



**WESTERNPORT WATER**

Trading name for

**WESTERNPORT REGION WATER CORPORATION**

**ABN 63 759 106 755**

**STANDARD ELECTRICAL SWITCHBOARD  
SPECIFICATION**

VERSION CONTROL				
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# ELECTRICAL SWITCHBOARD SPECIFICATION

## 1. GENERAL TECHNICAL SPECIFICATION

### 1.1 Standards and Wiring Methods

All equipment supplied, materials used and techniques used shall conform in all respects to the requirements of the latest issues of the specifications of the Standards Association of Australia, referred to herein as A.S. Electrical wiring methods shall be in accordance with the requirements of AS/NZ 3000:2008 and to the satisfaction of the "Code of Practice – 1999 - Service and Installation Rules" and the "Electrical Safety (Installations) Regulations 1999".

If there is any conflict between the terms of any of the above mentioned specifications and this specification, this specification shall preside.

### 1.2 Manufacturers' Brand name and Model Numbers

When brand names and model numbers are mentioned in this Specification and on the drawings, they are used only to describe the type of equipment and/or materials required and this must not be read to imply preference over any other product of equal quality and/or performance.

Where it is proposed to substitute equipment or materials different to that specified the contractor shall provide adequate verification in writing to the Superintendent that the equipment offered is equal to or better than that specified.

### 1.3 Contractor Drawings

Within two weeks from the date of acceptance of the contract, and prior to fabrication, the Contractor shall submit the following drawings for approval to the Superintendent.

For each Job:

- (i) Control Schematic
- (ii) Power Schematic.
- (iii) Telemetry Interface Schematic.
- (iv) Switchboard construction details with general layout and equipment arrangement details, list of equipment and materials and label schedules.

Within two weeks of final commissioning the Contractor shall supply to the Superintendent a full set of "As Constructed" reproducible drawings, three sets of prints and one file copy on disk of each drawing in DXF or DWG format. Drawings to include all final and correct information such as wire numbers, tag numbers, relay numbers, label details, etc. Line numbers to be included on each schematic with relay contact type and number and its

associated line number referred to beside each relay coil.

#### **1.4 Factory tests and inspection**

The Contractor shall inform the Superintendent when the switchboard is completed prior to any equipment being mounted or wiring commenced so as the Superintendent can factory inspect for quality of manufacture and painting where applicable.

The Contractor shall inform the Superintendent prior to shipment of the completed switchboard with all equipment mounted and wired so as the Superintendent can routine test.

The tests shall be carried out by the Contractor and witnessed by the Superintendent and/or his nominated representative. The program for testing is to be formulated by the Contractor and approved by the Superintendent. Testing shall include functional testing of all equipment to verify correct operation of all control functions as per the Specification.

Costs associated with setup for testing, necessary equipment for testing and testing itself are the responsibility of the Contractor. The testing should enable thorough checking and the simulation of the normal modes of operation.

#### **1.5 Packing and Transport**

The Contractor shall be responsible for suitable packing and transportation to the delivery point. Packing and protective coverings shall be applied to avoid risk of any damage including paintwork damage during transit and any damage which does occur shall be rectified to the satisfaction of the Superintendent.

#### **1.6 Commissioning**

The Contractor shall be required to commission the equipment in accordance with provisions of Clause 31 of General Conditions of Contract. Commissioning tests will be carried out by the Contractor and witnessed by the Superintendent and/or his appointed representative and shall include tests to verify correct operation of all equipment. The Contractor is to prepare the program for commissioning and forward this program to the Superintendent for approval one week prior to commissioning.

## **2. SWITCHBOARD DETAILS**

### **2.1 INDOOR SWITCHBOARDS**

#### **2.1.1 Description**

Indoor switchboards shall be free standing, front connected, low voltage (415/240 V nominal), weatherproof enclosed cubicle type units incorporating protection, controls and starting equipment together with main switches and ancillary plant and other sub circuit protection and controls.

#### **2.1.2 Construction**

Switchboard construction shall comply generally with the requirements of AS 1136 for cubicle type switchgear and control gear assemblies. Adequate space including

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clearance distances and maintenance access shall be available for all equipment and for the accommodation of external cable entry and connections.

Internal segregation shall be provided between each compartment or section serviced by a door or a removable access panel excepting that bus or cabling compartments may be continuous. Segregation of functional unit compartments shall be as set down in AS 3439 for Form 4 switchboards.

