

C3.5.3

PARTICULAR SPECIFICATION FOR ELECTRICAL WORKS

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PART EB: PARTICULAR SPECIFICATIONS**EB1. PURPOSE OF CONTRACT**

The purpose of this contract is to facilitate the phased upgrade of Hammarsdale WWTW to achieve an ADWF of 27 Ml/d and improve overall process efficiency through equipment modernization. Under this contract, the following upgrades to the mechanical and electrical equipment will be achieved:

- A completely new inlet works (screening and degritting) together with a new pump station to supply the existing bioreactors.
- A completely new dewatering facility using high efficiency centrifuges together with new sludge handling and storage equipment.
- Replacement of the existing reactor surface aerators with modern, efficient units
- Replacement of existing reactor mixers with modern, efficient units
- Various upgrades to the electrical and control and instrumentation infrastructure, as detailed within this specification and the control and instrumentation specification.

EB2. REFERENCES TO PRODUCT BRANDS

It is not the intention at any point in this document to recommend any particular product brand. Any accidental references to product brands shall automatically be assumed that an equivalent product is acceptable as long as the products are fundamentally the same and fit for purpose.

EB3. SCOPE OF WORK

The Work to be performed under this Contract is in connection with the construction and erection of the electrical and electronic installation at the Hammarsdale WWTW, eThekweni, Kwazulu-Natal.

Work Included: The Work includes, but is not limited to, the supply installation and commissioning of material and equipment associated with the following systems, equipment, and services:

EB1.1 SMALL POWER AND LIGHTING SYSTEM

- a. Electrical service provisions, LV distribution network, LV equipment, distribution boards and small power.
- b. Interior and Exterior building lighting
- c. Area Lighting
- d. Removal of old redundant electrical equipment
- e. Conduits and boxes in slabs on or below grade, inaccessible space below slabs above grade, and walls below grade, in cooperation with other trades.
- f. Testing, commissioning, and full certification of the installed system

EB1.2 EARTHING AND LIGHTNING PROTECTION SYSTEM

- a. Earthing and Lightning protection system for buildings.
- b. Testing and commissioning and full certification of the installed system

EB1.3 STANDBY DIESEL GENERATOR SYSTEM

- a. Standby diesel generator system for a portion of the site electrical system.
- b. Testing, commissioning and full certification of the installed system

EB1.4 MAIN SUBSTATION MEDIUM VOLTAGE SWITCHGEAR UPGRADE

- a. Supply and installation of new MV switchgear for the main supply substation.
- b. Disconnection and removal of old isolator and oil type circuit breaker.

- c. Testing, commissioning and full certification of the installed system.
- d. MV Cable work as required.

EB1.5 SITE MINI-SUBSTATION UNIT (MSU) REPLACEMENT

- a. Supply and installation of new MSU's as replacement of the existing units which have reached the end of useful life.
- b. Disconnection and removal of existing MSU's.
- c. Testing, commissioning and full certification of the installed system.
- d. MV Cable work as required.

EB1.6 NEW HEAD OF WORKS PLANT ELECTRICAL SYSTEM

- a. Electrical service provisions, LV distribution network, LV equipment, motor control centres (MCC), distribution boards and small power.
- b. Supply and installation of a replacement MSU for the HOW plant.
- c. Tie-in and extension of the existing MV cable ring system to supply the HOW MSU, as required.
- d. Supply and installation of cable support systems, including racking, trenching, conduit as required.
- e. Testing, commissioning and full certification of the installed system.

EB1.7 NEW DE-WATERING PLANT ELECTRICAL SYSTEM

- a. Electrical service provisions, LV distribution network, LV equipment, motor control centres (MCC), distribution boards and small power.
- b. Supply and installation of a new MSU for the new de-watering plant.
- c. Tie-in and extension of the existing MV cable ring system to supply the dewatering MSU.
- d. Supply and installation of cable support systems, including racking, trenching, conduit as required.
- e. Testing, commissioning and full certification of the installed system.

EB1.8 PUMP STATION No's.1-4, AERATOR NO's 1-6 MCC AND LV RETCIULATION REPLACEMENT

- a. Supply and installation of four new MCC panels for the existing pump stations numbers 1 -4 and aerators no. 1-6.
- b. Disconnection and removal of existing MCC panels.
- c. Removal of the existing electrical cabling and field stations.
- d. Supply and installation of new cabling and motor field stations.
- e. Testing, commissioning and full certification of the installed system.

EB1.9 INFORMATION AND COMMUNICATION TECHNOLOGY (ICT) SYSTEM

- a. Included as part of the Communications and Electronics systems

EB1.10 SECURITY SYSTEM

- a. None

EB4. SITE AND SYSTEM CONDITIONS

Site Conditions

Altitude:	The altitude in the area varies between 500m and 700m above above mean sea level.
Temperature:	Ambient temperature between 15°C and 50°C. Average daily maximum ambient: 32°C. Electrical Equipment Rating: 50°C.
Humidity:	Maximum – 100 % Average – 82 %
Rainfall:	Approximately 1500 mm per annum. An average of 2 – 3 working days per month is lost due to inclement weather. No claims for delays as a result of adverse weather conditions will be considered.
Lightning:	The area is subject to severe lightning storms, approximately 4.8 flashes/km ² /year.
Pollution:	MEDIUM. Inland
Wind:	Design wind speed of 108 km/h (700 pa).
Mean annual value of solar radiation:	1,0 kW/m ²

Electricity Supply System

The nominal system voltage in the Hammarsdale area is 11 kV, 400 V three phase and 230 V single phase fed by Eskom.

The maximum MV system voltage is 12,5 kV.

The system frequency is 50 Hertz and the phase rotation is R-W-B anti-clockwise.

EB5. DETAILED SCOPE OF WORK

The works is further described below and provides information of the various items described as part of the Scope of Works.

EB3.1 SMALL POWER AND LIGHTING SYSTEM

- **Admin Building:** The small power and lighting is to be upgraded in the existing Admin Building. All lighting and power outlets are to be removed and replaced with new. In areas where there building modifications, existing power outlets and lighting is to be removed, circuit wiring removed and equipment returned to the plant maintenance team. Lighting, power outlets, deemed to be suitable for re-use will be determined during construction.
- **De-Watering Building:** This is a new building. All new small power and lighting is required to be installed.
- **Head of Works Building:** This is a new building. All new small power and lighting is required to be installed.
- **Second Class Water Pump Station:** This is a new building. All new small power and lighting is required to be installed.
- **Guard Houses:** There are two new buildings. All new small power and lighting is required to be installed.

EB3.2 EARTHING AND LIGHTNING PROTECTION SYSTEM

- **Admin Building:** Lightning protection and a new earth mat is required to be installed in the existing Admin Building. Lightning protection to be installed using 8mm aluminium conductor linked to an underground earth mat.
- **De-Watering Building:** This is a new building. Lightning protection to be installed using 8mm aluminium conductor linked to an underground earth mat.
- **Head of Works Building:** This is a new building. Lightning protection to be installed using 8mm aluminium conductor linked to an underground earth mat.
- **Second Class Water Pump Station:** This is a new building. Lightning protection to be installed using 8mm aluminium conductor linked to an underground earth mat.
- **Guard Houses:** There are two new buildings. Lightning protection to be installed using 8mm aluminium conductor linked to an underground earth mat.

EB3.3 STANDBY DIESEL GENERATOR SYSTEM

A centrally based fuel farm consisting of 2 x 1100kVA generators are to be installed outdoors next to the existing generator plant room. The generators are to be supplied and installed in separate ISO containers.

The standby diesel generator system will provide emergency back-up power to the following plant areas:

- New Head of Works
- New De-watering process
- Existing Pump Stations No's 1 and 2

The calculation of the generator capacity is based on load lists provided in sections EB3.6, EB3.1 and EB3.8, a summary of the loads is provided in the table below.

Standby Diesel Generator System - Load List		
Plant Area	Running Load (kW)	Demand (kVA)
Head of Works	255	318
De-watering plant	125	156
Pump Station No. 1	327	409
Pump Station No. 2	193	241
Total	900	1125
Diversity Factor	0.85	
Peak Load	765	956

Each generator is to be supplied with a 1000L service tank mounted in the base or stand-alone inside each container unit.

Generator Unit

The contractor to supply and install 2 x 11100kVA generator units in individual ISO container units. All products shall be new and approved by the Engineer prior to manufacture. Each container to be new and include the following:

- Prime rated 1100kVA generator system, radiator cooled.
- Lockable access door for operation and maintenance activities
- Acoustic panels to comply with maximum noise levels specified
- Ventilation for generator air flow and cooling requirements
- Small power and Lighting
- 2 x hand held fire extinguishers (Powder)
- Local distribution Board
- Battery Charger circuit and wiring to battery charger unit
- Generator Heater circuit and wiring to the generator heater unit
- Generator controller, linked to DSE controller on emergency panel
- Insulated exhaust system
- Access to all maintenance related activities
- Colour - White

Fuel Tank – Service Tank (Day Tank)

- A service fuel tank shall be supplied as part generator unit. The tank shall have a diesel capacity of 1000 litres. The fuel tank shall be a free-standing type or part of the generator base unit.
- A water trap is fitted in the fuel pipeline from the tank to the engine.
- The tank shall be fitted with a suitable filter, a fuel gauge glass, "low fuel level" alarm, giving an audible and visible signal on the switchboard as well as a low-low fuel level cut-out.
- The interconnection fuel piping shall consist of copper tubes and the connection to vibrating components shall be in flexible tubing with armoured covering.
- A fusible link shut off valve to be provided to automatically shut off the fuel system in case of fire.

Fuel Tank – Bulk Tank

- A Bulk fuel tank shall be supplied to feed each generator Service Tanks. To comply with SANS 10131 requirements. A fire rating and manufacture certificate to be provided.
- The tank shall have capacity for 3000L of diesel Fuel. The fuel tank shall be a free-standing type and mounted as indicated on the drawings.
- Colour - White
- The tank shall be fitted with a suitable filter, a full height gauge glass. A level transmitter with "low fuel level" alarm, giving an audible and visible signal on the switchboard as well as a low-low fuel level cut-out.
- The fuel supply from the Bulk tank to the Day tanks to be via automatic filling via pump feed based on day tank levels. The following to be provided for:
 - Bulk tank fuel supply control system to be independent of other tank levels.
 - Self-priming centrifugal Fuel pump with minimum 20l/min flow rate.
 - 4-20mA transmitters in each tank (3No.)
 - Control panel for the power supply and control system. Wall mounted.
 - IP65 rated Fuel level indication panel complete with:
 - i. HDMI screen indicating levels of all 3 x tanks. Visible from outside of box.
 - ii. C/B, Overload control
 - iii. "auto / Manual / Off switch"
 - iv. Start / Stop Button.
 - v. Indicator Lights. Run, stop, trip

- The contractor to supply and install an electrically operated self-priming centrifugal pump with 2 x 10m length of oil resistant hose for filling the bulk or day fuel tank/s from 200 litre drums. Items to be included:
 - self-priming centrifugal pump with minimum 20l/min flow rate.
 - 2 x 10m oil resistance flexible hoses connected to the pump.
 - Secure pump system under cover
 - Wall mounted IP65 rated control panel
 - i. C/B, Overload control
 - ii. "Run, / Off switch"
 - iii. Start / Stop Button.
 - iv. Indicator Lights. Run, stop, trip
- The interconnection fuel piping between the bulk tank and the day tanks shall consist of copper tubes and the connection to vibrating components shall be in flexible tubing with armoured covering.
- A bulk fill point shall be provided outside the bund wall for diesel bulk fill from the fuel truck. A 40mm dry break coupling and 40mm pipework to be installed.

Automatic Change-Over systems

- Due to multiple LV supplies from various transformers, new automatic change-over panels are to be installed at the various pump rooms (5No.). New change-over panels are to replace the existing manual change-over panels at Pump Station 1 (2No.), Pump Station 2 (1No.). New change-over panels to be installed at the Head of Works building and the De-watering building.
- The change-over panel to include the following as indicated on the Schematic:
 - Circuit Breakers
 - 4-Pole change over system
 - By-pass system
 - Indication meters and lights

EB3.4 MAIN SUBSTATION MEDIUM VOLTAGE SWITCHGEAR

The existing main substation MV switchgear is to be replaced with new equipment, the scope of work will include the following:

MV Switchgear

Design, manufacture, FAT, delivery to site, off-loading, installation, SAT and commissioning of the 3 panel 11 kV board installed in the main substation. The following specific criteria must be included:

- The substation room dimensions are approximately 4m x 4m, with the panels required to fit in with the required clearances.
- The MV switchgear will be metal clad indoor type, with SF₆ or vacuum circuit breakers, as per the switchgear data sheets.
- The MV board will include one incoming circuit breaker and two feeder breakers.
- The incoming circuit breaker shall include a voltage transformer.
- The new panels must adhere to EtheKwini Water and Sanitation Standards in terms of specifications, equipment and operation.
- On-site testing of the completed panels including primary injection of CT's, CT magnetisation curves, secondary injection of protection relay and functional testing of the panel.
- All consumables, wiring, lugs and ferrules required to complete the installation.
- The complete panel is to be fully factory tested and witnessed by the Client or his appointed representative at the manufacturer's facilities, before delivery to site.
- An Arc Fault Detection (AFD) system shall, as per the relevant standards, be installed in all 11 kV panels. A continuous thermal, current or arc light monitoring and sensing system to work in conjunction with the AFD shall initiate a trip of the circuit breaker in no more than 0.1s. The system shall meet the relevant testing standards of the IEC specification.
- Smart ready type with the following automation and monitoring functions achieved via a remote terminal unit (RTU):
 - Short circuit/earth fault indication for remote and local reading;
 - Remote switch position indication;
 - Remote opening/closing of switches;
 - Remote measurement of current, voltage (incomer), kW, kVA, kVAr, power factor;
 - Local/remote switch;
 - A.c. fail alarm;

Battery Tripping Unit

A floor standing 110 VDC battery tripping unit (BTU) with maintenance free batteries shall be supplied and installed in the substation, connected to the MV panels and equipped with/for the following:

- Constant-Voltage Charger – charger sizing must allow for simultaneous trip on battery under-voltage detection.
- Self-contained Ni-Cad batteries
- Minimum back-up time of 8 hours as well as supplying intermittent peak loads
- Potential free contacts indicating the following:
 - BTU Healthy
 - BTU Fault
 - BTU Charging

Protection Monitoring and Control

The MV switchgear protection relays require the following main features:

Overcurrent, earth fault, over/under voltage, phase reversal, overload, harmonics, breaker failure and arc fault sensing. Relays provided shall be capable of measuring, monitoring and supervising the following: current, voltage, active and reactive power, power factor frequency, event recording and CB condition monitoring.

