

ANNEXURE E

Amended Part C3: Scope of Works

PART C3 : SCOPE OF WORKS

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A. NORTH WORKS: MODULES 1 - 4 (PRIMARY SETTLING TANKS)

A1 Electrical

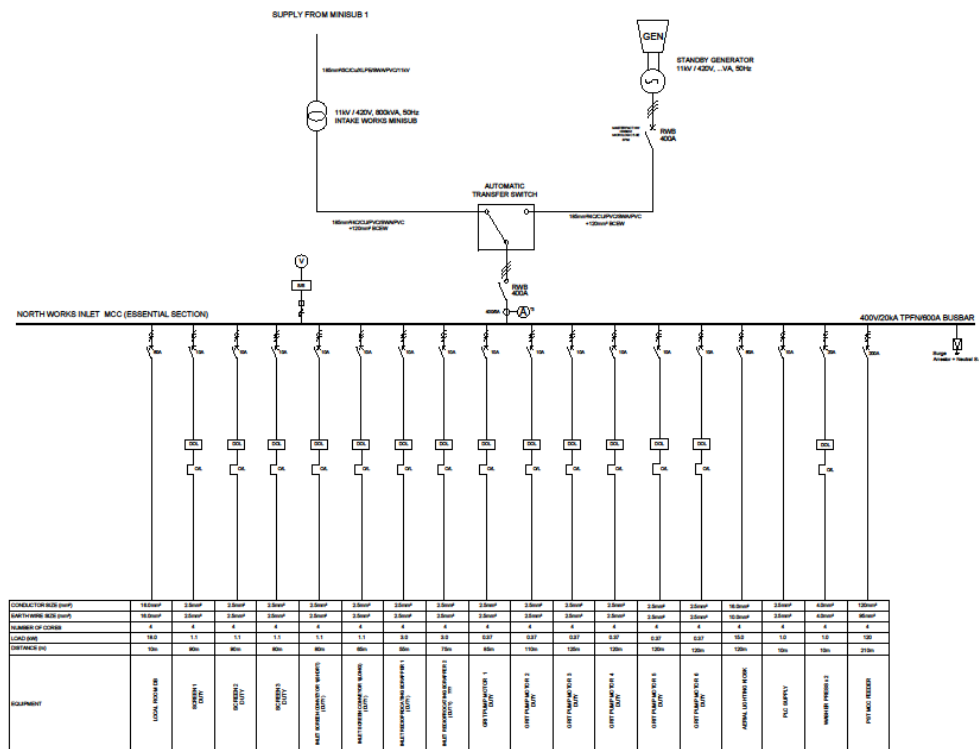
- Design, Manufacture, Supply, offloading, Installation and Commissioning of a new Primary Settling Tanks Stainless Steel MCC as per Single Line Diagram to be installed in the proposed new PST Building
- Installation of New Power Cable including Circuit Breaker from existing East Balancing Dam Minisub the new MCC.
- Installation of New Power & Control Cabling for 6 x PSTs from the new PST MCC
- Decommission existing 2 x PST MCCs and 2 x Industrial Welding Plugs and deliver to C.O.T stores.
- Install 3 x New Weatherproof Industrial Welding Plugs (Wall Mounted)
- Install 6 x New Emergency Stop/Start Stations on Stainless Steel Mounting/Support Structure for Primary Sludge Pumps.
- Decommission 2 x Post Top Mounted Lights and replace with 3 x 5m Post Top Mounted Led Floodlights(X6) back-to-back mounting arrangement.
- Design Supply, Installation and Coordination of new Fibre optic link including Splice Boxes for SCADA monitoring.
- Earthing & Lighting Protection refurbishment with COC by a Specialist for existing 3 x PSTs and New LPS Installation for 3 x PSTs.
-



Figure: 2 x DBs & Industrial Welding Plugs to be Decommissioned and replaced with new

Figure: PP 1.2 to PP 1.3: Replace with New including Cabling of 10mm²/C/Cu/PVC/SWA/PVC/1000V + 6mm² BCEW

Figure: North Works PST MCC SLD



MOTOR CONTROL CENTRE CONSTRUCTION AND ELECTRICAL SPECIFICATION																					
			MATERIAL TYPE & THICKNESS			FINISH		CABLE ENTRY													
Recessed	-	Vermin	X	1.2mm	-	Electra Gals	-	Etch Prime	-	Top	-	Separated Divisions	-	Colour Main	Width	TBA	Buster Rating	500A	Front Access		
Semi Recessed	-	Dust Proof		1.2mm	-	SGR12	-	Brushed	-	Bottom	-	Emergency Section	X	Colour Emergency	Signal Red	Height	TBA	Fail Level	200A	Rear Access	
	-	Indings Panels	X	2mm	X	STAINLESS STEEL	X	Powder Coat	-	Grand Plate	-	UPS Section	-	Colour Control	Depth	TBA					
Door Standing	X								-	Back	-	Normal Section	-	Colour Normal	Light Orange		Earth Bar	X	Supply Cable		
Doors	X								-		-	UPS Section	-	Colour Normal	Light Orange		Earth Stud	-	Supply Cables		
									-		-	Spare Capacity	-		30%						

GENERAL NOTES		
1. ALL WORKS MUST COMPLY WITH SANS 10146		
2. SURGE ARRESTOR CLASS TYPE TO BE FINALISED ON DESIGN COMPLETION OF LIGHTNING & EARTHING SYSTEM		
3. ALL DIRECT-ON-LINE AND SOFT STARTER MOTORS TO BE OF TYPE 3 COORDINATION		
LEGEND		
	400V RATED BUS BAR	
	SINGLE POLE AND NEUTRAL	
	TRIPLE POLE AND NEUTRAL	
	SWITCH DISCONNECTOR	
	CIRCUIT BREAKER	
	SURGE ARRESTOR (F) = NEUTRAL	
	EARTH LEAKAGE UNIT	
	DIRECT ONLINE	
	FORWARD - REVERSE DIRECT ONLINE	
	VARIABLE SPEED DRIVE	
	SOFT STARTER	
	SELECTOR SWITCH	
	VOLTMETER	
	AMMETER	
	CURRENT TRANSFORMER	
	PUMP	

CLIENT: TSHWANE LOCAL MUNICIPALITY 1001 10TH AVENUE PRETORIA 0001	Water and Sanitation Department Admin Building Depot/ Main Water Treatment Works Bosman Street Extension POC Box 1022 Pretoria www.tshwane.gov.za
ELECTRICAL SCHEMATIC 011 461 1000 011 461 1001 011 461 1002	

CLIENT APPROVAL:		
NAME: _____	SIGNATURE: _____	
DATE: _____		
REV	DATE	DESCRIPTION
0	2024/03/28	FOR INFORMATION
		M.TSHEA