Switchboard enclosures shall be of welded construction with internal stiffening members or framing as necessary to ensure overall strength and rigidity. Equipment mounting plates, brackets, etc. shall be provided for fixing of all internal equipment; fixings shall not be made through external panels. Panel joints and edges shall be folded or continuously seam welded and ground smooth to seal against the ingress of dust and moisture. Additional stiffening and support members shall be provided where necessary to support any heavy equipment.

### **2.1.3 Material**

Material of the switchboard shall be marine grade aluminium free of dents, blemishes, or scale of a minimum thickness 3mm. Painting to be in accordance with Clause below.

### **2.1.4 Doors**

Doors shall be constructed of material of same type and thickness as that specified in Clause below. They shall be of folded section and shall be fitted with stiffening members to ensure adequate rigidity without warping. They are to be fitted with a door rim and black "Neoprene" seal arrangement as detailed on typical drawings, so as to form a dust and moisture tight seal when the door is closed.

Hinges shall be provided that adequately support the door and shall be chrome plated. They shall be the pintle type hinges with a stainless steel pin. Hinge fixing screws shall be fully concealed where hinges are exposed.

Door handles shall be a chromium plate lockable T-handle keyed to the "Lockwood" CLOO 1 locking system

Doors larger than 600mm high shall be fitted with a "three-way" roller latch, arranged to fasten the door at the top, bottom and mid point.

Access Doors and panel which are intended to be opened by "Authorized Electricians Only" shall be constructed as for doors described above, including "Neoprene" sealing arrangements. Fixing shall be via chromium plated "captive bolts". These doors and panels shall be suitably labelled with a white label with red letters; "ACCESS TO AUTHORISED PERSONNEL ONLY".

Doors to the control cabinet shall be fitted with sealing rubber to provide a minimum of 10mm bearing area onto the doorframe. Each door shall have self-locking lever action retainers. All external doors must have lever action retainers fitted to prevent

doors from closing while cabinet is being accessed

One only hinged lap top computer platform shall be installed at a convenient location in relation to the common control panel.

#### **2.1.5 Cable Entry**

Cable entry shall be from below. All cables shall enter via the bottom cable zone through suitable non-corrosive cable glands installed in a hot dip galvanized or aluminium gland plate.

Building light and power wiring entry can be via the rear of the cable zone or as directed by the Superintendent. In these instances it is where the cabling is to be "hidden" in the pump station wall cavities thus alleviating the need to install exposed conduits on the internal walls of the pump station.

The cable zone is to be partitioned from the rest of the switchboard to prevent the ingress of dust and moisture and gasses.

#### **2.1.6 Escutcheon Plates**

Escutcheon plates shall be provided within operator accessible compartments such that the operator is fully protected from all equipment when the door is opened. The escutcheon shall be neatly cut such that all switch and circuit breaker toggles, fuse carriers, etc, are accessible without removal of the escutcheon plate. Spaces to accommodate future additional switches, circuit breakers or fuses shall be pre-cut and neatly blanked by removable strips.

All escutcheon plates shall be flame resistant and affixed to flanges within the switchboard by plated knurled head screws.

#### **2.1.7 Plastic Covers**

Clear plastic covers are to be provided where contactors and control gear occupy the same compartments as the circuit breakers and fuses. Any reset buttons required shall be mounted on this clear plastic cover. This cover shall be sufficiently strong to withstand the pressure exerted by the operator when operating the reset buttons.

Where control devices and/or instruments are mounted on doors which are open-able by the plant operator all terminals and wiring on the rear side of the door shall be fully enclosed behind a removable clear plastic cover to prevent accidental contact.

#### **2.1.8 Plinths**

All switchboards to be provided with 100mm high mild steel hot dip galvanized plinths. For the outdoor aluminium switchboards the plinth is to be electrolytically isolated via a continuous neoprene seal between the underside of the switchboard and the top of the plinth. The switchboard is to be securely fastened to the plinth with stainless steel bolts.\

## **2.2 PAINTING OF SWITCHBOARDS**

### **2.2.1 Preparation**

All preparation and finishing shall be executed by experienced and competent tradesmen in accordance with the paint manufacturer's recommendations." Any alternative offer shall be accompanied by a similar detailed specification and must be approved by the Superintendent before any painting work is commenced.

Switchboard surface preparation and painting shall be as follows:

- (i) Clean all surfaces with a suitable cleansing fluid.
- (ii) Wash, dry and prime with two-pot epoxy primer to a minimum film thickness of 0.05mm.
- (iii) Final finish shall be two coats of a two-pot polyurethane full gloss paint with a minimum time of 24 hours between coats, .

### **2.2.2 Colour and Standard of Finish**

Internal switchboard and equipment mounting plates shall be white.

