage to protect from vandalism. Locate its manual switch on the SCADA cabinet inside the Kiosk/Station.

(b) At outdoor wastewater sites, if there is an aerial pole or a vent pole on-site, mount the light near the top of the pole pointing towards the wet well.

2.9 GENERAL PURPOSE OUTLETS AND ISOLATORS

2.9.1 Socket Outlets

(a) The design shall facilitate socket outlets to be installed to meet the requirements of Section 4.6.1.

(b) Sockets for office areas shall be IP56 10A 230V 50 Hz as per AS/NZS 3112.

(c) Other industrial areas PDL 56 IP66 or equivalent: 1Ph 10A 230V 50Hz and 3Ph 32A 415V 50Hz. Include 30mA RCD protection for single phase outlets.

(d) Provide at least one single-phase 10A socket and one three phase 32A socket, both for intermittent use.

(e) Provide a single-phase socket inside the SCADA control panel.

2.9.2 Fixed Outlets

(a) Fixed outlets shall be installed for permanently connected equipment such as hot water cylinders, auto-doors, roller shutter doors, hand dryers, etc.

(b) Single phase fixed outlets shall be grey polycarbonate, complete with isolator.

2.9.3 Special Purpose Outlets

(a) A label stating the purpose for which the outlet is intended shall clearly and permanently identify each special purpose outlet. This label is in addition to the tag number label specified in Section 2.3.

(b) Outlets which supply at any voltage or frequency other than 230V, 50Hz, shall have pin configurations which will not accept the standard 10A, 230V “crows foot” (AS/NZS 3112) plug most commonly used in New Zealand.

(c) Where pump or other process loads sockets are installed, they need to have a IP56 series plug and socket. Plug and socket must be provided with screw lock.

2.10 INSTRUMENTATION AND CONTROLS

2.10.1 Design and Selection

(a) All Instrumentation and controls shall be 24VDC, exceptions must be approved by CCC EICA Engineer.

(b) The Designer shall produce a P&ID showing the Instrumentation in the process. P&ID symbols shall be as per standard drawings.

(c) Instrumentation shall be from the approved materials list, or with prior written approval from the EICA Engineer. At the start of detailed design, the Designer shall provide CCC a list of chosen instrumentation for approval by the EICA Engineer.

(d) If a required instrument is not on the approved materials list, it shall be selected by the following criteria;

i. Known brand.

ii. Compatibility with other plant instrumentation

iii. Robustness and durability

iv. Field wiring accessibility

v. IP Rating and or hazardous area rating

vi. Suitability for the task

vii. Mechanical construction

viii. Reliability

ix. Repeatability

x. % Error and accuracy

xi. Mounting system

xii. Proven measurement technology

xiii. Industry standard outputs and network communications compatibility.

xiv. Local display and operation

xv. Programming and local trending capability

xvi. Ease of calibration and self-diagnostics.

xvii. Communications protocol support

xviii. Programmable features such as engineering units displayed.

(e) While all these features are not applicable to all instrumentation they are to be considered where applicable when selecting new instrumentation.

(f) Note: Instrument connections shall be as per preferred equipment list.

2.10.2 General Requirements

(a) Provide the following functionality at all sites:

i. Auto and manual operation of the pumps using Hand-Off-Auto (HOA) control panel.

ii. Ensure the plant fully resets and restarts itself after power surges, blackouts, and brown outs.

iii. Stations with buildings shall have Station Flooding ‘Water on Floor’ alarm where floor trench or dry well is present.

iv. All generator alarms shall be communicated to SCADA..

(b) All instruments shall be supplied complete with sufficient interconnecting cable to reach the transmitter location.

(c) Instruments selected shall be capable of accurately measuring the entire minimum to maximum design ranges.

(d) Housing material shall be suitable for the installation location.

2.10.3 Mounting and Accessories

(a) Provide all mounting hardware and accessories required for a complete and functional system, even if not explicitly shown on the drawings.

(b) Instruments shall be mounted in such a way that they can be easily maintained without special access equipment.

(c) Instruments operating under pressure shall be provided with a means of dispersing the pressure prior to maintenance. For pressure instruments, provide a 2-valve manifold. For Differential Pressure instruments, provide a 5-valve manifold.

2.10.4 Standards

(a) Supplied instrumentation shall comply with the relevant standards related to the type of measurement being carried out. The Designer shall be aware of what the relevant standards are for the specific instrument being supplied.

2.10.5 Standard Signals

(a) 4-20mA unless otherwise specified.

(b) HART protocol for totalisation.

(c) 24VDC where externally powered.

2.10.6 Magnetic Flow Meter

(a) Provide with remote transmitter complete with the following features:

i. Wall mount kit.

ii. Backlit LCD.

iii. HART protocol capability.

(b) Transmitter shall be capable of displaying:

i. Flow rate in m^3/h

ii. Flow total in m^3 (non-resettable).

iii. Flow range in m^3/hr

a) Flow range shall be 0 to 125% of max flow, or -125% to 125% of max flow for bidirectional meters.

(c) External connections required for SCADA are:

i. 4-20 mA (flow rate) with HART superimposed over.

ii. HART to be used for totalised flow.

iii. Two clean contact output relays: first contact for flowmeter fault, second contact for reverse flow or high flow alarm.

(d) Flow meter accuracy to be verified following installation and while buried by utilising the flow meter manufacturer's proprietary verification tools and software packages. A verification certificate shall be supplied with each meter.

(e) Sensor sized to so that nominal flow through the meter is between 1 m/s - 3 m/s or as per design flows.

(f) Full bore flow meters are required in all wastewater applications. Reduced bore flowmeters may be provided in low flow water reticulation scenarios to achieve the entire design flow range.

(g) Flanged to AS 4087 or greater (check pressure rating below). Supplier shall liaise with the Contractor to ensure flange material and drilling pattern shall be compatible with the process piping.

(h) Lining shall be EPDM or hard rubber.

(i) Sensor protection rating to IP68. Direct buried meters shall be conformally coated and factory potted. Provide denso-wrapping after installation.

(j) Where field potting is performed by the Contractor, they shall provide a warranty on the work equal to the manufacturer warranty in place prior to field modifications.

(k) Transmitter protection rating to IP65.

(l) Supply voltage 24V DC.

(m) Where it is not possible to use 24V DC, a 230V AC RCD protected circuit may be used.

(n) Unit accuracy to be +1% or better over entire flow range. A calibration certificate shall be supplied with each meter to verify its accuracy.

(o) Pressure rating shall be the greater of 16 bar or 1.5 x maximum operating pressure.

(p) Supplied complete with sufficient interconnecting cable to reach the transmitter location with no cable joints.

2.10.7 Analysing Instruments

(a) Must be placed considering the relative density of the gas they measure.

(b) Provide calibration equipment that allows calibration to be carried out at a safe working level without special access equipment.

(c) All maintenance, calibration and verification to be performed by qualified instrument technicians.

2.10.8 Site Specific Requirements

2.10.8.1 Potable Water Wells

(a) Bore pumps pumping to suction tanks shall have the bore flow connected directly to the VSD with PID flow control integral in the VSD. The PID setpoint is configured in the VSD and shall be set to 95% of the lesser of either the consented flow as set by ECAN, or 80% of the flow value at which the well draws sand as defined by the well installer. The flow signal is re-transmitted to the RTU via a HART compatible signal splitter and shall be wired in such a way that if the signal to the RTU fails the pump continues to operate. The flowmeter shall have a fault relay indicating to the RTU that the flowmeter reading is uncertain. This shall alarm and stop the pump.

(b) Bore flowmeter shall be designed and configured for:

i. Instantaneous flow using the analogue 4-20mA output. High flow alarm in SCADA is to be set at 105% of the lesser of either the consented flow as set by ECAN, or the developed flow as set by the well installer.

ii. Flowmeter fault indication using a digital output.

iii. High flow fault using a digital output, set to 110% of the lesser of either the consented flow as set by ECAN, or the developed flow as set by the well installer.

iv. Forward flow volume totalisation using HART protocol on the analogue channel.

(c) Bore pumps shall have dual integral pump thermistors connected to a monitoring relay, and a low water level switch. Both wired to produce an external fault to the bore pump VSD and to RTU.

(d) Bore wells shall have level transmitters installed for monitoring only, configured as follows:

I. Non-artesian pressure bores shall have hydrostatic level transmitter installed in well casing for monitoring well level and a pressure transmitter on the well head to measure pump pressure.

II. Artesian bores shall have a pressure transmitter installed on the well head to measure artesian pressure.

III. Consult the EICA Engineer for specifying a reference datum for the level sensor.

(e) Artesian wells shall be fitted with a solenoid-operated control valve where filling suction tank.

2.10.8.2 Potable Water Suction Tanks

(a) Hydrostatic or pressure transmitter for level control.

(b) High and low tank level switches

(c) Security switches on each hatch shall be wired in common as secondary security alarms.

(d) A stainless-steel junction box for tank-mounted instruments shall be provided adjacent to the access hatch.

(e) Where an external box is provided for marshalling to break the cable run between the tank and switchroom, provide a stainless-steel marshalling cabinet at the base of the water tank.

2.10.8.3 Potable Water Pump Stations

(a) Flowmeter for measuring station outflow. The water pump station flowmeter shall be designed and configured for:

i. Instantaneous flow using the analogue 4-20mA output.

ii. Flowmeter fault indication using a digital output.

iii. Reverse flow indication using a digital output.

iv. Forward flow volume totalisation using HART protocol on the analogue channel.

(b) Pressure transmitter for reticulation pressure upstream of the pumps (delivery pressure).

(c) Where pumps are fed by reticulation, pressure transmitter downstream of the pumps (suction pressure).

(d) A single station mechanical over pressure switch for reticulation water delivery pressure hardwired into the pump/s starter control. The overpressure switch must be installed downstream of the pump/s. This installation requirement applies equally to bore pumps when they are used in reticulation applications. This fault is latching and set at 100kPa above Pump Off setpoint. Refer to CCC standard potable water booster electrical drawings.

(e) Each surface pump shall be fitted with its own thermal flow switch. CCC preference is for switch to be installed on the delivery side, it shall be wired as an external fault input to the pump starter and wired to an external timer relay. Switch is to operate below the minimum sustainable pump flow. Refer to CCC standard potable water booster electrical drawings.

(f) Provide differential pressure switches on sand filters.

2.10.8.4 Wastewater Pump Stations (excluding Lift Stations or Vacuum Stations)

(a) Radar level sensor with an analogue 4-20mA 24vdc output for wet-well level control which provides:

i. stop/start control for the pumps.

ii. a "high water" alarm

iii. an “overflow” alarm

iv. a “low water” alarm

v. a transmitter failure alarm

(b) High level float switch arrangements:

I. Float switch wired to override the PLC and start the pumps.

II. Pump 2 requires a delay timer to start after Pump 1 in Duty/Standby pump arrangements.

III. Pump stations with Duty / Standby pump arrangement require a Low Torque alarm on the Pump 1 VSD. Low Torque alarm on the Pump 2 is for notification only and does not inhibit the pump. Low torque alarm shall stop Pump 1 and allow Pump 2 to start.

IV. High level float inhibits, one output from RTU for each pump.

(c) Station outflow flowmeter and pressure transmitter. Wastewater pump station flowmeter shall be designed and configured for:

i. Instantaneous flow using the analogue 4-20mA output.

ii. Flowmeter fault indication using a digital output.

iii. Reverse flow indication using a digital output.

iv. Forward flow volume totalisation using HART protocol on the analogue channel.

2.10.8.5 Lift Stations

(a) These are generally pump stations with one Duty pump.

(b) Hydrostatic level sensor with an analogue 4-20mA 24vdc output for wet-well level control which provides:

i. stop/start control for the pumps.

ii. a "high water" alarm

iii. an “overflow” alarm

iv. a “low water” alarm

(c) High level float switch wired into the pump controller.

2.10.8.6 Stormwater Pump stations

(a) A storm water design specification and URS is currently being developed.

2.10.9 PLC and HMI

(a) PLC and associated hardware shall be installed in an extra low voltage compartment suitable for general access.

(b) Consideration shall be made for 20% spare I/O to be available in the future. The design shall document how spare I/O is provided and agreed with EICA Engineer.

(c) The rack arrangement and layout of I/O modules shall be as per the standard drawings.

(d) Digital I/O:

i. All digital alarms are wired fail safe, inputs are active high in the healthy state and shall alarm when 24VDC is removed from PLC the Input

ii. Indications and motor running circuits shall be wired active high so 24VDC at the PLC indicates running.

iii. Interposing relays shall be used to separate indicating lamps and PLC inputs.

(e) All I/O on all modules shall utilise wiring loops to marshalling terminals, grouped by I/O module.

(f) I/O shall be protected in groups. Minimum grouping shall separate Analogue and Digital.

(g) Instrument power supply circuits and PLC I/O power supply circuits shall be separate. Separate DC supplies extending outside the cabinet from those inside the cabinet.

2.10.10 Batteries

(a) Batteries shall be Gel Deep Cycle.

(b) Battery runtime shall be agreed with the EICA Engineer in writing at the start of design, but not less than 24hrs runtime.

(c) Automatic battery test functionality by a contactor driven by a PLC output shall be provided for RTU batteries.

2.11 SITE SECURITY

(a) Access to electrical equipment and any controls on electrical equipment shall be by secure access. Secure access may be by site security such as security fences and locked gates, an outer weatherproof and vandal proof enclosure such as provided for roadside pump stations or inside a secure room or building.

(b) Provide hatch switches on external hatches at potable water suction tanks, wired to the PLC and monitored by SCADA as a secondary security.

(c) External cabinets and building door access shall have door switches fitted, wired to the PLC and monitored by SCADA.

2.12 EARTHING

2.12.1 Main Earth

(a) Provide a main earth connected to the main earth bar as required by AS / NZS 3000. The main earth shall be copper.

(b) Earth stake shall be bolted type. Earth clamp connection is not accepted.

(c) The main earth stake shall be installed in a test pit.

(d) For sites with main incomer rating of >160A, also provide a connection from the main earth bar to the building foundation reinforcing steel and rebar.

2.12.2 Instrument Earth (Clean Earth)

(a) A separate instrument earth bar shall be used for termination of instrument earth cables and shields. The instrument earth shall be completely isolated from the main earth bar within the switchboard or kiosk.

(b) The instrument earth bar shall be connected to a dedicated instrument earth stake.

i. The exception to this is in kiosk applications where a small number of instrument shields exist, in which case a connection from the instrument earth bar to the main earth stake may be provided.

(c) The connection from instrument earth bar to instrument earth rod shall be minimum 16mm^2 copper.

2.12.3 Equipment Earthing and Bonding

(a) Provide bonding to AS / NZS 3000 requirements.

(b) The motor cable earth shall not be used to earth the motor terminal box.

2.12.4 Lightning Protection System

(a) Where required by risk assessment, a lightning protection system shall be provided in accordance with AS/NZS 1768.

(b) Aerial mounting masts shall be earthed through a separate earth electrode mounted as close as practical to the mast.

(c) The earth conductor between the earth electrode and the mast shall be the most direct route without sharp bends to ensure the safe conduction of the discharge.

2.13 UPS

(a) Site control power is typically 24V DC with battery backup. UPS is generally not required. However, where required by the scope UPS shall be specified by the Designer.

(b) The Designer shall propose to CCC the UPS runtime that is required at each specific site, for acceptance by the EICA Engineer.

(c) Provide all UPS with maintenance bypass switches.

2.14 HAZARDOUS AREAS

Refer to Appendix A.13 for additional requirements consideration.

3 EQUIPMENT REQUIREMENTS

3.1 GENERAL

3.1.1 Materials

(a) All equipment shall be new and from the approved materials list

i. Alternatives to the approved list may be used with prior written approval from the EICA Engineer.

ii. Existing (non-new) equipment may be re-used with prior written approval from the EICA Engineer.

(b) Any product or materials supplied for the project shall be supplied to comply with the following;

i. Be the latest version of the device.

ii. Be supplied with appropriate software.

iii. Be suitable for the intended use.

iv. Have a proven track record in similar installations.

v. Be compatible with other associated equipment.

vi. Be supported by local suppliers or agents.

vii. Be designed to operate in the environment it is to be installed in.

viii. Be suitable for installation into areas that are accessible for maintenance.

ix. Have the manufacturers label attached.

x. Where the material or device is to be hidden from view and is a motor or machine an appropriate name plate duplicate shall be supplied.

xi. Be protected against electrolytic corrosion due to the action of dissimilar metals.

xii. Installed in compliance with the manufacturers recommended installation requirements.

xiii. No materials used in the construction shall be inflammable, hydroscopic or subject to deterioration which may compromise the safety of the equipment.

xiv. Where equipment is not listed in the preferred equipment list, equipment shall have the equal or greater designed lifespan than as listed in Section 3.1.3.

3.1.2 Alternatives

(a) The Contractor shall provide supporting documentation that the proposed alternative is equal or better than that listed in the preferred equipment list.

3.1.3 Equipment Life Expectancy

(a) Equipment provided shall meet or exceed the below minimum life expectancies:

Equipment	**Minimum Life Expectancy (years)**
3phase Motor (low duty)	40

Equipment	Minimum Life Expectancy (years)
3phase Motor (heavy duty)	25
Earth Stake	30
LV XLPE cables	30
Switchgear	25
Pilot Devices	25
Lighting and Small Power Equipment	25
Motor Starters, Harmonic Filters, Power Factor Correction	15
PLCs, RTUs, HMIs, Radios, Battery Chargers, Power Supplies, Antenna	15
Instrumentation	10
Batteries	10

3.1.4 Labels

(a) All equipment, when installed, shall have a label matching what is shown on the design drawings (tag name and description) and to meet the requirements as specified herein. Refer to Section 2.3 for details.

(b) All electrical enclosure doors shall be labelled indicating cell function (for switchboards and MCCs) or enclosure function (for single compartment enclosures).

(c) For outdoor electrical cabinets affix a stamped metal label to the outside of the cabinet indicating the pump station name and identifier.

(d) Label size shall comply with Section 2.3.

3.1.5 Shop Drawings

(a) Shop drawings, shall be provided by the Contractor. The Designer shall review shop drawings, before sending to CCC for EICA Engineer approval. Equipment cannot be manufactured until the EICA Engineer have stamped and accepted the shop drawings.

(b) EICA Engineer shop drawing review status:

i. Accepted: Documents satisfy requirements and Contractor may proceed

ii. Not Accepted: Documents do not satisfy requirements without major modifications.
Contractor should not proceed as adjustments are required.
Respond to EICA Engineer comments, make corrections and resubmit.

(c) Subsequently resubmitted shop drawings shall clearly indicate any changes from previous revisions. Failure to identify changes to the EICA Engineer does not imply acceptance of the entire drawing set.

(d) The EICA Engineer's approval of the Contractor's drawings and documentation do not in any way relieve the Contractor of their responsibility to meet the criteria specified. EICA Engineer review is to ensure user requirements are captured, not a quality assurance check.

(e) Submit detailed information to permit the EICA Engineer to execute the necessary review activities that what is being provided meets the requirements specified here.