The incoming circuit breaker is to be fitted with a power meter.

Panel Factory Acceptance Tests (FAT) and Site Acceptance Tests (SAT)

The following tests will be required as a minimum for the factory and site tests.

- FAT Tests
 - 2 kV Test on control wiring
 - Secondary Injection test on Protection relays.
 - Primary Injection test on Current Transformers.
 - Full function electrical and mechanical test.
 - Full mag curve test on CT's to determine CT knee points
 - Ductor test.
 - Pressure test.
 - Speed trace.
- SAT Tests
 - Breaker speed test
 - Injection test
 - Pressure test
 - Full functional test

Additional Site Work

In addition to the work detailed above, allowance must be made for the following items:

- The dismantling and removal of the existing MV switchgear from the substation and placement in the site lay-down area.
- Supply and installation of a MV cable between the Eskom supply point and the works Incomer panel.
- Reconnection of the MV feeder cables. Allowance has been made for the extension of the existing cables in the event of insufficient length to terminate on the new panel.
- Earthing of the panels to the substation earthing system.
- During the changeover no power will be available for installation and cold commissioning procedures. The tenderer must provide for construction power should it be required.

EB3.5 SITE MINI-SUBSTATION UNIT (MSU) REPLACEMENT

The existing electrical reticulation on site includes five 500kVA, 11/0.4kV, ONAN MSU's. The units have reached the end of their useful life and require replacement. The new MSU's to be supplied will be similar oil type with matching capacities. The following units have been identified as requiring replacement:

- MSU No. 1 – Pump Station No. 1, Reactor No. 1 & No. 2
- MSU No. 2 – Pump Station No.3 & No. 4, Reactor No.3 & No. 4 and Administration Building
- MSU No. 3 – Head of Works
- MSU No. 4 – Sludge dewatering
- MSU No. 5 – Pump Station No. 4, Reactor No. 5 & No. 6

The scope of work will include the following:

Design, manufacture, FAT, delivery to site, off-loading, installation, SAT and commissioning of five (5) 500kVA, 11/0.4kV, ONAN MSU's as per the data sheets. The following specific criteria must be included:

Equipment offered must be rated for maximum operating temperatures of 50°C.

Ring Main Unit (RMU)

The RMU will consist of:

- Two by 400A incomer/ outgoer vacuum/ SF6 circuit breakers complete
- One 400A transformer vacuum/ SF6 circuit breaker complete
- Integral earth fault and overcurrent protection.
- Smart ready type with the following automation and monitoring functions achieved via a remote terminal unit (RTU):
 - Short circuit/earth fault indication for remote and local reading;

- Remote switch position indication;
- Remote opening/closing of switches;
- Remote measurement of current;
- Local/remote switch;
- A.c. fail alarm;
- Battery charger faulty alarm;
- RTU door open alarm; and
- Ring main unit door open alarm (outdoor units).

Transformer

The transformers provided in the MSU will be rated at 500kVA, with 11kV primary connection and 400V secondary, with a Dyn configuration. A ONAN transformer is required, with natural cooling preferred. The star point is to be solidly earthed.

MSU Factory Acceptance Tests (FAT) and Site Acceptance Tests (SAT)

The MV switchgear component of the MSU shall be tested as detailed in MV Switchgear Section B3.4. The following testing is required for the transformer:

- Winding resistance
- Insulation resistance
- Voltage ratio
- Impedance test
- Vector group test
- Transformer losses
- Induced over voltage test
- Separate source voltage withstand test
- Tank sealing effectiveness
- QA/QC requirements

Additional Site Work

In addition to the work detailed above, allowance must be made for the following items:

- Disconnection of the MV and LV cables terminated on the MSU's to be replaced.
- The dismantling and removal of the existing MSU's and placement in the site lay-down area.
- Reconnection of the MV & LV feeder cables. Allowance has been made for the extension of the existing cables in the event of insufficient length to terminate on the new panel.

EB3.6 NEW HEAD OF WORKS ELECTRICAL SYSTEM

A new head of works is being constructed including screening, de-gritting and a new raw sewage pump station. In addition a new second class water system will be installed. The electrical scope of work for the new plant includes the manufacture, supply, installation, testing and commissioning of the electrical equipment required to support the processing operations. The load lists for the new head of works and second class water systems are provided in the tables below.

Head of Works - Load List					
Equipment Number	Description	Connected Load (kW)	Duty/ Standby	Running Load (kW)	Emergency Power
DO01A	Screenings dolly skip	0.55	1	0.4	1
DO01B	Screenings dolly skip				
DO02A	Grit dolly skip	0.55	1	0.4	1
DO02B	Grit dolly skip	0.55	1	0.4	1
GWR01	Grit Classifier Mixer	0.55	1	0.4	1
	Grit screw conveyor	1.1	1	1.0	1
GWR02	Grit Classifier Mixer	0.55	0	0	0
	Grit screw conveyor	1.1	0	0	0
GTR01	Grit Trap	1.1	1	0.8	1
GTR02	Grit Trap	1.1	1	0.8	1
PMP01A	Existing bioreactor supply pump	75	1	65.2	1
PMP01B	Existing bioreactor supply pump	75	1	65.2	1
PMP01C	Existing bioreactor supply pump	75	1	65.2	1
PMP01D	Existing bioreactor supply pump	75	0	0	0
PMP04A	Dry well sump pump	4	1	3.5	1
PMP03A	High pressure booster pump	7.5	1	7	1
PMP03B	High pressure booster pump	7.5	0	0	0
MSR01A	Coarse Screen	2.2	1	1.5	1
MSR01B	Coarse Screen	2.2	1	1.5	1
MSR02A	Fine Screen	2.2	1	1.5	1
MSR02B	Fine Screen	2.2	1	1.5	1
MSR03A	Ultra fine screen	2.2	1	2	1
	Ultrafine screen HP wash manifold	0.18	1	0.1	1
	Ultrafine screen cleaning brush	0.18	1	0.1	1
MSR03B	Ultra fine screen	2.2	0	0	0
	Ultrafine screen HP wash manifold	0.18	1	0.1	1
	Ultrafine screen cleaning brush	0.18	1	0.1	1
WHC01	Coarse and fine screenings Washer Compactor screw	2.2	1	1.5	1
	Coarse and fine screenings Washer Compactor agitator	0.37	1	0.2	1
WHC02	Coarse and fine screenings Washer Compactor	2.2	0	0	0
	Coarse and fine screenings Washer Compactor agitator	0.37	0	0	0
SCC01A	Ultrafine screenings conveyor	2.2	1	2	1
SCC01B	Ultrafine screenings conveyor	2.2	0	0	0
WHC03	Ultrafine screenings strainer and compactor	1.1	1	1	1
WHC04	Ultrafine screenings strainer and compactor	1.1	0	0	0
SCC01	Grit Slurry Pump	3	1	2	1
SCC02	Grit Slurry Pump	3	1	2	1
	Control Transformer (400/220V 2kVA)	2	1	1.0	1
	Welding Plug 1	20	1	20	0
	Welding Plug 2	20	0	0.0	0
	Small power and lighting DB feeder	25	1	15	1
	Instrument distribution board	18.5	1	12	1
	Total (kW)	443		275	255

Second Class Water System - Load List					
Equipment Number	Description	Connected Load (kW)	Duty/ Standby	Running Load (kW)	Emergency Power
	Second Class Water Pump 1	15	1	12.0	0
	Second Class Water Pump 2	15	1	12.0	0
	Second Class Water Pump 3	15	1	12.0	0
	Second Class Water Pump 4	15	0	0.0	0
	Control Transformer (400/220V 2kVA)	2	1	1.0	0
	Welding Plug 1	20	1	20.0	
	Small power and lighting DB feeder	10	1	8	0
	Total	92		65	0

The following main scope of works are identified, with full technical detailed provided in the data sheets, technical drawings and bill of quantities:

Motor Control Centre's

Manufacture, fabrication, assembly, testing, delivery to site, installation and commissioning of the MCC panels for head of works and second-class water system. The HOW MCC will be installed in the substation room of the new head of works building and the second class water system will be installed in the existing screened sewage pump station building. The following points are noted:

- HOW MCC
 - Rating - 630A, 400V, 25kA MCC
 - Temperature Rating - 50°C.
 - Top cable entry required
 - The front/ rear access and layout to be proposed by the tender considering the substation size. A back to back MCC panel located in the centre of the room has been considered, allowing only front panel access.
 - MCC load list is provided in the table above.
 - Applicable drawings:
 - 60325-E-LI-100 HOW MCC Panel Single Line Diagram
 - 60325-E-LI-101 HOW MCC Panel General Arrangement Diagram
 - 60325-E-GW-901 MCC Typical Schematic Drawings
 - Cable Schedule for the HOW MCC panel is provided in Section EB11
- Second Class Water MCC
 - Rating - 200A, 400V, 25kA MCC
 - Temperature Rating - 50°C.
 - Bottom cable entry required
 - Front and rear access
 - MCC load list is provided in the table above.
 - Applicable drawings:
 - 60325-E-GW-911 Second Class Water MCC Panel Single Line Diagram
 - 60325-E-GW-912 Second Class Water MCC Panel General Arrangement Diagram
 - 60325-E-GW-901 MCC Typical Schematic Drawings
 - Cable Schedule for the Second Class Water MCC panel is provided in Section EB11
- Interface with the PLC control system will via Modbus TCP on Ethernet. Communication cables between the smart motor controllers, VFD's, power meters and the PLC network switch must be CAT6 STP Ethernet cables All motor control relays, and communication devices shall be programmed under this contract by the contractor.
- The PLC panel must be integral to the MCC panel, detail of the PLC panel size is provided in the C&I specification document.
- The cold commissioning shall include simulation of the motors being started from their local position and from the HMI via the PLC.
- The positions of the MCC's are shown on the layout plan drawing:
 - 60325-E-LI-102 Inlet works cable racking and routing drawing.
- The MCC's shall be equipped to provide the control function described in the process and instrumentation diagrams and in the instrumentation and control specification.
- Future loads have been indicated on the single line diagram – "greyed" out. Cubicles must be equipped for the loads as per the schematic drawings.

Unless otherwise stated all MCCs shall, as well as complying with the Standard Specification, shall comply as follows

- Be designed and manufactured in accordance with SANS 1973 and SANS / IEC 61439-1
- The control equipment shall conform to SANS / IEC 60947 Parts 1 -7
- Be suitable for operation on supply voltages of 400 Volts, 50 Hz, AC and a control voltage of 231 volts AC.
- Switchgear selection to be for type two co-ordination.
- Type tested and partially type tested certificates to be supplied.
- Temperature rise assessment/calculations to be supplied. - ambient temperature of 35° C and a maximum of 45° C to be used in calculations.
- Form 4A
- Be floor mounted and have IP rating of IP 54
- Have Top entry for all cables.Suitable gland plates to be provided.
- Be electrostatically spray-painted exterior quality epoxy electric orange colour B26.
- The control voltage shall be 220VAC.

- The design of the MCC shall make provision for extracting hot air from the VSD's and other equipment where this equipment is contained within the MCC enclosure.

The work will include:

- Design and preparation of detailed design drawings in accordance with the manufacturer's standards.
- Labelling of the MCC, cubicles and all equipment inside the cubicles.
- Proof of SANS compliance to be provided.
- Provision of substation safety signage and equipment, including suitable portable fire extinguishers.
- The supply and installation of the network communication cables from the individual MCC cubicles to the PLC panel.

Due to the space constraints of the substation room, VFD's for drives greater than 37kW may be offered in standalone panels supplied from MCC feeders. The VFD panels must include the following equipment:

- Input and output chokes
- Door mounted programming devices

LV AND CONTROL CABLES

All cables and labelling are to be supplied by the contractor. Lengths as shown on the cable schedules are estimates only. Quantities for order are to be determined by contractor based on, on site measurement. All cables are to be measured on site before being cut. If the cable is found to be too short it will be for the contractor's account to rectify. Cable joints on newly installed or supplied cables will not be accepted without written prior approval by the engineer. All cables shall be Red Stripe.

The following work is included:

- The installation, termination, jointing and connection of all the LV power cables, earthing and control cables as per attached cable schedule. The cable termination rate is to include cost of all required material including glands, lugs and ferrules.
- The manufacture, supply and installation of field stop / isolator stations.

Earthing of all new motors will be done via the fourth core of the power cable.

Notes:

- Future equipment cabling has been excluded from this scope of work. Cable racking has been sized to allow for future installation.
- All glands to be of Pratley Envirogland or equivalent.
- All crimping dies are to be in perfect condition, correctly sized and suited to the lug to be crimped. The lugs are to be of the correct type and size for the cross section of the cable to be crimped.
- All control cables are to be double ferruled with bootlace ferrules and with the numbers at the supply and destination ends.
- All cable ties are to be fully weather and ultra violet resistant.

CABLE SUPPORT SYSTEMS AND SUPPORT STEELWORK

All cables shall be run horizontally or vertically with single layers on ladder cable racking. All cables shall be strapped individually with normal PVC straps at a maximum unsupported length of 300 mm, every third bind (900mm) point shall utilise a stainless steel strap instead of PVC. Cables smaller than 4-core 35mm² can be strapped every 900mm using multi strap stainless steel straps and not more than three cables at a time. The maximum distance between cable racking supports shall be 1500mm. A maximum of 3 cables with a cross-sectional area less than 35mm² may be supported on a single 45mm x 45mm angle iron for minor cable runs.

The Contractor is to make due allowance for all angle iron droppers, and support steelwork including any brackets required for cable racks, isolators, light fittings, lighting distribution boards etc.

Cable racking shall be manufactured from 3CR12.

EB3.7 NEW DE-WATERING PLANT ELECTRICAL SYSTEM

A new de-watering plant is being constructed. The electrical scope of work for the new plant includes the manufacture, supply, installation, testing and commissioning of the electrical equipment required to support the processing operations. The load lists for the new de-watering plant and the de-watering feed pump station are provided in the tables below.