PROJECT:

ROOIWAL WWWT REFURBISH
AND UPGRADE

TITLE:

NORTH INLET WORKS MCC
SINGLE LINE DIAGRAM

DESIGNED BY: M.TSHEA	CHECKED BY: M.TSHEA	
APPROVED BY: M.TSHEA	SIGNATURE: _____	DATE: 2024/03/28
SIGNED: _____		
DRAWING NO. NORTH INLET 001	SCALE: 1:1.5	

- Refurbish including rust treatment for existing Blower House MCC. Replace 6 x existing Degritter Pumps DOL starter drive Sections & Timers and Interlocked to Classifiers, 2 x Degritter Blower DOL Starter Drive Sections, 1 X Compressor DOL Starter Drive Section, 1 x DB Section, 1 x Incomer Section and 1 x PLC Section for the 6 X new 3 kW De-gritter pumps.
- Convert existing 2 x De-Gritter Classifier Sections into new 2 X Washer Press Fully Equipped DOL Starter Drive Sections.
- Convert and Equip existing Essential Spare Section to Feed New Classifier MCC.
- Replace Essential Board's 1 x Conveyor and 2 x Washwater Pump DOL Starter Drive Sections with new equipment including Screen Panel Section and Emergency Main Switch Section
- Installation of new cabling and Aux equipment for the above-mentioned items.
- Installation of New Emergency Stop Start Stations on Stainless Steel Supports for 2 x Washer Presses, Long & Short Conveyors and 3 X Inlet Screens.
- Installation of 2 x Ultrasonic Sensors utilizing Isonics technology complete with wiring and control cables.



Figure: Existing Blower House MCC to be Refurbished.

- Complete New electrical DB, Power, Lighting, Building Earthing & Lighting Protection refurbishment by a Specialist and issuing of a COC for the Blower House Building & the New to be Refurbished Incinerator Building.



Figure: New Electrical Building Services Power, Lighting, LPS and DB Installation for Incenerator Building & Blower House Building.

- New Power, Instrumentation & Control Cable Installation for Mechanical Screens
Screen System complete with Cable Trays & Racks from Blower House Building MCC including Aerial lighting installation.



Figure: New power & control Cabling , racking and Aerial Lighting for Mechanical Screens.

- New Power, Instrumentation & Control Cable Installation for Degritter System
complete with Cable Trays & Racks from Blower House Building MCC including
Aerial lighting installation.

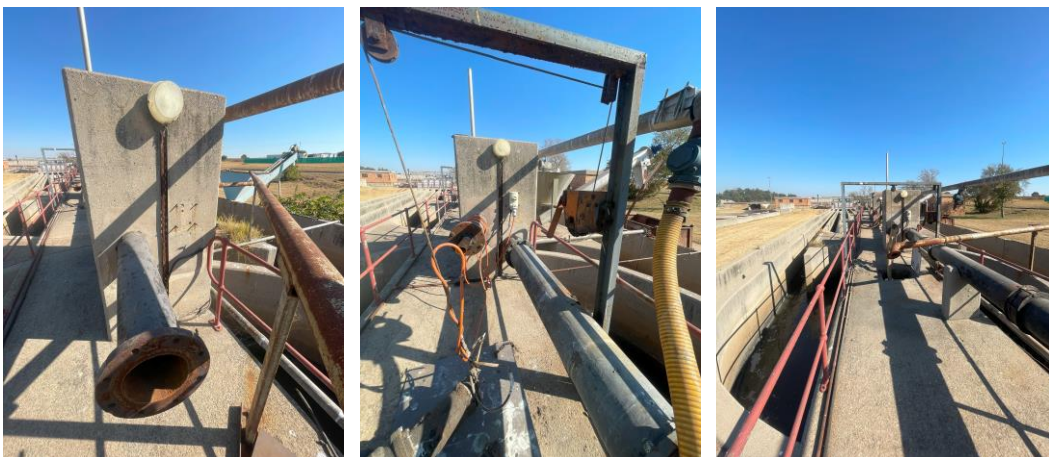


Figure: New Stop/Start Stations, Welding plug, power & control Cabling , racking and Aerial Lighting for the Degritter System

- Design Supply, Installation and Coordination of new Fibre optic link including Splice Boxes for SCADA monitoring.
- Decommission the existing generator and replace with a new generator as specified with Automatic Transfer Switch.



Figure: Decommission Generator and replace with a new ...kVA Generator

C. NORTH WORKS BIOLOGICAL REACTOR

C1 Electrical:

- Installation of Three new electrical cables from the blower room distribution board (DB) to the three screw-pump station MCC's
- New Cabling including cable racking from the three screw-pump station MCC's to the 24 X 7.5kW and 24 X 10kW reactor mixers with VSDs



Figure: New power & control Cabling , racking and Aerial Lighting

D. NORTH WORKS SECONDARY SETTLING TANKS

D1 Electrical:

- Complete New Power & Control Cabling Installation from for 18 x SSTs systems from Screw Pump Station No. 1, 2 & 3 as per cable schedules and Equipment & Motor Load List.
- Complete new installation of new electrical cables from the old blower room distribution board (DB) to the existing three screw-pump station MCC's as per cable schedules.
- New Cabling including cable racking & Trays installation for the new cables.
- Decommissioning of 9 X Lighting Pole at the DB Centers and replace with New Poles and LED Lighting as specified. Installation of new 18 x Stainless Steel Emergency Stop Stations and Weatherproof 18 x Industrial Welding Plugs



E. NORTH WORKS: EAST BALANCING DAM

E1 Electrical:

- Design, Supply, Delivery & Installation of a new MCC as per Single Line Diagram.
- Complete New Power & Control Cabling Installation from for 6 x Mixers and 6 x Pumps systems from the New MCC as per cable schedules.
- Installation of New aerial lighting on the Balancing Tanks Platforms.
- Installation of New Fibre & SCADA Interface System.
- Installation of Ultrasonic Sensors with Isonics Technology.



Figure: New power & control Cabling , racking for New Mixers & Control Systems

- Decommission and deliver to City of Tshwane Stores old MCC
- Design, Supply, Installation & Commissioning of a New MCC as per Single Line Diagram.