3.2 ELECTRICAL ENCLOSURES

3.2.1 General

(a) Electrical enclosures include but are not limited to;

i. Main Switchboards

ii. Main Power Distribution Centres

iii. Motor Load Centres

iv. Motor Control Centres

v. Distribution Boards

vi. Control Panels

vii. Marshalling Boxes

viii. Junction Boxes

(b) Operator controls shall be provided in an otherwise dead front panel, without direct access or exposure to terminals, terminal covers, contactors, etc except for operating panels designed to protrude through the front of a masking panel. Refer to 2.4.

(c) Metering cabinet, integral DB, flow meters and instruments intended to be read shall be located above 1,000mm above floor level or surrounding ground level.

(d) Internal components shall be appropriately protected from accidental touch.

3.2.2 Switchgear Standards

(a) All equipment provided must comply with Section 1.4, AS/NZS IEC 60947 and AS/NZS 61439.

(b) Switchgear shall be 3 phase, 4 wire with MEN earthing.

3.2.3 Technical Specification

(a) The panel builder shall fabricate switchboards and control panels that meet the requirements of Section 3.2 Any conflict between this specification and the design drawings shall be notified to the EICA Engineer prior to starting work.

(b) The design shall be presented in a way that allows the panel builder to meet the requirements of Section 3.2.6 to the fullest extent practicable.

(c) Outdoor kiosks shall have a thermostat-controlled anti-condensation heater installed.

(d) The IP rating shall be suitable for the environment where the enclosure is installed.

(e) Design shall include for segregation of voltages where possible including separate enclosures and ducting to segregate 400/230V AC from 24/12V DC circuits.

(f) Enclosure operator panels shall be logically laid out and labelled.

(g) 24VDC control voltage shall be used, not 230VAC.

(h) Provide for 20% spare space for all elements. Terminated spare conductors do not count towards spare space.

(i) Height not to exceed 2200mm.

(j) Switchgear ratings shall be suitable for at least 125% of the maximum demand.

(k) Main panels are generally floor mounted.

(l) Small control panels and distribution boards are generally wall mounted.

(m) All gland plates must be aluminium. Cable entry (top or bottom) shall be as required by design.

(n) Shop drawings shall be reviewed by the Designer and approved by the EICA Engineer.

3.2.4 Materials

(a) Electrical enclosures shall be manufactured from metal. HOA stations, indoor terminal boxes and marshalling cabinets and instrument cabinets may be made from a non-metal material, subject to acceptance from the EICA Engineer.

(b) All non-stainless metalwork shall be powder coated. Final colour shall be Cream Ripple.

(c) Cable access to the switchgear shall be via aluminium earthed gland plates 5 mm thick.

(d) Equipment gear plates shall be painted mild steel or industrial Formica.

(e) All copper bars shall hard drawn high conductivity copper specifically manufactured for this purpose. Bus bars shall be tinned copper.

3.2.5 Switchboards

(a) Switchgear shall be a design-verified power switchgear and control gear assembly according to AS/NZS IEC 61439-2. Form of construction shall be agreed with the EICA Engineer during design.

(b) Switchboards provided with a permanent generator shall have an isolator upstream of the controlled mains MCCB.

(c) Where switchboards are controlled by the generator Deep Sea controller, provide three key slots on the front of the switchboard as specified in Section 3.5.10 Generator Controls .

(d) Equipment shall be laid out to achieve the best use of the space while maintaining a logical layout and flow and follow the CCC preferred layout.

3.2.6 Construction

(a) Switchboards shall be AS/NZS 61439 Form 3B or higher.

(b) Every switchboard shall be provided with a label with engraved text as shown below:

i. Manufacturer and contact details.

ii. Serial Number

iii. Voltage, Frequency and Current Rating

iv. Form of Segregation (Form xx)

v. Form of Protection (IPxx)

vi. Asset Tag

vii. Year of Manufacture

viii. Every switchboard cell shall have a label showing asset tag and cell description (e.g. Pump 1 Isolator, Spare etc.).

(c) Access to Bus Bar chambers shall be though removable panels secured with fixings requiring a tool to remove them. A clear Lexan panel shall also be provided. All panels shall be suitably labelled identifying the danger of removing such panels.

(d) Bus Bar connections shall be secured with constant pressure washers.

(e) All live metal work shall be suitably shrouded to avoid accidental touch by operators carrying out routine inspection or maintenance work.

(f) Switchgear metal work shall be designed to allow expansion in length and ease of replacement or modification of cabinet configuration.

(g) The switchboard shall not be taller than the switchroom access.

(h) Switchboard design shall include provision for access and maintenance of all components. For single sided boards this includes provision for access to all current carrying elements from the front of the board.

(i) Switchboards with a mains supply from the Orion network shall have a metering chamber for the Energy Retailer kWhr meter. Provide a clear cover.

(j) CT chambers shall have a clear cover and be arranged so that CT ratios and connections are visible.

(k) MCCBs shall be provided with isolator through the door, or dead front MCCBs with controls accessible at the face of the switchboard.

(l) Components attached to the gearplate directly shall be by screws in the threaded holes, blind rivet nuts, or bushes. Use only slotted, posi-drive or Philips headed screws. Hex head drive self-tappers are not acceptable. Pop riveting is only acceptable to attach PVC trunking systems and DIN Rail.

(m) Where a special cabinet base is required, it shall be a welded steel ‘I’ section or channel, galvanized and painted. It shall be supplied with appropriate clamps. Base shall have provision for insertion of 50 mm diameter pipes through the width of the base to assist lifting with fabric strops.

(n) All metalworks shall be bonded using earth bonding cables.

(o) Cable and ducts entering the cabinet shall be connected through a gland mounted on an Aluminium gland plate.

(p) All devices shall be wired to terminals, excepting small light and power circuits wired directly to miniature circuit breakers.

(q) All cores for all cables shall be wired to terminals; these do not count as spare space.

(r) Switchboard design shall include provision for access and maintenance of all components. For single sided boards this included provision for access to all current carrying elements from the front of the board.

(s) Provide Push-in terminals only. Screw terminals shall not be used.

(t) Marshalling terminals shall be a knife disconnect type to permit testing.

(u) Door stays shall be provided on all outdoor kiosk doors.

(v) Install Arc Flash Detection Devices (AFDD) and feeder protection relay in accordance with the manufacturer's instructions. Mount the relay through a dead-front panel behind a compartment door.

3.2.7 Doors

(a) All doors shall open in the same direction where practicable and be capable of having key locks or latches fitted.

(b) Doors accessing extra low voltage (24V DC), sealed metering equipment, or dead front local distribution boards shall use a hand toggle. All other doors require tool access. Doors requiring tool access shall use a slot suitable for a large flat-head screwdriver.

(c) Door openings shall allow the withdrawal of any component inside the cabinet without the removal of other components inside that cabinet.

(d) Equipment shall not be mounted on the back of doors.

3.2.8 Control Panels (SCADA Panel)

(a) Control Cabinets shall be separate to the switchboards. These shall be constructed to facilitate replacement of the control cabinet separately to the replacement of the switchboard.

(b) The Designer shall follow CCC standard panel layouts which CCC will provide on request.

(c) Control cabinets shall have no exposed Low Voltage (230VAC) inside the cabinet. The only permissible 230VAC connections inside the Control cabinet are:

i. GPO outlet – suitable for connection of programming terminals

ii. Permanent connection to battery charger terminals

iii. Station lighting contactor

These connections shall be fitted with a suitable escutcheon or guard with appropriate warning label.

(d) All other electrical connections inside the cabinet shall be Extra Low Voltage (nominally 24V DC).

(e) Cabinets shall be provided with lighting where not located in a building or where insufficient lighting is available. Cabinet lighting at Network sites is activated by a door mounted microswitch wired to the PLC / RTU and a digital output shall then activate the panel lighting. Where there is no security login the lighting and switch are hardwired. A lighting override switch shall be provided on control panel and only control the switchroom light.

(f) All equipment shall be DIN-rail mounted where possible.

(g) Components and trunking spacing shall allow adequate space for cable numbering and attachment of cable ferrules.

(h) All field wiring shall be terminated in terminal blocks mounted on DIN rails. All terminations shall be labelled as per the number shown on the drawings. Field wiring shall not land directly onto the control components. PLC interface modules designed for field terminations are an exception to this.

(i) Every control panel and junction box shall be provided with a label with engraved text as shown below:

i. Asset Tag

ii. Description

iii. Description of controls

(j) Provide a IP67 RJ45 convenience port on the front of the control panel below the HMI.

(k) 19” Rittal double door cabinet may be used.

3.2.9 Control Relays

(a) Control relays shall be 24VDC with visual status indication and manual operate (test) mechanism.

3.2.10 Arc Flash Protection

(a) All new switchboard designs shall include an Arc Flash Assessment study in accordance with AS / NZS 4836 (latest revision).

(b) Arc flash protection shall be provided on all new switchboards with main switch ratings greater than 630 Amps. Arc flash protection shall consist of an Arc Flash Detection Device (AFDD) and feeder protection relay that automatically disconnects supply.

(c) For switchboards with a main switch rating between 400A and 630A, a protection study shall determine if arc flash protection shall be provided where the main switch will not operate in the Instantaneous region with the available fault current.

(d) The Designer shall provide the assessment to CCC and propose suitable arc flash protection.

3.2.11 Pushbuttons and Lamps

(a) Pushbuttons and lamps colours shall be per the below table:

Function	**Colour**
Running	Green
Fault	Red
Reset	Blue
Actuator Open	Blue
Actuator Close	White
Actuator Stop	Red

3.2.12 Hours Meters

(a) Hours meters shall have the field reset function disabled.

3.2.13 Enclosure Wiring and Cabling

(a) Cable trunking shall be open slot type - closed slot will not be accepted. Trunking will be mounted horizontally and vertically to achieve a logical flow of cabling. Cable jointing inside trunking is not permitted. All jointing shall be carried out at terminal blocks.

(b) All terminals for incoming/outgoing circuits for control, data and communications shall be mounted in accessible positions that are also convenient for cable termination.

(c) No more than two conductors shall be terminated in any one side of any terminal. Each wire shall be labelled. Whenever possible shorting straps or combs shall be used to bridge identical terminals. Terminal bridging strips shall be insulated or covered.

(d) Terminals on digital control circuits shall be feed through type. Terminals on analogue circuits shall be blade disconnect type.

(e) Segregation or shielding shall be provided between instrumentation, communications, data, 230VAC, 400VAC, 24VDC and 12VDC circuits and associated terminals.

(f) Solder joints and solder tinned cable ends into terminals are not permitted.

(g) Where instrument earths are terminated on a terminal it shall be fully insulated from the chassis.

(h) Conductors of PVC insulated panel wiring (other than instrumentation, communications and data circuits) shall be flexible and adequately rated for the circuit loading. These conductors shall have a minimum cross-sectional area of 0.75mm².

(i) All control wiring conductors up to 4mm² shall have Starfix crimp ferrules or similar.

(j) Wiring to doors shall be anchored at the panel side and be of sufficient length to enable the door to swing fully open without strain on the wiring.

(k) Cable and wire colour coding shall comply with Section 2.6.3.

3.2.14 Operating Panels

(a) Components of operating panels shall be mounted to meet the requirements of Section 4.2.5. It is the Contractor's responsibility to confirm site mounting details of the enclosure to ensure the operating panel is correctly positioned once the enclosure is installed on site.

3.2.15 Batteries

(a) Batteries shall be restrained on all three axes.

(b) Battery isolator to have auxiliary contact for switch position as a digital input to RTU.

3.2.16 Power Supplies

(a) In general DC power shall be supplied by a battery backed charger.

(b) MCB rating supplying the charger shall be appropriately sized for initial combined charging and load current.

(c) Float charge at 27VDC.

(d) High current limiting rather than collapsing the charger.

(e) DC power supplies without battery backing:

i. Shall only be permitted for localised device requirements where communications is not required.

ii. shall include minimum power conditioned feed.

(f) Fault indication provided to the RTU.

(g) Provide MCB protected DC circuits to:

i. Each cabinet (when the DC supply feeds multiple cabinets).

ii. Individually within a cabinet to:

a) RTU or PLC

b) Communications devices

c) Analog inputs

d) Analog outputs

e) Digital inputs

f) Digital outputs

iii. Individually for DC loads outside of a cabinet.

(h) Provide VTs monitoring the supplied voltage, wired to an analogue input of the PLC.

(i) Provide all power conditioning equipment required by the design to meet the requirements of Section 2.2.

(j) Where an alternative to the approved equipment is accepted and the alternative have the listed functions onboard, provide external monitoring and signalling devices to meet the requirements specified herein.

3.2.17 Earthing

(a) Refer to Section 2.12 for earthing requirements.

(b) A separate instrument earth is to be installed. Instrument screened cables and instrument cabinets are to be connected to instrument earth. Refer to Section 2.12.2 for additional requirements for instrument earth.

3.2.18 Delivery

(a) At the completion of testing the Contractor shall set all devices to OFF and package the switchgear ready for delivery. A set of marked up As Built drawings shall accompany the switchgear.

(b) The wrapped switchgear shall be labelled as follows;

i. Delivery address

ii. Contact person and phone number on site

(c) Switchgear shall be packaged to suit the delivery and off-loading method.

3.3 MOTOR STARTERS

3.3.1 General

(a) All motor starters shall be one size bigger than the pump kW rating.

(b) Configure VSDs for Heavy Duty mode.

(c) Configure starter HMI to disable local reset button (where fitted).

(d) All motor starters shall include a separate rotary lockable isolator on the main switchboard.

(e) All analogue connections to the PLC shall be 4-20mA.

(f) Provide pump HOA controls with the following features:

i. A label showing the motor description and tag name.

ii. Wiring and functionality as shown on the CCC typical design drawings, summarised below:

a. Auto Off Manual selector (note the order is also prescribed)

i. Auto – Motor starts on a command from PLC, high float (if present) or control circuit.

ii. Off – Motor does not run.

iii. Manual – Motor runs.

b. Blue pushbutton with inset white R, may mechanically reset the fault.

c. Remote reset

iii. HOA controls shall be located on the switchboard when the motor starters are in the switchboard, otherwise a separate HOA station is provided mounted in a dedicated panel immediately adjacent to the starter or drive. Where space limitations apply HOA controls may be installed on the switchboard with written approval from the EICA Engineer.

iv. A copy of the motor nameplate on the control panel door for submersible pumps

v. 24VDC Control relays

vi. At least one form of Thermal protection

vii. Overload protection

viii. 20% spare DIN rail terminals

(g) External fault conditions shall be wired to the starter Ext Flt connection or external fault circuit. Where motor starters have more than one external fault condition, these shall be wired through interposing relays each with a contact wired to a PLC digital input to record on the HMI which external fault occurred.

(h) The motor starter shall be connected to the site Ethernet. Communications shall be Modbus TCP/IP. Communications shall be for information only. The starter shall be configured so that failure or disconnection of the Ethernet has no impact on process operation.

3.3.2 Soft Starters

(a) The design shall include Power Factor Correction to meet the requirements of Section 2.2.

(b) Include a non-resettable physical hours counter on the cubicle front panel when not an integral feature of the soft starter.

(c) Separate overload protection is required where the soft starter protection cannot be turned down low enough to protect the motor. Separate overload protection shall trip the soft starter as an external fault input. In this instance carefully consider the order of remote reset if the separate protection is latching.

(d) Soft starter shall be provided with the following features:

i. Where required, Power Factor Correction installed inside the soft starter cabinet.

ii. IP21 for mounting inside switchboards (≤4kW) and IP54 for wall mounting (>4kW).

iii. Soft Starter Control HMI Pad shall be provided for motors >4kW.

a) Configure to display current and run hours.

iv. Modbus TCP Ethernet communications

3.3.3 Variable Speed Drives

(a) Provide VSDs with

i. Manual 0-10VDC speed adjustment potentiometer (not required for well pumps).

ii. Digital speed display(where mounted remote from the VSD).

(b) All Well Pumps must have dv/dt or sinus filters. Check pump and cable manufacturers guidelines for selection and arrangement.

(c) Low harmonic drives are preferred. Common harmonic filtering may be specified where multiple small VSDs (<30kW) are installed.

(d) Variable Speed Drives shall be provided with the following features:

i. Integrated EMC filter

ii. Maximum Transient Current 165% for 2 sec/ 150% for 60 seconds.

iii. IP 20 for mounting inside enclosures and IP 54 for wall mounting.

iv. VSD Control HMI Pad

v. Modbus TCP Ethernet communications

(e) The drive shall be connected to the site Ethernet. Communications shall be Modbus TCP/IP. Communications shall be for information only. The drive shall be configured so that failure or disconnection of the Ethernet has no impact on the process operation of the VSD.

(f) VSDs for equipment rated 95 kW or above must be floor mounted. VSDs for equipment rated below 95 kW can be wall mounted.

(g) Where VSDs are mounted in an enclosure, it must have adequate ventilation conforming to manufacturers requirements. IP21 VSDs installed in IP54 enclosures without suitable ventilation are not accepted. Louvers must be fitted without filters.

3.3.4 Direct On Line (DOL)

(a) During design, agree in writing with the EICA Engineer if networked DOLs (Eg: Schneider TeSys) meeting the requirement of 3.3.1(h) are required.

3.4 MOTORS

(a) Provide high efficiency electric motors from reputable manufacturers. Report the motor efficiency prior to ordering any such equipment.

3.4.1 Pump Motors

(a) All motors shall be provided with a form of thermal protection.

(b) Pump motors shall be 3 phase for pumps 3 kW or above.

(c) Motors shall be the highest efficiency available from the Manufacturer, IE3 or better (to IEC 60034-30).

3.5 PERMANENT GENERATOR AND DIESEL ENGINES

3.5.1 General

(a) Permanently installed generators shall only be provided at sites previously agreed in writing with the EICA Engineer.

(b) Generators shall be rated for Prime operation unless previously agreed in writing with the EICA Engineer.

(c) Provide good access for refuelling, volume indicators and Council's preference for aboveground storage when designing the fuel storage. Integration (inside) the main building will be considered only if beneficial and complying with the Hazardous Substances and New Organisms Act.

(d) Detail an alternator manufactured in accordance with AS 60034 Rotating electrical machines that meets the following requirements:

i. Operates at 400Vac 50Hz (±2.5 Hz), 3 phase 4 wire

ii. Minimum power factor 0.8.

iii. Switching in compliance with AS / NZS 3010.

(e) Provide a generator capable of starting and running the pump sets from stand still and zero delivery pressure.

(f) Include with Generator tender response the minimum and maximum operating points of the Generator for comparison against expected site demand at low duty.

3.5.2 Sizing

(a) Provide sizing calculations to the EICA Engineer at all design stages.

(b) Agree the basis of sizing the generator with the EICA Engineer prior to starting design.

i. Specify a unit capable of powering enough pumps to allow for the pumping of the Maximum Flow, plus all auxiliary equipment (ventilation fans, battery chargers, lighting, dosing equipment, UV disinfection etc).

ii. Consider all identified future loads. If the inclusion of future loads in the generator sizing triggers a larger generator, then confirm the basis for sizing with the EICA Engineer.

(c) Generators should be rated to allow for the effects of the harmonic load content for a station utilising variable speed drives or other wave-chopping devices. The harmonic loading can account for up to 35% of a set's rating.

(d) Minimum and expected load calculations shall also be determined to identify the potential for diesel engine operation at light loads.

(e) For any DOL or soft start applications generator size needs to be 1.5 times electrical load as a minimum.