De-watering Plant - Load List					
Equipment Number	Description	Connected Load (kW)	Duty/ Standby	Running Load (kW)	Emergency Power
BB01A	Cake pump bridge breaker	0.18	1	0.1	1
BB01B	Cake pump bridge breaker	0.18	0	0.0	
CEN01	Centrifuge	60	1	36	1
CEN02	Centrifuge	60	1	36	
MIX01	Centrifuge feed tank mixer	0.55	1	0.45	1
MIX02	Centrifuge feed tank mixer	0.55	1	0.45	1
AHU01	Poly Make-up Air handling Unit	7.5	1	7	1
SCC01A	Centrifuge cake conveyor	2.2	1	1.5	1
SCC01B	Centrifuge cake conveyor	2.2	0	0	
FAN01A	HVAC Fans (dewatering building)	3	1	2.8	
FAN01B	HVAC Fans (dewatering building)	3	1	2.8	
FAN01C	HVAC Fans (dewatering building)	3	1	2.8	
PMT01A	Poly Make-Up System	4	1	3.0	
PMT01B	Poly Make-Up System	4	0	0.0	
PMP01A	Centrifuge feed pump	15	1	12	1
PMP01B	Centrifuge feed pump	15	0	0	
PMP02A	Poly dosing pump	0.75	1	0.56	
PMP02B	Poly dosing pump	0.75	0	0	
PMP03A	Cake transfer pump	55	1	50	1
PMP03B	Cake transfer pump	55	0	0	
PMP06A	Poly lubrication pumps	0.37	1	0.33	1
PMP06B	Poly lubrication pumps	0.37	0	0	
	Control Transformer (400/220V 2kVA)	2	1	1.0	1
	Welding Plug 1	20	1	20	
	Welding Plug 2	20	0	0	
	Small Power and lighting	10	1	8	1
	Instrument distribution board	10	1	8	1
	Total (kW)	355		193	125

De-watering Feed Pump Station - Load List					
Equipment Number	Description	Connected Load (kW)	Duty/ Standby	Running Load (kW)	Emergency Power
PMP04A	WAS transfer pump	15	1	13	
PMP04B	WAS transfer pump	15	0	0	
MAC01A	WAS macerator and solids separator	7.5	1	6	
MAC01B	WAS macerator and solids separator	7.5	0	0	
	Control Transformer (400/110V 2kVA)	2	1	1	
	Welding Plug 1	20	1	20	
	Small Power and lighting	5	1	4	
	Total (kW)	72		44	0

The following main scope of works are identified, with full technical detailed provided in the data sheets, technical drawings and bill of quantities:

500kVA MSU

The supply installation and testing of a new 500kVA 11/0.4kV/ANAN Dyn11 MSU, including concrete mounting plinth. Testing requirements are detailed in section B3.5.

The work will include the tie-in to and extension of the existing site MV reticulation system.

MOTOR CONTROL CENTRE

Manufacture, fabrication, assembly, testing, delivery to site, installation and commissioning of the two MCC panels for the de-watering plant. The sludge pumping MCC will be located in the existing sludge pumping building, replacing the existing one.

The main de-watering MCC will be installed in the substation room of the new de-watering building. The following points are noted

- Sludge Pumping MCC
 - Rating – 100A, 400V, 25kA MCC
 - Temperature Rating - 50°C.
 - MCC load list is provided in the table above.
 - Applicable drawings:
 - 60325-E-SD-701 Sludge Pumping MCC Panel Single Line Diagram
 - 60325-E-SD-703 Sludge Pumping MCC Panel General Arrangement Diagram
 - 60325-E-GW-901 MCC Typical Schematic Drawings
 - Cable Schedule for the Sludge Pumping MCC panel is provided in Section EB12
- Main De-watering MCC
 - Rating - 500A, 400V, 25kA MCC
 - Temperature Rating - 50°C.
 - MCC load list is provided in the table above.
 - Applicable drawings:
 - 60325-E-SD-700 De-watering MCC Panel Single Line Diagram
 - 60325-E-SD-702 De-watering MCC Panel General Arrangement Diagram
 - 60325-E-GW-901 MCC Typical Schematic Drawings
 - Cable Schedule for the De-watering MCC panel is provided in Section EB12
- Interface with the PLC control system will via Modbus TCP on Ethernet. Communication cables between the smart motor controllers, VFD's, power meters and the PLC network switch must be CAT6 STP Ethernet cables All motor control relays, and communication devices shall be programmed under this contract by the contractor.
- The PLC panel must be integral to the MCC panel, detail of the PLC panel size is provided in the C&I specification document.
- The cold commissioning shall include simulation of the motors being started from their local position and from the HMI via the PLC.
- The positions of the MCC's are shown on the layout plan drawing:
 - 60325-E-SD-704 De-watering cable racking and routing drawing.
- The MCC's shall be equipped to provide the control function described in the process and instrumentation diagrams and in the instrumentation and control specification.
- Future loads have been indicated on the single line diagram – "greyed" out. Cubicles must be equipped for the loads as per the schematic drawings.

Unless otherwise stated all MCCs shall, as well as complying with the Standard Specification, shall comply as follows

- Be designed and manufactured in accordance with SANS 1973 and SANS / IEC 61439-1
- The control equipment shall conform to SANS / IEC 60947 Parts 1 -7
- Be suitable for operation on supply voltages of 400 Volts, 50 Hz, AC and a control voltage of 231 volts AC.
- Switchgear selection to be for type two co-ordination.
- Type tested and partially type tested certificates to be supplied.
- Temperature rise assessment/calculations to be supplied. - ambient temperature of 35° C and a maximum of 45° C to be used in calculations.
- Form 4A
- Be floor mounted and have IP rating of IP 54
- Have Top entry for all cables.Suitable gland plates to be provided.
- Be electrostatically spray-painted exterior quality epoxy electric orange colour B26.
- The control voltage shall be 220VAC.
- The design of the MCC shall make provision for extracting hot air from the VSD's and other equipment where this equipment is contained within the MCC enclosure.

The work will include:

- Design and preparation of detailed design drawings in accordance with the manufacturer's standards.
- Labelling of the MCC, cubicles and all equipment inside the cubicles.
- Proof of SANS compliance to be provided.
- Provision of substation safety signage and equipment, including suitable portable fire extinguishers.
- The supply and installation of the network communication cables from the individual MCC cubicles to the PLC panel

Due to the space constraints of the substation room, VFD's for drives greater than 37kW may be offered in standalone panels supplied from MCC feeders. The VFD panels must include the following equipment:

- Input and output chokes
- Door mounted programming devices

LV AND CONTROL CABLES

As per section B3.6.

CABLE SUPPORT SYSTEMS AND SUPPORT STEELWORK

As per section B3.6.

EB3.8 PUMP STATION AND REACTOR MCC REPLACEMENT

The existing pump stations No's 1 to 4 have reached the end of useful life and require replacement. In addition the electrical reticulation supply the pump station and reactor equipment will also be replaced.

The current MCC configuration consists for two or three panels installed in each of the four pump stations, with pumping and individual reactors each being supplied by a dedicated MCC. The new configuration will see a single MCC panel installed in each of the pump stations, supplying all pumping and reactor equipment associated with that particular pump station. The areas supplied by each pump station MCC panel will be as follows:

- Pump Station 1 MCC – Pump Station No. 1, Reactor No. 1 and Reactor no. 2
- Pump Station 2 MCC – Pump Station No. 2 and Reactor no. 3
- Pump Station 3 MCC – Pump Station No. 3 and Reactor no. 4
- Pump Station 4 MCC – Pump Station No. 4, Reactor No. 5 and Reactor no. 6

It is noted that Pump station No. 1 and No. 2 will be supplied with emergency back-up power. The load lists for the upgraded pump stations are provided in the tables below.

Pump Station No. 1 - Load List					
Equipment Number	Description	Connected Load (kW)	Duty/ Standby	Running Load (kW)	Emergency Power
ATR01	Surface Aerator	37	1	30	1
ATR02	Surface Aerator	37	1	30	1
ATR03	Surface Aerator	37	1	30	1
ATR04	Surface Aerator	37	1	30	1
ATR05	Surface Aerator	11	1	11	1
MIX01	Anoxic mixer	8	1	6	1
MIX02	Anoxic mixer	8	1	6	1
	Return Sludge Pump 2	15	1	13	1
	Return Sludge Pump (Standby)	15	0	0	0
ATR06	Surface Aerator	37	1	30	1
ATR07	Surface Aerator	37	1	30	1
ATR08	Surface Aerator	37	1	30	1
ATR09	Surface Aerator	37	1	30	1
ATR10	Surface Aerator	11	1	11	1
MIX03	Anoxic mixer	8	1	6	1
MIX04	Anoxic mixer	8	1	6	1

Pump Station No. 1 - Load List					
Equipment Number	Description	Connected Load (kW)	Duty/ Standby	Running Load (kW)	Emergency Power
	Return Sludge Pump 2	15	1	13	1
	Return Sludge Pump (Standby)	15	0	0	0
	Control Transformer (400/220V 2kVA)	2	1	1	1
	Welding Plug 1	20	1	10	0
	Small Power and Lighting	5	1	4	1
	Overhead Crawl Feeder	4	1	3	0
	Total (kW)	439		327	314

Pump Station No. 2 - Load List					
Equipment Number	Description	Connected Load (kW)	Duty/ Standby	Running Load (kW)	Emergency Power
ATR11	Surface Aerator	37	1	30	1
ATR12	Surface Aerator	37	1	30	1
ATR13	Surface Aerator	37	1	30	1
ATR14	Surface Aerator	37	1	30	1
ATR15	Surface Aerator	11	1	11	1
MIX05	Anoxic mixer	8	1	6	1
MIX06	Anoxic mixer	8	1	6	1
	Return Sludge Pump 2	15	1	13	1
	Return Sludge Pump (Standby)	15	0	0	0
	Control Transformer (400/110V 2kVA)	2	1	1	1
	Welding Plug 1	20	1	15	0
	Small Power and Lighting (5kVA 400/400V Txf)	5	1	4	1
	Overhead Crawl Feeder	4	1	3	0
	Administration Building	25	1	15	1
	Total (kW)	260		193	175

Pump Station No. 3 - Load List					
Equipment Number	Description	Connected Load (kW)	Duty/ Standby	Running Load (kW)	Emergency Power
ATR16	Surface Aerator	37	1	30	0
ATR17	Surface Aerator	37	1	30	0
ATR18	Surface Aerator	37	1	30	0
ATR19	Surface Aerator	37	1	30	0
ATR20	Surface Aerator	11	1	11	0
MIX07	Anoxic mixer	8	1	6	0
MIX08	Anoxic mixer	8	1	6	0
	Return Sludge Pump 2	15	1	13	0
	Return Sludge Pump (Standby)	15	0	0	0
	Control Transformer (400/110V 2kVA)	2	1	1	0
	Welding Plug 1	20	1	15	0
	Small Power and Lighting	5	1	4	0
	Overhead Crawl Feeder	4	1	3	0
	Total (kW)	235		178	0

Pump Station No. 4 - Load List					
Equipment Number	Description	Connected Load (kW)	Duty/ Standby	Running Load (kW)	Emergency Power
ATR21	Surface Aerator	37	1	30	0
ATR22	Surface Aerator	37	1	30	0
ATR23	Surface Aerator	37	1	30	0
ATR24	Surface Aerator	37	1	30	0
ATR25	Surface Aerator	11	1	11	0
MIX09	Anoxic mixer	8	1	6	0
MIX10	Anoxic mixer	8	1	6	0
	Return Sludge Pump 2	15	1	13	0
	Return Sludge Pump (Standby)	15	0	0	0
ATR26	Surface Aerator	37	1	30	0

Pump Station No. 4 - Load List					
Equipment Number	Description	Connected Load (kW)	Duty/ Standby	Running Load (kW)	Emergency Power
ATR27	Surface Aerator	37	1	30	0
ATR28	Surface Aerator	37	1	30	0
ATR29	Surface Aerator	37	1	30	0
ATR30	Surface Aerator	11	1	11	0
MIX11	Anoxic mixer	8	1	6	0
MIX12	Anoxic mixer	8	1	6	0
	Return Sludge Pump 2	15	1	13	0
	Return Sludge Pump (Standby)	15	0	0	0
	Control Transformer (400/110V 2kVA)	2	1	1	0
	Welding Plug 1	20	1	15	0
	Small Power and Lighting (5kVA 400/400V Txf)	5	1	4	0
	Overhead Crawl Feeder	4	1	3	0
	Total (kW)	408		309	0

The following main scope of works are identified, with full technical detailed provided in the data sheets, technical drawings and bill of quantities:

MOTOR CONTROL CENTRE

Manufacture, fabrication, assembly, testing, delivery to site, installation and commissioning of four MCC panels for the pump station and reactor plants.