The external switchboard colour shall be "saltbush" as per the Lysaght colour standard.

Finished work shall be free from blemishes such as sags, runs and "orange peel" effect.

During transportation and installation every care shall be taken to avoid paint work damage; any damage, which does occur, shall be repaired to the satisfaction of the Superintendent.

## **2.3 OUTDOOR SWITCHBOARD**

### **2.3.1 Power Supply**

The contractor shall supply and install a three (3) phase, 415 volt, 4 wire underground service to the pump control cabinet from the nearest street distribution pillar. Overhead power lines will not be permitted.

### **2.3.2 Cable**

The incoming power cable shall be installed underground and be protected via an underground grade conduit, as per AS 3000/2008. Entry into the switchboard shall be directly below the Supply Authority (SA) metering section of the Switchboard and Control Assembly (SCA).

### **2.3.3 Connections**

All connections within the control cabinet shall be made or arranged by the contractor. I.e. (supply authority).

### **2.3.4 Fees**

The contractor shall arrange for the supply authority inspection fee and connection

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fee to be paid and all non-compliances are to be rectified at the contractors own cost.

### **2.3.5 Material**

Outdoor switchboards shall be generally as per details for indoor switchboards except that material is to be 3mm thick Marine Grade Aluminium and painting as per Clauses below with internal colour Gloss White and external colour Saltbush (Lysaght colour). All external joints and edges shall be continuously seam welded and ground smooth for waterproofing.

### **2.3.6 Roof**

The roof shall slope slightly to the rear and overhang doors sufficiently to prevent ingress of moisture. End of roof overhang to be "upturned" slightly. Outdoor switchboards to be fitted with vermin proof louvers at the top and bottom of each end for ventilation purposes.

### **2.3.7 Gland Plates**

Gland plates for outdoor switchboards shall be marine grade aluminium plate strong enough to support installed cables.

### **2.3.8 Access**

To allow for suitable access, the plinth and control cabinet shall be positioned with a minimum of two- (2) metres clear, level standing space in front of the control panel. It shall be positioned so that this clear standing area does not include any lids or well openings but allows good visibility into well.

### **2.3.9 Plinth**

The concrete plinth shall have bevelled edges. Conduits to control cubicle for power supply and wet-well wiring shall rise through the plinth. The entire standing space in front of the panel shall be 100mm concrete paving.

### **2.3.10 Seals**

Doors to the control cabinet shall be fitted with continuous sealing rubber to provide a minimum of 10mm bearing area onto the doorframe and achieve a IP rating of 56. Each door shall have self-locking lever action retainers.

All external doors must have lever action retainers fitted to prevent doors from closing while cabinet is being accessed.

### **2.3.11 Manual/Auto Control of Pumps**

Primary control will be a MJK Hydrostatic Transducer to SCADAPack 32 RTU/Controller and Proface touch screen, with level indication, a high level alarm will be connected by a float switch directly to the high level alarm relay which operates the alarm light and/or input to the telemetry unit. The telemetry high level input is to be supported by battery back up.

## **2.4 EQUIPMENT WITHIN THE SWITCHBOARD**

### **2.4.1 Main Switch**

The Main switch will be sized to the maximum load of the Switchboard + 25% and will be a Load brake change over switch, labelled as Normal supply/Off/Generator supply. To move from normal supply to generator supply, or in reverse, the switch will be designed so it can only be moved to the off position first. The generator supply will close contacts to the Generator Inlet socket, and be interlocked so that the normal supply and the generator supply cannot be closed together at any time. In the case of a permanent generator being part of the contract, the Contractor shall supply and install an automatic transfer switch in the switchboard.

### **2.4.2 Switchgear**

All electrical equipment shall be internally mounted, (preferred method is by din rail mount) on panels or the panels shall only be accessible from the front (i.e. there will be no back access).

Switchgear and other apparatus fitted within the switchboard shall be arranged for total front connection. All equipment shall be neatly installed and wired such that it may be safely operated and maintained and also readily replaceable at any time.

### **2.4.3 Fasteners**

Stainless steel fasteners must be used for the mounting of all equipment in either indoor or outdoor switchboards.

### **2.4.4 Bus Bars**

Bus bars and bus droppers shall be of high conductivity copper complying with the requirements of AS C52 and rated such that temperature rise does not exceed 40 degrees centigrade for continuous operation at rated current.

Bus bars shall be contained in separate segregated sections of the switchboard or alternatively shall be insulated by PVC sleeving or PVC coating.