3.5.3 Drip Tray

(a) Required on Open sets.

3.5.4 Voltage Regulator

(a) Capable of operating at nominal voltage ±10% (360 - 440V).

(b) Inherent ±2%, no load to full load at 0.8 to unity power factor at any voltage within the range setting.

(c) Remotely adjustable for sync purposes.

3.5.5 Earthing

(a) Employ a multiple earth neutral system.

(b) The neutral point shall be brought out to a terminal.

(c) The generator must not have a Neutral Earth link in the alternator.

3.5.6 Excitation

(a) The alternator shall be self-excitation for sets <500kVA.

(b) >500kVA shall use AREP or PMG excitation. Confirm excitation requirements with EICA Engineer in writing.

3.5.7 Construction

(a) Directly couple the alternator to the engine by means of a flexible coupling.

(b) Consider the effect of the air temperature within the building on the engine air intake after prolonged diesel runs.

3.5.8 Governor

(a) Provide an electronic governor class G3 (to ISO 8528) capable of maintaining a steady speed within the limits specified.

3.5.9 Exhaust

(a) Vent the exhaust at a height above the roofline conforming to ECAN requirements. Refer to the ECAN Pollution Prevention Guide http://tools.ecan.govt.nz/eppg/.

(b) Ensure exhaust arrangement is compliant with the Canterbury Air Regional Plan (https://www.ecan.govt.nz/your-region/plans-strategies-and-bylaws/canterbury-air-regional-plan/)

(c) Provide a vermin proof exhaust pipe weather protection cap – not a counter balanced type.

(d) Ensure servicing points such as water and oil levels etc are readily visible and accessible. Provide drain taps for oil and coolant.

(e) Provide shut off valves for ease of engine heater replacement.

3.5.10 Generator Controls and Changeover

(a) Engine management system shall use a Deep Sea 8620 enhanced model controller mounted in the generator package, capable of synchronising with the grid for a soft transfer (closed transition). Long-term paralleling for export to the grid is not required, but can be used for testing purposes.

(b) Provide a Castell trapped-key interlocking system on the front of the main switchboard.

(c) The interlock system shall be provided with a **single key** with the following operation:

i. Controller AUTO MANUAL lock

   a. Can withdraw key in MANUAL

   b. Switching to MANUAL shall open both mains and generator circuit breakers

ii. Mains OPEN CLOSE lock

   a. Can withdraw key in OPEN position

b. Switching to OPEN or CLOSE forces operation the circuit breaker

iii. Generator OPEN CLOSE lock

a. Can withdraw key in OPEN position

b. Switching to OPEN or CLOSE forces operation the circuit breaker

(d) Controls shall be powered by the generator batteries.

(e) Emergency stops shall not be installed on publicly accessible outer areas of a generator. Note that obvious stop controls are required for inspection and maintenance – see D3.2.4 AS/NZS 3010.

(f) Auto Mains Fail (AMF) operation shall be provided.

(g) All control equipment shall be in appropriate enclosures ensuring they are visible without the need to open doors, hatches etc.

(h) The generator controller shall make three attempts at starting with cranking periods of up to 10 seconds, each with an equal rest period (of 10 seconds) between. In the event of the unit failing to start after the last attempt, the controls shall lock out and energise the remote alarm.

(i) Changeover shall be provided by motorised MCCB or ACB as appropriate for the size. Do not use Schneider communicating coils.

i. Closing shall use the corresponding supply voltage, generator 230VAC for Generator CB, transformer 230VAC for Mains CB.

(j) Generators are run at 80% each month as part of routine maintenance.

3.5.11 Instrumentation and Protection

(a) Engine protection devices linked to a common SCADA alarm shall include:

i. Over temperature

ii. Low oil pressure

iii. Over speed

iv. Low coolant level

v. Low coolant flow (water-to-water cooling systems only).

(b) Local indicators shall include engine running, voltage, current, frequency and faults and of faults in the battery charger. In general, the Deepsea module provides these indications.

(c) Instrumentation shall include as minimum:

i. Diesel tank level to RTU

ii. Engine Water temperature

iii. Lubricating oil pressure

iv. Lubricating oil temperature

v. Engine Speed

vi. Engine Temperature

vii. Coolant level

(d) Provide the following indications to the RTU from the DeepSea controller over Modbus TCP/IP:

i. Hour meter

ii. Engine water temperature

iii. Lubricating oil pressure

iv. Lubricating oil temperature

v. Tachometer

(e) Provide voltage-free contacts to give the following indication to the SCADA system:

i. Not in Auto [Contacts closed in Remote Auto]

ii. Engine Running [Contacts closed for running]

iii. Generator Healthy

iv. Fail safe charger fault [Contacts open for fault]

(f) Provide the following controls:

i. Remote islanded run [Contact closed to run]

ii. Remote parallel run at pre-configured output [Contact closed to run]

3.5.12 Starting

(a) The method of starting control shall be selectable between auto and manual. Starting equipment shall be rated for a minimum of 10 starts per hour.

(b) Provide an Auto/Amp temperature compensated power supply/battery charger if the unit does not have a factory fitted charger. Include a fitted battery:

i. of at least the capacity of the manufacturer's recommendation,

ii. of the largest physical size that will fit the manufacturers battery cradle, and

iii. with the highest Cold Cranking Amps (CCA) rating for its physical size (CCA varies even with physical size).

3.5.13 Communications

(a) Control and critical feedback shall be hardwired. Provide an Ethernet communication connection using Modbus/TCP for monitoring additional statistics and statuses.

3.5.14 Cooling System

(a) Cooling is by way of a water-to-air radiator, deviations from this must have written approval from EICA Engineer.

(b) Allow for radiant cooling to the air within the building. Incorporate forced ventilation of the building if required for prolonged diesel runs under full power with the building doors and/or windows closed (see clause 6.6 – Penetrations and watertightness). Consider the conflict between ventilation and noise control when designing this system.

(c) Fit the engine cooling system with a low wattage heater and thermostat suitable for operation on 230-volt mains supply and adequate to maintain an engine temperature of approximately 25°C.

(d) When using a water-to-water heat exchanger and there is no viable option to change:

i. The cooling system may utilise approximately 14°C water from the reticulated supply.

ii. Establish a minimum safe quantity of raw water and permanently set this using a flow control valve. The flow control valve must allow the raw water supply to be controlled independently from any pressure changes that would otherwise affect the flow rate i.e. it MUST be pressure compensated.

iii. Provide a solenoid valve to enable raw water flow only when the diesel is running, low flow sensor and coolant loss alarm.

iv. Mount a pocket type thermometer in an obvious, easily seen position in the raw water discharge to allow monitoring of the discharge temperature.

v. Discharge cooling water to a sewer unless this option is totally impractical. Limit the discharge temperature to 20°C if the water is discharged to a waterway. Ensure Resource Consent compliance with allowable flows and temperatures for any discharge to a waterway.

vi. Detail an RPZ (Reduced Pressure Zone) valve fitted to the cooling system additional to the RPZ required in clause 15.5 – Water Supply, to prevent backflow of potentially contaminated water into the pump station water supply.

vii. If raw water is not dumped to waste, detail a double wall plate heat exchanger (e.g. Alfa Laval M6-MDFM) to prevent possible contamination of the reticulated supply.

3.5.15 Fuel Storage

(a) The generator set and fuel supply system shall be capable of running at 75% of the rated output for 72hrs at a time (without fuel top-up).

(b) Include with the generator sizing calculations the expected fuel storage volume and run time provided.

(c) Sub-base fuel tanks are not required on systems with external fuel tanks.

(d) Fuel cap shall be lockable.

(e) Include design for safe access for refuelling operator where a fall hazard exists.

(f) Provide a fuel system with the following features:

i. Use a standard sized tank capable of supplying the engine for 72 hours at the normal operating maximum load. This may be well below the maximum engine/generator's full capacity. Note that some engines use high fuel flows and the fuel tank as injector/pump cooling and the tank minimum capacity may be considerable.

ii. Tank capacity should be sized to provide 15% of the above required fuel volume as maximum free board. Detail the fuel intake from the tank to the diesel generators 100mm above the bottom of the tank, to allow any impurities to settle at the tank bottom.

iii. Fuel tank level float switch set at 75% of diesel tank height (approx. 75% volume), wired to the site RTU or PLC.

iv. A hydrostatic / radar level sensor, wired to the RTU, with diesel theft software installed in the RTU (CCC to provide standard software block).

v. A double skinned tank will require additional secondary containment, shall be bunded and shall be provided with shelter on water supply sites with wells.

vi. A stationary container test certificate is required for tanks with a capacity greater than 500 litres.

vii. If within 3m of a building tanks must be 4 hour fire rated unless there is fire protection available.

viii. Automatic fuel shut off in case of fire by way of a shutoff solenoid connected to the fire switch (fusible link), with a manual bypass valve around the solenoid. The fire switch shall alarm to the Generator controller to shut engine down and alert the control room.

ix. A black dipstick to facilitate easy level readings.

x. Primary supply and water separator filters.

xi. For tanks larger than 500L, diesel fuel polishing system on external fuel tanks is required (not required on sub-base tanks).

(g) Ensure diesel storage is located at the following distances from the boundary (as adapted from Table 4, Schedule 4 of the Summary of Approvals of Substances transferred under the Hazardous Substances (Dangerous Goods and Scheduled Toxic Substances) Transfer Notice 2004 (As Amended)):

Tank Capacity (L)	Distance from high intensity land use (m)*	Distance from low intensity land use (m)
<600	0	0
1,000	1.5	0
2,500	2	0
5,000	3	2
*Includes residential land uses, and high use roads		

(h) There may be a requirement to obtain resource consent for the storage tank if the site is:

i. within 20m of a river, a bore, a wetland boundary; or

ii. within a 1 in 20-year flood plain; or

iii. where the depth to unconfined or semi-confined groundwater is less than 30m; or

iv. within 100m of an active fault and the land is over a semi-confined or unconfined aquifer.

v. within 1000m of a community groundwater bore.

3.5.16 Fuel Pipes

(a) Provide twin wall PE (Dura pipe).

(b) Ducting to any buried fuel line shall indicate leaks from a telltale or similar.

(c) Provide containment of any leak to prevent ground contamination.

(d) Underground piping has pressure valve on pipe terminations to allow for pressure testing the interstitial space within the pipe. Include in manuals for annual testing. Do not drain to in-ground sumps.

(e) Do not use galvanized steel or sheet metal tanks, pipes or fittings in any diesel fuel storage, delivery, or fuel system. Do not use copper pipe except where the manufacturer has factory fitted it to the engine. Connections to copper pipe shall use a suitable flexible hose that will not cause work hardening and subsequent brittleness of the copper pipe.

3.5.17 Noise Levels

(a) Design the generator its acoustic enclosure and the building combined in accordance with Section 2.1.6 Noise Levels.

(b) Detail service and maintenance access and incorporate acoustically controlled inlet and outlet air louvres in the acoustic enclosure, which could be of a proprietary design.

(c) Specify a residential grade engine silencer and insulate the exhaust pipework, cladding it to at least 3 metres above floor height.

3.5.18 Documentation

(a) Documentation shall include a shortened section describing the basic manual procedures required to test run and to, on attendance to a faulted site, identify the standard procedure for identifying and clearing faults.

3.5.19 Switchboard

(a) Generator and mains switching shall be via motorised MCCB or ACB (as appropriate for current rating) mounted in the switchboard.

(b) Isolation for the generator shall be at a Generator mounted MCCB or ACB. Isolation for the mains shall be at a mains supply isolator upstream of the incoming MCCB / ACB, metering and potential fuses. Both isolators shall be lockable through a permanently affixed locking mechanism. Refer to Section 3.2.

(c) Active Harmonic Filters installed for mains power quality shall be disabled when the generator MCCB is closed.

3.6 ELECTRICAL ACTUATORS

3.6.1 General

(a) Valve actuators will be provided as part of the Mechanical works. All materials to electrically connect**,** control and convey cabling are part of the Electrical contract.

(b) Mechanical will specify valve features, including:

i. Manual operating mechanism will always be provided.

ii. handwheel and manual declutching or lug level as appropriate for the valve type,

iii. If the actuated valve is lockable

(c) Actuators should be equipped with the following:

i. 3 Phase motor or 24V DC as appropriate

ii. 24V DC controls

iii. HAND-OFF-AUTO and OPEN-STOP-CLOSE controls

iv. OPENED and CLOSED limit outputs.

v. Internal OPENING and CLOSING TORQUE limit fault.

vi. Command to OPEN, CLOSE and STOP (where applicable).

vii. Valve fault change-over relay output

viii. MANUAL or AUTO feedback output

ix. Valve control interface – hardwired is control preferred. Modbus control requires EICA Engineer approval.

(d) All modulating actuators, and other actuators as specified, will have digital opened/closed feedback and analogue position feedback.

(e) Where actuators are mounted in hazardous areas they shall be connected with the appropriate Ex glands.

(f) Remote HOA panels will be added for actuated valves in inaccessible locations or hazardous areas.

(g) Actuators that are installed in areas accessible to the public shall be provided with a blanking plate which covers the actuator integral controls, lockable by CCC, to prevent tampering.

3.6.2 Actuator Controls

(a) Actuated valve shall have HOA controls remote from the actuator.

(b) Provide actuated valve HOA controls as determined by the valve type and functionality. Minimum requirements are:

i. Valve description and tag name

ii. Wiring and functionality as shown on the CCC typical design drawings, including:

a. 24VDC Controls

b. Open status LED

c. Closed status LED

d. Power Supply Healthy LED

e. 20% spare DIN rail terminals

(c) Additional controls include but are not limited to:

i. HOA selector switch

ii. Open command pushbutton

iii. Close command pushbutton

3.7 PACKAGED EQUIPMENT

3.7.1 General

(a) General requirements:

i. Packaged equipment shall be provided in accordance with the associated procurement spec, with the following minimum requirements met:

ii. Provide with tender documents, a draft functional description of the package being provided, Including installation manual, datasheet and technical description manual

iii. Instrument and equipment shall come with stainless steel tag plates, tags shall be as shown on P&ID and as per CCC tagging standards. Specialist equipment for package

plant that will be maintained by the vendor may be tagged to the vendors standard with written approval by the EICA Engineer.

(b) Design:

i. Designer shall detail the power and controls wiring interfaces for all packaged equipment.

ii. Specify that packaged equipment comes pre-wired to junction boxes for connection to the submains power and SCADA. Provide separate JBs for Power and ICA.

iii. Designer shall ensure that sufficient space is provided for the equipment provided.

(c) Equipment:

iv. All EICA equipment on vendor packages shall be suitable for the environment in which they are installed, IP67 or better when available.

v. Packaged equipment shall comply with all of Section 1 and Section 2.10 Instrumentation and Controls.

vi. Packaged equipment with an onboard PLC shall have Modbus communication to the Plant PLC, used for monitoring only. All control is preferred to be hardwired, and the package shall be capable of continued operation if communication to the PLC is lost.

vii. Provide remote transmitters for instruments mounted in inaccessible locations.

viii. Provide loop isolators for hardwired analogue signals between Packaged Equipment and the Plant PLC.

ix. SI units of measurement must be used.

x. Drawings and documentation must be in English.

xi. Provide approved equipment from Appendix B for PLCs, HMIs, Ethernet switches, RTUs, sensors, switches and transmitters, motor starters and drives.

(d) Minor equipment like gauges and terminals may be provided as the manufacturer's standard.

3.7.2 Shop Drawings

(a) Comply with Section 3.1.5.

(b) Supply panel drawings for all Control Panels supplied as part of the package. Drawing to show equipment layout, dimensions, wiring, and materials list and tubing details.

(c) Include check marked specification confirming compliance with this specification, with any deviations or non-compliance specifically noted.

(d) Lay shop drawing submissions out in logical order with the PDF bookmarked with, at minimum, each section, subsection and heading.

i. Provide fabrication drawings, general arrangements, P&ID, equipment lists, wiring diagrams, data mapping lists and functional description.

a) The location of each instrument, local control panel and control device must be clearly and specifically called out on the location plans.

b) Provide plan and elevation drawings showing the locations and elevations of every device to be wired: motors, field instruments, valves, and any other electrical, instrumentation or controls equipment/motors.

ii. Provide FAT and SAT ITPs and reports.

iii. Provide O&M and troubleshooting guides.

3.7.3 Installation

(a) Per the manufacturers recommendations.

(b) Meet labelling standards as specified herein.

(c) Remote communication connections to packaged equipment is generally not acceptable but may be considered for commissioning support on a case-by-case basis. The supplier shall identify the need at the time of tender and seek approval from EICA Engineer.

3.8 UV REACTORS

(a) UV disinfection equipment shall be supplied in accordance with the Taumata Arowai Drinking Water Quality Assurance Rules.

(b) UV disinfection equipment should also be supplied in accordance with the CCC Water Treatment Plant Design Specification.

3.9 ETHERNET SWITCHES

(a) Ethernet switches shall:

i. Be DIN mounted (if installed outside of 19” server racks)

ii. Have 24Vdc power supplies.

4 INSTALLATION REQUIREMENTS

4.1 GENERAL

(a) Only new materials shall be used in construction, unless agreed to in writing by the EICA Engineer.

(b) No materials used in construction shall be flammable, hydroscopic and subject to deterioration which may compromise the safety of the equipment.

(c) Any equipment installed in publicly accessible locations shall be protected from vandalism by metallic cages, shrouds, or covers – galvanised steel or 316SS as appropriate for the environment.

4.1.1 Standards and Regulations

(a) The installation and all materials used shall comply with relevant statutory regulations, manufacturer recommendations and the following:

i. Electricity Act 1992

ii. Electricity (Safety) Regulations 2010

iii. AS/NZS 3000 Wiring Rules

iv. AS/NZS 60079.14 Explosive Atmospheres (where applicable)

v. Electrical Codes of Practice ECP34 to ECP 60

vi. AS/NZS 3820 Essential Safety for low voltage equipment

vii. AS/NZS 3019 Electrical Installations – In service testing

viii. All applicable Network Company connection standards

ix. NZS 4219 Seismic performance of engineering systems in buildings

(b) The contractor shall supply ‘Producer Statements’ for all specially manufactured equipment and shall supply an Electrical Certificate of Compliance for all electrical work.

4.1.2 Ownership of Redundant Equipment

(a) Ownership of redundant equipment remains with CCC unless strictly stated otherwise. Allow to remove from site and deliver to a CWTP EI&C Team. Equipment shall be properly disconnected, provided together with all ancillary parts, cleaned, but otherwise in an as-found condition.

4.1.3 Quality Assurance

(a) Check that the works are installed and tested in accordance with the specification and relevant codes and standards.

(b) Ensure that all workmanship and material quality is of the highest standard. After the equipment is installed, touch-up scratches and verify that nameplate and other identification is accurate.

(c) Supply a basic quality plan at time of tender and a detailed plan 10 days after award of tender or as advised by the Engineers. The plan should outline the method of ensuring that quality of materials and workmanship is monitored at all phases of the project.

(d) Maintain a written record of the plan and record all compliance checks.

(e) Equipment shall be installed, configured, tested and commissioned in accordance with manufacturer’s instructions and recommended practices.

(f) Configuration details shall be recorded and submitted according to manufacturer's configuration sheets where available, these shall include all user configurable adjustments.