The MCC's will be installed in the existing pump station buildings. The following points are noted

- Pump Station No. 1 MCC
 - Rating – 800A, 400V, 25kA MCC
 - Temperature Rating - 50°C.
 - MCC load list is provided in the tables above.
 - Applicable drawings:
 - 60325-E-LS-300 Pump Station No. 1 MCC Panel Single Line Diagram
 - 60325-E-LS-304 Pump Station No. 1 MCC Panel General Arrangement Diagram
 - 60325-E-GW-901 MCC Typical Schematic Drawings
 - Cable Schedule for Pump Station No. 1 MCC panel is provided in Section EB13
- Pump Station No. 2 MCC
 - Rating – 630A, 400V, 25kA MCC
 - Temperature Rating - 50°C.
 - MCC load list is provided in the tables above.
 - Applicable drawings:
 - 60325-E-LS-301 Pump Station No. 2 MCC Panel Single Line Diagram
 - 60325-E-LS-305 Pump Station No. 2 MCC Panel General Arrangement Diagram
 - 60325-E-GW-901 MCC Typical Schematic Drawings
 - Cable Schedule for Pump Station No. 2 MCC panel is provided in Section EB13
- Pump Station No. 3 MCC
 - Rating – 630A, 400V, 25kA MCC
 - Temperature Rating - 50°C.
 - MCC load list is provided in the tables above.
 - Applicable drawings:
 - 60325-E-LS-302 Pump Station No. 3 MCC Panel Single Line Diagram
 - 60325-E-LS-306 Pump Station No. 3 MCC Panel General Arrangement Diagram
 - 60325-E-GW-901 MCC Typical Schematic Drawings
 - Cable Schedule for Pump Station No. 3 MCC panel is provided in Section EB13
- Pump Station No. 4 MCC
 - Rating – 800A, 400V, 25kA MCC
 - Temperature Rating - 50°C.
 - MCC load list is provided in the tables above.
 - Applicable drawings:
 - 60325-E-LS-303 Pump Station No. 4 MCC Panel Single Line Diagram
 - 60325-E-LS-307 Pump Station No. 4 MCC Panel General Arrangement Diagram

- 60325-E-GW-901 MCC Typical Schematic Drawings
 - Cable Schedule for Pump Station No. 4 MCC panel is provided in Section EB13
- Bottom cable entry required
- Front and rear access available.
- Interface with the PLC control system will via Modbus TCP on Ethernet. Communication cables between the smart motor controllers, VFD's, power meters and the PLC network switch must be CAT6 STP Ethernet cables All motor control relays, and communication devices shall be programmed under this contract by the contractor.
- The PLC panel must be integral to the MCC panel, detail of the PLC panel size is provided in the C&I specification document.
- The cold commissioning shall include simulation of the motors being started from their local position and from the HMI via the PLC.
- The MCC's shall be equipped to provide the control function described in the process and instrumentation diagrams and in the instrumentation and control specification.
- Future loads have been indicated on the single line diagram – "greyed" out. Cubicles must be equipped for the loads as per the schematic drawings.

Unless otherwise stated all MCCs shall, as well as complying with the Standard Specification, shall comply as follows

- Be designed and manufactured in accordance with SANS 1973 and SANS / IEC 61439-1
- The control equipment shall conform to SANS / IEC 60947 Parts 1 -7
- Be suitable for operation on supply voltages of 400 Volts, 50 Hz, AC and a control voltage of 231 volts AC.
- Switchgear selection to be for type two co-ordination.
- Type tested and partially type tested certificates to be supplied.
- Temperature rise assessment/calculations to be supplied. - ambient temperature of 35° C and a maximum of 45° C to be used in calculations.
- Form 4A
- Be floor mounted and have IP rating of IP 54
- Have bottom entry for all cables. Suitable gland plates to be provided.
- Be electrostatically spray-painted exterior quality epoxy electric orange colour B26.
- The control voltage shall be 220VAC.
- The design of the MCC shall make provision for extracting hot air from the VSD's and other equipment where this equipment is contained within the MCC enclosure.

The work will include:

- Design and preparation of detailed design drawings in accordance with the manufacturer's standards.
- Labelling of the MCC, cubicles and all equipment inside the cubicles.
- Proof of SANS compliance to be provided.
- Provision of substation safety signage and equipment, including suitable portable fire extinguishers.

Additional Site Work

In addition to the work detailed above, allowance must be made for the following items:

- The dismantling and removal of the existing MCC panels from the pump stations and placement in the site lay-down area.
- The removal of the existing cabling and field start/stop stations at the pump stations and reactors.
- Supply and installation of the new LV cabling and field stop stations.

LV AND CONTROL CABLES

As per section B3.6.

CABLE SUPPORT SYSTEMS AND SUPPORT STEELWORK

As per section B3.6.

EB6. DRAWING SCHEDULE

The following drawings are part of the tender and should be priced accordingly.

Drawing Number	DRAWING DESCRIPTION	REVISION
60325-E-LI-100	HOW MCC Panel SLD	Rev B
60325-E-LI-101	HOW MCC Panel GA	Rev B
60325-E-LI-102	HOW Cable & Racking Routing Diagram	Rev B
60325-E-LI-103	Head of Works - Power Layout	Rev B
60325-E-LI-104	Head of Works - Lighting Layout	Rev B
60325-E-LI-105	Head of Works - Earthing and Lightning Protection Layout	Rev B
60325-E-LI-106	Head of Works - Local DB Electrical Schematic Diagram	Rev B
60325-E-LS-300	Pump station No. 1 MCC Panel SLD	Rev B
60325-E-LS-301	Pump station No. 2 MCC Panel SLD	Rev B
60325-E-LS-302	Pump station No. 3 MCC Panel SLD	Rev B
60325-E-LS-303	Pump station No. 4 MCC Panel SLD	Rev B
60325-E-LS-304	Pump station No. 1 MCC Panel GA	Rev B
60325-E-LS-305	Pump station No. 2 MCC Panel GA	Rev B
60325-E-LS-306	Pump station No. 3 MCC Panel GA	Rev B
60325-E-LS-307	Pump station No. 4 MCC Panel GA	Rev B
60325-E-SD-700	De-watering MCC panel SLD	Rev B
60325-E-SD-701	Sludge transfer pump station MCC panel SLD	Rev B
60325-E-SD-702	De-watering MCC panel GA	Rev B
60325-E-SD-703	Sludge transfer pump station MCC panel GA	Rev B
60325-E-SD-704	De-watering Cable & Racking Routing Diagram	Rev B
60325-E-SD-705	Dewatering Building Power Layout	Rev B
60325-E-SD-706	Dewatering Building Lighting Layout	Rev B
60325-E-SD-707	Dewatering Building Earthing & Lighting Protection Layout	Rev B
60325-E-SD-708	DB-DW Electrical Schematic Diagram	Rev B
60325-E-GW-900	HWWTW MV Reticulation Single Line Diagram	Rev B
60325-E-GW-901	Typical MCC Schematic drawings	Rev B

Drawing Number	DRAWING DESCRIPTION	REVISION
60325-E-GW-902	Administration Building - Power Layout	Rev B
60325-E-GW-903	Administration Building - Lighting Layout	Rev B
60325-E-GW-904	Administration Building - Earthing and Lightning Protection	Rev B
60325-E-GW-905	Administration Building - Lighting and Small Power Demolition plan	Rev B
60325-E-GW-906	Administration Building - DB-10 Electrical Schematic Diagram	Rev B
60325-E-GW-907	Auxiliary Power - Site Plan	Rev B
60325-E-GW-908	Auxiliary Power - Schematic Drawing	Rev B
60325-E-GW-909	Second Class Water Pump Station Electrical Layout	Rev B
60325-E-GW-910	Guardhouse Electrical Layout	Rev B
60325-E-GW-911	Second Class Water MCC Panel SLD	Rev B
60325-E-GW-912	Second Class Water MCC Panel GA	Rev B
60325-E-GW-913	Electrical Typical Detail	Rev B

TRAINING REQUIREMENTS

EB11.1 GENERAL

The Contractor shall conduct comprehensive training for EWS maintenance and operational staff of the plant during the commissioning period.

Electrical (Medium Voltage and Low Voltage) ,Control ,Instrumentation and SCADA ,Mechanical and Process equipment operation and maintenance training shall form part of the overall training programme.

All equipment shall be in operational order before training shall commence.

The training shall be designed specifically for the works paying close attention to specialized equipment

Specified training shall allow for at least 5 each operational/maintenance staff members and 5 engineering staff members.

The contractor must allow for sufficient time when specialists are engaged for specialized training to allow expert training to be given to operational/maintenance and engineering staff.

During the installation phase, the Employer may nominate a team of operational/maintenance/engineering employees who will be closely involved with the installation and commissioning process. These employees will only observe to get the maximum information regarding the installation, to enable efficient maintenance to be undertaken by the Employer.

EB11.2 TRAINING MANUAL

Training and training manuals shall be based on the O&M Manuals.

Each trainee shall have his/her own manual with three additional copies which shall form part of the Operation and Maintenance Manuals.

EB11.3 TRAINING SCHEDULE

The Engineer shall approve the training schedule. A CV of the training facilitator shall be submitted to the Engineer for approval.

The training shall include operator training, technical and maintenance training.

The program for the training shall include instruction for a minimum 2 days on-site.

The schedule shall cover the following:

- General process/system overview
- Functional operation of the system. A complete operational narrative in conjunction with PID, electro mechanical schematic detailing the start up ,shut down process, interlock checking , specific operations of process equipment across all driplines , what alarms are critical, where to reset, fault finding, standby supply operations etc.
- Maintenance Schedules and how to complete them.
- Standard Maintenance Procedures.
- Spare Part Lists

EWS maintenance staff and other supporting staff should be fully proficient in the system operation and maintenance thereof.

EB11.4 MAINTENANCE AND OPERATION TRAINING

The training shall be designed to teach operators how to operate the Process, Electrical, Mechanical, Instrumentation and Control systems and shall include the following but not limited to the following:

- a) Start-up, shut-down and operating instruction for all operational modes for the works shall be provided. This shall be comprehensive and shall include actions to be taken in the case of all alarm conditions and basic to in-depth fault finding.
- b) A layout drawing of the installation, a process flow diagram, and a P&ID shall be provided for each Operator. The instructions described in B11.1 above shall also be provided in printed form for each operator.
- c) If a SCADA and Telemetry system is part of the control system, the SCADA operations training as described in the SCADA and Telemetry standard specification shall be incorporated in the training.
- d) This training shall be designed to teach operations and maintenance personnel how to operate, repair and maintain the electrical, mechanical ,instrumentation and control systems.

EB11.5 MV SWITCHGEAR, RING MAIN UNITS AND MINI-SUBSTATIONS

Description of training	Equipment	Training By	Duration	Certificate
Detail training on the switchgear, its components	11kV Fixed Pattern Switchgear, Ring Main Units	OEM Accredited Facilitator	TBA	Yes
Detail training on operations with regards to Switching, Isolating, testing, and earthing processes, understanding the alarms and trips and how to reset and what action is needed	11kV Fixed Pattern Switchgear, Ring Main Units	OEM Accredited Facilitator	TBA	Yes
Simple overview of 11 kV protection and switchgear settings	11kV Fixed Pattern Switchgear, Ring Main Units	OEM	TBA	Yes,
Detailed overview of 11 kV protection and switchgear settings, programming - target audience is engineers (2) and technicians (2 off)	11kV Fixed Pattern Switchgear, Ring Main Units	OEM Accredited training course. All costs to be borne by tenderer if training is offered out of Durban	TBA - Depends on training provider	Yes, CPD accreditation
Basic and in-depth maintenance, frequency,	11kV Fixed Pattern Switchgear, Ring Main Units	OEM	1 TBA	Yes,
Where and how to install common spare parts.	11kV Fixed Pattern Switchgear, Ring Main Units	OEM	TBA	Yes,
Detail list of where to obtain spare parts locally/nationally	11kV Fixed Pattern Switchgear, Ring Main Units	OEM	TBA	Yes,
Safety in operations and maintenance	11kV Fixed Pattern Switchgear, Ring Main Units	OEM	TBA	Yes,

EB11.6 GENERATOR SYSTEMS

Description of training	Equipment	Training By	Duration	Certificate
Detail training on the generator and its critical components	Generator	OEM Accredited Facilitator	TBA	Yes
Detail training on operations with regards to control philosophy understanding the alarms and trips and how to reset and what action is needed	Generator	OEM	TBA	Yes
Programing of Engine Management System, fault finding etc	Generator- Change over	OEM	TBA	Yes
Simple overview of protection settings	Generator	OEM	TBA	Yes ,

EB11.7 MOTOR CONTROL CENTRES

Description of training	Equipment	Training By	Duration	Certificate
Detail training on the MCC and its critical components	MCC's	OEM Accredited Facilitator	TBA	Yes
Detail training on operations with regards to control philosophy understanding the alarms, plc interlocks, instrumentation control SCADA and trips and how to reset and what action is needed	MCC's	OEM	TBA	Yes
Simple overview programming of Motor protection relay and settings	MCC's	OEM	TBA	Yes,
Where and how to install common spare parts.	MCC's	OEM	TBA	Yes,
Detail list of where to obtain spare parts locally/nationally	MCC's	OEM	TBA	Yes,
Safety in operations and maintenance	MCC's	OEM	TBA	Yes,

EB7. WITNESSING OF FACTORY ACCEPTANCE TESTING

The Employer's team and engineering team reserve the right to witness and sign off Factory Acceptance Testing (FAT) of all equipment. Witnessing of testing and the relevant representatives from the Employer and engineering team shall be confirmed during the contract. In the absence of witnessing, inspection certificates detailing all works testing conducted shall be forwarded to the Engineer for approval.

The Tenderer should make provision for all allowances, disbursements, accommodation and associated costs for travelling to areas outside the Ethekwini Metropolitan Area, to inspect and conduct factory acceptance testing or any other Inspections, tests, etc. of equipment in the BoQ.

The following provisions shall be made for travel inside South Africa per relevant equipment item FAT:

- Total number of representatives: 2 – Employer, 1- Engineering team
- Hotel/Guest house accommodation in a 3 or 4 star hotel for 2 nights
- Return flights economy class
- Car hire with a class B car
- Subsistence allowance as per the SARS guideline "Guide for Employers in Respect of Allowances" for travel within the Republic of South Africa.






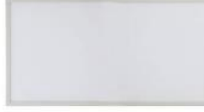
The following provisions shall be made for travel outside South Africa per relevant equipment item FAT:








- Total number of representatives: 2 – Employer, 1- Engineering team
- Hotel/Guest house accommodation in a 3 or 4 star hotel for 5 nights
- Return flights economy class
- Car hire with a class B car
- Subsistence allowance as per the SARS guideline "Guide for Employers in Respect of Allowances" for travel outside the Republic of South Africa.
- VISA costs and travel insurance.