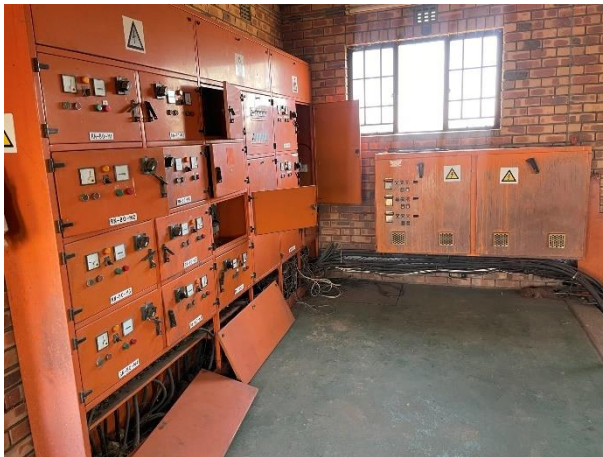


Figure: Decommission and Install New MCC

F. NORTH WORKS: WEST BALANCING DAM

F1 Electrical:

- Refurbish existing MCC including rewiring and Installation of 1 x New Altistart 48 Soft Starter Module in the existing MCC.
- Rewiring and configuration of existing SCADA Control System to include new equipment.
- Installation of New Power & Control Cables for the new 3 x Pumps and 3 x Mixers including cable Trays & Racking.



Figure: Refubish , Rewire & Install new Soft Stater in the Existing MCC



Figure: Reconfigure SCADA System and Installation of Power & Control Cables for new pumps (3 Off)



Figure: New Power & Control Cable Installation for Mixers and Control Instruments

H. NORTH WORKS RETURN SLUDGE SCREW PUMP STATION No. 2

H1 Electrical:

- Refurbish existing MCC including rewiring.
- Installation of new SCADA Control System to incorporate new equipment.
- Installation of New Power & Control Cables for the new 1 x Screw Pump Motor including cable Trays & Racking.



Figure: New Power & Control Cable Installation for Screw Pump & Refubish ment of Existing MCC

I. NORTH WORKS RETURN SLUDGE SCREW PUMP STATION No. 3

I1 Electrical:

- Refurbish existing MCC including rewiring and new Aux equipment.
- Installation of new SCADA Control System to incorporate all equipment.
- Installation of New Electrical Building Power, lighting and LPS System for the Building

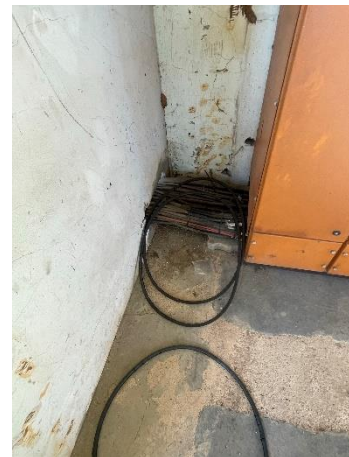
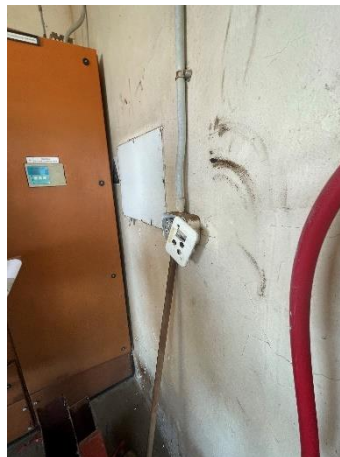


Figure: New Power & Control Cable Installation for Screw Pump & Refubish ment of Existing MCC

K. NORTH WORKS HUMUS RETURN PUMP STATION No. 2

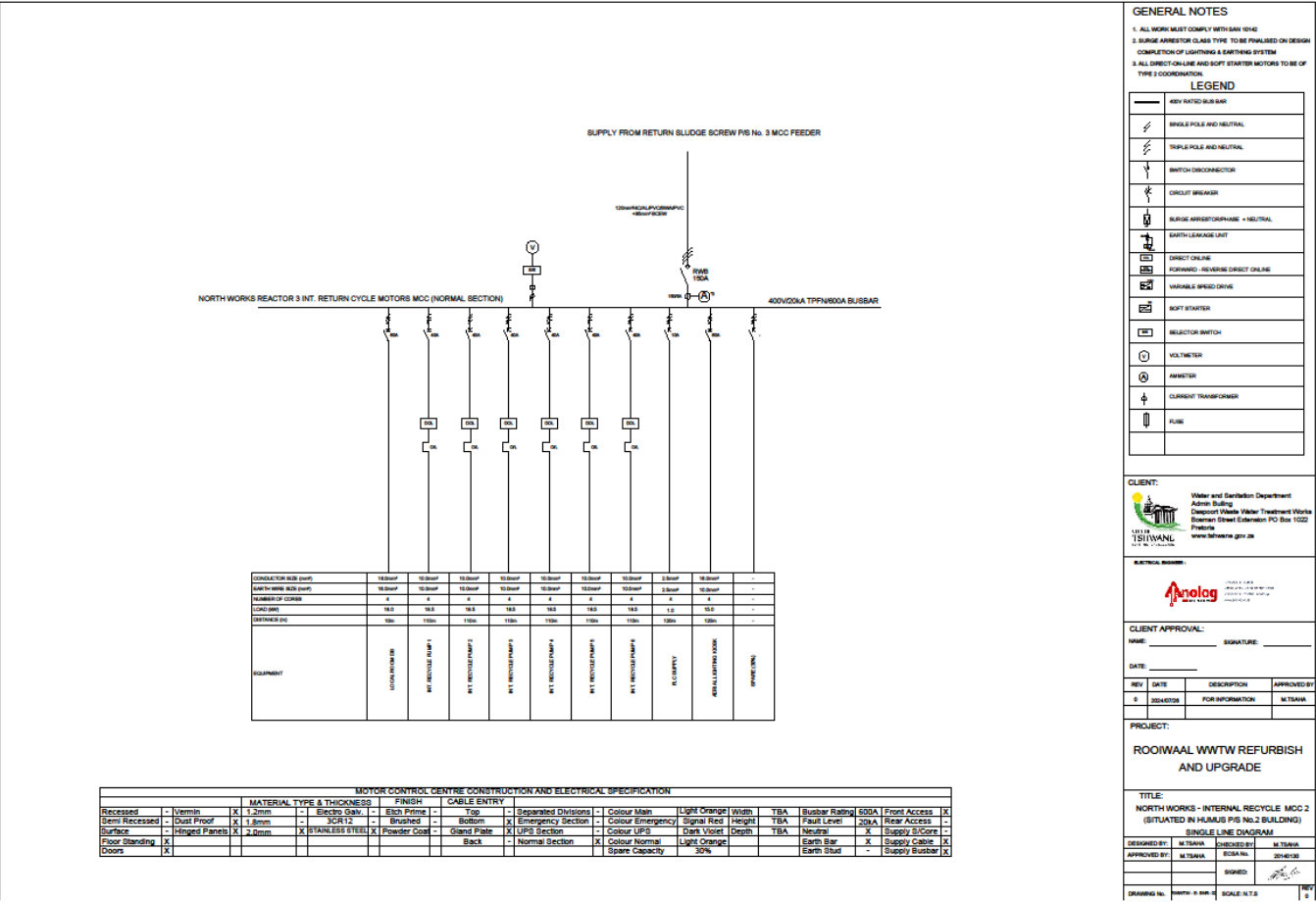
K1 Electrical:

- Decommission 3 x existing MCCs (1 X Internal and 2 x External) and deliver to City of Tshwane Stores
- Design Supply, Install and Commission new Return Cycle Pump Station MCCs to supply all equipment as per Single Line Diagram (6 x Recycle Return Pump Motors)
- Installation of New Power & Control Cables for the new Equipment as specified including cable Trays & Racking.