4.1.4 Workmanship

(a) All work shall be carried out;

i. By suitably qualified persons skilled in the installation of this type of work.

ii. Under the supervision of a suitably qualified supervisor.

iii. In accordance with all relevant standards and codes of practice.

iv. In a neat and professional manner to the satisfaction of the EICA Engineer.

v. In accordance with the relevant Technical Specification.

4.1.5 Specifications and Drawings

(a) Where equipment layouts, types, positions, or installation differs from that shown on IFC drawings the Contractor shall submit alternative layouts, types and location of equipment for approval by the EICA Engineer before any work is carried out. Alternatives are not permitted without written approval from the EICA Engineer.

(b) The position of equipment and the layout of equipment inside cabinets and switchboards, as shown on the IFT drawings, are to be considered approximate only and there is no warranty expressed or implied that every detail and item to be included is shown.

(c) Any reference to dimensions and distances shall be confirmed on site.

(d) The drawings and specifications are intended to be mutually self-explanatory and complete, but all work called for in one, even if not the other shall be fully executed.

4.1.6 Labels

(a) Labels shall be installed in accordance with Section 2.3.

(b) All components inside cabinets shall be labelled as per the name shown on the label schedule drawings.

(c) All cabinet doors shall be labelled with engraved labels describing the function of the cell.

4.1.7 Location and Fixing

(a) Labels shall be screwed to the device or attached by stainless steel wire or chain so that they can be removed and re-used if the equipment is replaced.

(b) If it is impractical to fix a label to a piece of equipment, then the label should be fixed to a surface as close to the equipment as possible.

(c) Within switchboards, self-adhesive and engraved labels attached to trunking are acceptable where it is impractical to attach them to the gear plate.

4.1.8 Bracing and Fixings

(a) Any bracing fixing into concrete or blockwork shall be positioned such that is free of clash with reinforcement and clear of movement joints.

(b) Drilling through existing reinforcement is not permitted unless approved in written by the Structural Engineer.

(c) Drilling into prestressed concrete is not permitted without the written approval of the structural Engineer.

4.1.9 Seismic Requirements

(a) The Contractor is responsible to carry out site measurements prior to fabrication and installation of all bracing components and to confirm the locations of seismic joints within the structure based on the contract documents provided and allow flexible connections as per Section 2.1.5.

(b) Any potential clash on site between a bracing component and any other permanent element of the building shall be raised with the Engineer as soon as identified for resolution in accordance with the contract.

(c) All clearances between non-structural items and between non-structural items and the main structure shall comply with NZS 4219 clearance requirements.

(d) All proprietary bracing systems and their connections shall be installed strictly in accordance with manufacturer's recommendation.

(e) The use of alternative bracing components to the ones shown on drawings or in the specifications is not permitted unless approved in writing by the Engineer.

(f) Mixing bracing systems (rigid and non-rigid) on an electrical component linear run is not permitted unless approved in writing by the Engineer.

4.1.10 Environmental

(a) Any penetrations into a potable water tank or reservoir shall be installed to avoid contamination, taking into account the potential flow of any liquid.

(b) All ducts providing a path for corrosive gases from the wet well shall be sealed with a removable firestop plug. Builders expanding foam shall not be used.

(c) The design shall consider specific environmental conditions of the site.

4.1.11 Power Supply to Site

(a) Provide a connection request to the Lines Company. Arrange for testing, initial energisation, and inspection by the electrical inspector of the mains supply to the project.

(b) Where CT Metering is required, the Contractor shall arrange for the delivery of the Revenue Metering equipment to be installed in the switchboard.

4.2 ELECTRICAL ENCLOSURES

4.2.1 General

(a) Switchboard shall be located to enable ease of cable installation to achieve recommended cable bending radii.

(b) Switchgear shall not be installed underground.

(c) All holes shall be de-burred, and joints filed flat.

(d) Junction boxes shall be provided with a clear Lexan panel.

4.2.2 Switchgear Standards

(a) Switchgear shall be 3 phase, 4 wire with MEN earthing.

(b) All equipment installed shall adhere to the relevant AS/NZS, BS, NZS, NZECPs or IEC standard covering that particular product. In no circumstances shall products or fabricated equipment be installed that is not manufactured to acceptable standard types as quoted in the New Zealand Electricity Regulations and AS/NZS 3000.

4.2.3 Electrical Enclosure Wiring and Cabling

(a) Wiring shall be carried out in a neat and systematic manner and shall not be possible for any cables or wires to contact sharp or rough edges that may damage sheath or wire insulation.

(b) Field-installed panel wiring shall meet the requirements of Section 3.2.13.

(c) Wiring shall be contained within trunking, compliant with Section 3.2.13.

4.2.4 Installation

(a) Switchboards and MCCs shall be levelled and installed with all vertical surfaces at ninety degrees to the horizontal plane.

(b) Care shall be taken to ensure that mechanical damage does not occur during unpacking and installation.

(c) Cabinet shall have a concrete floor however the cabinet is not to be set in concrete. There shall be at least 1500mm clear hard stand in front of the cabinet.

4.2.5 Operating Panels

(a) As a general requirement all operating panels shall be mounted such that the centreline of the display is at 1600mm AFFL.

   i. A VSD with an integrated HMI panel needs to be mounted so that its control panel is no higher than this height requirement.

4.3 CABLES

4.3.1 General

(a) Cables shall not be embedded directly in concrete or plaster unless knock outs are allowed for. Where it is necessary to run cable through block walls or concrete slabs and the like, any such cable shall be enclosed within PVC conduit. Where these walls or slabs are fire resistance construction install the PVC conduit in accordance with Section 4.4.4(g).

(b) Cable entries to equipment shall be made using appropriate glands, sleeves, or bushes. The degree of protection provided by the equipment enclosure shall not be reduced by the cable penetration(s).

(c) Cabling to equipment that is likely to move and/or vibrate during normal operation (generators, motors and the like) shall be installed with cable slack or loops that allow for the vibration and movement. In severe cases, the fixed cabling shall terminate in a junction box and the final connections completed with flexible cable.

(d) All cables shall be installed in accordance with the standards and manufacturer's recommendations to minimise failure under normal use, and any abnormal conditions that may reasonably be anticipated, including electrical fault conditions.

(e) Cables installed in trays, trunking or on catenaries shall be securely fixed at 300 mm intervals with cable ties. Provide adequate support at the top of all cabling vertically installed, ensuring that the weight of cables is supported at a maximum distance of 300 mm.

(f) All cables shall be installed together free of twists and able to be traced without removing other cables.

(g) Analogue and digital data cables, ELV cables and Ethernet communication cables shall be physically segregated from all AC power and control cables. The separation listed here is required for all cable runs external to panels, and in all places where practical. If it is not practical, ensure the length where separation is not achieved is as short as possible.

   i. Data cables: 300mm

   ii. ELV: 300mm

iii. Communications: 500mm

(h) Where signal cables cross electrical cables, they must be at right angles to the electrical cable and be separated by a physical barrier or the distances stated above.

(i) Care shall be taken to prevent cuts or abrasion damage to cable sheaths. Dry lubricant shall be applied to cables during pulling in to prevent welding or scuffing of cable sheaths.

(j) No cable shall (at any time) be bent to less than its minimum recommended bending radius.

(k) Cables shall not be installed where they may be subject to damage due to a subsequent work (such as nailing of linings and the like).

(l) Plastic sheathed cables shall not be run in any situation where timbers have been treated with tar oil, creosote or allied products.

(m) Single core cables forming part of a three-phase system shall be rigidly held in trefoil formation by approved cable clamps. Such cable installations shall be capable of resisting the forces arising from any fault current that may flow in any conductor(s) without significant disruption to the cable formation.

(n) Where Contractor proposes parallel cables as an amendment to the cable schedule, they shall provide supporting documentation showing compliance with AS/NZS 3000 and AS/NZS 3008.

(o) After installation but before connection, all cables are to be tested for insulation resistance using a 500V tester for 230V circuits and a 1000V tester for 400V circuits. The results of the tests shall be recorded and supplied to the CCC.

(p) Ethernet device connections shall be made with Cat 5e (or better) cables. Ethernet cables shall be the appropriate length for the installation and avoid unnecessary spooling of spare cable.

(q) Structured cabling:

i. Shall terminate at Cat 5e (or better) RJ45 sockets.

ii. Where six or less RJ45 sockets are required, these may be provided either with an IP20 Din rail mounted socket (when inside panels) or in a wall mounted flush box.

iii. Where more connections are required a multi-ganged socket assembly shall be used.

iv. For connections requiring 12 or more connections, 19-inch rack mountings shall be used.

4.3.2 Cable Marking

(a) All cables, including marked multicore cables and fibre optic cables, and individual cores/strands shall have durable, waterproof labels fixed to them at both ends with the identification number as shown on the cable schedules and device circuit / wiring diagrams.

(b) All cores and strands shall be numbered with a reference and shall not change across terminals.

(c) PLC/RTU I/O core labels shall identify type, rack, slot.

(d) Cable shall be marked on each side of any termination, inside any cabinet or junction box and at any field termination.

(e) The marking system shall be attached by an approved method such cable ties or clear housings threaded onto the cable.

4.3.3 Communication Cables

(a) Install communication cabling in accordance with the recommendations of the manufacturer so that the warranty is in no way compromised.

4.3.4 Instrument Cables

(a) Installation must comply with Section 2.6.4.

4.3.5 Reticulation

(a) Communication cables shall be hung from steel plastic coated catenary tensioned cables in ceiling spaces and in accessible under floor areas for less than 12 cables.

(b) Install communication cables on cable trays or ladder in the following scenarios:

i. within building risers and communications enclosures.

ii. where more than 12 cables run together in ceiling and service spaces.

(c) Cables shall be concealed where practical.

(d) Where cables cannot be concealed, they shall be run in surface mounted trunking or conduit appropriate to the location with 50% spare capacity. Trunking and conduit shall be run parallel and square to building features both vertically and horizontally.

(e) Only data cables shall be run in trunking or catenary wires – power, fire cables etc are strictly prohibited from being run together with or cable tied to data cable.

(f) Dedicated stainless steel trunking or conduit shall be provided for all communication cabling run within the confines of a manufacturing plant.

(g) Complies with Section 2.6.6.

4.3.6 VSD Cables, Screens and Glands

(a) Special consideration shall be made when installing VSD cables. Installation must comply with 2.6.7 VSD Cable Installation.

4.3.7 Cable Jointing

(a) Cable joints shall only be permitted with the prior written approval of the EICA Engineer.

(b) All joints and terminations shall comply with the cable manufacturer's recommendations. Joints shall only be carried out using:

i. Proprietary jointing kits

ii. Prefabricated junction boxes

iii. Underground jointing chambers

iv. Termination pillars

(c) Proprietary bimetallic links or lugs shall be employed where cables of different conductor materials are to be jointed. All components and materials used in a cable joint shall be selected to avoid corrosion due to contact between dissimilar metals.

(d) Above ground cable joints shall be accessible and made using feed through terminals in proprietary junction boxes.

(e) The enclosure of any completed joint shall be compatible with the location of the joint and shall prevent inadvertent contact with line conductors, the ingress of moisture, vermin or other harmful substances.

(f) Cables shall be supported so that no weight or stress is transferred to the joint – strain relief shall be provided.

(g) Joints and accessories shall fit closely and shall be correctly matched.

(h) Only workers experienced in all aspects of the proposed jointing work shall make the joint. The EICA Engineer may inspect the work, and if the work is deemed unsatisfactory, may require remedial work.

(i) The use of self-adhesive tape as the sole means of insulating and sealing a joint is not acceptable.

4.3.8 Cable Terminations

(a) All spare conductors and cable cores shall be wired to a suitable terminal.

(b) Terminals shall not support the weight of cables, and cable terminations shall not be under mechanical stress.

(c) All conductors shall be terminated sequentially and (for multi-core control cables) unused conductors shall be terminated so that the sequence is unbroken.

(d) Cover power cable terminations with a clear plastic shroud in areas that are normally accessible.

(e) Cores shall not be cut to fit undersized terminations.

(f) Cable terminations shall be made with correctly sized crimp or compression lugs, fitted according to manufacturer's instructions and recommendations using proprietary crimping tools or presses with correctly sized dies.

(g) Torque lug terminations may be made providing the staff carrying out the terminations have specific training regarding the system being used. If a torque wrench is used, then the torque setting shall be recorded and submitted to CCC.

(h) All terminals for all devices shall be wired to terminals, excepting small light and power circuits wired directly to miniature circuit breakers.

(i) All control wiring conductors up to 4mm² shall have Starfix crimp ferrules or similar.

4.4 CABLE SUPPORT AND PROTECTION SYSTEMS

4.4.1 General

(a) All cable supports shall be straight and, to the greatest extent possible, either horizontal or vertical and parallel with building lines. The intent is to produce a tidy installation.

(b) Where trunking is used ensure that the correct manufacturers fittings (Glands, bends, flexible couplings etc) are used. Ensure that inspection joints/pull boxes are used.

(c) Vertical cable trunking shall be fitted with insulated cable supports at a maximum of 2.5 m intervals to support cables.

(d) Must comply with Section 2.7.

4.4.2 Sizing

(a) The minimum size of conduit shall be 20 mm.

(b) Cable trays and trunking shall be filled to a maximum of 67% of their capacity.

4.4.3 Bonding

(a) To be bonded with a nut and bolt with a spring washer or a bolt with two nuts.

4.4.4 Cable Ducts / Conduits

(a) Conduits or ducts shall be provided at the depth(s) shown on the Drawings.

(b) Conduit shall be provided with a minimum of 12 mm of cover when embedded in concrete or plaster.

(c) Long radius sweeps or bends shall be used for all changes of direction. Drainage elbows will not be accepted.

(d) Install suitable draw wires where specified. The Contractor shall identify instances where draw wires are required.

(e) Where ducts or conduit risers enter a building or switchboard, they shall be sealed with a cap or filler system manufactured for that purpose.

(f) Where cables may be required to be removed for maintenance such as submersible pump cables, the duct seal shall be able to be removed without damage to the duct.

(g) Conduits that penetrate walls or floors of fire resisting construction shall be treated in the following or equivalent approved manner:

i. Seal all PVC conduit penetrations with fire stop collars.

ii. Seal all steel conduit penetrations with PYROSAFE SVT universal bulkhead system and pack any gaps with FYREFYBA ceramic fibre.

iii. For small penetrations with gaps less than 10 mm, seal with fire resistant foaming sealant.

4.4.5 Catenary Wires

(a) Catenary wires shall be securely fixed at each end and supported at intermediate points as required. Turnbuckles of a suitable size to permit future adjustment shall be provided.

(b) Electrical Catenary wires shall support cables clear of all structures, services and other equipment.

(c) Maintain a minimum distance of 50 mm between catenaries, or 150 mm between mains and other Catenary wires.

(d) Where cables are supported on catenary wires, not more than five cables shall be bunched together on any one catenary wire.

(e) Cables shall be securely clipped or tied to catenary wires using proprietary clips or ties.

(f) All cables shall be protected where they pass through any openings, gaps, holes, etc, by ensuring that surrounding surfaces are smooth and free of sharp edges. Where necessary holes shall be bushed with close fitting plastic bushes

(g) Cable entries to buildings shall be vermin-proof and shall be sealed to prevent ingress of gases and water.

4.4.6 Installation

(a) Conduit for any circuit shall be erected, completed, and swabbed out before any cable is drawn in.

(b) Cable support systems shall be installed in accordance with the manufacturer's recommendations to minimise failure under normal use, and any abnormal conditions that may reasonably be anticipated.

(c) Cables shall be neatly arranged on cable trays, ladder or in trunking. Twisting, unnecessary crossovers, bunching, and excessive slack or tightness shall be avoided. Where cables join or leave cable supports unnecessary crossovers and tangling shall be avoided.

(d) Distances between inspection joints/pull boxes should be no more than 15m apart.

(e) A separation of 300 mm or more is required for all cable runs external to panels, and in all places where practical. If it is not practical, ensure the length where separation is below 300 mm is as short as possible.

(f) Data cables shall be protected from mechanical damage along their entire length.

4.4.7 Underground Cabling

4.4.7.1 Cable Laying

(a) All installed underground cables designated for future use, shall be suitably capped and sealed until properly terminated, to prevent the ingress of moisture.

i. Exposed ends of underground cables not intended for future use shall be capped and sealed.

ii. Ends of underground cables must be GPS located and recorded on the As-Builts

(b) A loop or slack section of cable shall be left at each side of a road or traffic way to allow for settlement of the road without stretching the cable.

(c) Plaques shall be provided to identify the points at which buried cables enter the ground. These shall be securely fixed to the structures or external walls of buildings from which the cables enter the ground.

4.4.7.2 Backfilling

(a) Backfilling material shall be free of stones, debris, rubbish, etc., and shall be placed, and thoroughly compacted in 200 mm (loose) layers. The surface shall be made good so as to match the original adjacent surface(s) in accordance with CSS.

(b) The CCC may inspect installation. Trenches shall not be backfilled until the CCC has given approval.

4.4.8 Cable Glands

(a) All cables, where practicable, shall be glanded with the correct compression gland. All cable entry point shall be sealed to prevent ingress of vermin and insects.

(b) Armoured cable terminations shall be fitted with appropriate metal cable glands that shall grip the cable securely and seal on the outer sheath of the cable. The glands shall be complete with matching lock nuts and shall include provision for securely bonding the cable armour to earth.

(c) PVC/PVC, XLPE/PVC and NS cable terminations shall be fitted with suitable sealing glands. These shall grip the cable securely and seal on the cable sheath.

(d) Cables run in hazardous areas shall be fitted with the appropriated ‘Exe’,’Exd’ and ‘Exn’ gland.

(e) 360deg cable gland must be used where VSD cable is specified.

(f) Single gland bushing may be used where multiple mains cables terminate. Otherwise use an individual cable gland on each cable.

4.4.9 Cable Marking

(a) All cable and cable cores including marked multicore cables shall be marked with the identification number as shown on the cable schedules and device circuit / wiring diagrams.

(b) All cables shall have durable, waterproof labels (with unique circuit identification) fixed to them at both ends.

(c) Cable shall be marked on each side of any termination, inside any cabinet or junction box and at any field termination.

(d) The marking system shall be attached by an approved method such as cable ties and clear housings threaded onto the cable.

4.5 LUMINAIRES

(a) Indoor Luminaries shall not be installed until the building is weatherproof.

(b) Where luminaries are to be recessed into building work, openings shall be correctly sized, and provision made for maintenance access if required.

(c) Luminaries' erected in rows shall be geometrically straight and at the same level except if otherwise shown on the drawings.

(d) Luminaires shall be cast aluminium, plastic, or polycarbonate. No outside fitting shall be of ferrous material.

(e) External light fittings shall be installed in vandal proof cages where publicly accessible.

(f) The emergency lighting system, if installed, must meet the requirements of Section 2.8.

4.6 GENERAL PURPOSE OUTLETS AND ISOLATORS

(a) Shall be mounted in accessible locations.

(b) All outlet boxes and isolators shall be labelled with a tag number.

4.6.1 Socket Outlets

(a) All socket outlets and isolators shall be mounted in accessible locations.

(b) Socket outlets in commercial settings shall be mounted at a height of 1.00m above finished floor level, or 0.20m above benches. In industrial settings (factories, switchrooms, plant rooms and the like) they shall be mounted 1 m above finished floor level, unless mounted on a switchboard.