Bus bar supports and bracing shall be suitable for the required minimum short time, withstand current rating of the switchboard and shall be fabricated from heat resistant, non-hygroscopic insulating material. Uninsulated bars shall be sleeved for a distance of at least 50mm from each support. Connections to bus bars shall be carefully prepared and protected to avoid possible oxidation and/or overheating and shall be secured by bolt fixings incorporating a suitable locking washer.

The rated short time withstand current of the main bus circuits and "through fault" capacity of the switchboard as defined in AS 1136 shall be not less than six thousand ampere for 1 second.

### 2.4.5 Control Fuses

All Pump stations will be controlled by a SCADAPack 32 P4A 105-01-0-0 RTU and interfaced to a Proface AGP3302-B1-D24 Touch screen, the units will be installed and wired as per the attached drawings including the battery backup, the high level run on timers, and provision for telemetry Ariel cables.

All control including floats shall be at extra low voltage unless otherwise indicated.

Control fuses shall be of the non-rewireable, HRC 440-volt general-purpose cartridge type of English Electric or equivalent manufacture.

Fuses shall be rated as nominated on the drawing(s). If not nominated on the drawings they shall be selected to properly protect equipment and wiring serviced by the fuse. All fuse links shall have a rated breaking capacity of not less than 50 kA.

Fuse bases shall be equivalent to English Electric "Red Spot" with shrouded fixed contacts.

Comment [r1]: Imported from Newhaven Spec

### 2.4.6 Circuit Breakers

Circuit breakers shall be of the moulded case industrial class and fitted with both inverse time thermal trip elements and instantaneous magnetic trip elements. Circuit breakers shall have a symmetrical AC interrupting capacity as noted on the drawing. Circuit breakers shall comply with the provisions of AS/NZS 3947.2:2002.

The circuit breaker toggle shall be a "trip free" mechanism and the "tripped" position of the toggle shall be different from its "on" and "off" positions.

Where shown on typical drawings Residual Current Device combination circuit breakers are to be provided.

All motors, Solenoids, valves and other high current devices shall have independent circuit protection.

### 2.4.7 Surge Protection

All switchboards shall have MOV type surge protection of all phases.

### 2.4.8 Contactors

Motor contactors shall be Sprecher and Schuh series. Contactors shall be the air-break electro-magnetic type as per AS 3947.4.1:2001. The continuous through current and make/break capacity shall not be less than the required motor rating detailed in the specification or shown on the drawings. There shall be an appropriate de-rating allowance for secondary contactors in reduced current starters.

At the stated carrying capacity contacts shall have an intermittent duty rating of not less than Class 0.3 and a mechanical endurance of at least 5 million "no load" operations.

Contactors shall be continuously rated and easily replaced should the need arise. They shall be of the moulded block type construction incorporating double break silver

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alloy contacts or similar with suitable arc control enclosures. To avoid operational noise and vibration pole faces shall be fitted with suitable shading rings.

Each contactor shall have a through-fault rating compatible with the circuit breaker or HRC fuses protecting the motor circuit based on the rating for the largest motor which could be controlled by the contactor.

Contactors shall be equipped with not less than one normally open and one normally closed auxiliary contacts each having a 6A continuous rating. Additional auxiliary contacts shall be provided to suit the particular control circuit as detailed on the typical drawings.

#### **2.4.9 Thermal Overload Relays**

Thermal overload relays shall be "Sprecher & Schuh" or equivalent.

Current sensing thermal overload relays shall be employed for three phase motor protection. These shall be three element bi-metallic types complying with the requirements of AS 1023 for Class B devices. All relays shall include an adjustable, calibrated current setting and shall be selected to suit the full load current of the protected motor. Trip contacts/shall operate with a positive snap action and the current path in the trip circuit shall not include pivots or sliding elements.

The design of thermal overload relays shall include provision for tripping under conditions of excessive current unbalance such as the loss of low voltage phase or high voltage phase.

Where a separate "hold" relay is to be used in the motor protection circuit, thermal overload relays shall be auto resetting. In all other cases they shall be the manual reset types. The manual reset shall be by means of an extended rod operator with an associated door or escutcheon mounted push button. Alternatively or where shown on the schematic diagram, a solenoid-reset device shall be provided to facilitate electrical resetting.

#### **2.4.10 Thermistors**

Where motors are to be fitted with thermistor elements to monitor winding temperature the associated control unit shall be constructed in accordance with AS 1023 for positive temperature coefficient thermistors and shall not be the auto-resetting type; arrangements involving a "hold" relay in association with auto-resetting trip relay will not be accepted. A prominent warning label shall be mounted on or near each thermistor unit warning that

Voltages in excess of 2.5 volts must not be applied to the thermistor control units. Thermistor relays shall be Sprecher and Schuh RT3-M or direct equivalent.