Figure: New Power & Control Cable Installation for Screw Pump & Refubish ment of Existing MCC

Figure: (Humus Pump Station Building) North Works Reactor 3 Internal Recycle Motors SLD



L. NORTH WORKS DAF BYPASS BUILDING MCC

L1 Electrical:

- Decommission 3 x existing MCCs and deliver to City of Tshwane Stores
- Design Supply, Install and Commission 1 x New DAF Bypass MCC to include DAF Bypass Screen and Conveyor as per Single Line Diagram.
- Installation of New Power & Control Cables for the new Equipment as specified including cable Trays & Racking.
- Installation of New Electrical Building Power, lighting and LPS System for the Building



Figure: New Power & Control Cable Installation for all equipment & Decommission x existing MCCs

M. NORTH WORKS FINAL EFFLUENT PUMP STATION

M1 Electrical:

- Decommission 4 x existing MCCs and deliver to City of Tshwane Stores
- Design Supply, Install and Commission 1 x New Final Effluent MCC as per Single Line Diagram.
- Install 5 x Emergency Stop Station for 2 x Humus Motors and 3 x Final effluent Pumps.
- Installation of New Power & Control Cables for the new Equipment as specified by the Mechanical & Process Engineer Pump Motor including cable Trays & Racking.
- Installation of New Electrical Building Power, lighting and LPS System for the Building



Figure: New MCC. Power & Control Cable Installation for all equipment & Decommission 5 x existing MCCs

N. WEST WORKS DIGESTED SLUDGE PUMP STATION

N1 Electrical:

- Refurbish existing MCC (3 x Soft Starter Digested Sludge Pumps, 1 x Sump Pump, 1 x Incomer, 1 x Local DB and 1 x PLC Section including rewiring and ancillary equipment.
- Install 4 x Emergency Stop Station for 3 x Digested Sludge Pumps and 1 x Sump Pump.
- Replace damaged cable for 1 x Sludge Pump.
- Installation of New Electrical Building Power, lighting and LPS System for the Building

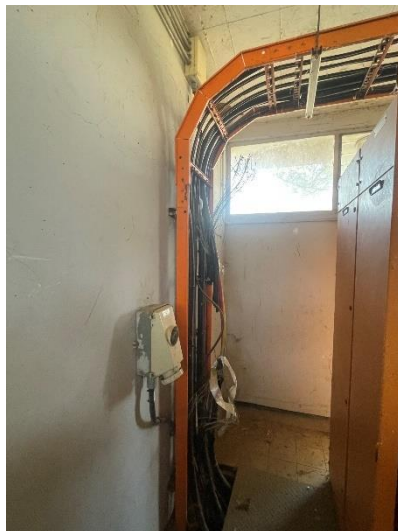


Figure: Refurbish MCC and Replace damaged power cable

O. NORTH WORKS AEROBIC DIGESTED SLUDGE PUMP STATION

O1 Electrical:

- Decommission existing 3 X MCCs and deliver to City of Tshwane Stores
- Refurbish existing Aerobic Digested Sludge Pump Station MCC with 3 x Digested Sludge Pumps (DOL), 1 x Sump Pump, Incomer Local DB & PLC Section including new Ancillary equipment.
- Design Supply, Install and Commission 1 x New Aerobic Digested Pump Station MCC as per Single Line Diagram.
- Install Emergency Stop Station as specified in equipment list.
- Installation of New Power & Control Cables for the new Equipment as specified including cable Trays & Racking and cable trenching.
- Installation of New Electrical Building Power, lighting and LPS System for the Building.



Figure: Refurbish Aerobic Digested Sludge Pump Station MCC & Decommission 3 x MCCs

P. WEST WORKS RAW SLUDGE PUMP STATION

P1 Electrical:

- Decommission existing MCC and deliver to City of Tshwane Stores.
- Design Supply, Install and Commission 1 x New Raw Sludge Pump Station MCC as per Single Line Diagram and equipment List.
- Install Emergency Stop Station as specified in equipment list.
- Installation of New Power & Control Cables for the new Equipment as specified including cable Trays & Racking and cable trenching.
- Installation of New Electrical Building Power, lighting and LPS System for the Building.



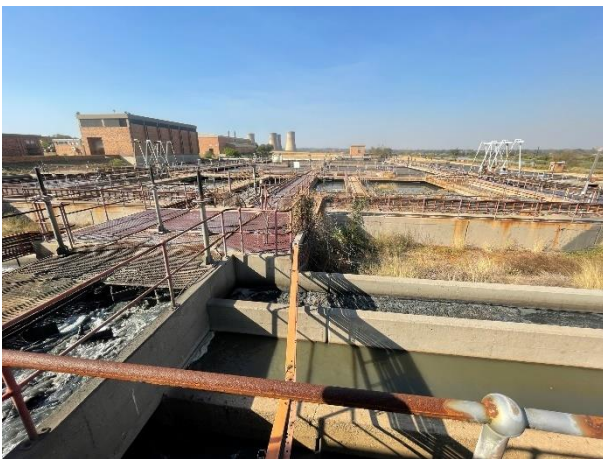
Figure: Decommission MCC and replace with new

Q. MISCELLANEOUS ELECTRICAL WORK

Q1 Electrical

- Refurbish Minisubs by retrofitting with a Coastal Specification Cover.
- Retrofit Existing Floodlights with LED Luminaires.
- Replace Floodlight Supply Kiosk with New Units.
- Rust Treatment for existing RMT Unit Cover.
- Installation of New Reactor Aerial Lighting.
- Installation of new online Analyzers.
- Installation of new LED Road/Streetlighting.
- Mv Network Refurbishment





C3.1.4 Extent of the works

In terms of the bill of quantity the extent of the work are as follows:

ELECTRICAL

SCHEDULE 1	PRELIMINARY AND GENERAL
SCHEDULE 2	
SCHEDULE 3	
SCHEDULE 4	
SCHEDULE 5	
SCHEDULE 6	
SCHEDULE 7	
SCHEDULE 8	
SCHEDULE 9	
SCHEDULE 10	

C3.1.5 Location of the works

The site for the Works is the Rooiwal Wastewater Treatment Works situated approximately 20 km north of Pretoria city centre. The coordinates for the Rooiwal entrance gate are: 25° 33' 25"S, 28° 13' 40"E.