(c) Mounting shall be directly to walls or in flush boxes or grey polycarbonate mounting blocks as applicable. Where perimeter trunking is installed, socket outlets shall be mounted in the top section.

(d) Three phase switched socket outlets shall be surface mounted.

(e) RCDs must be installed as per AS/NZS 3000.

(f) All socket outlets must have a switch.

4.6.2 Fixed Outlets

(a) Fixed outlets shall be provided where required in Section 2.9.2 and as shown on the drawings and shall be mounted 1m above finished floor level, or 0.20m above benches.

(b) Single phase fixed outlets shall be grey polycarbonate, complete with isolator.

4.6.3 Outlet Boxes

(a) In timber-framed walls, switch and socket outlet boxes shall be fixed to dwangs, noggins or studs to provide the necessary support.

(b) Where boxes are in block work or in concrete, steel galvanised boxes shall be used. They shall be sealed to prevent the ingress of cement slurry and securely fixed to prevent movement during concreting. They shall be examined (as soon as possible) after concreting and cleaned out and protected against corrosion as necessary.

4.6.4 Special Purpose Outlets

(a) Refer to Section 2.9.3.

4.7 INSTRUMENTATION

(a) Potable water reservoir tank level shall be with a hydrostatic transducer supported from a stainless-steel ring and D shackle with sufficient cable looped at the top to allow the sensors to be completely removed from the tank without disconnecting the cables. On stainless steel tanks, a pressure transducer can be installed at the base of the tank for level measurement.

(b) Potable water reservoir tank level switches shall be with a float tree. Shall be supported with conduit clips with sufficient cable looped at the top to allow the sensors to be completely removed from the tank without disconnecting the cables. On stainless steel tanks, pressure switches are to be installed at the base of the tank for level measurement.

(c) Wet well level transducers shall be a radar and configured to fail to zero such that backup high level float operation is effective.

(d) Leave excess cable in the base of the cabinet, not the wet well or storage tank.

(e) Equipment shall be installed so it can be maintained, removed, and reinstated without requiring entry into the well.

(f) Field transmitters shall be mounted in a stainless-steel enclosure. Transmitters in wet or process areas shall be separated and protected from exposure to liquid, so that there is no danger of the transmitter getting splashed or wet during O&M or calibration.

(g) Certificate of approval to be used for drinking water purposes shall be provided for instruments that have wetted parts and used for potable water installation.

4.7.1 Mounting

(a) Field instruments shall be mounted as specified by CCC preferred installation method. If no preferred method exists, then manufacturer's instructions shall be followed.

(b) Mount instruments in an accessible location for installation and maintenance. Instruments shall not be mounted on removable items such as handrails, vibrating equipment without suitable damping, or cable support systems.

(c) Instruments shall be mounted in a safe position removed from hazardous, hot, corrosive, and high positions where possible. Where this is not possible supply and installation a remote transmitter located in 'safe' areas agreed with the Engineer.

(d) Consideration should be given to the location of the instrument to see that it is accessible for calibration, servicing, and maintenance without providing special devises to access it.

(e) Door security switches shall be mounted to activate appropriately in their natural position, without bending or manipulation to the trigger arm post-installation.

4.7.2 Flow Meters

4.7.2.1 General

(a) The installations must follow the manufacturer's installation guidelines allowing for appropriate clear pipe upstream and downstream.

i. Zero-zero flowmeters are acceptable.

ii. Where no data is provided then 5 diameters upstream, and 3 diameters downstream shall be provided.

iii. Bi-directional flowmeters shall be provided with 5 diameters on both sides.

(b) Where practical flow meter installations are preferred above ground in a secure location.

(c) Under normal circumstances, flow meters will be buried direct in the location directed by the Engineer with upstream/downstream clear pipework in accordance with the manufacturer's specifications. Conformal coating is to be applied prior to being delivered to site.

(d) The flow sensor will be installed in the pipeline complete with earthing rings. The sensor earthing shall be bonded to the transmitter in the switchboard by bringing an additional 6mm^2 earth cable back alongside the signal cable.

(e) The flow sensor will be wrapped in 'denso' tape (600), followed by 'denso' PVC overwrap tape (931), ensuring that the body, terminal box, flanges, and bolts are completely covered.

(f) The void around the sensor will be back filled with a packing sand mixture.

(g) If the sensor location is subject to heavy traffic, then a form of 'U' shaped concrete box culvert will be installed above the sensor to avoid any external weight on the coil housing.

(h) The flow sensor installation will be verified and signed off by an Independent Verifier approved by both Christchurch City Council and Environment Canterbury, prior to back-filling for buried flow meters.

(i) Following installation, the flow meter accuracy is to be verified while buried by utilising the flow meter manufacturer's proprietary verification tools and software packages.

4.7.2.2 Configuration

(a) The flowmeter default display shall be Flow Total in m^3 . Default set to 600m^3.

4.7.3 Calibration Certificates

(a) All instruments installed at the plant shall have a factory calibration certificate confirming instrument specifications. Instruments shall be re-calibrated as per manufacturer instructions.

4.7.4 Documentation

(a) All new instruments shall be supplied with relevant software CD's and instruction manuals to enable onsite programming, data uplifting and downloading, parameter setting and diagnostic facilities. Summary test sheets shall be provided in addition to manufacturers configuration datasheets. Examples are included in the appendices.

(b) Asset Equipment templates are to be filled out and submitted to CCC for all new or replaced instrumentation. Refer TRIM 14/141308 911 Asset Management – CCC – Station Asset Templates.

4.7.5 Process Connection

(a) Provide quarter turn isolation valves to allow instruments to be isolated and disconnected.

(b) Provide a means to relieve the system pressure on the instrument to allow it to be disconnected.

4.7.6 Units and Displays

(a) Pressure transmitters shall be configured to display pressure in kPa.

(b) Flow transmitters shall be configured to display flow in m3/hr and m^3.

(c) Refer to Section 1.7 for additional requirements.

4.8 SITE SECURITY

(a) Access to electrical equipment and any controls on electrical equipment shall be by secure access. Secure access may be by site security such as security fences and locked gates, an outer weatherproof and vandal proof enclosure such as provided for roadside pump stations or inside a secure room or building.

(b) Equipment shall be protected from vandalism by selection of robust enclosure systems; galvanized steel ducts, steel cages for outdoor equipment in areas accessible to the public.

(c) The Contractor shall provide any temporary security measures to meet the requirements specified herein at any time during construction where the site security is in progress or not complete.

4.9 EARTHING

(a) Provide the earth system as shown on the drawings and described in Section 2.12.

(b) The main earth conductor connection to the main earth stake shall be installed in a test pit.

(c) Provide test pit covers to allow future CCC inspection and testing of earth stakes within test pits. The cover shall be trafficable or non-trafficable as required for the location installed.

(d) Earthing shall be installed in compliance with the Electricity Regulations 1997, associated Electrical Codes of Practice (particularly NZECP 35), AS/NZS 3000, and Orion Electricity Network Design Standards (particularly NW70.59.01).

(e) Earthing shall be carried out strictly in accordance with equipment manufacturer's recommendations.

(f) Earth bars and wires, etc, shall be of adequate size, thickness and spacing to provide a robust, efficient, and electrically sound installation.

(g) Connections to building reinforcing shall be provided through exothermic welding and connecting earth lead cast in concrete. Coat the connection in zinc paint prior to encasing in concrete.

(h) Note that soil conditions and foundation size may not be sufficient to meet the maximum earth resistance and additional driven earths may also be necessary.

4.10 MOTOR STARTERS

4.10.1 General

(a) Install in accordance with the manufacturer's instructions.

(b) Verify that the overload devices are properly adjusted for the equipment installed.

4.10.2 Variable Speed Drives

(a) Variable Speed Drives shall be configured as follows:

i. Maximum Transient Current 165% for 2 sec/ 150% for 60 seconds.

ii. VSD HMI Control Pad displays current, run hours and speed (if 3rd option available) in default display.

iii. Modbus TCP/IP Ethernet communications for monitoring ONLY

a) shall not be used for control

b) control shall continue to work with Ethernet disconnected.

iv. Speed reference to VSD shall be 4-20mA.

v. Actual speed (feedback) to PLC shall be 4-20mA.

vi. External fault conditions shall be wired to the starter Ext Flt connection.

vii. Current limiting shall be set no higher than 105% of the motor name plate rating – except during starting when the current limit shall suit starting requirements.

viii. Thermal Fault for all pumps shall be set at 110% of motor name plate rating.

ix. Current limiting for Well Pumps shall be set at 100% of the motor name plate rating – except during starting when the current limit shall suit starting requirements.

4.10.2.1 VSD enclosures

(a) Install the VSDs per the manufacturer's requirements for wall or floor mounting and as described in Section 3.3.3.

(b) Where VSDs are mounted in an enclosure, it must have adequate ventilation conforming to manufacturers requirements. IP21 VSDs installed in IP54 enclosures without suitable ventilation are not suitable.

4.10.2.2 VSD Cable Installation

(a) All manufacturers' installation recommendations (including those relating to RFI suppression and EMC requirements) are to be followed. These recommendations normally include effective earthing for high frequencies, screening, and the use of specialist VSD cables.

(b) VSD cables shall be terminated at both ends (i.e. at the VSD and the motor chassis) with a conductive (EMC) gland. The cable screen shall be clamped by the gland so that it is bonded to the chassis around the entire circumference of the cable. The paint shall be stripped from the terminal box to achieve a 360° contact between the gland and the chassis.

(c) Metal saddles or conductive (copper) cable clamps on the VSD are acceptable only if the Manufacturer documentation allows.

(d) The Contractor shall engage the Manufacturer to pre-commission the drives and provide a performance guarantee for the configuration.

(e) Cable screens shall not be formed into a pigtail. Exception allowed specified in section 4.10.2.3.

(f) Motor cable earthing conductors shall be connected to the equipment dedicated earth terminal at both ends of the cable by use of a lug.

(g) Motor earthing shall not be used as a bond.

(h) Where VSD cables terminate in a stainless steel enclosure the screen shall be used to bond the box.

4.10.2.3 Earthing

(a) Where a screen also serves as the PE (protective earth) conductor, the cable shall have EMC clamping as described in this specification and shall also have the screen beyond the clamp twisted into a pigtail. A green/yellow sleeve shall be applied to the pigtail. The pigtail shall be longer than the live conductors, so that if the cable is pulled from the equipment the PE conductor shall be the last to be tensioned.

(b) Where a submersible bore pump is not provided with shielded VSD cable, the metallic bore casing shall be bonded to the terminal box at which the shielded VSD supply cable ends by use of a braided copper strap of appropriate cross sectional area.

4.11 MOTORS

(a) Motor installation shall be performed in accordance with the motor manufacturer's written recommendations and the written requirements of the manufacturer of the driven equipment, including motor, frame, shaft grounding devices and anchor devices.

(b) Ensure the motor is properly aligned by use of a laser alignment tool.

(c) Provide label with equipment tag to clearly identify the motor.

4.12 ELECTRICAL ACTUATORS

(a) Where actuators are mounted in hazardous areas they shall be connected with the appropriate Ex glands.

(b) Remote hand stations shall be added for actuated valves in inaccessible or confined spaces.

(c) Manual operating mechanism shall always be provided.

4.13 GENERATORS

(a) In accordance with Section 3.5 PERMANENT GENERATOR AND DIESEL ENGINES.

(b) Configure the RTU logic to start the engine as required.

4.14 VENTILATION AND AIR CONDITIONING

(a) All panels containing heat producing devices shall be equipped with passive ventilation louvers to ensure equipment is not subjected to temperatures above 40ºC.

(b) Outdoor equipment shall be installed in vandal proof cages and isolators installed inside the building when the equipment is installed in publicly accessible locations.

5 SYSTEM INTEGRATION

5.1 GENERAL

(a) This section details mandatory requirements that may NOT be varied without the written agreement of the EICA SCADA Engineer.

(b) CCC will endeavour to provide the available backups of configuration files, however it is the responsibility of the Integrator to visit site and obtain the latest system configuration by download.

(c) Cybersecurity policies must be followed as provided by the EICA SCADA Engineer.

(d) Prior to project completion the Contractor must provide CCC with all unlocked application configuration files.

(e) A Brodersen translator is used for YRNP to DNP3 translations between Yokogawa RTU and SCADA.

(f) PLC is used generically to refer to both Schneider Unity PLCs, either M340 or M580 processors, SCADApacks, Brodersens (DNP3 Translator) or Yokogawa RTUs installed in the network.

(g) Note that the primary difference between PLCs and RTUs in CCC projects is that RTUs are typically installed at reticulation networks sites external to the plant. Special provisions are required for managing communications back to SCADA at the base station.

(h) The term “Blocks” throughout this document encompasses all the following for the required automation outcomes:

i. Remote Terminal Unit (RTU) Program Organisational Unit (POU) library and template project.

ii. Human Machine Interface (HMI) template library.

iii. System Platform templates.

iv. DNP3 Translator Configuration.

v. Automation Integration Documentation.

vi. Operation Manual.

5.2 DOCUMENTATION OVERVIEW

(a) The following documentation produced by the designer will be provided to the system integrator:

i. Hardware design, as expressed in the IFC electrical drawings.

ii. Process Narrative (L1FD).

(b) The system integrator shall produce the following documents to be handed over as deliverables to CCC:

iii. Level 2 Functional Description (L2FD).

iv. Software Detailed Design Specification (SDDS).

v. Software Test Plan (STP).

vi. Device configuration sheets.

5.2.1 Process Narrative (L1FD)

(a) The Process Narrative is to provide a high-level overview of the system or process, focusing on the overall objectives, boundaries, and main functions. It sets the context for more detailed design documents.

(b) The Process Narrative is to provide an Integrator, working with a set of specific CCC software standards, the information necessary to understand the process control requirements of the PLC needed to meet the process performance requirements.

(c) A template for documenting the Process Narrative (L1FD) can be provided upon request.

(d) The Process Narrative must be submitted by the Designer to the EICA SCADA Engineer for acceptance with the detailed design and IFT review submittals.

(e) The intended audience for the process narrative is Project managers, stakeholders, process owners, and engineers needing a broad understanding.

(f) The Process Narrative shall:

i. Provide a process description under normal operation and describe the purpose and objectives of the system or project – a High-level description of the process or plant.

ii. Provide scope and boundaries, what is included/excluded in the system.

iii. Provide a summary of level of automation and operator interventions required.

iv. Document major functions as a list of main functions or processes (e.g., water treatment, pumping, chemical dosing).

v. Include equipment descriptions that match the P&ID and include equipment tags that match the P&IDs and Electrical drawings.

vi. Describe the interaction between any new equipment being installed with existing plant to which the process connects.

vii. Document high-level performance requirements (e.g., throughput, reliability, availability, compliance requirements).

viii. Document constraints and assumptions, any known limitations or assumptions.

ix. Document main control parameters and setpoints for each equipment (e.g. tank Level, or pump pressure etc.).

x. Provide an IO List with IO tag and description, rack / slot / channel. Standard I/O tags can be provided upon request.

xi. Document all alarms (tag, banner text, priority and action). The Designer shall request from CCC example alarms prior to implementing the alarm and setpoint lists.

5.2.2 Level 2 Functional description (L2FD)

(a) The purpose of the L2FD is to describe what each subsystem or function must do, focusing on process flow, process interlocks, design capacities, safety requirements, start up and shut down procedures and all normal and abnormal operational workflows.

(b) A template for documenting the L2FD can be provided upon request.

(c) The intended audience is process engineers, automation engineers, and stakeholders who need to understand the functionality in detail.

(d) The L2FD shall:

i. Provide details of functional requirements as step-by-step sequences of operation for each function. Include Inputs, outputs, interlocks, setpoints, and alarms. Functional diagrams, flowcharts, state diagrams, pseudocode, or sequence tables are preferred.

ii. Document all alarms (tag, banner text, priority and action). The Integrator shall iterate and improve on the alarms provided in the process narrative.

iii. Describe the operating modes, e.g.: Automatic, maintenance, manual, etc.

iv. Describe operator interface requirements e.g.: displays, controls, and indications.

v. Provide a description of actions under equipment failure modes or abnormal operation. Identify power failure and recovery actions and any specific failure or partial operational modes that might be required for resilient operation.

vi. Identify major interlocks or control action triggers, this includes all software and hardwired interlocks for all equipment. Clearly state any instances where operators may override interlocks. If this is not explicitly stated, then by default safety interlocks may not be overridden.

vii. Address the interface between the primary elements of the process (field instruments, sensors, actuators and motor control) and the control logic requirements necessary to achieve the intended process control.

(e) Where software is required to control to a set level or duration and these details are specific to the process, the L2FD shall specifically state suitable initial setpoints and setpoint ranges.

(f) For sites with network connected equipment, the Designer shall request IP addresses from CCC and document these in the L2FD.

(g) When VSDs are installed on site, the ramp rates and VSD speeds shall be specified. Set the ramp rates from the following conditions excluding under power failure, unless surge transient analysis dictates alternative rates:

I. Determine the pump's minimum flow and the corresponding VSD minimum operating frequency (Hz).

II. Determine the pump's maximum flow and the corresponding VSD maximum operating frequency (Hz).

III. Determine the VSD ramp rate up to the minimum operating speed (nominal setting is 5 Hz/s).

IV. Determine the VSD limit to the rate of change above the minimum operating speed when accelerating or decelerating.

V. On shut down, the VSD shall go through a free wheel stop.

VI. Confirm any alternative rates are acceptable with the equipment supplier.

5.2.3 Software Detailed Design Specification (SDDS)

(a) The purpose of the SDDS is to describe how the functional requirements will be implemented in software, including code structure, configuration, and detailed logic.

(b) A template for documenting the SDDS can be provided upon request. In addition to this, some useful documentation is referenced below:

i. TRIM 11/570208 CCC ArchestrA Object Definitions

ii. TRIM 14/762783 CCC Automation Software - Yokogawa RTU Library Block Register

iii. TRIM 09/312425 Christchurch City Water & Waste - SCADA Maintenance Manual

(c) There is continuous upgrade and updates of standard CCC software blocks, liaise with CCC EICA SCADA engineer for latest software blocks.

(d) Bespoke code that sits outside of the standard CCC library blocks shall be identified and communicated in writing to EICA SCADA Engineer. This allows consideration for updating the library blocks to meet the practical requirements.

(e) The intended audience for the SDDS is software developers, programmers, testers, and technical reviewers.

(f) The SDDS Shall:

i. Cover all the contents of the L2FD.

ii. Document the software architecture, program structure (modules, tasks, classes), data flow and communication.

iii. Document detailed logic implementation: data types and CCC Library Blocks used to implement the project.

iv. Document screenshots of the project HMI graphics and SCADA mimics, screen layouts, navigation, tag mapping, graphics, and scripts.

v. Document detailed I/O Mapping of physical and virtual I/O to software variables.

vi. Contain a complete alarm list, description, priority, and formatting of alarms.

vii. Document error handling and diagnostics: Fault management, error messages, and diagnostics.

5.2.4 Software Test Plan (STP)

(a) The purpose Software Test Plan is to detail the various individual tests to be performed and the expected automation control outcome.

(b) The Integrator is expected to produce the STP, examples can be provided upon request.