#### **2.4.11 Current Transformers**

Current transformers (CT) shall be of the fully encapsulated type constructed in accordance with the relevant section of AS 3947.3:2001 and shall have a current ratio as indicated on the typical drawings. Windings shall be capable of continuous

operation at the full load rating of the installed circuit.

The Contractor shall supply and install a 4-20mA CT, preferably an IME TT1AB252A if suitable to the motor cable size.

Instrument current transformers shall be to accuracy Class 2.0 and may be of the external primary type provided the number of primary loops is as specified by the manufacturer.

Protection circuit current transformers shall have rated secondary reference voltage and accuracy limit factor consistent with the associated protection relay and its function.

#### **2.4.12 Control Transformers**

Extra low voltage (ELV) control transformers shall be of the double wound type, continuously rated, with earthed metal internal winding screen. The current rating of the control transformer shall be to suit the associated control circuit. The minimum rating of any control transformer shall be 100VA.

The secondary circuits for all control transformers shall be fused on the active side and earthed on the neutral side of the transformer.

#### **2.4.13 Switches**

Switches shall be 'on load' switches unless otherwise specified or indicated on the typical drawings and shall comply with the requirements of AS 3947.3:2001.

All switches shall be of the independent manual operation type. The operating handle shall be all insulated and be adequately sized to allow easy operation of the switch. The 'open' and 'closed' positions of each switch must be clearly and permanently marked.

Switches serving as main switches shall have their live terminals and associated contacts effectively shielded to prevent inadvertent contact when these switches are in the "OFF" position.

The main supply switch will be an interlocked main, off, generator supply change over switch, installed at a position that has easy access and operation.

Switches shall have a continuous current rating not less than is specified or shown on the drawings. If not shown their rating must not be less than 125% of the maximum demand current of the circuit controlled by the switch. Switches shall be suitable for utilisation category AC-23 unless otherwise noted and rated making and breaking capacities shall comply with table 4.2 of AS 3947.3:2001 for the said utilisation category.

The minimum short time withstand current shall be as nominated for the total switchboard.

Motor starter isolating switches shall be Terasaki safe 'T' circuit breakers for motor circuits 'CF Series Curve 1 Standard Rating' or equivalent for motor sizes up to 45KW.

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For motor sizes above 45KW Terasaki NK series or equivalent are to be used. Motor starter isolating switches are to have provision for 'locking' in the 'OFF' position for maintenance purposes.

#### **2.4.14 Selector Switches**

Rotary selector switches shall be of the cam operated oil-tight design complying with AS 3947.3:2001 and shall be suitable for flush mounting. Switches shall include engraved escutcheon plates designating both the switch function and its respective positions.

Switches shall be rated at not less than 6 ampere AC.

Auto/off/manual selector switches shall include a cylinder lock attachment so that they can be locked in the "off" position and the key removed to give true isolation of the associated motor. Key must only be removable in the 'OFF' position and the key must be unique for that switch.

#### **2.4.15 Time Switches**

Time switches shall be of the solid state type with digital time readout and easily programmed for at least six "ON/OFF" cycles per 24 hours. Battery back up or solid state backup shall be incorporated in the time switch to retain valid time in the event of a power failure.

#### **2.4.16 Indicator Lights and Push Buttons**

Indicator lights and push buttons shall comply with provisions of AS 3947.3:2001. Indicator lights push buttons shall be of the heavy-duty 'oil-tight' type.

Indicator lamps shall be extra-low-voltage, LED type, with a minimum rated life of 10,000 hours at their rated voltage. All lamps shall have a voltage rating higher than the operating voltage and shall be renewable by means of front access. The colour of lamp lenses and push buttons shall comply with Section 5 of AS 1431 Part 2 unless specified or as detailed on the typical drawings.

Indicator lights shall be the "push to test" type Sprecher and Schuh DTL3 series or direct equivalent.

#### **2.4.17 Control Relays**

In general, control relays shall be of the moulded block construction, industrial pattern complying with AS 3947.3:2001 and incorporating double break silver alloy contacts rated at 10 ampere AC.

Relay coils shall be continuously rated and be double insulated.

Control relays shall be "Sprecher & Schuh" Type CS4 or direct equivalent.

#### **2.4.18 Phase failure Relays**

For all Switchboards a Phase fail relay which switches off any running pumps or plant with a delay on timer will be provided.

Phase failure relays must be able to detect loss of one or more phases or phase reversal and have a minimum sensitivity adjustment of 0 to 15% over and under voltage.