Access

The treatment works is easily accessed by road from the R101 (Old Warmbad Road). When travelling north from Pretoria towards Hammanskraal, turn right into Rooiwal Road and continue over the bridge. Take the first left (after the second bridge over the Apies River) and at the T-junction turn right. The entrance to the Rooiwal Wastewater Treatment Works will be approximately 1,8 km down the road on the left hand side.

Topography

The Rooiwal Wastewater Treatment Works site slopes gently (approximately 5⁰) to the south and south-east directions towards the Apies River, from an elevation of approximately 1190 m above sea level at the inlet to the works.

Geotechnical Considerations:

The results and conclusions of the geotechnical investigation conducted by ARQ Consulting Engineers (Pty) Ltd reference number 6100/12363 are as follows;

In general, the site is underlain by grey to pink coarse-grained granite of the Labowa Granite Suite of the Bushveld Complex, with excavation conditions being predominantly soft to a depth of between 3,5 to 5 m. G7 quality material is considered to be representative of the material on site with collapsible and expansive soils not being expected to be cause for concern. Groundwater was not encountered in tests pits on the site and is hence not considered to be of major influence for civil works. On recommendation from the geotechnical engineer; slopes are to be battered at 1V:1,5H (approximately 30 degrees) for the temporary situation and 1V:3H for permanent works.

Although the geotechnical report has been based on trial pits east of the proposed site for the construction of the slabs and ablution block, it has been assumed that the conditions are comparable.

C3.1.6 Temporary works

No temporary works have been allowed for. However, depending on other contractor's work at the site at the time of construction, access to the site may have to be shared.

C3.2 ENGINEERING

C3.2.1 Design services and activity matrix

Not applicable.

C3.2.2 Employer's design

The design of the Works is detailed on the drawings (also see C3.2.4 with design described in the document).

C3.2.3 Contractor's design

The following must be provided by the Contractor:

No.	Information	Required when	Format	No. of copies	Employer's agent approval required.	Further info in
1	Project team details					
2	Project program					
3	Requirements for civil and structural works (Clause 2, Part C3.2)					
4	Requirements for mechanical, electrical and instrumentation works (Clause 2, Part C3.2)					
5	Piping & Instrumentation Diagrams control philosophy (Clause 2, Part C3.2)					
6	Detailed manufacturing drawings & calculations					
7	Unpriced purchase orders					
8	Progress reports					

Abbreviations:

ACD = After Commencement Date

AG = After "go ahead" for that equipment

Employer's Agent = Engineer.

Client's CHS Agent = The person appointed under CR 5(5,6 and 7) of 2014

Note 1:

Project team organogram, showing names and positions of key personnel, including their CVs. Contact details of project manager and responsible director is required.

Note 2:

Fully dimensioned drawings of the plant, the necessary data concerning the geometry of structures housing the plant, the position and sizes of all foundations, bolt holes, openings in walls or floors and all other special features affecting the design and construction of the Works for his approval, so that the Employer can arrange for the necessary concrete work, foundations, bolt holes, openings for pipes, cable ducts, etc., for the proper erection and installation of the plant.

The Contractor shall be responsible for any errors or omissions in the Contractor's Drawings unless they are due to incorrect Employer's Drawings or other written information supplied by the Employer or the Engineer. Approval by the Engineer of the Contractor's drawings shall not relieve the Contractor from any responsibility under this sub-Clause.

Within 14 days the Contractor shall deal with any amendments to the drawings required by the Engineer and submit the final version to the Engineer. Any cutting or alteration of structural work arising from inadequate or incorrect dimensions and particulars afforded by the Contractor, or through late receipt of such particulars, may be arranged by the Engineer to be carried out as he thinks fit at the expense of the Contractor concerned under this Contract. In any event, the Contractor shall bear any costs he may incur as a result of delay in providing Contractor's drawings and other information or as a result of errors or omissions therein, for which the Contractor is responsible.

The Contractor shall at his own cost carry out any alterations or remedial work necessitated by such errors or omissions, for which he is responsible and modify the Contractor's drawings and such other information accordingly. Contractor's drawings will be used by the Employer for no other purpose than completing, operating, maintaining, adjusting and repairing the Works.

Note 3:

Including, but not limited to

ostrength and durability calculations of all gearboxes in accordance with AGMA

218.01;
ocalculations of relay settings, including graphs where applicable.

Note 4:

Including all technical information or documentation appended to or included with the order.

Note 5:

The programme shall identify all major activities, principal items of plant and equipment and their components. The following activities and their duration shall, in addition to the requirements of Clause 8.3 of the Conditions of Contract, form the minimum basis for the preparation of the programme: -

- Insurance bond and general obligations;
- Design;
- Plant equipment and arrangement drawings;
- Project Quality Plan;
- Schedules;
- HAZOPs;
- Procurement;
- Inspection and works testing;
- Delivery;
- Installation;
- Adjustment;
- Testing;
- Commissioning; and
- Defects Notification Period.

Note 6:

The Contractor shall provide a Piping and Instrumentation Diagram (P&ID) which will cover all equipment provided under this contract. The preliminary P&ID shall be submitted within 6 weeks, which will be checked and tag numbers will be provided by the Engineer for inclusion into the P&ID. The control philosophy shall also be provided within 6 weeks.

Note 7:

The Contractor shall provide a monthly progress report to the Engineer. The report shall cover at least the following aspects:

- Progress of various activities in comparison to original program;
- Attainment of key milestones;
- List of purchase orders placed;
- Names and positions of key personnel working on the project;

- Staffing levels on Site (when Site work commences); and
- Identification of any aspects, including faults and mistakes to be rectified or are to be rectified by the contractor, needing to be addressed by the Employer or the Engineer.

Note 8:

Tenderers must note that the provision of a Construction Health and Safety (CHS) Agent's services is required in terms of the Occupational Health and Safety Act, 1993 (Act No. 85 of 1993) and Construction Regulations, 2014 on this project. Such Agent will act as a representative for CoT and will perform all health and safety duties as specified in the Occupational Health and Safety Act on behalf of the Municipality for the Rooiwal Wastewater Treatment Works.