The Tenderer shall make provision for the Employer's representatives and engineering team representatives to witness FAT testing on the following equipment:

- MV Switchgear
- Generator Systems
- Mini-substation Units
- Motor Control Centres

EB8. LUMINAIRE SCHEDULE**LUMINAIRE SCHEDULE**










TYPE	EQUIVALENT WATTAGE	LOCATION	DESCRIPTION	IMAGES/CODE
L1	2x28	Kitchen Areas, Office Areas	1200mm Surface mounted, 2x28W, Open Channel Fluorescent luminaire. Aluminium Body. To be supplied complete with control gear, surge protection complete, 3m flex cable and 5amp plug top. 4000 Kelvin Natural White . To include all necessary accessories.	
L1(E)	2x28	Various	As per Type "L1" Light with 30 minute emergency back-up battery at 100% output.	
L2	2x28	Change Room	1200mm Surface mounted, IP65 rated, 2x28W, Fluorescent luminaire. Polycarbonate Body, Clear Diffuser. To be supplied complete with control gear, surge protection, 3m flex cable and 5amp plug top. 4000 Kelvin Natural White . Minimum Lumen Output of 5200Lm. To include all necessary accessories.	
L2(E)	2x28	Various	As per Type "L2" Light with 30 minute emergency back-up battery at 100% output.	
L3	3x36	Office Areas	1200x600 Recessed 3x36W Fluorescent Panel Luminaire, Aluminium extruded frame, acrylic diffuser complete with DC power supply. Minimum lumen output of 6000 Lumens. To be supplied complete with control gear, surge protection, 3m flex cable and 5amp plug top. Light output colour: 4000 Kelvin natural white. Luminaire colour: White. To include all necessary accessories.	
L3(E)	3x36	Various	As per Type "L3" Light with 30 minute emergency back-up battery at 100% output.	








L4	2x26	Passage Areas, Water Closets	Ceiling Recessed, Round Downlight, 2x26W, CFL luminaire, Steel body with anodised Aluminium reflector, acrylic diffuser complete with power supply. To be supplied complete with control gear and surge protection. Light output colour: 4000 Kelvin natural white. Luminaire colour: White. To include all necessary accessories.	
L4(E)	2x26	Various	As per Type "L4" Light with 30 minute emergency back-up battery at 100% output.	
L5	1x15	Stairways, Building Exteriors	Wall mounted, surface IP65 bulkhead CFL, PL18W, luminaire, LM6 die cast Aluminium housing, UV stabilised acrylic diffuser complete with power supply. To be supplied complete with control gear and surge protection. Light output colour: 4000 Kelvin natural white. Luminaire colour: White. To include all necessary accessories.	
L5(E)	1x15	Various	As per Type "L5" Light with 30 minute emergency back-up battery at 100% output.	
L6	2x36	Pump Rooms, MCC Rooms	1200mm Wall mounted, IP65 rated, 2x36W, Fluorescent luminaire. Aluminium Body. To be supplied complete with control gear, surge protection complete, 3m flex cable and 5amp plug top. 4000 Kelvin Natural White .	
L6(E)	2x36	Various	As per Type "L6" Light with 30 minute emergency back-up battery at 100% output.	
L7	2x26	Exterior Areas, Generator Area	Pole (1.2m Pole and 6m Pole) mounted or wall mounted, IP65 rated, 50W, 120lm/w LED Floodlight. Black Plastic Body. To be supplied complete with control gear, surge protection complete. 4000 Kelvin Natural White . To include all necessary accessories.	

Note: 1. All luminaires are subject to the approval of the Engineer prior to ordering and purchase.

2. All images are of luminaires used for the design. The supplier to provide specified fittings subject to approval by the Engineer.
3. Light output verification is subject to simulation of submitted IES/LDT files. Non-submission of photometric data files could lead to rejection of the proposed luminaire.
4. All light fittings supplied must comply with SANS requirements for manufacture and SANS 10114-1. The Engineer reserves the right to request such compliance certificates. Failure to submit such compliance certificates will result in the fittings being rejected.
5. Alternate fittings proposed will only be considered if cost saving, better quality and longer guarantee is provided and subject to approval by the engineer, architect and client.

EB9. ELECTRICAL EQUIPMENT SCHEDULE

<h2 style="text-align: center;">Hammarsdale WWTW</h2> <h3 style="text-align: center;">Schedule of proposed equipment</h3>			
Equipment	Description	Areas	Image
Type A SSO	16A, 3-pin double SSO, with two type M wall mounted at 300mm AFFL Unless otherwise stated.	All	
Type B SSO	16A, 3-pin double SSO with one type M and two Type N Sockets (ZA plug) wall mounted at 300mm AFFL Unless otherwise stated.	All	
Type C SSO	16A, 3-pin single SSO with one type M and one Type N sockets (ZA plug). Mounted in power skirting.	Offices	
Type E SSO	16A, 3-pin single SSO with one Type M and two Type N sockets (ZA Plug) and two USB outlets. Mounted ON WALL 300mm AFFL.	All	
Type F SSO	16A, 3-pin single SSO in IP65 rated weather proof york box. Mounted ON WALL 1200mm AFFL.	Plant Rooms/ Pump Rooms	
Type G Industrial Socket	62, 5-pin single industrial socket in IP65 rated weatherproof enclosure. Mounted ON WALL 1200mm AFFL.	Plant Rooms/ Pump Rooms	
Type D data point	RJ45 data socket, mounted in power skirting	Offices	
Type T Telephone point	RJ11 telephone socket, mounted in power skirting	Offices	
Distribution Board	230V/ 400V Distribution Boards recessed in wall	New Technicians/ Laboratory	

Circuit Breaker	Single pole miniature Circuit breaker	Distribution boards	
Circuit Breaker	Triple pole miniature Circuit breaker	Distribution boards	
Power Skirting	2-Tier Power Skirting	Offices	
Isolators	15A, 2P; 20A, 2P; 30A, 2P Isolators Mounted in Ceiling or at high level.	All	
Cable Trunking	PVC Cable Trunking	All	
Generators	1100KVA Outdoor Generator, in Sound Attenuated Enclosure	Generator Area	
Bulk-Diesel Tank	3000L Self-Bunded Bulk Tank	Generator Area	

EB10.CABLE SCHEDULE

CABLE REF.	CABLE DESTINATION		CABLE TYPE SIZE AND NO.	Voltdrop mV/A/m	INSTALLATION METHOD	LENGTH m (1)	LOAD A (2)	VOLT DROP V	VOLT DROP %	Accumulated V. drop	<5%	Comment
	FROM	TO										
LV01	GENERATOR 1	GEN SYNC PANEL	4 x 185sqmm 4C ECC XLPE Cu	0.26	IN GROUND	20	400	2.08	0.52	0.52	Y	1600A Breaker
LV02	GENERATOR 2	GEN SYNC PANEL	4 x 185sqmm 4C ECC XLPE Cu	0.26	IN GROUND	12	400	1.25	0.31	0.83	Y	1600A Breaker
LV03	GEN SYNC PANEL	DISTIRBUTION PANEL	8 x 185sqmm 4C ECC XLPE Cu	0.26	IN GROUND	5	400	0.52	0.13	0.96	Y	3200A Breaker
LV04	DISTRIBUTION PANEL	DEWATERING C/O PANEL	3 x 185sqmm 4C ECC XLPE Cu	0.26	IN GROUND	270	130	9.13	2.28	9.65	Y	400A Breaker at Full Load
LV05	DISTRIBUTION PANEL	HEAD OF WORKS C/O PANEL	3 x 185sqmm 4C ECC XLPE Cu	0.26	IN GROUND	305	130	10.31	2.58	10.83	Y	400A Breaker at Full Load
LV06	PUMPSTATION 1 DB	GEN AUX MAIN DB	1 x 25sqmm 4C ECC	1.613	IN GROUND	5	100	0.81	0.20	0.81	Y	100A Breaker
C001	GEN SYNC PANEL	PUMPSTATION 1 C/O PANEL 1	1 x 4sqmm 12C + E	10.184	IN GROUND	380	2	7.74	1.93	7.74	Y	Sensing Cable

EB11.CABLE SCHEDULE-HEAD OF WORKS

From		To		Type	Voltage (V)	Type	Installed Load (kW)	No. of Cables	No. of Cores	Nominal Section mm ²	Total Length (m)	Term. (no.)	Type
Equip. No.	Equipment Description	Equip No.	Equipment Description										
MSU03	Head of Works MSU	MCC01	HOW MCC Panel	Power	400	Incomer	458	2	4	185	300	4	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC01	HOW MCC Panel		Welding Plug 1	Power	400	Feeder	20	1	4	16	100	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC01	HOW MCC Panel		Welding Plug 2	Power	400	Feeder	20	1	4	16	25	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC01	HOW MCC Panel		Small power and lighting DB feeder	Power	400	Feeder	25	1	4	25	20	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC01	HOW MCC Panel		Instrument distribution board	Power	400	Feeder	18.5	1	4	10	40	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC01	HOW MCC Panel	MIC07	Screenings dolly skip	Power	400	DOL (FWD/REV)	0.55	1	4	1.5	100	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC01	HOW MCC Panel	MIC16	Grit dolly skip	Power	400	DOL (FWD/REV)	0.55	1	4	1.5	50	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC01	HOW MCC Panel	MIC17	Grit dolly skip	Power	400	DOL (FWD/REV)	0.55	1	4	1.5	50	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC01	HOW MCC Panel	MIC12	Grit Classifier Mixer	Power	400	DOL	0.55	1	4	1.5	40	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC01	HOW MCC Panel	MIC13	Grit screw conveyor	Power	400	DOL	1.1	1	4	1.5	40	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC01	HOW MCC Panel	MIC14	Grit Classifier Mixer	Power	400	DOL	0.55	1	4	1.5	40	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC01	HOW MCC Panel	MIC15	Grit screw conveyor	Power	400	DOL	1.1	1	4	1.5	40	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC01	HOW MCC Panel	MIC08	Grit Trap	Power	400	DOL	1.1	1	4	1.5	75	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC01	HOW MCC Panel	MIC09	Grit Trap	Power	400	DOL	1.1	1	4	1.5	75	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC01	HOW MCC Panel	MIC30-VFD	VFD Panel	Power	400	FDR	75	1	4	95	5	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MIC30-VFD	VFD Panel	MIC30	Existing bioreactor supply pump	Power	400	VFD	75	1	3	95	25	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MIC30-VFD	VFD Panel	MIC30	Existing bioreactor supply pump	Earth	Earth	VFD		1	1	95	25	2	Insulated Copper Earth Wire (ICEW)
MCC01	HOW MCC Panel	MIC31-VFD	VFD Panel	Power	400	FDR	75	1	4	95	5	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MIC31-VFD	VFD Panel	MIC31	Existing bioreactor supply pump	Power	400	VFD	75	1	3	95	25	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MIC31-VFD	VFD Panel	MIC31	Existing bioreactor supply pump	Earth	Earth	VFD		1	1	95	25	2	Insulated Copper Earth Wire (ICEW)

From		To		Type	Voltage (V)	Type	Installed Load (kW)	No. of Cables	No. of Cores	Nominal Section mm ²	Total Length (m)	Term. (no.)	Type
Equip. No.	Equipment Description	Equip No.	Equipment Description										
MCC01	HOW MCC Panel	MIC32-VFD	VFD Panel	Power	400	FDR	75	1	4	95	5	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MIC32-VFD	VFD Panel	MIC32	Existing bioreactor supply pump	Power	400	VFD	75	1	3	95	25	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MIC32-VFD	VFD Panel	MIC32	Existing bioreactor supply pump	Earth	Earth	VFD		1	1	95	25	2	Insulated Copper Earth Wire (ICEW)
MCC01	HOW MCC Panel	MIC33-VFD	VFD Panel	Power	400	FDR	75	1	4	95	5	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MIC33-VFD	VFD Panel	MIC33	Existing bioreactor supply pump	Power	400	VFD	75	1	3	95	25	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MIC33-VFD	VFD Panel	MIC33	Existing bioreactor supply pump	Earth	Earth	VFD		1	1	95	25	2	Insulated Copper Earth Wire (ICEW)
MCC01	HOW MCC Panel	MIC26	Dry well sump pump	Power	400	DOL	4	1	4	1.5	30	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC01	HOW MCC Panel	MIC22	High pressure booster pump	Power	400	DOL	7.5	1	4	4	40	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC01	HOW MCC Panel	MIC23	High pressure booster pump	Power	400	DOL	7.5	1	4	4	40	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC01	HOW MCC Panel	MIC01A	Coarse Screen	Power	400	VFD (FWD/REV)	2.2	1	3	1.5	100	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC01	HOW MCC Panel	MIC01A	Coarse Screen	Earth	Earth	VFD		1	1	1.5	100	2	Insulated Copper Earth Wire (ICEW)
MCC01	HOW MCC Panel	MIC01B	Coarse Screen	Power	400	VFD (FWD/REV)	2.2	1	3	1.5	100	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC01	HOW MCC Panel	MIC01B	Coarse Screen	Earth	Earth	VFD		1	1	1.5	100	2	Insulated Copper Earth Wire (ICEW)
MCC01	HOW MCC Panel	MIC02A	Fine Screen	Power	400	VFD	2.2	1	3	1.5	100	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC01	HOW MCC Panel	MIC02A	Fine Screen	Earth	Earth	VFD		1	1	1.5	100	2	Insulated Copper Earth Wire (ICEW)
MCC01	HOW MCC Panel	MIC02B	Fine Screen	Power	400	VFD	2.2	1	3	1.5	100	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC01	HOW MCC Panel	MIC02B	Fine Screen	Earth	Earth	VFD		1	1	1.5	100	2	Insulated Copper Earth Wire (ICEW)
MCC01	HOW MCC Panel	MIC18	Ultra fine screen	Power	400	DOL	2.2	1	4	1.5	40	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC01	HOW MCC Panel	MIC19	Ultrafine screen HP wash manifold	Power	400	DOL	0.18	1	4	1.5	40	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC01	HOW MCC Panel	MIC38	Ultrafine screen cleaning brush	Power	400	DOL	0.18	1	4	1.5	40	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC01	HOW MCC Panel	MIC20	Ultra fine screen	Power	400	DOL	2.2	1	4	1.5	40	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC01	HOW MCC Panel	MIC21	Ultrafine screen HP wash manifold	Power	400	DOL	0.18	1	4	1.5	40	2	Cu/PVC/PVC/SWA/PVC 600/1000V