(c) The Software Test Plan (STP) shall:

i. Describe testing that will be carried out to meet the requirements of the SFAT (Software Functional Acceptance Test).

ii. Document testing and validation: test cases, acceptance criteria, and verification methods.

iii. Include details of the Contractors pre-testing.

iv. Identify the degree of simulation for each element noting that:

a) Where a block has been tested and is documented in the CCC Software Application Guides that local software loopback testing is acceptable.

b) Where no prior testing for a specific device is noted in the CCC Software Application Guides at least one real device shall be included for testing.

c) Where a device cannot be provided for testing in SFAT the STP may propose and detail testing of the functionality during Site Acceptance testing after commissioning.

v. Includes a complete record of I/O, alarms and adjustable setpoints.

vi. Include screenshots relevant to the test plan of HMI and SCADA screens.

5.3 SOFTWARE FUNCTIONAL ACCEPTANCE TESTING (SFAT)

5.3.1 Documentation

(a) All software shall be fully complete prior to SFAT. Documentation shall be complete to the DRAFT stage, in the form of the final document to allow verification of the operation in accordance with the operating and maintenance manuals and the functional descriptions.

(b) Allow two (2) weeks between submitting the SFAT documents and the day of the SFAT for CCC review.

(c) The following documents shall be submitted, reviewed, and accepted by the EICA SCADA Engineer prior to SFAT:

i. SDDS and L2FD with completed tag list and alarm description lists.

ii. STP, and STP record sheets documenting expected results.

iii. HMI and SCADA draft screenshots.

iv. SFAT agenda. CCC will identify anything they want added to the SFAT agenda.

5.3.2 Testing

(a) Functionality must be thoroughly tested by the Integrator, and be free from errors, prior to the SFAT by simulation or other means.

(b) The Integrator shall provide EICA SCADA Engineer a summary of updates that were made as an outcome of the SFAT, for acceptance.

(c) The SFAT shall be completed before site functional commissioning and site acceptance testing.

(d) The Software Functional Acceptance Test (SFAT) shall:

i. Demonstrate functionality of controls for the software objects being used. Simulated tests are acceptable at the SFAT.

ii. The Integrator shall provide EICA SCADA Engineer a summary of updates to the SDDS and L2FD that were made as an outcome of the SFAT, for acceptance.

iii. Demonstrate the functionality as described in the Software Test Plan (STP).

iv. Demonstrate the response of the control system in normal, abnormal, alarm and fault conditions.

v. Demonstrate functionality of HMI and SCADA.

vi. Demonstrate successful implementation of inter-site communication.

vii. Include structured pre-planned testing as described in the STP and unstructured testing as considered appropriate by the Designer and CCC.

viii. Include all devices, in manual and automatic operating modes and switching between modes.

5.4 DOCUMENT UPKEEP AND INTEGRITY

(a) The upkeep and Integrity of the SDDS and L2FD is the Contractors responsibility until the plant has been handed over.

(b) The SDDS and L2FD documents are to be treated with the same importance as that of the PLC/RTU code.

5.5 APPLICATION SOFTWARE

5.5.1 Development Library & Firmware Versions

(a) The integrator shall confirm the installed equipment firmware is the latest issue before any configuration files are uploaded.

(b) Integrators shall use SCADA, PLC, HMI and RTU programming software versions, libraries and firmware versions currently in use by CCC. The Contractor shall confirm the versions in use with the EICA SCADA Engineer. Software submitted with incorrect versions shall be resubmitted at no cost or time delay.

(c) Practical conflicts with this requirement shall be communicated to EICA SCADA Engineer in writing. Written approval is required before use.

5.5.2 Tag Naming

(a) Request CCC standard tagging documentation with worked examples. Submit a list of tags for all equipment to CCC EICA Engineer for approval.

(b) PLC tag names shall use the standard for plant and equipment tagging. Refer “CCC Tagging Convention”, (TRIM:ELEC 06/6074). It is the contractor’s responsibility to ensure they use the latest version.

(c) All automation configurations shall use equipment tagging as per the CCC Tagging Convention and other CCC documents.

5.5.3 Software Standards

(a) Structured Text, Function Blocks and Sequential Function Charts are preferred. Ladder Logic is prohibited.

(b) For RTUs around the reticulation networks the following requirements apply:

i. Code shall be grouped such that code sections align with process sections.

ii. Code documentation shall include a description of the function of code sections.

iii. Code documentation shall avoid restating generic information about software objects used that are contained in other automation documentation.

iv. Redundant PLC code including tags shall be removed before site installation and commissioning.

v. Simulation or test code to be removed before site commissioning.

(c) Bumpless transfer when switching modes shall be provided for all equipment.

(d) The control system shall automatically restart on return of power.

(e) Standard automation software configuration is available. The integrator shall request the current standard from the EICA SCADA Engineer. Any modification to standard software must be agreed in writing.

5.6 SCADA INTEGRATION PROCEDURES

(a) The Integrator shall request from CCC the available standard templates to be used.

(b) The procedures described in the CCC documents listed below shall be followed.

(c) Contractor to request the latest version of software and associated documentation prior to commencing work. Rework resulting from failure to obtain latest version shall be at the cost of the Contractor.

(d) Software shall be written to provide an Operator with the ability to take software manual control of individual items of plant while minimising the impact on surrounding equipment.

(e) Automation Change Requests (ACR):

I. A critical part of the ACR submission is a document detailing what steps are required to be completed to integrate the changes into the production system.

II. The ACR system is applied to works on electrical, automation, SCADA, control systems, calibration or instrumentation at the Christchurch Waste Treatment Plant or Council water and waste network.

III. Link to CCC web portal: Automation Change Request (ACR)

5.7 SOFTWARE FOR DEVICE CONFIGURATION

(a) Unless specifically agreed otherwise, for all devices able to be configured the Contractor shall supply the software configuration tools and the device configuration settings in a format that is able to be used and modified by CCC. This shall include the right to use common configuration settings and programs across other CCC devices and assets. Software design shall comply to CCC automation standards.

i. Where configuration software is not freely available and not included as a deliverable, the software required shall be adequately described to allow CCC to independently purchase if they wish.

(b) Configuration files shall be supplied without passwords and both in native application form suitable for editing and loading onto the device and as a pdf document.

(c) Bluetooth and Wi-Fi connectivity shall be disabled any time the site is unattended, and permanently prior to handover.

6 TESTING, COMMISSIONING AND OPERATIONAL HANDOVER

6.1 GENERAL

(a) Testing (FAT and SAT) shall include all devices, in manual and automatic operating modes and switching between modes.

(b) Testing and Commissioning shall be carried out by the Contractor prior to Practical Completion, using pre-approved written ITPs and Commissioning Procedures. Submit the written ITPs and Commissioning Procedures to the EICA Engineer for approval at least 5 working days in advance. The ITP shall include the proposed schedule for design, fabrication and testing of the Equipment, and identify the anticipated dates for tests, including witnessed tests.

(c) All results shall be recorded on the ITP and Commissioning Procedures sheets and included into the O&M manual. A completed copy shall be provided to the EICA Engineer when requested, before the start of testing.

6.2 INSPECTION & TEST PLAN (ITP)

(a) The test plan shall meet, but not be limited to, the below requirements:

i. Be carried out within a reasonable amount of time from the switchboard and control panel completion.

ii. Include tests on the completed control panels and switchboards.

6.3 SWITCHBOARD AND CONTROL PANEL FACTORY TESTS

(a) Switchboards and control panels shall be Factory Acceptance Tested (FAT).

(b) Factory Acceptance Testing is carried out in the presence of the EICA Engineer to the Contract or their representative and CCC must be given the opportunity to attend. At least 5 working days notice required prior to the FAT.

(c) The Contractor shall supply all certification, marked up As Built drawings and completed test sheets.

(d) The successful FAT documentation must be signed off by the EICA Engineer and Engineer to the Contract. Once the FAT results have been accepted the equipment may be delivered to site.

(e) Factory Acceptance Testing shall not commence until the Switchboard Assembler has confirmed that all functions have been tested and that all functions operate correctly. The Contractor shall provide a test list confirming the tests completed and the successful functionality.

(f) The Contractor shall supply all test equipment and demonstrate the function of the equipment as required. At the completion of testing the Engineer will present the Contractor with a list of defects or sign the test sheet.

(g) Testing will be regarded complete after the Contractor has successfully demonstrated all functions of the devices in a test environment which allows simulation of all operating parameters of the plan.

(h) At the completion of testing the Contractor shall set all devices to OFF and package the equipment ready for delivery. A set of marked up As Built drawings shall accompany the equipment.

(i) The following documentation shall be available for inspection by the Engineer if requested, and should be supplied in the Operations and Maintenance Manual:

i. Suppliers Declaration

ii. Assembly Manufacturers Declaration

6.3.1 Power Off

(a) Testing is carried out to ensure that basic work has been completed in a specific area before power is applied to a device.

(b) Tests shall include, but are not limited to:

i. General testing as described in AS/NZS 3000.

ii. Correct circuit connections and continuity between devices.

iii. Correct earthing (continuity and size).

iv. Correct voltage applied.

v. Device location allows adequate access for maintenance.

vi. Correct sizing of cables and power supply.

vii. Correct environmental protection.

viii. Device is as specified.

ix. Installation is to manufacturer's recommendations.

x. Hazardous area classification compliance is correct.

xi. Labelling and device tagging is per the CCC requirements.

xii. Drawings are marked up to 'As Built' to include all information relating to the actual installation.

xiii. Equipment is installed in a safe, neat and functional manner.

xiv. Device is setup correctly and any automatic functions are disabled.

xv. All connections on power and control circuits are tight and all wiring is protected.

xvi. A point-to-point test has been carried out on all power and control wiring.

xvii. On a unit with Bus Bars, an HV test has been carried out and results recorded.

xviii. Mechanical test to ensure all fixings and fitting are secure and bolts torqued where necessary.

xix. Doors open and close freely and all internal equipment is accessible and secured in the correct manner.

xx. Layout check to ensure the panel layouts on and inside the panels are as per construction drawings.

xxi. The equipment is as specified or approved as an alternative.

6.3.2 Power On

(a) Power On testing shall only be carried out with all circuit breakers, isolators, fuse switches and fuse terminals in the open position. All equipment shall be turned off and all automatic devices and switches turned to OFF.

(b) Power On testing is carried out to ensure that all relevant equipment is supplied by the correct voltage supply. Any damage cause to equipment that is caused by incorrect wiring shall be renewed at the cost of the Contractor.

(c) The Contractor shall systematically liven circuits to check that power supply outputs are correct, that any non mains powered equipment has the correct supply and to enable any programmable devices to the set up.

(d) Power On testing is per the Contractors test procedure, including but is not limited to:

i. General testing as described in AS/NZS 3000.

(e) Once Power On testing has been completed all devices shall again be isolated.

6.3.3 Equipment and Device Testing

(a) Equipment and device testing shall, as far as is practical by simulation of field IO device, PLC IO set up and calibration sheet marked up with test and calibration results that include confirmation of indication in both the PLC code using the programming tool and the SCADA alarm and mimic displays. Refer to Section 5 for requirements.

6.4 FACTORY INSPECTION AND ACCEPTANCE

(a) A compulsory inspection shall be carried out by the EICA Engineer to confirm their acceptance of the completed switchboard and / or control panel prior to shipping to site.

(b) The EICA Engineer will inspect aspects of the equipment, including but not limited to:

i. The rating of the switchgear is as specified.

ii. Pilot devices are as specified.

iii. Cable management and trunking is satisfactory.

iv. General arrangement matches the drawings.

v. Equipment is installed as expected.

vi. Doors and equipment can be locked where required.

vii. Door interlocks with MCCBs, fuse switches and isolators are effective, and interlocks are not defeatable.

viii. All wiring, internal and door mounted equipment is labelled.

ix. The requirements of metering are as specified.

x. Cable sizes, colours and installation are as specified.

6.5 CONTRACTOR FIELD TESTING / PRE COMMISSIONING

6.5.1 General

(a) Testing is to be carried out and documented by the Contractor prior to Commissioning. Refer to CCC test plan template for details.

(b) Contractor shall field test the installation for the following:

i. Tests of all cables, recorded through markup of IFC (or later) drawings.

ii. Transducer calibration and set up.

iii. End (device) to end (HMI and SCADA) testing of all I/O.

iv. A sample (1 in 10) of all FAT tests.

v. Include tests deferred from SFAT and identified to be confirmed during site testing.

vi. Rotation of motors is correct. This test to be carried out in manual.

vii. Circuit and earthing tests.

viii. Switchboards and control panels tests.

(c) Depending on the process the testing may or may not be witnessed, in any event documentation showing successful completion shall be provided by the Contractor.

(d) Demonstrate to the Engineer the functional operation of all elements under simulated process conditions.

6.5.2 Cables

(a) After installation but before connection, all cables are to be tested for insulation resistance using a 500V tester for 230V circuits and a 1000V tester for 400V circuits. The results of the tests shall be recorded and supplied to CCC.

(b) All Ethernet cables shall be tested for conformance with Cat 5e compliance. Test reports shall be included in the documentation.

6.6 COMMISSIONING

(a) Commissioning is carried out to check that the plant performs all its designed functionality. It shall test automatic functions, manual overrides, emergency functions, compatibility with other plant functions and equipment and enable operation of the plant so that minor adjustments and settings can be made to ensure reliable operation. All adjustments and settings shall be recorded by the Contractor in the As-Built and O&M documentation.

(b) A Commissioning Plan shall be submitted to the EICA Engineer for approval 2 weeks before the start of commissioning. This shall be accompanied by a Preliminary Operations & Maintenance (O&M) manual containing data sheets for all items of plant to be commissioned.

(c) Commissioning is carried out by the Contractor and their Subcontractors. Commissioning shall be carried out by skilled and qualified persons

(d) Clauses related to testing and commissioning of specialist equipment are contained in the relevant Technical Specification.

(e) In commissioning sites with a wet well, run all available pumps at maximum speed from high level float, record the time to reach minimum operating level to enable correct setting of the high float level run time – test with fresh water and no inflows.

(f) The Contractor is to supply all equipment necessary to test and commission the plant.

(g) The correct manual and automatic operation of the plant shall be demonstrated to the Engineer at the completion of Commissioning.

6.6.1 Flow Meters

(a) Flow meters shall be calibrated and certified upon installation.

(b) Testing, calibration and certification shall be performed by the suppliers listed in Appendix A.7.

6.6.2 Control System Witnessing

(a) The Contractor shall demonstrate to CCC's representative(s) that the works effectively meet the specified performance and have been successfully tested and commissioned as a complete and integrated installation, under operating conditions.

6.7 CCC SITE ACCEPTANCE TESTING

(a) Site acceptance testing (SAT) is typically carried out by CCC Networks Operations personnel.

(b) The Contractor shall inform CCC once Commissioning has been complete and is ready for System Acceptance Testing by CCC Networks Operations personnel.

6.8 TRAINING

(a) The Contractor shall provide training as identified in the Contract, to CCC-nominated persons.

(b) Training shall:

i. Be undertaken before operational handover of the plant.

ii. Include As-built O&M Manual.

iii. Include all operational and maintenance activities and be supported by the O&M Manual

iv. Be provided by a person with experience in all the elements installed in the Contract.

7 COMMUNICATIONS AND RADIOS

7.1 COMMUNICATIONS

(a) This section identifies the requirements for forms of Operational Technology (OT) communications networks. Note that Information Technology (IT) networks are managed separately by CCC IT and some CCC sites incorporate both OT and IT networks.

(b) OT networks shall comply with CCC IT policy set out in the below specification subject to the differences noted herein. Link: Minimum security standards for our suppliers : Christchurch City Council (ccc.govt.nz)

(c) All communications shall use Ethernet.

i. Modbus TCP/IP is the preferred protocol for inter-site communication.

ii. DNP3 for compliance.

iii. Other protocols shall not be used without prior written approval by the EICA Engineer.

(d) Any new network equipment or cabling shall be from the approved equipment list.

7.2 SUPPLY, CONFIGURATION AND INSTALLATION

(a) CCC will configure and free issue radios to the project, unless noted in the contract documents.

(b) The Contractor shall liaise with CCC to organise configuration of radios by CCC Network Operations.

(c) The Contractor shall install the radios, antenna, cabling and accessories as per the design.

(d) After install, CCC Network Operations will attend site, in conjunction with the Contractor, to check received signal strength and operation. The Contractor shall record the signal strength in the O&M Manual.

7.3 ETHERNET VIA UHF

(a) Where Ethernet is carried via UHF the following additional requirements exist:

i. Licensed frequencies shall be used, unless prior written approval is received from the EICA Engineer.

ii. Routing device shall be configured to restrict transmission of packets via the RF circuit to specifically permitted messages

iii. Application design shall specifically address the bandwidth limitations of the network

iv. Application design shall specifically address the impact on RF networks sharing a frequency, repeater and / or backhaul connection.

7.4 GSM RADIOS

(a) GSM radios shall not be used without prior written approval of the EICA Engineer.

(b) Where installed, GSM radio aerials shall be installed outside of buildings at a location agreed with the EICA Engineer.

7.5 RADIO FREQUENCY PATHS

(a) Design shall include radio equipment details, frequency, aerial details and repeater. Site plan drawing shall accurately show the antenna point to the repeater.

(b) Radio antenna shall be mounted with a clear visible path to repeater sites. Mounting shall extend above the roof height and on a side of the building to give the best signal strength. This includes UHF, Microwave and Cellular communications.

(c) Installation shall include signal strength testing provided by CCC-nominated communications installer.

(d) Small masts – as typically attached to outdoor cabinets – shall be mounted with the base attachment as a footer with flexible steel conduit into the cabinet arranged so that a single person can lower and raise the mast.

7.6 NETWORK ASSESSMENT

(a) Contractor shall perform network assessment tests and provide results to CCC, this includes RF noise ratio.

(b) Check to be done by CCC Operation representative and remediation to be actioned as required.

7.6.1 Signal to Noise Ratio (SNR)

(a) The signal to noise ratio is the ratio of the power of a signal to the power of background noise.

(b) Criteria Pass ≥ 30dB

(c) Fail < 30d

8 DOCUMENTATION

8.1 GENERAL

(a) Drawings shall be submitted in PDF and AutoCAD DWG, with accompanying database and metadata files.

8.2 SITE DOCUMENTATION

(a) Original site documentation is to always remain on site. Once new documents have been approved the site documentation is to be updated with the new documentation set. Redundant site documentation is to be removed once the updated set has been approved.

8.3 MARKUPS AND AS-BUILTS

(a) The Contractor shall keep a clean set of contract drawings specifically to record any changes to the drawings due to variations, changes in position of equipment, changes in design and any other event which cause the drawings to change.

i. Red pen markups done to the original design drawings are acceptable for temporary documentation only.

ii. Where the Contractor has modified the design, the red lines shall be presented to the originator of the drawings after successful commissioning of the plant for updating in CAD prior to providing them for insertion into the Operation and Maintenance Manuals.

iii. Where the Contractor has carried out the design, they shall present drawings in the latest AutoCAD DWG native format in a form able to be edited and updated.

8.3.1 Underground Cable Joints

(a) The Contractor shall record on the drawings the location of any underground cable joints, recording at minimum the following information:

i. Depth below ground level of joint

ii. Submit for approval by the EICA Engineer the proposed GPS equipment prior to making the joint.

iii. GPS coordinates of the joint shall be taken with approved GPS equipment.