It must be noted that the CHS personnel will also be responsible to ensure that the contractor or contractors to be appointed comply with and adhere to all other aspects of the Occupational Health and Safety Act (Act 85 of 1993), including all relevant and applicable Regulations for Rooiwal Water Works, including all amendments to the act and its regulations as amended from time to time.

It must be noted that the Water and Sanitation Division intends to appoint an Agent for the rendering of services by a competent person(s) with reference to the Construction Regulations, 2014, as promulgated on 07 February 2014, under Sections 16 and 43 of the Occupational Health and Safety Act (Act 85 of 1993), for the abovementioned project to act as an Agent in terms of the Construction Regulations 2014.

Your attention is drawn to the duties of the CoT to ensure compliance with the provisions of the Occupational Health and Safety Act (Act 85 Of 1993), as reflected in Construction Regulation, 2014 under Regulation 5, which is presented below, but not limited to this regulation, as a performance standard against, which an Agent is expected to perform on behalf of the CoT. Tenderers must consider the following when costing for health and safety, in order to minimise costs where duties are already performed by the Agent, but also to ensure own compliance to the requirements on CoT. In terms of Regulation (5) as reflected in the Construction Regulations, 2014:

5(5) A Client must appoint an Agent in writing to act as his or her representative and where such an appointment is made, the responsibilities as are imposed by these regulations upon a Client, shall as far as is reasonably practical, apply to the Agent so appointed.

5(6) No Client may appoint any person as an Agent, unless the Client is reasonably satisfied that the person he or she intends to appoint has the necessary competencies and resources to perform the duties imposed on a Client by these regulations.

The Agent must:

- a) Develop a health and safety specification as agreed with and on behalf of the Client, based on the hazard identification and risk assessments conducted of any proposed project/contract;
- b) Provide any Principal Contractor who is making a tender or appointed to perform construction work for the Client with the aforesaid health and safety specification;
- c) Assess the contractor's health and safety management plan (HSMP);
- d) Ensure that all who submit tenders have made adequate provision for health and safety measures in accordance with the health and safety specification;
- e) Ensure that the successful tenderer or tenderers which are appointed as the Principal Contractor and Contractor(s) (Sub-Contractor(s)) submits an HSMP. This HSMP should be developed in terms of the specifications drawn up by the Client's Agent in relation to the hazard identification and risk assessments conducted on the project. The Agent must also approve the HSMP after discussion and negotiation between the parties to ensure all requirements are covered, prior to the commencement of any construction work;
- f) Maintain the Principal Contractor's HSMP during the construction period (based on an hourly rate for 8 hours per day for the duration of the construction period).
 - (i) Ensure that the Principal Contractor and / or Contractor(s) (Sub-Contractor(s)) implements and maintains the approved HSMP by inter alia conducting periodic occupational health and safety audits at intervals mutually agreed upon between the client and principal contractor;
 - (ii) Stop the Principal Contractor and or any Contractor (Sub-Contractor) from executing Construction work that is not in accordance with the Principal Contractor's and / or Contractor(s) (Sub-Contractor(s)) approved HSMP contemplated in Regulation 5(1) for the site or that poses a threat to the health and safety of any person;
- g) Provide site administration for the duration of the construction period.
 - (i) Ensure that a copy of the Principal Contractor's HSMP and / or Contractor(s) (Sub-Contractor(s)) is available at the site and available to the client, client's Agent, employee, inspector, contractor, representative trade union, health and safety representative or any member of the health and safety committee, at all times;
 - (ii) Ensure that, where changes are brought about to the design or construction, sufficient health and safety information and appropriate resources are made available to the Principal Contractor and / or Contractor(s) (Sub-Contractor(s)) to execute the work safely;
 - (iii) Ensure that the Safety Officer or Officers appointed by the Principal Contractor and / or Contractor(s) (Sub-Contractor(s)) is a competent person(s) with sufficient and adequate qualifications, experience and expertise to act as a Safety Officer(s);
 - (iv) Approve the Safety Officer(s) of the Principal Contractor and / or Contractor(s) (Sub-Contractor(s)) in terms of his or her safety qualifications, experience and expertise prior to the commencement of any construction work, if such is appointed;
 - (v) Provide the Principal Contractor and any Contractor(s) appointed by the Principal Contractor as a Sub-Contractor(s) with all the required safety documentation and safety registers to be completed on a daily basis, and ensure that all safety documentation and safety registers to be completed

- on a daily basis are complied with and adhered to by the Principal Contractor and / or Contractor(s) (Sub-Contractor(s));
- (vi) Ensure that the Principal Contractor and / or Contractor(s) (Sub-Contractor(s)) sign the latest version of the CoT's Health and Safety Compliance Agreement prior to the commencement of any construction work;
- h) Conduct safety/audit meetings for the duration of the construction period:
- (i) Promptly provide the Principal Contractor and / or Contractor(s) (Sub-Contractor(s)) and / or his / her representative with any information that might affect the health & safety of any person at work carrying out construction work;
- (ii) To ensure that every Principal Contractor and / or Contractor(s) (Sub-Contractor(s)) is registered and in good standing with a compensation fund or with a licensed compensation insurer in terms of the Compensation for Occupational Injuries and Diseases Act (130 of 1993) (COIDA Act), prior to work commencing on site;
- (iii) Monitor and review the Principal Contractor's and / or Contractor(s) (Sub-Contractor(s)) risk assessment changes and any Safe Work Procedures changes during the construction work performance (Regulations 7(1) & 7(2));
- (iv) Monitor that all people working on site can prove they have undergone the HSMP prescribed health and safety induction training (Regulation 7(9)), prior to the commencement of any construction work on site;
- (v) Monitor that any Contractor (Sub-Contractor) is appointed by the Principal Contractor or Contractor (Sub-Contractor) in terms of the requirements of the Health and Safety Specifications and in accordance with an approved Health and Safety Plan as approved by the Agent, according to the Construction Regulations, 2014, prior to the commencement of any construction work on site;
- (vi) Ensure that all Contractors (Sub-Contractors) appointed by the Principal Contractor are registered and in good standing with the Compensation fund or with a licensed compensation insurer prior to work commencing on site;
- i) Monthly report:
- (i) Monitor and review the Principal Contractor's and / or Contractor(s) (Sub-Contractor(s)) Health and Safety File(s) and its documentation on a daily and continuous basis for the duration of the project, which is to be available at any time and to be presented to the Client at the end of the project (Regulation 5(7));
- (ii) Perform the daily inspections on behalf of the Client, in association with the Principal Contractor or Contractors, and report to the Client of the inspection findings (Regulation 4(1d)) by compiling a monthly Safety Audit Report;
- j) Provide travelling time associated to the Occupational Health and Safety Act (Act 85 of 1993) and Regulations.
- k) Provide travelling costs associated with the Occupational Health and Safety Act (Act 85 of 1993) and Regulations.
- l) Provide administration costs associated to the Occupational Health and Safety Act (Act 85 of 1993) and Regulations.
- m) Ensure that all the Items in Regulation 4 of the Construction Regulations, 2014 which are not mentioned above also be adhered to.