From		To		Type	Voltage (V)	Type	Installed Load (kW)	No. of Cables	No. of Cores	Nominal Section mm ²	Total Length (m)	Term. (no.)	Type
Equip. No.	Equipment Description	Equip No.	Equipment Description										
MCC01	HOW MCC Panel	MIC39	Ultrafine screen cleaning brush	Power	400	DOL	0.18	1	4	1.5	40	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC01	HOW MCC Panel	MIC03	Coarse and fine screenings Washer Compactor screw	Power	400	DOL	2.2	1	4	2.5	100	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC01	HOW MCC Panel	MIC04	Coarse and fine screenings Washer Compactor agitator	Power	400	DOL	0.37	1	4	1.5	100	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC01	HOW MCC Panel	MIC05	Coarse and fine screenings Washer Compactor	Power	400	DOL	2.2	1	4	2.5	100	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC01	HOW MCC Panel	MIC06	Coarse and fine screenings Washer Compactor agitator	Power	400	DOL	0.37	1	4	1.5	100	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC01	HOW MCC Panel	MIC36	Ultrafine screenings conveyor	Power	400	DOL	2.2	1	4	1.5	40	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC01	HOW MCC Panel	MIC37	Ultrafine screenings conveyor	Power	400	DOL	2.2	1	4	1.5	40	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC01	HOW MCC Panel	MIC34	Grit Slurry Pump	Power	400	DOL	1.1	1	4	1.5	40	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC01	HOW MCC Panel	MIC35	Grit Slurry Pump	Power	400	DOL	1.1	1	4	1.5	40	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MSU03	Head of Works MSU	MCC05	2nd Class Water MCC Panel	Power	400	Feeder	107	1	4	50	35	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC05	2nd Class Water MCC Panel		Welding Plug 1	Power	400	Feeder	20	1	4	16	60	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC05	2nd Class Water MCC Panel	MIC01	Second Class Water Pump 1	Power	400	VFD	15	1	3	10	60	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC05	2nd Class Water MCC Panel	MIC01	Second Class Water Pump 1	Earth	Earth	VFD		1	1	10	60	2	Insulated Copper Earth Wire (ICEW)
MCC05	2nd Class Water MCC Panel	MIC02	Second Class Water Pump 2	Power	400	VFD	15	1	3	10	60	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC05	2nd Class Water MCC Panel	MIC02	Second Class Water Pump 2	Earth	Earth	VFD		1	1	10	60	2	Insulated Copper Earth Wire (ICEW)
MCC05	2nd Class Water MCC Panel	MIC03	Second Class Water Pump 3	Power	400	VFD	15	1	3	10	60	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC05	2nd Class Water MCC Panel	MIC03	Second Class Water Pump 3	Earth	Earth	VFD		1	1	10	60	2	Insulated Copper Earth Wire (ICEW)
MCC05	2nd Class Water MCC Panel	MIC04	Second Class Water Pump 4	Power	400	VFD	15	1	3	10	60	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC05	2nd Class Water MCC Panel	MIC04	Second Class Water Pump 4	Earth	Earth	VFD		1	1	10	60	2	Insulated Copper Earth Wire (ICEW)
MCC01	HOW MCC Panel	MIC07	Screenings dolly skip Field Stop/Start Station	Control	220			1	7	1.5	100	2	Cu/PVC/PVC/SWA/PVC 600/1000V

From		To		Type	Voltage (V)	Type	Installed Load (kW)	No. of Cables	No. of Cores	Nominal Section mm ²	Total Length (m)	Term. (no.)	Type
Equip. No.	Equipment Description	Equip No.	Equipment Description										
MCC01	HOW MCC Panel	MIC16	Grit dolly skip Field Stop/Start Station	Control	220			1	7	1.5	50	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC01	HOW MCC Panel	MIC17	Grit dolly skip Field Stop/Start Station	Control	220			1	7	1.5	50	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC01	HOW MCC Panel	MIC12	Grit Classifier Mixer E-stop	Control	220			1	4	1.5	40	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC01	HOW MCC Panel	MIC13	Grit screw conveyor E-stop	Control	220			1	4	1.5	40	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC01	HOW MCC Panel	MIC14	Grit Classifier Mixer E-stop	Control	220			1	4	1.5	40	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC01	HOW MCC Panel	MIC15	Grit screw conveyor E-stop	Control	220			1	4	1.5	40	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC01	HOW MCC Panel	MIC08	Grit Trap E-stop	Control	220			1	4	1.5	75	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC01	HOW MCC Panel	MIC09	Grit Trap E-stop	Control	220			1	4	1.5	75	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MIC30-VFD	VFD Panel	MIC30	Existing bioreactor supply pump E-stop	Control	220			1	4	1.5	25	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MIC31-VFD	VFD Panel	MIC31	Existing bioreactor supply pump E-stop	Control	220			1	4	1.5	25	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MIC32-VFD	VFD Panel	MIC32	Existing bioreactor supply pump E-stop	Control	220			1	4	1.5	25	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MIC33-VFD	VFD Panel	MIC33	Existing bioreactor supply pump E-stop	Control	220			1	4	1.5	25	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC01	HOW MCC Panel	MIC26	Dry well sump pump E-stop	Control	220			1	4	1.5	30	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC01	HOW MCC Panel	MIC22	High pressure booster pump E-stop	Control	220			1	4	1.5	40	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC01	HOW MCC Panel	MIC23	High pressure booster pump E-stop	Control	220			1	4	1.5	40	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC01	HOW MCC Panel	MIC01A	Coarse Screen Field Stop/Start Station	Control	220			1	4	1.5	100	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC01	HOW MCC Panel	MIC01B	Coarse Screen Field Stop/Start Station	Control	220			1	4	1.5	100	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC01	HOW MCC Panel	MIC02A	Fine Screen Field Stop/Start Station	Control	220			1	4	1.5	100	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC01	HOW MCC Panel	MIC02B	Fine Screen Field Stop/Start Station	Control	220			1	4	1.5	100	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC01	HOW MCC Panel	MIC18	Ultra fine screen Field Stop/Start Station	Control	220			1	4	1.5	40	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC01	HOW MCC Panel	MIC19	Ultrafine screen HP wash manifold E-stop	Control	220			1	4	1.5	40	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC01	HOW MCC Panel	MIC38	Ultrafine screen cleaning brush E-stop	Control	220			1	4	1.5	40	2	Cu/PVC/PVC/SWA/PVC 600/1000V

From		To		Type	Voltage (V)	Type	Installed Load (kW)	No. of Cables	No. of Cores	Nominal Section mm ²	Total Length (m)	Term. (no.)	Type
Equip. No.	Equipment Description	Equip No.	Equipment Description										
MCC01	HOW MCC Panel	MIC20	Ultra fine screen Field Stop/Start Station	Control	220			1	4	1.5	40	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC01	HOW MCC Panel	MIC21	Ultrafine screen HP wash manifold E-stop	Control	220			1	4	1.5	40	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC01	HOW MCC Panel	MIC39	Ultrafine screen cleaning brush E-stop	Control	220			1	4	1.5	40	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC01	HOW MCC Panel	MIC03	Coarse and fine screenings Washer Compactor screw E-stop	Control	220			1	7	1.5	100	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC01	HOW MCC Panel	MIC04	Coarse and fine screenings Washer Compactor agitator E-stop	Control	220			1	7	1.5	100	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC01	HOW MCC Panel	MIC05	Coarse and fine screenings Washer Compactor E-stop	Control	220			1	7	1.5	100	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC01	HOW MCC Panel	MIC06	Coarse and fine screenings Washer Compactor agitator E-stop	Control	220			1	7	1.5	100	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC01	HOW MCC Panel	MIC36	Ultrafine screenings conveyor E-stop	Control	220			1	7	1.5	40	3	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC01	HOW MCC Panel	MIC37	Ultrafine screenings conveyor E-stop	Control	220			1	7	1.5	40	4	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC01	HOW MCC Panel	MIC34	Grit Slurry Pump E-stop	Control	220			1	4	1.5	40	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC01	HOW MCC Panel	MIC35	Grit Slurry Pump E-stop	Control	220			1	4	1.5	40	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC05	2nd Class Water MCC Panel	MIC01	Second Class Water Pump 1 E-stop	Control	220			1	4	1.5	60	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC05	2nd Class Water MCC Panel	MIC02	Second Class Water Pump 2 E-stop	Control	220			1	4	1.5	60	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC05	2nd Class Water MCC Panel	MIC03	Second Class Water Pump 3 E-stop	Control	220			1	4	1.5	60	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC05	2nd Class Water MCC Panel	MIC04	Second Class Water Pump 4 E-stop	Control	220			1	4	1.5	60	2	Cu/PVC/PVC/SWA/PVC 600/1000V

EB12.CABLE SCHEDULE-DE-WATERING

From		To		Type	Voltage (V)	Type	Installed Load (kW)	No. of Cables	No. of Cores	Nominal Section mm ²	Total Length (m)	Term. (no.)	Type
Equip. No.	Equipment Description	Equip. No.	Equipment Description										
MSU06	De-watering MSU	MCC08	De-watering MCC Panel	Power	400	Incomer	370	2	4	120	150	4	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC08	De-watering MCC Panel		Welding Plug 1	Power	400	Feeder	20	1	4	16	34	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC08	De-watering MCC Panel		Welding Plug 2	Power	400	Feeder	20	1	4	16	39	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC08	De-watering MCC Panel		Lighting & Small Power DB	Power	400	Feeder	25	1	4	25	11	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC08	De-watering MCC Panel		Instrument distribution board	Power	400	Feeder	18.5	1	4	10	40	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC08	De-watering MCC Panel	MIC12	Cake pump bridge breaker	Power	400	DOL	0.18	1	4	1.5	36	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC08	De-watering MCC Panel	MIC13	Cake pump bridge breaker	Power	400	DOL	0.18	1	4	1.5	36	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC08	De-watering MCC Panel		Centrifuge	Power	400	FDR	60	1	4	50	28	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC08	De-watering MCC Panel		Centrifuge	Power	400	FDR	60	1	4	50	33	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC08	De-watering MCC Panel	MIC05	Centrifuge feed tank mixer	Power	400	DOL	0.55	1	4	1.5	42	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC08	De-watering MCC Panel	MIC26	Centrifuge feed tank mixer	Power	400	DOL	0.55	1	4	1.5	47	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC08	De-watering MCC Panel		Poly Make-up Air handling Unit	Power	400	FDR	7.5	1	4	2.5	33	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC08	De-watering MCC Panel	MIC10	Centrifuge cake conveyor	Power	400	DOL	2.2	1	4	1.5	36	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC08	De-watering MCC Panel	MIC11	Centrifuge cake conveyor	Power	400	DOL	2.2	1	4	1.5	36	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC08	De-watering MCC Panel		HVAC Fans (dewatering building)	Power	400	DOL	3	1	4	1.5	29	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC08	De-watering MCC Panel		HVAC Fans (dewatering building)	Power	400	DOL	3	1	4	1.5	29	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC08	De-watering MCC Panel		HVAC Fans (dewatering building)	Power	400	DOL	3	1	4	1.5	29	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC08	De-watering MCC Panel		Poly Make-Up System	Power	400	FDR	4	1	4	1.5	38	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC08	De-watering MCC Panel		Poly Make-Up System	Power	400	FDR	4	1	4	1.5	34	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC08	De-watering MCC Panel	MIC06	Centrifuge feed pump	Power	400	VFD	15	1	3	10	40	2	Cu/PVC/PVC/SWA/PVC 600/1000V

From		To		Type	Voltage (V)	Type	Installed Load (kW)	No. of Cables	No. of Cores	Nominal Section mm ²	Total Length (m)	Term. (no.)	Type
Equip. No.	Equipment Description	Equip. No.	Equipment Description										
MCC08	De-watering MCC Panel	MIC06	Centrifuge feed pump	Earth	Earth	VFD		1	1	10	40	2	Insulated Copper Earth Wire (ICEW)
MCC08	De-watering MCC Panel	MIC07	Centrifuge feed pump	Power	400	VFD	15	1	3	10	42	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC08	De-watering MCC Panel	MIC07	Centrifuge feed pump	Earth	Earth	VFD		1	1	10	42	2	Insulated Copper Earth Wire (ICEW)
MCC08	De-watering MCC Panel	MIC08	Poly dosing pump	Power	400	VFD	0.75	1	3	1.5	24	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC08	De-watering MCC Panel	MIC08	Poly dosing pump	Earth	Earth	VFD		1	1	1.5	24	2	Insulated Copper Earth Wire (ICEW)
MCC08	De-watering MCC Panel	MIC09	Poly dosing pump	Power	400	VFD	0.75	1	3	1.5	24	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC08	De-watering MCC Panel	MIC09	Poly dosing pump	Earth	Earth	VFD		1	1	1.5	24	2	Insulated Copper Earth Wire (ICEW)
MCC08	De-watering MCC Panel	MIC14	Cake transfer pump	Power	400	VFD	55	1	3	50	36	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC08	De-watering MCC Panel	MIC14	Cake transfer pump	Earth	Earth	VFD		1	1	50	36	2	Insulated Copper Earth Wire (ICEW)
MCC08	De-watering MCC Panel	MIC15	Cake transfer pump	Power	400	VFD	55	1	3	50	36	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC08	De-watering MCC Panel	MIC15	Cake transfer pump	Earth	Earth	VFD		1	1	50	36	2	Insulated Copper Earth Wire (ICEW)
MCC08	De-watering MCC Panel	MIC16	Poly lubrication pumps	Power	400	VFD	0.37	1	3	1.5	24	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC08	De-watering MCC Panel	MIC16	Poly lubrication pumps	Earth	Earth	VFD		1	1	1.5	24	2	Insulated Copper Earth Wire (ICEW)
MCC08	De-watering MCC Panel	MIC17	Poly lubrication pumps	Power	400	VFD	0.37	1	3	1.5	24	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC08	De-watering MCC Panel	MIC17	Poly lubrication pumps	Earth	Earth	VFD		1	1	1.5	24	2	Insulated Copper Earth Wire (ICEW)
MCC08	De-watering MCC Panel	MIC12	Cake pump bridge breaker	Control	220			1	4	1.5	36	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC08	De-watering MCC Panel	MIC13	Cake pump bridge breaker	Control	220			1	4	1.5	36	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC08	De-watering MCC Panel		Centrifuge	Control	220			1	4	1.5	28	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC08	De-watering MCC Panel		Centrifuge	Control	220			1	4	1.5	33	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC08	De-watering MCC Panel	MIC05	Centrifuge feed tank mixer	Control	220			1	4	1.5	42	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC08	De-watering MCC Panel	MIC26	Centrifuge feed tank mixer	Control	220			1	4	1.5	47	2	Cu/PVC/PVC/SWA/PVC 600/1000V