(b) Submit for acceptance by the EICA Engineer a draft redline markup of the cable joint recording prior to backfilling / covering the joint.

8.4 WARRANTIES AND LICENCES

(a) The Contractor shall:

i. At Practical Completion, provide written warranties on all supplied hardware. This needs to detail all components, serial numbers, where purchased and supplier details, date of purchase, warranty start date, warranty end date and length of warranty.

a) Warranties to be provided from the day of energisation.

b) Warranty End Date is the Warranty Start Date plus 12 months, unless a longer warranty duration is specified for individual equipment items.

c) If equipment is replaced under warranty during the warranty period, then the Warranty Start Date becomes the date the replacement is completed.

d) Warranty details to be updated on the CAT sheet.

ii. Provide license certificates and documentation on all software supplied.

8.5 PRODUCER STATEMENTS

(a) All design of seismic bracing for non-structural elements shall be provided with:

   i. PS1 as per Section 2.1.5(h) for the design of the seismic restrains of all electrical systems and equipment.

(b) PS3 for the construction works related to the seismic bracing (by Contractor).

(c) PS4 requirements as per project contract requirements.

8.6 CONFIGURATION FILES

(a) All software tools and configuration files shall be digitally submitted to CCC PM and EICA Engineer, including a description on how these are to be used.

(b) Configuration files are required for the below, including but not limited to:

   i. PLC/RTU code, including libraries and resource configurations as zipped or archived.

   ii. VSD configuration

   iii. Soft Starter configuration

   iv. Instrument setup

   v. Deep Sea Controller configuration

   vi. Network switch and gateway configuration

   vii. DNP3 translator configuration

   viii. HMI Configuration

8.7 O&M MANUAL

8.7.1 General

(a) The EICA section of the O&M manual shall be inserted into the Project O&M manual prepared in the CCC City Water and Waste department generic format. This template is for a complete multidiscipline project, and it is not expected that the EICA Contractor complete a manual such as this, but it shall be used as a template for the O&M manual.

(b) The Contractor shall request the below template from CCC, however the requirements specified in this document supersede any conflicting requirements in the template:

   i. TRIM 09/455343 CCC Water Supply Pumping Station O&M Manual Template

(c) O&M Manuals shall be submitted to the CCC Project Manager and the EICA Engineer.

(d) For existing sites or renewals, O&M information meeting the below requirements are required for all equipment within the Contractors scope of supply and installation.

8.7.2 Format

(a) O&M Manuals shall be submitted in both a text-searchable PDF and editable MS Word formats. Schedules and lists shall be provided in Excel format.

(b) Two printed copies and a digital copy of O&M manuals shall be provided.

(c) Printed drawings shall be A3 size.

(d) The PDF shall be bookmarked with, at minimum, the following:

i. Each section, subsection and heading

ii. Each figure

iii. Each table

iv. Each appendix

v. A bookmark must be provided to match each tab of the hardcopy version

8.7.3 Contents

(a) The O&M manuals shall, at minimum, contain the following:

i. Safety

ii. Equipment Summary

iii. Operational Procedures

a) Start-up and shutdown of systems

b) Normal operational procedures

c) Emergency shutdown procedures

d) Basic fault finding procedures

iv. Maintenance Activities and Schedules

v. Recommended Spare Parts List

vi. Drawings

vii. Manufacturers manuals and data sheets

viii. SDDS

8.7.4 Safety

(a) This category describes the safety precautions to be taken when operating and maintaining the equipment or working near it.

8.7.5 Equipment Summary

(a) A table shall indicate the following information:

i. Tag

ii. Equipment name

iii. Make

iv. Model

(b) The model number shall be the manufacturers complete number to allow ordering of an identical replacement if required.

(c) Provide a brief description of the equipment and its purpose.

8.7.6 Operational Procedures

(a) Recommended procedures on the following shall be included:

i. Installation

ii. Adjustment

iii. Normal Startup

iv. Normal Stopping

v. Emergency Stopping

vi. Shutdown

vii. Troubleshooting

viii. Disassembly / Reassembly

ix. Calibration / Realignment

(b) Provide the location of controls and Operator interfaces and control system operating procedures.

(c) Tabulation of proper settings for pressure relief valves, low- and high-pressure switches, and other protection devices

(d) List of all electrical relay settings including alarm and contact settings

8.7.7 Preventive Maintenance Procedures

(a) Preventive maintenance procedures shall include recommended procedures to be performed on a periodic basis, both by removing and replacing the equipment or component, and by maintaining the equipment in place.

(b) Indicate weights and types of oil, grease, or other lubricants recommended for use and their application procedures.

(c) These procedures shall be submitted in the form of a table that clearly shows recommended frequencies for each procedure.

(d) Lubrication schedules, including lubricant grade, type, and temperature ranges, shall be covered.

8.7.8 Recommended Spare Parts List

(a) A complete parts list shall be provided with the following information:

i. A generic description

ii. Manufacturer's part, model or identification number for each part.

iii. Addresses and telephone numbers of the nearest supplier

iv. Estimated cost.

v. Estimated lead time.

(b) Cross-sectional or exploded view drawings shall accompany the parts list. Part numbers shall appear on the drawings with arrows to the corresponding part.

8.7.9 Wiring Diagrams

(a) Include complete internal and connection wiring diagrams for electrical equipment items.

(b) Include dimensioned installation drawings, single line diagrams, control diagrams, wiring and connection diagrams, list of material for contactors, relays and controls, outline drawings showing relays, meters, controls and indication equipment mounted on equipment or inside cubicles, control and protective schematics, and recommended relay settings.

8.7.10 Shop Drawings

(a) Include approved shop or fabrication drawings with all comments and corrections incorporated, complete with dimensions.

8.7.11 Certification and other Documentation

(a) Equipment warranties, affidavits, certifications, calibrations, laboratory test results, etc. required by the Technical Specifications shall be placed in this category.

(b) Recorded radio signal strengths.

8.8 INTERGRATION DOCUMENTS

(a) The Process narrative, L2FD and SDDS must be updated to capture As-Commissioned setpoints and parameters and retained in the O&M Manual.

8.9 ASSET DATA

(a) Asset data for all installed or removed (disposed) equipment shall be submitted in the appropriate CCC CAT sheet.

(b) Guidance and templates for CCC CAT sheets are available on CCC public website at the below link:

https://ccc.govt.nz/consents-and-licences/construction-requirements/infrastructure-design-standards/as-built-survey-and-data-requirements

(c) The installation and removal of equipment in the plant has implications on the recorded data about that asset. It is very important that the asset data is upgraded when work is carried out at the plant.

APPENDIX A - PREFERRED SUPPLIERS

A.1 PANEL BUILDERS

(a) The following contractors are approved for construction and supply of electrical switchgear:

i. TLJ Switchgear (preferred)

ii. IC Switchgear

iii. Bremca Industries

A.2 ELECTRICAL CONTRACTORS

A.2.1 3W NETWORK STATIONS

(a) The following contractors are approved Electrical subcontractors in the network:

i. Melray

ii. Millennium Electrical

iii. City Care

iv. Downer

A.2.2 PLANT (CWTP)

(a) **In addition to the above**, the following contractors are approved Electrical subcontractors at CWTP:

i. K K Electrical (Maintenance only)

ii. Prolec (Energy Centre only)

A.3 DIESEL GENERATOR SUPPLIERS

(a) The following contractors are approved for supply of diesel generators:

i. Goughs CAT

ii. Qpower

iii. Aggreko

iv. FG Wilson

A.4 HIGH VOLTAGE (11 KV) CONTRACTORS

(a) All high voltage design and installation shall be carried out by an approved Orion contractor. Contact Orion for a list of approved contractors. At CWTP this is generally Connetics (current maintenance contractors). Refer to APPENDIX F – CWTP HIGH VOLTAGE REQUIREMENTS

A.5 SYSTEM INTEGRATORS

(a) The following contractors are approved for work involving modification to the CCC SCADA System HMI, RTUs, PLCs and Local HMI panels.

i. Millennium Electrical

ii. Bremca Industries

iii. NZ Controls

iv. Prolec (CWTP Energy Centre only)

A.6 COMMUNICATIONS

(a) The following licensed radio installers, commissioning and testing providers shall be used:

i. Canterbury Communications – cabling and aerials

ii. Downer (Sam Bailey) – Mikrotik Routers

(b) The following microwave radio installers, commissioning and testing providers shall be used:

i. Complete Comms

A.7 FLOW METER TESTERS AND VERIFIERS

(a) The following test and verification suppliers shall be used:

i. Water and Wastewater magnetic flow meter installations

a) Steve Beek of NZ Flow

b) Other parties as authorised by ECAN.

APPENDIX B – PREFERRED EQUIPMENT

A.8 GENERAL

(a) Refer to the latest preferred equipment list TRIM Record 23/950221. This document is consistently updated.

(b) The equipment is preferred but alternatives may be offered for approval at time of tender.

(c) Items are grouped for ease of location only.

APPENDIX C - EXAMPLE ACCEPTANCE TEST SHEETS

Action	Signed	Date
Control Cabinet		
Battery terminated correctly		
230VAC breakers operating correctly		
24VDC breakers operating correctly		
Pump temperature protection circuit correctly wired and labelled		
Pump correctly wired and labelled		
Hydrostatic level transducer correctly terminated and labelled		
Switchboard factory test sheet attached		
Electrical Certificate of Compliance attached		
Switchboard metering installed correctly		
Cellular aerial mounted and operating correctly		
Switchboard mounted correctly		
10A socket installed correctly		
Cabinet lighting installed correctly		
All wire terminations neat and tidy and labelled correctly		
Batteries installed securely		
CCC padlock not installed, but available inside cabinet		
Pump cabling in separate duct		
Sensor cabling in separate duct		
Pump Controller / Motor Starter		

Pump controller configured as per the Electrical Specification and Construction Drawings		
Pump controller language set to English		
Pump controller default set to “NL Default”		
Max current set in Pump Controller as per Motor nameplate		
Pump Controller Comms interface orientation are correct		
All fault logs reset and pump in “Auto” mode		
Pump name plate installed on pump controller		
Remote Terminal Unit		
Cellular connection available		
Configured as per Electrical Specification and Construction Drawings		
CCC Sim card installed in Remote Terminal Unit		
Connected to CCC network		
Correctly communicating with pump controller		
Physical I/O test complete		
Remote Terminal Unit has latest firmware installed		
Pump Operation		
Start, Stop and Alarm level configured as per the Construction Drawings		
Pump starts and stops at correct levels when operating in “Auto” mode		
Pump starts and operates until water level at top of pump when float switch manually activated		
Pump trips when temperature protection circuit manually broken		

APPENDIX D – WWTP PARTICULAR REQUIREMENTS

This section applies to the Wastewater Treatment Plants listed below. When executing work at the plants, any requirements listed here take precedence over the requirements in the body of this specification.

- Christchurch Wastewater Treatment Plant, Bromley
- Akaroa Wastewater Treatment Plant
- Lyttleton Wastewater Treatment Plant
- Governors Bay Wastewater Treatment Plant
- Diamond Harbour Wastewater Treatment Plant
- Duvauchelle Wastewater Treatment Plant

A.9 WORKMANSHIP

(a) All work shall be carried out;

i. Under a work permit issued by the Shift Engineer or Plant Manager.

A.10 BUSBARS

(a) All bus bars shall be tinned.

(b) Wastewater sites are commonly exposed to corrosive atmospheres typically the presence of H2S. For wastewater sites all switchboard wiring and busbars shall have a completely tinned finish. Tinned coating shall be applied after all drilling has been completed.

A.11 CABLE LABELLING

(a) Labels shall be applied at both ends using the cable number specified in the cable schedule:

i. Be applied to Copper, Fibre optics, sockets and network devices

ii. Be provided according to the CCC Tag Naming scheme in CCC Tagging Convention, (TRIM:ELEC 06/6074).

iii. Use a common unique identifier from the device to the switch

iv. Patch leads shall include both the cable tag and the end device tag

v. Socket outlets adjacent end devices shall be labelled with the end device tag

vi. Where an end device has multiple ports, the tag shall include the port number

(b) For example:

i.	Network switch label	905.1 NQ001
ii.	Patch lead to port 7 on the switch	905.1 DJ005_905.1NQ001-07
iii.	Structured cabling socket label	905.1 DJ005
iv.	Structured cabling cable label	905.1 DJ005
v.	Structured cabling socket by device	905.1 DJ005
vi.	Patch lead to device	905.1 DJ005_1050DQ001

vii. VSD 105.0 DQ001

A.12 WASTEWATER SITE SWITCHROOM

(a) Generally, switchroom shall be positively pressurized with filtered air to minimize the corrosive effects of H_2S. Any user terminals shall be placed outside the corrosive area in a separate stainless-steel cabinet that is positively pressurized using a filtered air supply. Any keyboard shall have a protective membrane.

(b) Where H_2S conditions may occur a door limit switch shall be installed and set to alarm after 30 minutes open.

(c) Where filtered air is being introduced, analogue differential pressure sensor on clean air supply set to alarm after on low (fan off) and high (filter blocked) pressure.

A.13 HAZARDOUS AREA REQUIREMENTS

(a) Installation of electrical equipment in hazardous areas shall be avoided as far as practicable.

(b) When undertaking a design for electrical equipment in a hazardous area classification, installation and maintenance of electrical equipment shall be conducted to AS/NZS 60079.

(c) The Designer shall provide the hazardous area dossier including but not limited to the following documents:

i. Classification drawing and report

ii. Loop drawings

iii. Datasheets

iv. Hazardous area equipment certificates

v. Signed entity calculations for barrier to field instrument (for intrinsically safe circuits)

vi. Equipment register. Equipment register shall include equipment type and model, drawings, classification drawing, protection technique and certification number.

A.14 HVAC REQUIREMENTS

A.14.1 GENERAL

(a) Equipment provided to be installed in locations exposed to direct and prolonged sunlight shall be suitable for that type of environment (UV stabilised plastics, adequate ventilation, etc).

(b) Equipment shall not be installed in polluted atmospheres unless special precautions have been taken in the design of the equipment, and it is suitable for installation in the environment.

A.14.2 TEMPERATURE

(a) The design shall document how temperature is kept within the limits described below.

(b) Designer to advise if the temperature cannot be kept within 35 ºC limits and additional ventilation and/or cooling arrangements will be required, prior to commencing the design.

(c) The temperature shall be monitored with SCADA and alarms shall be configured for: warning at 40 ºC , critical alarm at 45 ºC .

(d) High temperature point heat sources with integral cooling fans shall be vented outside of the switchroom. This includes:

i. Active harmonic filters

ii. VSDs

(e) The switchroom shall be provided with heat pump HVAC to address all the heat sources installed within. Any deviation from this approach shall be fully engineered to address environmental issues such as dust, H_2S content and moisture.

A.14.3 CONTAMINANTS

(a) Where cooling air is drawn in from outside attention must be made to the air quality. Filtering of air shall take place where contamination is present at the source of makeup air. Air is not to be drawn from process areas.

(b) The design shall document how contaminants at the air source are addressed.

(c) Should force ventilation be required, appropriate filters shall be used to limit dust or ingress of other substances (e.g. hydrogen sulphide). If the filter is expected to be changed more frequently than 6-month intervals, filters shall be fitted with a differential pressure sensor monitored by the RTU, with a SCADA alarm raised to indicate filter clogging.

A.14.4 HVAC EQUIPMENT LOCATION

(a) Outdoor equipment and their isolators shall be installed in vandal proof cages in accordance with Section 4.1.

(b) At wastewater sites the design shall consider of the effects of H_2S on outside units.

APPENDIX E – SETPOINTS

A.15 SUCTION TANKS

(a) These are filled from bores, either pumped or artesian, and provide potable water to the suction sidee of reticulation pumps.

(b) 110% is defined as the overflow level, 0% defined as empty.

(c) Other levels:

110%	Overflow level
100% + 150mm	High float level, turn off all bore pumps in auto
100% + 75mm	Software high alarm
100%	Artesian valves close
100%	Full
95%	Artesian valves open
85%	First pump call
80%	Second pump call
0% + 1075mm	Software low alarm
0% + 1000mm	Low float level, turn on all bore pumps in auto
0% + 500mm	Stop pumps, interlock auto, permit manual run

A.16 WASTEWATER SITES

(a) Shall have following settings for the wet well:

100%	Set at overflow
Invert + 200mm	High float
Invert + 100mm	Second Pump Call
Invert of lowest gravity incomer	First pump call
First call stop + 100mm	Second call stop
Top of volute or motor, lowest as permitted by manufacturer	First call stop

0%	Nominal floor of wet well

(b) Washdown pumps are manual control only, no RTU nor SCADA connection

A.17 WASTEWATER LIFT STATIONS

(a) Level monitoring at Lift Stations shall be by hydrostatic level measurement only.

(b) Shall have following settings:

Invert	First call
Invert + 100mm	High float

(c) Software for CWTP the following documents shall be used:

- TRIM://23/444579 - CWTP Unity and ArchestrA Standards GPL Implementation Manual [NZ50000]
    - Documents a selection of GPL blocks permitted at CWTP
- TRIM://21/7078 - CWTP Unity and ArchestrA Standards GPL Application Manual [NZ50001]
    - Identifies the specific Plant SCADA templates based on GPL libraries that have been used on site

A.18 SYSTEM INTEGRATION

- TRIM 09/367143 Christchurch City Wastewater Treatment Plant SCADA Operations Manual”

A.19 OPERATOR TRAINING

(a) The Contractor is responsible for caring out any training required to Plant Manager and other selected staff. After handover the Contractor shall arrange a training session or sessions to fully explain the operation of the new plant. A training facility available in the Operations building and this can be booked by contacting reception and booking the facility.

(b) Training should commence during commissioning with formal sessions away from the site if required.

(c) The Contractor shall arrange to have the relevant trained personnel available, provide all written materials and manuals and other materials to carry out the required level of training to enable staff to effectively operate the plant.

APPENDIX F – CWTP HIGH VOLTAGE REQUIREMENTS

A.20 HV GENERAL REQUIREMENTS

A.20.1 COMPETENCE & WORKMANSHIP

(a) All works are to be carried out by CCC approved contractors:

i. Connetics (preferred)

ii. Independent Line Services

(b) HV electrical works must be carried out by competent Electrical Workers Registration Board (EWRB) trades persons who are licensed and competent for high voltage installations.

(c) It is the HV Contractors responsibility to confer with the Design Engineer prior to carrying out any work that may need clarification.

(d) All high voltage terminations must be completed and tested by a person holding Electricity Supply Industry competency. All electrical work is to be carried out by competent tradespeople as defined in the Electricity Safety Regulations 2010.

(e) All aspects of the work shall meet the requirements of the Principal and Engineer. The Contractor shall, at his own expense, make good any part of the installation work which is non complaint.

(f) The CMCA Engineer shall carry out a final inspection prior to livening to ensure the work meets the requirements of the design.

(g) Only competent and suitably qualified persons shall have access to 11KV Installations unless they are under close supervision.

(h) Appropriate PPE shall be worn when entering areas where energised 11KV equipment is located.

A.20.2 TESTING AND PERMITS

(a) The Contractor is to provide and document specific testing requirements.