It must be noted that the abovementioned Agent will also be responsible to ensure that the Principal Contractor and / or Contractor(s) (Sub-Contractor(s)) to be appointed must comply and adhere to all other aspects of the Occupational Health and Safety Act (Act 85 of 1993), including all relevant and applicable Regulations to the abovementioned Act as well as to comply and adhere to all amendments to the Act and abovementioned Regulations as amended from time to time.

C3.2.4 Drawings

The drawings issued to tenderers as part of the tender documents must be regarded as provisional and preliminary for the tenderer's benefit to generally assess the scope of work.

The work shall be carried out in accordance with the latest available revision of the drawings approved for construction.

At commencement of the contract, the Engineer shall deliver to the Contractor copies of the construction drawings and any instructions required for the commencement of the works. From time to time thereafter during the progress of the works, the Engineer may issue further drawings or revisions for construction purposes as may be necessary for adequate construction, completion and defects correction of the works.

The drawings for the works prepared by the Engineer for the purposes of obtaining tenders are included in Volume 2 of this Tender document.

C3.2.5 Design procedures

Refer to Clause C3.2.3.

C3.2.5 Electrical and instrumentation design criteria

Refer to Clause C3.2.3.

C3.3 Procurement

C3.3.1 PREFERENTIAL PROCUREMENT PROCEDURES

The conditions associated with the granting of preference are stated in Volume 1, Section RD.B.

Material suppliers: All suppliers of materials for this project must be from within the City of Tshwane unless the specific material required for any part of the works is not available within the specified area, other sources should be utilized. All materials to be used must be approved materials by the applicable SANS standard or any

relevant international standard and must bear the approval mark and any certification of such materials should be presented to the Engineer before approval to utilize such material is granted. All proposed suppliers of materials should be clearly stated and listed with addresses and physical addresses of their base of operation/s and this will form part of the basis for the evaluation and awarding of this contract and subsequently binding under this stipulation to use such stipulated suppliers. All materials to be supplied should be new and free from any defects and should comply with any applicable SANS standard as updated from time to time by the South African National Standards or any applicable international standards as approved by the Engineer.

C3.3.2 SUB-CONTRACTING

Should the Tenderer wish to employ Sub-contractors for part of the works, this is to be clearly indicated and the schedule in Volume 1 is to be completed to indicate the full names and addresses of all proposed Sub-contractors for which approval of the Employer (or the Engineer acting on his behalf) is sought, stating the section of the works that each will be handling.

Labor Intensive Construction Methods (SPWP)

All items on the bill of quantities marked "LI" is earmarked for the general labor of the affected ward and should be so executed. This includes, but not limited to:

- The preparation of the bedding in pipe trenches.
- Backfilling and compaction of the pipe trenches and around valve chambers.
- The construction of the pre-cast concrete retaining walls if required.
- The installation of the security fence.

Local Emerging Contractors (LECs)

All items on the bill of quantities marked "SC" is earmarked for the upliftment of the Local Emerging Contractors within the affected ward/s and if such skills are not within the affected ward these items will be subcontracted to LECs within the City of Tshwane. These items include, but not limited to:

- Construction of brickwork related work
- Installation of fencing
- Construction of concrete kerbing and channeling.
- Re-clearing areas when instructed by the Engineer.
- Landscaping of trees and shrubs.
- Construction of segmented pavement around the structures.

The Contractor is encouraged to use LECs on any part of the works, over and above the above stated items, that he deems could be sub-contracted for the upliftment of the community and development of local economy and skills base. In areas where required by the Engineer the Contractor will be required to make use of local emerging contractors to execute dedicated portions of the work. Only approved tendered rates will apply for work executed and the Contractor must ensure that the Local Emerging Contractors are paid a market related price for work done. The

Contractor will be compensated for the additional site supervision, management of Local Emerging Contractors, material management, training and personal protective clothing that may be required for the Local Emerging Contractors as a percentage value of the work done by the Sub-contractor.

The City of Tshwane has a mandate and responsibility to fight poverty, build clean, healthy, safe and sustainable communities). To achieve this, the City adopted an Integrated Poverty Reduction and Community Development Strategy which requires all departments to cooperate and contribute towards poverty reduction through indigent exit programs and projects. Therefore, Water and Sanitation is committed to utilize indigents that are registered on the CoT Indigent Register on all projects. The aim is to ensure commitment by each contractor on a project to utilize at least 50% of its personnel of the indigents list provided by the CoT in order to enhance poverty alleviation and the uplifting of indigents.

The Contractor appointed will have to make use of the Indigent Register in each area that will be provided by the CoT. Fifty percent of all personnel on a project must to be appointed from the Indigent Register provided. The idea is to place indigents in the correct or appropriate project roles/occupations to help them achieve income capacity and/or to equip them through skills development. The Contractor must provide data about the number of indigents required, qualifications, type of placement/occupation and gender before the project starts. The Contractor appointed must accommodate students that are in need of practical training or in-service training.

The Contractor will adopt the following structure for the selecting, training and appointing of Local Emerging Contractor(s) for this project:

- a. The project steering committee (PSC) under the leadership of the ward councilor(s) will compile a list of all the Local Emerging Contractors in the ward(s) where the project will be executed.
- b. Immediately after the approval of the appointment of the Contractor on the project, the PSC under the leadership of the ward councilor(s) will invite all the Local Emerging Contractors in the ward(s) where the project will be executed as captured on the abovementioned list to apply for possible inclusion on the list of candidates to be appointed as Local Emerging Contractor(s) by the principal contractor on the project.
- c. The applicants will then be evaluated and a short list will be compiled by the PSC together with the appointed construction and materials manager and the appointed Contractor.
- d. The successful candidates will then be trained by the appointed NQF accredited EPWP training provider on all the predetermined unit standards.
- e. The successful candidate(s) will then enter into a written agreement/contract with the Contractor.
- f. The Contractor should make provision for administration of Local Emerging Contractors. The principal contractor must provide to the Local Emerging

Contractor(s) a construction and material manager to assist them with their construction work (C3.5.6 and C3.5.7). The Contractor will be paid to provide a construction and material manager to the Local Emerging Contractor(s) via the contract that will be awarded to the Contractor. All items that are suitable for Local Emerging Contractors in the area are marked with “SC” in the Bill of Quantities. The Contractor will price all items marked “SC” as well, except in the case of a nominated sub-contractor(s). These tariffs will be binding on the principal contractor if the work is executed by the Contractor and should no Local Emerging Contractor(s) be available. The tariffs on the “SC”-items tendered by the Contractor will also be used as an index in the evaluation process for appointing Local Emerging Contractors.