From		To		Type	Voltage (V)	Type	Installed Load (kW)	No. of Cables	No. of Cores	Nominal Section mm ²	Total Length (m)	Term. (no.)	Type
Equip. No.	Equipment Description	Equip. No.	Equipment Description										
MCC08	De-watering MCC Panel		Poly Make-up Air handling Unit	Control	220			1	4	1.5	33	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC08	De-watering MCC Panel	MIC10	Centrifuge cake conveyor	Control	220			1	4	1.5	36	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC08	De-watering MCC Panel	MIC11	Centrifuge cake conveyor	Control	220			1	4	1.5	36	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC08	De-watering MCC Panel		HVAC Fans (dewatering building)	Control	220			1	4	1.5	29	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC08	De-watering MCC Panel		HVAC Fans (dewatering building)	Control	220			1	4	1.5	29	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC08	De-watering MCC Panel		HVAC Fans (dewatering building)	Control	220			1	4	1.5	29	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC08	De-watering MCC Panel		Poly Make-Up System	Control	220			1	4	1.5	38	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC08	De-watering MCC Panel		Poly Make-Up System	Control	220			1	4	1.5	34	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC08	De-watering MCC Panel	MIC06	Centrifuge feed pump	Control	220			1	4	1.5	40	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC08	De-watering MCC Panel	MIC07	Centrifuge feed pump	Control	220			1	4	1.5	42	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC08	De-watering MCC Panel	MIC08	Poly dosing pump	Control	220			1	4	1.5	24	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC08	De-watering MCC Panel	MIC09	Poly dosing pump	Control	220			1	4	1.5	24	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC08	De-watering MCC Panel	MIC14	Cake transfer pump	Control	220			1	4	1.5	36	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC08	De-watering MCC Panel	MIC15	Cake transfer pump	Control	220			1	4	1.5	36	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC08	De-watering MCC Panel	MIC16	Poly lubrication pumps	Control	220			1	4	1.5	24	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC08	De-watering MCC Panel	MIC17	Poly lubrication pumps	Control	220			1	4	1.5	24	2	Cu/PVC/PVC/SWA/PVC 600/1000V

Cable Schedule - Sludge Transfer Pump Station

From		To		Type	Voltage (V)	Type	Installed Load (kW)	No. of Cables	No. of Cores	Nominal Section mm ²	Total Length (m)	Term. (no.)	Type
Equip. No.	Equipment Description	Equip. No.	Equipment Description										
MSU04	Centrifuge MSU	MCC08B	Sludge Transfer P/S MCC Panel	Power	400	Incomer	74	1	4	50	65	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC08B	Sludge Transfer P/S MCC Panel		Welding Plug 1	Power	400	Feeder	20	1	4	16	25	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC08B	Sludge Transfer P/S MCC Panel		Bottom pump area HVAC Fan	Power	400	Feeder	1.5	1	4	1.5	40	2	Cu/PVC/PVC/SWA/PVC 600/1000V

MCC08B	Sludge Transfer P/S MCC Panel	MIC01	WAS transfer pump	Power	400	VFD	15	1	3	10	25	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC08B	Sludge Transfer P/S MCC Panel	MIC01	WAS transfer pump	Earth	Earth	VFD		1	1	10	25	2	Insulated Copper Earth Wire (ICEW)
MCC08B	Sludge Transfer P/S MCC Panel	MIC02	WAS transfer pump	Power	400	VFD	15	1	3	10	25	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC08B	Sludge Transfer P/S MCC Panel	MIC02	WAS transfer pump	Earth	Earth	VFD		1	1	10	25	2	Insulated Copper Earth Wire (ICEW)
MCC08B	Sludge Transfer P/S MCC Panel	MIC03	WAS macerator and solids separator	Power	400	VFD	7.5	1	3	2.5	25	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC08B	Sludge Transfer P/S MCC Panel	MIC03	WAS macerator and solids separator	Earth	Earth	VFD		1	1	2.5	25	2	Insulated Copper Earth Wire (ICEW)
MCC08B	Sludge Transfer P/S MCC Panel	MIC04	WAS macerator and solids separator	Power	400	VFD	7.5	1	3	2.5	25	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC08B	Sludge Transfer P/S MCC Panel	MIC04	WAS macerator and solids separator	Earth	Earth	VFD		1	1	2.5	25	2	Insulated Copper Earth Wire (ICEW)
MCC08B	Sludge Transfer P/S MCC Panel	MIC01	WAS transfer pump	Control	220			1	4	1.5	25	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC08B	Sludge Transfer P/S MCC Panel	MIC02	WAS transfer pump	Control	220			1	4	1.5	25	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC08B	Sludge Transfer P/S MCC Panel	MIC03	WAS macerator and solids separator	Control	220			1	4	1.5	25	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC08B	Sludge Transfer P/S MCC Panel	MIC04	WAS macerator and solids separator	Control	220			1	4	1.5	25	2	Cu/PVC/PVC/SWA/PVC 600/1000V

EB13.CABLE SCHEDULE-PUMP STATIONS**Cable Schedule - Pump Station No. 1**

From		To		Type	Voltage (V)	Type	Installed Load (kW)	No. of Cables	No. of Cores	Nominal Section mm ²	Total Length (m)	Term. (no.)	Type
Equip. No.	Equipment Description	Equip. No.	Equipment Description										
MSU01	Mini-substation No. 1	MCC02-1	Pump Station No. 1 MCC Panel	Power	400	Incomer	439	3	4	150	240	6	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC02-1	Pump Station No. 1 MCC Panel		Welding Plug 1	Power	400	Feeder	20	1	4	16	20	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC02-1	Pump Station No. 1 MCC Panel		Overhead Crawl Feeder	Power	400	Feeder	4	1	4	2.5	20	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC02-1	Pump Station No. 1 MCC Panel	MIC02	Surface Aerator	Power	400	VFD	37	1	3	25	82	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC02-1	Pump Station No. 1 MCC Panel	MIC02	Surface Aerator	Earth	Earth	VFD		1	1	25	82	2	Insulated Copper Earth Wire (ICEW)
MCC02-1	Pump Station No. 1 MCC Panel	MIC03	Surface Aerator	Power	400	VFD	37	1	3	25	102	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC02-1	Pump Station No. 1 MCC Panel	MIC03	Surface Aerator	Earth	Earth	VFD		1	1	25	102	2	Insulated Copper Earth Wire (ICEW)
MCC02-1	Pump Station No. 1 MCC Panel	MIC04	Surface Aerator	Power	400	VFD	37	1	3	25	122	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC02-1	Pump Station No. 1 MCC Panel	MIC04	Surface Aerator	Earth	Earth	VFD		1	1	25	122	2	Insulated Copper Earth Wire (ICEW)
MCC02-1	Pump Station No. 1 MCC Panel	MIC05	Surface Aerator	Power	400	VFD	37	1	3	25	104	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC02-1	Pump Station No. 1 MCC Panel	MIC05	Surface Aerator	Earth	Earth	VFD		1	1	25	104	2	Insulated Copper Earth Wire (ICEW)
MCC02-1	Pump Station No. 1 MCC Panel	MIC07	Surface Aerator	Power	400	VFD	11	1	3	4	63	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC02-1	Pump Station No. 1 MCC Panel	MIC07	Surface Aerator	Earth	Earth	VFD		1	1	4	63	2	Insulated Copper Earth Wire (ICEW)
MCC02-1	Pump Station No. 1 MCC Panel	MIC01	Anoxic mixer	Power	400	DOL	7.5	1	4	6	68	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC02-1	Pump Station No. 1 MCC Panel	MIC06	Anoxic mixer	Power	400	DOL	7.5	1	4	6	82	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC02-1	Pump Station No. 1 MCC Panel		Return Sludge Pump 2	Power	400	SS	15	1	4	10	40	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC02-1	Pump Station No. 1 MCC Panel		Return Sludge Pump (Standby)	Power	400	SS	15	1	4	10	40	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC02-1	Pump Station No. 1 MCC Panel	MIC09	Surface Aerator	Power	400	VFD	37	1	3	25	90	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC02-1	Pump Station No. 1 MCC Panel	MIC09	Surface Aerator	Earth	Earth	VFD		1	1	25	90	2	Insulated Copper Earth Wire (ICEW)
MCC02-1	Pump Station No. 1 MCC Panel	MIC10	Surface Aerator	Power	400	VFD	37	1	3	25	112	2	Cu/PVC/PVC/SWA/PVC 600/1000V

MCC02-1	Pump Station No. 1 MCC Panel	MIC10	Surface Aerator	Earth	Earth	VFD		1	1	25	112	2	Insulated Copper Earth Wire (ICEW)
MCC02-1	Pump Station No. 1 MCC Panel	MIC11	Surface Aerator	Power	400	VFD	37	1	3	25	148	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC02-1	Pump Station No. 1 MCC Panel	MIC11	Surface Aerator	Earth	Earth	VFD		1	1	25	148	2	Insulated Copper Earth Wire (ICEW)
MCC02-1	Pump Station No. 1 MCC Panel	MIC12	Surface Aerator	Power	400	VFD	37	1	3	25	126	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC02-1	Pump Station No. 1 MCC Panel	MIC12	Surface Aerator	Earth	Earth	VFD		1	1	25	126	2	Insulated Copper Earth Wire (ICEW)
MCC02-1	Pump Station No. 1 MCC Panel	MIC14	Surface Aerator	Power	400	VFD	11	1	3	4	78	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC02-1	Pump Station No. 1 MCC Panel	MIC14	Surface Aerator	Earth	Earth	VFD		1	1	4	78	2	Insulated Copper Earth Wire (ICEW)
MCC02-1	Pump Station No. 1 MCC Panel	MIC08	Anoxic mixer	Power	400	DOL	7.5	1	4	6	64	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC02-1	Pump Station No. 1 MCC Panel	MIC13	Anoxic mixer	Power	400	DOL	7.5	1	4	6	100	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC02-1	Pump Station No. 1 MCC Panel		Return Sludge Pump 2	Power	400	SS	15	1	4	10	40	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC02-1	Pump Station No. 1 MCC Panel		Return Sludge Pump (Standby)	Power	400	SS	15	1	4	10	40	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC02-1	Pump Station No. 1 MCC Panel	MIC02	Surface Aerator	Control	220			1	4	1.5	82	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC02-1	Pump Station No. 1 MCC Panel	MIC03	Surface Aerator	Control	220			1	4	1.5	102	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC02-1	Pump Station No. 1 MCC Panel	MIC04	Surface Aerator	Control	220			1	4	1.5	122	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC02-1	Pump Station No. 1 MCC Panel	MIC05	Surface Aerator	Control	220			1	4	1.5	104	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC02-1	Pump Station No. 1 MCC Panel	MIC07	Surface Aerator	Control	220			1	4	1.5	63	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC02-1	Pump Station No. 1 MCC Panel	MIC01	Anoxic mixer	Control	220			1	4	1.5	68	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC02-1	Pump Station No. 1 MCC Panel	MIC06	Anoxic mixer	Control	220			1	4	1.5	82	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC02-1	Pump Station No. 1 MCC Panel		Return Sludge Pump 2	Control	220			1	4	1.5	40	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC02-1	Pump Station No. 1 MCC Panel		Return Sludge Pump (Standby)	Control	220			1	4	1.5	40	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC02-1	Pump Station No. 1 MCC Panel	MIC09	Surface Aerator	Control	220			1	4	1.5	90	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC02-1	Pump Station No. 1 MCC Panel	MIC10	Surface Aerator	Control	220			1	4	1.5	112	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC02-1	Pump Station No. 1 MCC Panel	MIC11	Surface Aerator	Control	220			1	4	1.5	148	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC02-1	Pump Station No. 1 MCC Panel	MIC12	Surface Aerator	Control	220			1	4	1.5	126	2	Cu/PVC/PVC/SWA/PVC 600/1000V

MCC02-1	Pump Station No. 1 MCC Panel	MIC14	Surface Aerator	Control	220			1	4	1.5	78	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC02-1	Pump Station No. 1 MCC Panel	MIC08	Anoxic mixer	Control	220			1	4	1.5	64	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC02-1	Pump Station No. 1 MCC Panel	MIC13	Anoxic mixer	Control	220			1	4	1.5	100	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC02-1	Pump Station No. 1 MCC Panel		Return Sludge Pump 2	Control	220			1	4	1.5	40	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC02-1	Pump Station No. 1 MCC Panel		Return Sludge Pump (Standby)	Control	220			1	4	1.5	40	2	Cu/PVC/PVC/SWA/PVC 600/1000V

Cable Schedule - Pump Station No. 2

From		To		Type	Voltage (V)	Type	Installed Load (kW)	No. of Cables	No. of Cores	Nominal Section mm ²	Total Length (m)	Term. (no.)	Type
Equip. No.	Equipment Description	Equip. No.	Equipment Description										
MSU02	Mini-substation No. 2	MCC02-2	Pump Station No. 2 MCC Panel	Power	400	Incomer	270	2	4	150	160	4	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC02-2	Pump Station No. 2 MCC Panel		Welding Plug 1	Power	400	Feeder	20	1	4	16	20	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC02-2	Pump Station No. 2 MCC Panel		Overhead Crawl Feeder	Power	400	Feeder	4	1	4	2.5	20	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC02-2	Pump Station No. 2 MCC Panel		Administration Building	Power	400	Feeder	37	1	4	50	100	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC02-2	Pump Station No. 2 MCC Panel	MIC16	Surface Aerator	Power	400	VFD	37	1	3	25	90	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC02-2	Pump Station No. 2 MCC Panel	MIC16	Surface Aerator	Earth	Earth	VFD		1	1	25	90	2	Insulated Copper Earth Wire (ICEW)
MCC02-2	Pump Station No. 2 MCC Panel	MIC17	Surface Aerator	Power	400	VFD	37	1	3	25	112	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC02-2	Pump Station No. 2 MCC Panel	MIC17	Surface Aerator	Earth	Earth	VFD		1	1	25	112	2	Insulated Copper Earth Wire (ICEW)
MCC02-2	Pump Station No. 2 MCC Panel	MIC18	Surface Aerator	Power	400	VFD	37	1	3	25	148	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC02-2	Pump Station No. 2 MCC Panel	MIC18	Surface Aerator	Earth	Earth	VFD		1	1	25	148	2	Insulated Copper Earth Wire (ICEW)
MCC02-2	Pump Station No. 2 MCC Panel	MIC19	Surface Aerator	Power	400	VFD	37	1	3	25	126	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC02-2	Pump Station No. 2 MCC Panel	MIC19	Surface Aerator	Earth	Earth	VFD		1	1	25	126	2	Insulated Copper Earth Wire (ICEW)
MCC02-2	Pump Station No. 2 MCC Panel	MIC21	Surface Aerator	Power	400	VFD	11	1	3	4	78	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC02-2	Pump Station No. 2 MCC Panel	MIC21	Surface Aerator	Earth	Earth	VFD		1	1	4	78	2	Insulated Copper Earth Wire (ICEW)
MCC02-2	Pump Station No. 2 MCC Panel	MIC15	Anoxic mixer	Power	400	DOL	8	1	4	6	64	2	Cu/PVC/PVC/SWA/PVC 600/1000V