Phase failure relays to be Carlo Gavazzi PPB01CM40B002 or direct equivalent.

Comment [r2]: Imported from Newhaven Spec

#### 2.4.19 Time Delay Relays

Time delay relays shall be of the rapid reset continuous rated solid-state electronic type with snap action contacts and calibrated time setting dial. Relays shall have a repeat accuracy of at least +/- 5% of the set time delay. Each time delay relay shall have at least one instantaneous contact and a minimum of two changeover time delayed contacts. Time delay periods to be preset as specified and adjustment range to minimally cover the specified time range.

Special reset functions must be accommodated where specified.

#### 2.4.20 Heaters and Thermostats

Surface mount cubicle heaters rated at 20 watt at 240VAC with appropriate thermostats with adjustable heat ranges of 10 to 30 degrees Centigrade are to be provided as follows:

- (i) Each telemetry compartment of each indoor switchboard.
- (ii) Every compartment of each outdoor switchboard excepting the TXU metering compartment or the distribution compartment.

All Heaters and Thermostats shall be "Rittal" or equivalent.

#### 2.4.21 Ammeters, Voltmeters and Hour Run Meters

These shall be of the flush panel mount square type and suitable to withstand the motor starting duty of the motor circuit they are connected to.

- (i) hour run meter is to be provided for each motor starter
- (ii) voltmeters to be IME RQ72E or direct equivalent
- (iii) An Amp meter is provided in the Proface touch screen and to be wired to a IME TT1AB252A 4-20mA Ct

A voltmeter and phase selector switch is to be installed on the door of each MAINS/GENERATOR switch compartment and wired to each fused phase of the phase failure relay.

The switch is to be K&N CG8A004 labelled OFF; R/W; W/B; B/R or equivalent. The indicator shall be IME RQ72E or equivalent.

#### 2.4.22 Generator Operation

Where there is a requirement for an on-site generator, the generator will be operated by a battery supplied Automatic Transfer Switch sized to the capacity of the switchboard.

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For outdoor switchboards a suitable weatherproof three-phase inlet for connection of a remote generator supply into the switchboard shall be provided. This connection shall be suitably rated to suit the pump station load and the change over mains isolator to which it is connected. It is to be a 5 pin round male socket to accept a 5 pin female plug with a threaded locked ring.

#### **2.4.23 General Purpose Outlets**

One single phase and one three phase and neutral GPOs shall be mounted on the control panel.

Single phase and three phase outlets shall be Clipsal 56 Series.

An R.C.D will supply all general power outlets.

#### **2.4.24 Earthing Requirements**

Switchboard earthing requirements shall conform in all respects to AS 3000/2000.

Equipment required to be earthed shall be connected directly to an approved earthing conductor (earth bar) by a copper conductor having an area of at least 2.5mm. Equipment of a withdrawable type shall have either a flexible earth connection from the movable portion to the fixed portion, or a plug socket connection which makes no later and breaks no earlier than any other electrical connection between fixed and moving portions.

Where mounted on a hinged metallic door, equipment shall be earthed with a flexible conductor connected to the earth bar or stud in which case the door shall also be earthed by the same conductor.

#### **2.4.25 Internal Wiring**

Switchboard internal wiring shall be neatly arranged and contained in capped plastic open slotted ducting or where ducting is not practicable wires shall be strapped together with nylon or other strong plastic ties or spiral binding to form neat looms. Where groups of wires are required to connect to equipment which is mounted on doors or access panels, the wire loom shall be arranged so that the opening and closing of the door is not impeded and the flexing of the wiring is minimised. In these instances reinforced flexible plastic tubing shall be used. A minimum of 10% of the installed cores within the wiring loom, shall be installed as spares.

All wiring shall be stranded copper wire insulated with Type V75 or V90 PVC insulating compound to AS 3147.

Power wiring shall be colour coded according to phase (Red, White & Blue) or neutral (Black) and sized to suit the circuit rating.

All control wiring shall be 1mm flexible (32/0.2mm) with insulation colour coding as follows:

- (i) 240V AC Active Red

- (ii) 240V AC Control Orange
- (iii) 240V AC Neutral Black
- (iv) 24V AC control Grey
- (v) 24V AC active Pink
- (vi) 24V AC Neutral Brown
- (vii) 24V DC Active Red with White Trace
- (viii) 24V DC Neutral Black with White Trace
- (ix) 12V DC Active Purple
- (x) 12V DC Neutral Black with White Trace

Wiring for current transformer secondary circuits shall be 2.5sq mm flexible (50/0.25mm).

Every wire shall be identified at each end with plastic engraved numeric ferrules "Critchley" Type Z or equivalent, with numbers as per the typical drawings.