(b) All switching to be in accordance with CWTP agreed processes, access and test permit standards.

(c) 11KV Switching activities shall utilize an "Operating Order" permitting system. This is to be produced by the Contractor and agreed to by CWTP EI&C staff when submitting an ACR.

A.20.3 EQUIPMENT AND MATERIALS

(a) Shall be new and of the most recent appropriate technology, unless specifically indicated within the design documents and comply with the relevant official standards listed is AS/NZS3000:2007 including Appendix A of the standard.

(b) Shall be installed in accordance with the manufacturer’s instructions, to best industry practice, and the most recent issue of the relevant Standards (NZS, AS, or BS).

(c) Shall be fit for the purpose.

(d) Shall be compatible with other materials and equipment used in the installation.

(e) Shall be as specified in the design. No substitution of materials or equipment shall be made without the prior approval of the Engineer.

(f) Shall be from reputable sources and be of a reputable trade name.

(g) Attention is drawn to the requirements in regulation 31 of the Electricity (Safety) Regulations 2010 relating to quality of supply. All equipment installed must comply with this section.

A.21 CIVIL & STRUCTURAL REQUIREMENTS

A.21.1 COMPLIANCE

(a) The following civil design aspects shall be taken into consideration and the relevant standards or an external contractor(s) design:

i. Structural elements such as pad design meet specified loadings of equipment and is suitably certified.

ii. The Contractor shall liaise with CWTP and obtain written approval that no fire risks are present before works commence.

iii. Transformers shall be at least 1m from nearby structures and at least 6m from a Portacom/nearest building.

iv. The Contractor shall liaise with CWTP to confirm oil containment requirements.

v. All equipment shall be restrained in accordance with NZS 4219:2009.

vi. Where transformers are not installed inside a building, they can be mounted inside a CCC approved Bunker.

A.21.2 RMU BUILDING REQUIRMENTS

(a) The HV Contractor shall include considerations for the venting or dissipation requirements of the RMU arc fault gas as per manufacturer recommendation.

(b) All conduits shall be sealed with removable firestop material. All apertures shall be sealed to prevent rodent entry and air egress.

(c) All buildings shall be built to IL3 or IL4 if required.

(d) Light fittings and switch shall be installed in the RMU space. Additional lighting can be connected to existing building lighting circuit.

(e) A double 3pin utility outlet shall be installed in the RMU space.

(f) The HV Contractor shall install battery-backed emergency lighting above the doorway, on both sides of the entry doorway.

(g) A new heater and thermostat shall be installed in the new room to adequately control the room temperature to reduce the risk of condensation. A F117-TAC20 heater or similar shall be considered.

(h) The HV Contractor shall provide all necessary signage to meet requirements, including exit signage for the doorway and existing doors.

(i) A physical separation of 50 mm is required between communication and control cabling as per AS/NZS3000.

(j) The Contractor shall supply and install all necessary cable support and access facilities associated with the cable installation including ladders, cable trays, cable covers, trunking, conduit, and ducts.

(k) Cable support systems shall be either anchored directly to the structures via brackets and clamps or provided with suitable support componentry on the cantilever or trapeze type.

Supports shall be located in accordance with the system supplier recommendations for the applicable load.

A.21.3 TRANSFORMER BUILDINGS

(a) The designer shall request previous example designs from CCC EICA Engineer.

(b) All conduits shall be sealed with removable firestop material. All apertures shall be sealed to prevent rodent entry and air egress.

(c) All buildings shall be built to IL3 or IL4 if required.

(d) Light fittings and switch shall be installed in the room. Separate lighting switches are required for each room.

(e) A double 3pin utility outlet shall be installed in the room

(f) The HV Contractor shall provide all necessary signage to meet requirements, including exit signage for the doorway and existing doors.

(g) Doorways to be big enough to allow removal of transformers and adequate ventilation.

(h) A physical separation of 50 mm is required between communication and control cabling as per AS/NZS3000.

(i) The Contractor shall supply and install all necessary cable support and access facilities associated with the cable installation including ladders, cable trays, cable covers, trunking, conduit, and ducts.

(j) Cable support systems shall be either anchored directly to the structures via brackets and clamps or provided with suitable support componentry on the cantilever or trapeze type. Supports shall be located in accordance with the system supplier recommendations for the applicable load.

A.21.4 TRANSFORMER BUNKER

(a) The designer shall request previous example designs from CCC EICA Engineer.

(b) The structure shall be a three-sided concrete block wall, with a 2hr fire rating.

(c) A plinth for each transformer – typically 1.7m long, 0.7m wide, and 0.2m high. The Contractor shall confirm the required dimensions and construction for the actual transformers.

(d) A nib wall at the front 100mm high to form a bund within the enclosure.

(e) A drain for rainwater to an adjacent soak-hole. The drain shall be fitted with oil-sensing shut-off stop material, such as imbiberbeads (imbiberbeads.com).

(f) Provide conduit entries for the High voltage and Low voltage cables for each transformer. These shall finish 100mm above the floor level.

(g) Removable barriers with a lockable gate, shall be provided. The HV Contractor shall confirm the height and access requirements.

A.21.5 CABLE DUCTS

(a) Polyethylene ducts are more suitable for trenchless operations and some open trench installations in difficult ground conditions due to their increased strength and flexibility.

(b) Minimum size of duct for 11kv cables to be 150mm.

(c) Ducts shall typically be installed in straight runs with large radius bends at changes in direction (minimum 1.5 metres radius).

(d) Installation shall be in accordance with the duct manufacturer's recommendations.

(e) All ducts shall have sealed sectional joints, anchored draw wires and end caps for empty ducts.

(f) The spare ducts shall be capped at each end.

(g) All uPVC duct joints shall be cemented / glued.

(h) Ducts other than those installed using directionally drilling methods shall be laid on a 100mm bed of crusher dust. Ducts shall be covered by a minimum of 75mm of crusher dust. (Recommend 100-200mm).

(i) The minimum cover to the finished ground level shall be 600mm.

(j) Photograph the installed ducting for the full distance of the run underground (if the duct is installed using trenchless methods then installation results will be provided for review).

(k) GPS survey and record the exact location of the ducts for the full distance of run underground. This information shall be provided in the As-Built documentation.

(l) Backfill and lay signal warning strip at a minimum depth of 300mm below finished ground level for the full distance of the ducts.

(m) The contractor shall be responsible for verifying the trenches and the installation of the ducts to ensure compliance with this document.

(n) The designer shall liaise with CCC EICA engineer to consider installation of spare ducts for future use.

A.22 TRANSFROMER REQUIREMENTS

(a) Transformers shall be 750KVA or 1000KVA, deviations require written approval from CCC EICA Engineer.

(b) Where no design has been provided, HV cabling shall be designed and implemented by the HV Contractor.

(c) All earthing and bonding shall be designed and provided by the HV Contractor.

A.23 RMU REQUIREMENTS

A.23.1 GENERAL

(a) CCC's Preferred RMU model is the Eaton Xiria

A.23.2 FAULT LEVELS

(a) The designer shall develop or obtain a model to obtain minimum and maximum fault levels at the location of works. The designer shall document the minimum and maximum fault levels.

(b) Below are the modelled fault levels at CWTP MLC-K as of February 2024.

11kV Fault Type	**Minimum (kA)**	**Maximum (kA)**
11kV Three phase fault	6.677	10.090
11kV Single phase fault	6.638	10.070

A.23.3 OVERCURRENT & EARTH FAULT PROTECTION GRADING

(a) Overcurrent, earth fault and arc flash detection functionality shall be provided for all 11kV supply circuit breakers. RMU circuit breakers only require arc flash protection to be implemented, future functionality for overcurrent and earth fault protection shall be included.

(b) Transformer and generator 11kV CBs shall implement phase overcurrent including both inverse and instantaneous overcurrent elements. Definite time neutral overcurrent protection shall be implemented.

(c) Designer to consider if neutral overcurrent protection is required.

(d) The generator settings shall be set in between the Orion settings and the transformer settings to provide some grading with both.

(e) Implement S (short time) and I (instantaneous) protection elements on the 400V CB Incomers protection settings to improve overcurrent co-ordination with the 11kV protection and reduce arc-flash risk. Downstream 400V protection grading should be considered by the 400V designers.

A.24 PROTECTON RELAYS

A.24.1 GENERAL

(a) All HV circuits will be protected by a dedicated SEL-851 protection relay (CCC preferred model), providing overcurrent, earth fault, and arc flash detection functions. Deviations from this protection relay model require written approval from CCC EICA Engineer.

(b) The network ring and transformer/generator feeder CT's shall be specified by the designer and suitability shall be considered. Designer to provide:

i. Rated CT burden

ii. Estimated CT Burden

iii. Accuracy limiting factor required for site (at selected CT ratio)

iv. Accuracy limiting factor calculated (at selected CT ratio and applied burden).

(c) Designer to detail the elements that direct trip the CB via the SEL internal trip logic.

i. Inverse time overcurrent

ii. Instantaneous overcurrent

iii. Neutral instantaneous overcurrent

iv. Cable box arc flash sensor pickup

v. Rear chamber arc flash sensor pickup

vi. Control room pushbutton trip (only when in REMOTE mode)

(d) Protection relay settings shall feature two options for manual close and trip of each circuit breaker – via the relay HMI and via external pushbuttons located in the site control room.

i. To trip/close via the HMI interface, the relay must be in LOCAL mode. The external control room push buttons will have no effect in this mode. An 8 second delay is implemented on both trip/close actions to allow the technician to exit the room. This countdown will be shown on the relay LCD screen.

ii. To trip/close via the control room push buttons, the relay must be in REMOTE mode. The relay HMI trip/close buttons will have no effect in this mode. An 8 second delay is implemented on both trip/close actions.

iii. For closing actions, the “Breaker Closed” LED will flash during this 8 second delay period. For tripping actions, the “Breaker Open” LED will flash during this 8 second delay period. During the 8 second delay period, the command can be cancelled by pressing the opposing button, i.e. to cancel a trip command press the close button. To cancel a close command, press the trip button.

(e) Arc flash protection will be enabled on all RMU HVCB’s using two point sensors in different locations.

i. The first point sensor will be located in the cable compartment of each RMU way to capture cable related arc flash events.

ii. The second point sensor will be located in the lower rear chamber.

iii. Designer to investigate voltage or current supervision requirements.

(f) The default front panel LED labels will need to be changed to reflect the settings. The LED labels are as follows with changes in bold.

LED	Label
Non-target LED_01	Enabled
Non-target LED_02	Trip
Target LED_01	Warning
Target LED_02	Local
Target LED_03	INST OC
Target LED_04	Phase OC
Target LED_05	Gnd/neu OC
Target LED_06	Arc Flash
Target LED_07	CB Closed
Target LED_08	CB Open

(g) Display points

Display Point	Information
DP1	Average Phase Current
DP2	Neutral Current
DP3	Circuit breaker ID / Device Number
DP4	CB Earthed
DP5	Trip Circuit Supervision
DP6	Breaker Fail
DP7	CB DC Supply Alarm
DP8	Hardware Alarm

(h) The following conditions shall be added to the SEL-851 customisable warning list. If any of these conditions occur, the associated LED (Target LED_01) will turn on Should the warning LED illuminate, the display point information shown on the HMI screen will show which condition has caused the warning alarm.

i. Relay diagnostics – hardware alarm Diagnoses internal relays faults such as RAM, power supplies etc.

ii. Trip circuit fail/faulty.

iii. CB DC supply fail

(i) SCADA shall not be used for control of the relays. SCADA will be used for relay indication using Communications via MODBUS/TCP.

(j) An SEL counter is used to count the number of trip commands that have been issued. This counter will include manual trips issued via the relay HMI or the control room pushbuttons.

A.24.2 ARC FLASH

(a) The Contractor is to install SEL-851 arc detection point sensors at all HV circuit breaker cable boxes. All sensors shall be connected to the corresponding inputs on the relay in the RMU control cubicle.

(b) To ensure the safety of those working on and around the equipment, an assessment of arc flash hazard levels shall be carried out.

(c) Use the IEEE Standard 1584 for working distances and typical conductor gap.

(d) Designer to detail arcing current, clearing time, cal/cm2 at Working Distance, Boundary (mm) and Required PPE for all RMU's.

A.24.3 TESTING REQUIREMENTS

(a) The RMU's non-relay dependent functions are to be fully tested and proven prior to relay testing; this includes local CB, DIS/ESW electro-mechanical operations, safety interlocking, and all other functions that are manufactured with the RMU.

(b) The following test requirements are an overview only. Full inspection and test plans are to be produced by the test contractor.

i. Phase CT checks, Verify the CT-to-relay path using primary injection. Confirm the CTs are wired as per the design schematics. Verify that the relay meter data corresponds to the test values. Verify the metered values are relayed to SCADA

ii. Provide SEL851 test points for technician testing.

iii. Control function checks, open/close via the relays HMI, CB open/close via the control room push buttons.

iv. Ensure that the CB Open LED, and CB Closed LED, correspond to the correct circuit breaker status. Ensure all other conditions cause the corresponding LED to illuminate.

v. Ensure that all LEDs and display points function properly.

vi. Check the worst-case ambient light detected by the arc flash sensors is no more than 50% of the trip settings.

(c) Ensure all indications can be accessed via MODBUS/TCP:

i. CB Open/Close Status.

ii. CB Earth Position Status.

iii. Trip Indications (Inverse overcurrent trip, Instantaneous overcurrent, Earth Fault definite time).

iv. Arc Flash Indications.

v. Software/Hardware Alarms.

vi. DC Supply Alarm A, B, C Phase and Phase RMS Currents.

vii. Neutral, residual, neg. sequence current.

viii. Relay status.

ix. Fault Count.

x. Trip circuit supervision.

A.24.4 PROTECTION CABINET REQUIRMENTS

(a) SEL-851 protection relays shall be installed in RMU control cubicles.

(b) Control and indication of the 11kV switchgear is via the respective protection relay. Local control is provided by pushbuttons.

(c) The protection and control systems are supplied at 24 VDC via a battery system in the RMU control cabinet.

(d) New protection settings are required to be applied to the protection relays. The Contractor shall apply the settings supplied by the Designer and test and commission them.

A.24.5 REMOTE CONTROL CABINET REQUIRMENTS

(a) The designer shall request example designs to be provided by CCC.

(b) Remote control shall not be implemented in the SCADA system.

(c) An RMU control cabinet shall be supplied to house the RMU controls indication lamps, 24VDC power supply batteries and charger. The CCC preferred model is the Rittal 5306.190 Enclosure with glazed door (800w x 600d x 2000h mm).

(d) The cabinet shall include seismic bracing. The CCC preferred model is the Rittal 8618.600 Seismic Bracing Kit.

(e) The cabinet shall include a clear front door and shall be lockable. The CCC preferred model is the Rittal 8619.033 40U Swing Frame & 8619.041 Mounting Kit.

(f) Distribution shall be provided within the cabinet for isolation of the loads.

(g) Batteries and a battery charger shall be supplied to provide 120AHr capacity. There shall be a segregated bottom section to house the batteries.

(h) A GOOSE (IEC 61850 protocol) capable Ethernet Switch is required.

A.25 11KV CABLE REQUIREMENTS

A.25.1 CABLE SELECTION

(a) All HV cables specified in the design shall comply with AS/NZS 4026:2008 and AS/NZS 1429.1:2006 and must be compatible with standard heat shrink and cold shrink jointing and termination accessories (i.e. manufactured by Raychem) that meet the requirements of AS/NZS 4805:2007.

(b) The cables specified in the design shall consider the three criteria in AS/NZS 3008.1.2:2010, the current-carrying capacity, voltage and short-circuit temperature rise.

(c) The minimum size of 11kV cable for the CWTP Ring Main Network shall be 185mm. Other cables are to be sized according to the Temperature, Voltage and Current requirements.

A.25.2 CABLE INSTALLATION

(a) Cables shall be laid as per design drawings and as per manufacturer's recommendations. Refer to AS/NZ 3000:2007 for details on cable installation.

(b) Other cable design aspects shall be considered in order to provide a safe, constructible, and maintainable design:

i. Cable strike from future trenching.

ii. Cable bending radius (Practicality of the installation).

iii. Ensure a minimum separation of 600mm between 11kV network cables to maintain circuit ratings.

A.25.3 CABLE TERMINATION

(a) Cables shall be terminated as per manufacturer's instructions and industry best practice.

(b) The terminations to the HV bushings shall be of the elbow type manufactured by NKT, Australmold or approved equivalent.

(c) The terminations made to HV switchgear shall be standard heatshrink terminations.

(d) The terminations to transformers LV bushings shall be of Polaris PTLIH type or approved equivalent.

(e) Design consideration shall be taken into account to terminate the HV and LV cables on the relevant plant.

A.25.4 CABLE JOINTING

(a) Cables shall be jointed as per manufacturer's instructions and industry best practice.

(b) Any jointing info/labels are to be supplied as part of As-Built documentation.

(c) Joints shall be located away from bends and where the cable may be under mechanical stress.

(d) All buried joints shall be GPS surveyed and located, refer to section A.27.2.

A.26 EARTHING

(a) The provision of earth bonding throughout the installation (electrical services and structure) is the responsibility of the contractor in conjunction with the electrician and shall comply with New Zealand Safety Regulations 2010, AS/NZS 3000 and NZ ECP35.

(b) The earth continuity conductor shall be adequately sized by the designer in accordance with the Electricity Regulations 2010 and NZ ECP35.

(c) The contractor shall supply earth continuity conductors for all circuits and sub circuits relating to scope of the design whether specifically detailed or not in the documents.

(d) All earthing conductors to be buried or immersed within concrete shall be visually inspected by the Designer prior to covering. All 11 kV cable screens shall be "two point" bonded (bonded at both ends).

A.27 DOCUMENTATION

A.27.1 AS-BUILT DOCUMENTATION & DRAWINGS

(a) All documentation shall be supplied in a timely manner. A complete set of as-builts shall be sent to both the Principal and EICA Engineer.

(b) Relevant certified civil, structural reports and producer statements are acquired and shall be included as part of the design certification documentation which will be provided for the 'Construction Issue' of the drawings & documentation.

(c) On completion of the installation the Contractor shall provide As-built documentation for all aspects of the installation. This shall include:

i. Product data and user manuals for all equipment installed.

ii. Electrical drawings with all as-built modifications detailed in CAD format.

iii. Electrical test records.

iv. Copies of all guarantees properly executed.

v. Copy of the CoC, ESC and record of inspection.

A.27.2 CONSTRUCTION EVIDENCE & SURVEY

(a) Photographic evidence of the installed cable for the entire length of the underground route shall be provided to the Electrical Inspector.

(b) The Contractor must ensure the precise placement of the cables for the entire length of the underground run is GPS surveyed and recorded prior to the trench backfill. This data must be included in the as-built documentation from a reputable survey contractor. This is especially relevant to underground cable Joints.

(c) The HV Contractor is to provide the electrical inspector photographic evidence and sketches of the earthing system, including the positions and terminations of the earth electrodes.

A.27.3 SAFETY IN DESIGN

(a) As part of the design, safety considerations are being taken into account through the life cycle of the project. This includes design, construction, commissioning, maintenance and decommissioning.

(b) A safety in design register shall be produced by the designer and is required as a deliverable to CCC.