MCC02-2	Pump Station No. 2 MCC Panel	MIC20	Anoxic mixer	Power	400	DOL	8	1	4	6	100	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC02-2	Pump Station No. 2 MCC Panel		Return Sludge Pump 2	Power	400	SS	15	1	4	10	40	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC02-2	Pump Station No. 2 MCC Panel		Return Sludge Pump (Standby)	Power	400	SS	15	1	4	10	40	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC02-2	Pump Station No. 2 MCC Panel	MIC16	Surface Aerator	Control	220			1	4	1.5	90	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC02-2	Pump Station No. 2 MCC Panel	MIC17	Surface Aerator	Control	220			1	4	1.5	112	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC02-2	Pump Station No. 2 MCC Panel	MIC18	Surface Aerator	Control	220			1	4	1.5	148	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC02-2	Pump Station No. 2 MCC Panel	MIC19	Surface Aerator	Control	220			1	4	1.5	126	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC02-2	Pump Station No. 2 MCC Panel	MIC21	Surface Aerator	Control	220			1	4	1.5	78	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC02-2	Pump Station No. 2 MCC Panel	MIC15	Anoxic mixer	Control	220			1	4	1.5	64	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC02-2	Pump Station No. 2 MCC Panel	MIC20	Anoxic mixer	Control	220			1	4	1.5	100	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC02-2	Pump Station No. 2 MCC Panel		Return Sludge Pump 2	Control	220			1	4	1.5	40	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC02-2	Pump Station No. 2 MCC Panel		Return Sludge Pump (Standby)	Control	220			1	4	1.5	40	2	Cu/PVC/PVC/SWA/PVC 600/1000V

Cable Schedule - Pump Station No. 3

From		To		Type	Voltage (V)	Type	Installed Load (kW)	No. of Cables	No. of Cores	Nominal Section mm ²	Total Length (m)	Term. (no.)	Type
Equip. No.	Equipment Description	Equip. No.	Equipment Description										
MSU02	Mini-substation No. 2	MCC02-3	Pump Station No. 3 MCC Panel	Power	400	Incomer	233	2	4	150	160	4	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC02-3	Pump Station No. 3 MCC Panel		Welding Plug 1	Power	400	Feeder	20	1	4	16	20	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC02-3	Pump Station No. 3 MCC Panel		Overhead Crawl Feeder	Power	400	Feeder	4	1	4	2.5	20	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC02-3	Pump Station No. 3 MCC Panel	MIC23	Surface Aerator	Power	400	VFD	37	1	3	25	82	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC02-3	Pump Station No. 3 MCC Panel	MIC23	Surface Aerator	Earth	Earth	VFD		1	1	25	82	2	Insulated Copper Earth Wire (ICEW)

MCC02-3	Pump Station No. 3 MCC Panel	MIC24	Surface Aerator	Power	400	VFD	37	1	3	25	102	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC02-3	Pump Station No. 3 MCC Panel	MIC24	Surface Aerator	Earth	Earth	VFD		1	1	25	102	2	Insulated Copper Earth Wire (ICEW)
MCC02-3	Pump Station No. 3 MCC Panel	MIC25	Surface Aerator	Power	400	VFD	37	1	3	25	122	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC02-3	Pump Station No. 3 MCC Panel	MIC25	Surface Aerator	Earth	Earth	VFD		1	1	25	122	2	Insulated Copper Earth Wire (ICEW)
MCC02-3	Pump Station No. 3 MCC Panel	MIC26	Surface Aerator	Power	400	VFD	37	1	3	25	104	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC02-3	Pump Station No. 3 MCC Panel	MIC26	Surface Aerator	Earth	Earth	VFD		1	1	25	104	2	Insulated Copper Earth Wire (ICEW)
MCC02-3	Pump Station No. 3 MCC Panel	MIC28	Surface Aerator	Power	400	VFD	11	1	3	4	63	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC02-3	Pump Station No. 3 MCC Panel	MIC28	Surface Aerator	Earth	Earth	VFD		1	1	4	63	2	Insulated Copper Earth Wire (ICEW)
MCC02-3	Pump Station No. 3 MCC Panel	MIC22	Anoxic mixer	Power	400	DOL	8	1	4	6	68	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC02-3	Pump Station No. 3 MCC Panel	MIC27	Anoxic mixer	Power	400	DOL	8	1	4	6	82	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC02-3	Pump Station No. 3 MCC Panel		Return Sludge Pump 2	Power	400	SS	15	1	4	10	40	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC02-3	Pump Station No. 3 MCC Panel		Return Sludge Pump (Standby)	Power	400	SS	15	1	4	10	40	2	Cu/PVC/PVC/SWA/PVC 600/1000V

MCC02-3	Pump Station No. 3 MCC Panel	MIC23	Surface Aerator	Control	220			1	4	1.5	82	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC02-3	Pump Station No. 3 MCC Panel	MIC24	Surface Aerator	Control	220			1	4	1.5	102	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC02-3	Pump Station No. 3 MCC Panel	MIC25	Surface Aerator	Control	220			1	4	1.5	122	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC02-3	Pump Station No. 3 MCC Panel	MIC26	Surface Aerator	Control	220			1	4	1.5	104	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC02-3	Pump Station No. 3 MCC Panel	MIC28	Surface Aerator	Control	220			1	4	1.5	63	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC02-3	Pump Station No. 3 MCC Panel	MIC22	Anoxic mixer	Control	220			1	4	1.5	68	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC02-3	Pump Station No. 3 MCC Panel	MIC27	Anoxic mixer	Control	220			1	4	1.5	82	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC02-3	Pump Station No. 3 MCC Panel		Return Sludge Pump 2	Control	220			1	4	1.5	40	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC02-3	Pump Station No. 3 MCC Panel		Return Sludge Pump (Standby)	Control	220			1	4	1.5	40	2	Cu/PVC/PVC/SWA/PVC 600/1000V

Cable Schedule - Pump Station No. 4

From		To		Type	Voltage (V)	Type	Installed Load (kW)	No. of Cables	No. of Cores	Nominal Section mm ²	Total Length (m)	Term. (no.)	Type
Equip. No.	Equipment Description	Equip. No.	Equipment Description										
MSU05	Mini-substation No. 5	MCC02-4	Pump Station No. 4 MCC Panel	Power	400	Incomer	437	3	4	150	240	6	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC02-4	Pump Station No. 4 MCC Panel		Welding Plug 1	Power	400	Feeder	20	1	4	16	122	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC02-4	Pump Station No. 4 MCC Panel		Overhead Crawl Feeder	Power	400	Feeder	4	1	4	2.5	20	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC02-4	Pump Station No. 4 MCC Panel	MIC30	Surface Aerator	Power	400	VFD	37	1	3	25	82	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC02-4	Pump Station No. 4 MCC Panel	MIC30	Surface Aerator	Earth	Earth	VFD		1	1	25	82	2	Insulated Copper Earth Wire (ICEW)
MCC02-4	Pump Station No. 4 MCC Panel	MIC31	Surface Aerator	Power	400	VFD	37	1	3	25	102	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC02-4	Pump Station No. 4 MCC Panel	MIC31	Surface Aerator	Earth	Earth	VFD		1	1	25	102	2	Insulated Copper Earth Wire (ICEW)
MCC02-4	Pump Station No. 4 MCC Panel	MIC32	Surface Aerator	Power	400	VFD	37	1	3	25	122	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC02-4	Pump Station No. 4 MCC Panel	MIC32	Surface Aerator	Earth	Earth	VFD		1	1	25	122	2	Insulated Copper Earth Wire (ICEW)
MCC02-4	Pump Station No. 4 MCC Panel	MIC33	Surface Aerator	Power	400	VFD	37	1	3	25	104	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC02-4	Pump Station No. 4 MCC Panel	MIC33	Surface Aerator	Earth	Earth	VFD		1	1	25	104	2	Insulated Copper Earth Wire (ICEW)
MCC02-4	Pump Station No. 4 MCC Panel	MIC35	Surface Aerator	Power	400	VFD	11	1	3	4	63	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC02-4	Pump Station No. 4 MCC Panel	MIC35	Surface Aerator	Earth	Earth	VFD		1	1	4	63	2	Insulated Copper Earth Wire (ICEW)
MCC02-4	Pump Station No. 4 MCC Panel	MIC29	Anoxic mixer	Power	400	DOL	7.5	1	4	6	68	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC02-4	Pump Station No. 4 MCC Panel	MIC34	Anoxic mixer	Power	400	DOL	7.5	1	4	6	82	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC02-4	Pump Station No. 4 MCC Panel		Return Sludge Pump 2	Power	400	SS	15	1	4	10	40	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC02-4	Pump Station No. 4 MCC Panel		Return Sludge Pump (Standby)	Power	400	SS	15	1	4	10	40	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC02-4	Pump Station No. 4 MCC Panel	MIC37	Surface Aerator	Power	400	VFD	37	1	3	25	90	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC02-4	Pump Station No. 4 MCC Panel	MIC37	Surface Aerator	Earth	Earth	VFD		1	1	25	90	2	Insulated Copper Earth Wire (ICEW)
MCC02-4	Pump Station No. 4 MCC Panel	MIC38	Surface Aerator	Power	400	VFD	37	1	3	25	112	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC02-4	Pump Station No. 4 MCC Panel	MIC38	Surface Aerator	Earth	Earth	VFD		1	1	25	112	2	Insulated Copper Earth Wire (ICEW)

MCC02-4	Pump Station No. 4 MCC Panel	MIC39	Surface Aerator	Power	400	VFD	37	1	3	25	148	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC02-4	Pump Station No. 4 MCC Panel	MIC39	Surface Aerator	Earth	Earth	VFD		1	1	25	148	2	Insulated Copper Earth Wire (ICEW)
MCC02-4	Pump Station No. 4 MCC Panel	MIC40	Surface Aerator	Power	400	VFD	37	1	3	25	126	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC02-4	Pump Station No. 4 MCC Panel	MIC40	Surface Aerator	Earth	Earth	VFD		1	1	25	126	2	Insulated Copper Earth Wire (ICEW)
MCC02-4	Pump Station No. 4 MCC Panel	MIC42	Surface Aerator	Power	400	VFD	11	1	3	4	78	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC02-4	Pump Station No. 4 MCC Panel	MIC42	Surface Aerator	Earth	Earth	VFD		1	1	4	78	2	Insulated Copper Earth Wire (ICEW)
MCC02-4	Pump Station No. 4 MCC Panel	MIC36	Anoxic mixer	Power	400	DOL	7.5	1	4	6	64	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC02-4	Pump Station No. 4 MCC Panel	MIC41	Anoxic mixer	Power	400	DOL	7.5	1	4	6	100	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC02-4	Pump Station No. 4 MCC Panel		Return Sludge Pump 2	Power	400	SS	15	1	4	10	40	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC02-4	Pump Station No. 4 MCC Panel		Return Sludge Pump (Standby)	Power	400	SS	15	1	4	10	40	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC02-4	Pump Station No. 4 MCC Panel	MIC30	Surface Aerator	Control	220			1	4	1.5	82	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC02-4	Pump Station No. 4 MCC Panel	MIC31	Surface Aerator	Control	220			1	4	1.5	102	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC02-4	Pump Station No. 4 MCC Panel	MIC32	Surface Aerator	Control	220			1	4	1.5	122	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC02-4	Pump Station No. 4 MCC Panel	MIC33	Surface Aerator	Control	220			1	4	1.5	104	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC02-4	Pump Station No. 4 MCC Panel	MIC35	Surface Aerator	Control	220			1	4	1.5	63	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC02-4	Pump Station No. 4 MCC Panel	MIC29	Anoxic mixer	Control	220			1	4	1.5	68	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC02-4	Pump Station No. 4 MCC Panel	MIC34	Anoxic mixer	Control	220			1	4	1.5	82	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC02-4	Pump Station No. 4 MCC Panel		Return Sludge Pump 2	Control	220			1	4	1.5	40	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC02-4	Pump Station No. 4 MCC Panel		Return Sludge Pump (Standby)	Control	220			1	4	1.5	40	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC02-4	Pump Station No. 4 MCC Panel		Surface Aerator	Control	220			1	4	1.5	90	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC02-4	Pump Station No. 4 MCC Panel	MIC38	Surface Aerator	Control	220			1	4	1.5	112	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC02-4	Pump Station No. 4 MCC Panel	MIC39	Surface Aerator	Control	220			1	4	1.5	148	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC02-4	Pump Station No. 4 MCC Panel	MIC40	Surface Aerator	Control	220			1	4	1.5	126	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC02-4	Pump Station No. 4 MCC Panel	MIC42	Surface Aerator	Control	220			1	4	1.5	78	2	Cu/PVC/PVC/SWA/PVC 600/1000V

MCC02-4	Pump Station No. 4 MCC Panel	MIC36	Anoxic mixer	Control	220			1	4	1.5	64	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC02-4	Pump Station No. 4 MCC Panel	MIC41	Anoxic mixer	Control	220			1	4	1.5	100	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC02-4	Pump Station No. 4 MCC Panel		Return Sludge Pump 2	Control	220			1	4	1.5	40	2	Cu/PVC/PVC/SWA/PVC 600/1000V
MCC02-4	Pump Station No. 4 MCC Panel		Return Sludge Pump (Standby)	Control	220			1	4	1.5	40	2	Cu/PVC/PVC/SWA/PVC 600/1000V