#### **2.4.26 Pump Cable Termination**

Cables shall be terminated in the switchboard termination partition at the bottom of each switchboard or alternatively where space is limited directly into the starter compartment.

Termination points are to be adequate for the pump motor maximum current draw and sized sufficiently to accommodate the pump motor cable. Termination points are to be easily accessible to allow disconnection when pump maintenance is necessary.

#### **2.4.27 Terminals**

Tunnel type, rail mounting moulded plastic terminal blocks equivalent to 'Klippon' shall be provided for termination of all control wiring external to the switchboard. Terminals shall carry numeric designation and shall be segregated according to voltage and function.

Terminal groups shall be arranged and spaced to facilitate easy connection of wiring and cables and spare space shall be available on each terminal rail to accommodate at least 20% additional number of terminals.

A separate terminal shall be provided for the connection of each individual wire. Bridging links as supplied by the terminal manufacturer shall be used to interconnect 'common' terminals.

#### **2.4.28 Labels**

All instruments, selector switches and all other equipment on and in the switchboard shall be clearly identified by engraved plastic labels denoting the device's description.

Details of label texts shall be confirmed with the Superintendent prior to manufacture..

All labels shall be at least 1.5mm thick and lettering shall be black on a white background accepting that warning labels shall have red lettering on a white background. Lettering size shall be appropriate to the item labelled to ensure easy readability. Labels shall be neatly affixed with stainless steel screws or stainless steel self tapers. Self adhesive labels are not permitted.

#### 2.4.29 Circuit Identification

An index for all power and lighting circuits shall be provided on the inside of the door of the distribution compartment and shall either be laminated or sealed behind a clear Perspex sheet.

#### 2.4.30 Telemetry

A suitable location shall be allocated in the switchboard for a modular telemetry unit, Volt free contacts shall be wire to a terminal strip near the telemetry unit. Inputs required are as the supplied I/O Sheet

All remote alarm outputs shall be terminated at labelled terminal blocks mounted within the telemetry compartment for connection by others to telemetry equipment being supplied by others. All wires shall be marked at both ends.

All alarms and indicators shall be interfaced through the telemetry system.

#### 2.4.31 Variable Speed Drives (VSD)

All motors over 4KW shall have reduced voltage (soft) starting.

VSD shall be suitable for driving the integral motor and pump of KW size specified.

VSD shall be 22KW Danfoss VLT Aquadrive FC200 including keypad interface or direct equivalent.

The VSD shall include the following options:

- (i) Pump application software macro.
- (ii) Key pad programmable with programmable keypad locking function.
- (iii) Programmable features such as type motor, minimum and maximum hertz, direction, control location, input and output functions and acceleration and deceleration rates.
- (iv) Two programmable fixed speed contact inputs.
- (v) Two 4 to 20mA input control signals – one to be auto control signal from starter cabinet.
- (vi) Two 4 to 20mA programmable output signals – one to be programmed for motor speed.
- (vii) Output contact for available condition.
- (viii) Output contact for run condition.

**Comment [r3]:** Is VAIS doing this work?

**Comment [r4]:** Re-word to suit current methods

**Comment [r5]:** Correct terminology?

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- (ix) Output contact for fault condition to include for VSD fault, motor overload and motor over current.
  - (x) Input contact for run enable
  - (xi) Input contact for motor overload reset.
  - (xii) Two inputs for analogue input selection – either from remote potentiometer or external 4 to 20mA control signal.

#### 2.4.32 Soft Starters

All Motors over 4KW shall have reduced voltage starting.

Soft starters are to incorporate soft start and soft stop options suitable for driving the integral motor and pump of KW size specified.

Soft starters are to be Danfoss MCD 500 or direct equivalent sized to the maximum duty cycle of each motor, with the following options:

- (i) Soft Start with selectable kick start current limit and full voltage start.
- (ii) Adjustable ramp time on start from 2 to 30 seconds.
- (iii) Phase sequence protection.
- (iv) Soft stop with **pump control feature** to control stopping over an adjustable time period of 2 to 120 seconds.
- (v) Adjustable starting torque of 5 to 90% of locked rotor torque.
- (vi) Energy saving option to provide power savings.
- (vii) LED indication of starting, running, stopping and various faults.
- (viii) Auxiliary contacts for starter logic and interlocking as required.
- (ix) Auxiliary contacts for starter to provide “available”, “run” and “fault” status.
- (x) Keypad HMI to be mounted on the door to eliminate the need for an amp meter
- (xi) Internal Bypass Contactors

#### 2.5 SPARE PARTS

The Contractor shall supply a list of recommended spares for each switchboard and detail this list in his tender. The price for these recommended spares is to be shown on The Schedule of Prices. The following list is the minimum requirement of spares for each switchboard:

- (i) 1 off contactor coil for each size contactor used
- (ii) 1 spare of each type of ELV control relay used
- (iii) 1 spare of each type of time delay relay used

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- (iv) 1 spare indicator lamp base
  - (v) 1 spare pushbutton
  - (vi) 10 spare indicator lamps of each voltage rating used(selection of colours as required)
  - (vii) 12 spare din rail mount terminals
  - (viii) 2 spare globes for flashing alarm lamp
  - (ix) 3 off HRC cartridges of each current rating as used
  - (x) 2 spare HRC fuse holders to suit supplied fuse bases

**Comment [r6]:** Mick, these were not in N SPS spec

## 2.6 LIGHTING AND POWER

The Contractor shall supply and install power and lighting fittings, accessories and associated wiring for general lighting and power within the switchboard or building.

Fluorescent lighting fittings in the switchboard shall be twin tube type semi-industrial with reflective mount and complete with encapsulated ballast starter switch and power factor capacitor. These shall be Thorn type RZIP36 or direct equivalent.

Lighting switches and general purpose outlets shall be the weatherproof impact resistant moulded polycarbonate type Clipsal 56C series or equivalent. Location and quantity of GPOs and lights is as detailed elsewhere in this Specification.

External lights shall be Phillips Vandalite Model VL201L with opal diffuser or equivalent and mounted above the doorways.

Industrial style spotlights of 120 watt power with suitable vandal proof mesh guards shall be provided to light access driveways to indoor type pump stations. The quantity of external lights is as detailed elsewhere in this Specification.

Outdoor cubicles shall have a 15 watt fluorescent strip light installed behind each openable door, switched by a suitable industrial type waterproof, Schmersal TS236-02Z or direct equivalent, door operated switch; one for each door.

The door switch is to contain two totally segregated volt free contacts. One set of contacts is to be used for the operation of the strip light; the other set wired to the Telemetry terminal strip as an intruder alert input that will activate and shut down the HMI

All light and power shall be protected by an RCD safety switch.

## 2.7 CABLING

All cables shall be 0.6/1kV PVC insulated complying with AS3147. Conductors shall be high conductivity stranded copper to AS 1125 and shall be sized as specified or if not specified of adequate rating for the equipment or circuit attached.

Multi-core cables shall be of circular section with orange sheathing. Individual conductors of power circuit cables shall have colour coded insulation to distinguish phases, neutral and

earth. All cables shall be identified with numeric type cable markers as per switchboard specification. All cables that run through a pit shall be identified by a cable number with labels secured by SS Cable ties.

## **2.8 CONDUITS**

All above ground conduit shall be heavy-duty rigid PVC type complying with AS 2053 coloured grey.

All below ground conduits shall be heavy-duty rigid PVC type complying with AS 2053 coloured orange

Conduits to be set accurately vertical or horizontal and securely fastened to walls, ceilings, etc, by means of two hole saddles of similar material to the conduits. Saddles shall be placed at frequent intervals not exceeding 600mm and fixed with non-corrosive fasteners with stainless steel screws or pins.

Above ground conduits shall be terminated with approved glands or terminators.

All conduits that run from wet well sewer pits shall be sealed at the switchboard end with a layer of plastic or cellophane at 75mm to stop the ingress of mortar and a layer of mortar from the plastic to the end of the conduit.

A Strip of Underground Cable identification tape, coloured orange shall be placed 150mm above all underground conduits.

## **2.9 BRACKETS AND FIXINGS**

All necessary brackets for mounting of wiring systems, etc, shall be provided by this contractor. In general brackets shall be fabricated from mild steel sections hot dipped galvanised after completion. Alternatively or where specified stainless steel brackets will be utilised.

All cables entering wet well sewer pits shall be secured on cable support brackets designed for the pump flexible cable to loop around a solid rubber cylinder that is mounted on the edge of the wet well man hole entry point. There shall be a loop in the cable below the conduit entry into the well to alleviate fluid running from the cable into the conduit and to allow a service person to pull the bracket and cable onto the Pit roof.

Fixings shall be by means of stainless steel bolts nuts and washers. Fixings into brickwork or concrete shall be by means of galvanised expansion bolts excepting that plastic plugs with stainless steel screws or

Stainless steel screw/nails may be used for securing conduit saddles. All holes for fixings shall be neatly drilled to the correct size and depth. Explosive powered fixings shall not be used.