- g. The Contractor can hold the Local Emerging Contractor(s) responsible for the quality and quantity of work done by them through their agreement/contract, but will be ultimately responsible and liable for the work done being the Contractor and mentor to the Local Emerging Contractor(s).
- h. The Contractor and Employer’s agent responsible for the site supervision will submit a performance evaluation report to the Employer, the CoT, and to the CIDB for their records should the Local Emerging Contractor(s) being registered with the CIDB, in the process of registering or planning to register with the CIDB after the completion of the construction works on the project.
- i. A register of all the trained, appointed local emerging contractor(s) and experienced emerging contractors per ward will be kept at the Water and Sanitation Division on the Manage System.
- j. Ensure that each Local Emerging Contractor(s) Health and Safety Management Plan is implemented and maintained on their portion of the Works.
- k. A monthly progress report including an annexure of the performance of Local Emerging Contractors will be submitted on a monthly basis.

The above structure will ensure that Local Emerging Contractors with potential to be trained and given the opportunity to be appointed as Local Emerging Contractor(s) and to gain valuable experience under the mentorship of a construction and materials contractors manager.

Scope of Mandatory Sub-Contract Work

In areas where required by engineer the Contractor will be required to make use of Local Emerging Contractors.

Preferred Sub-contractors/Suppliers

Local Emerging Contractors must be Black Enterprises. A Black enterprise (BE) is defined as a company or economic activity that is owned by Black persons and where there is substantial management control by Black people. Ownership refers to economic interest, whilst management refers to the membership of any board or similar governing body of the enterprise. The Broad-Based Black Economic Empowerment Act No. 53 of 2003, principles must apply to BE’s.

Enterprises must comply with the following:

- Business must be registered within the CoT boundaries,
- Owners must reside within the CoT.

SUB-CONTRACTING PROCEDURES

The Contractor shall advertise and call for competitive tenders in respect of each portion of the works that are required to be Sub-contracted in terms of the contract in accordance with the relevant provision of the latest edition of the CIDB Standard for Uniformity in Construction Procurement. The Contract Data in the associated procurement documents shall be based on the FIDIC form of Sub-Contracting with minimal project specific variations and amendments that do not change their intended usage.

The Employer together with the Contractor shall evaluate the tenders received in accordance with the provision of the Standard Conditions of tender. The evaluation panel shall comprise equal representatives from the Employer and from the Contractor.

The Contractor shall without delay enter into contract with the successful tendering Sub-contractor based on their accepted tender submission. The Contractor shall remain responsible for providing the Sub-contracted portion of the works as if the work had not been subcontracted.

Note:

- 1 The CIDB Best Practice Guideline D1, Subcontracting Arrangements, provides guidance on the selection of a suitable form of subcontracts.
- 2 Provision in the Pricing Data should be made for provisional sums for portions of the works that are to be Sub-contracted in this manner.

C3.4 CONSTRUCTION

C3.4.1 APPLICABLE SANS 2001 STANDARDS

The following SANS specifications are also referred to in this document and the Contractor is advised to obtain them from Standards South Africa (a division of SABS) in Pretoria.

SANS 10396: 2003	: Implementing Preferential Construction Procurement Policies using Targeted Procurement Procedures
SANS 1914-1 (2002)	: Targeted Construction Procurement
SANS 1921-1 (2004)	: Construction and Management Requirements for Works Contracts Part 1: General Engineering and Construction Works

SANS 1921-6 (2004) : Construction and Management Requirements for
Works Contracts Part 6: HIV / AIDS Awareness
SANS 10142 : Electrical Works Installations
SANS 1063 : Surge Protection.

The standardised specifications (SANS 1200) must be read in conjunction with the new SANS 1921 family of standards. In case of any discrepancy or conflict between the two, the new SANS specification shall take precedence and shall govern.

Refer also to the Preface on interim situation until full suite of SANS Series of Specifications is available, on the first page of the Project Specification.

The term “project specifications” appearing in any of the SANS 1200 standardised specifications is deemed to be equivalent to the term “scope of work” in SANS Specifications.

C3.4.2 APPLICABLE NATIONAL AND INTERNATIONAL STANDARDS

The following National and International Standards shall be applicable to the service provision under this Contract:

- a) SANS 1200;
- b) CIDB;
- c) Occupational Health and Safety Act 85 (1993); and
- d) Construction Regulations (2014).

Any other standards as may be deemed necessary depending on the type of activity.

C3.4.4 ELECTRICAL SPECIFICATIONS

Applicable Standardized Specifications, Particular Specifications and Project Specifications

ELECTRICAL SPECIFICATION CONTENTS

- 1. SCOPE OF CONTRACT**
- 2. APPLICABLE STANDARDIZED SPECIFICATIONS**
- 3. DRAWINGS**
- 4. 400 V MCC's / DB's CIRCUIT BREAKERS AND CONTACTORS**
- 5. LOW VOLTAGE MOTOR CONTROL CENTRES**
- 6. EARTHING**
- 7. PVC/SWA/PVC AND PVC/PVC CABLES**
- 8. FIBRE OPTIC CABLE**
- 9. NETWORK CABLE**
- 10. INSTRUMENTATION CABLE AND WIRING**
- 11. CONTROL CABLES**
- 12. CABLE NUMBERING**
- 13. CABLE ROUTE MARKERS**
- 14. CABLE LADDER**
- 15. LAYING OF CABLES**
- 16. POWER METERS**
- 17. HMI**
- 18. PLC'S**
- 19. SCADA CONFIGURATION**
- 20. PLC PROGRAMMING**
- 21. ULTRASONIC LEVEL DETECTORS**
- 22. INSTRUMENTATION LIGHTNING SURGE PROTECTION.**
- 23. LOCAL EMERGENCY STOP STATIONS**
- 24. LIGHTNING PROTECTION**
- 25. LUMINAIRES**
- 26. ETHERNET SWITCHES**
- 27. MOTORS**
- 28. ON LINE AUTOMATIC WATER ANALYSERS**

29. FIELD EQUIPMENT BOXES

1. SCOPE OF CONTRACT

This section specifies the requirements for the manufacture, supply, delivery, installation and commissioning of the Electrical Work at Rooiwal Wastewater Treatment Works.

Background Information

The Contractor shall provide all labour, supervision, installed and consumable materials, equipment, tools, services and every permanent or temporary item necessary for the manufacture, supply, delivery, unloading, installation, commissioning and putting into service of the specified deliverables.

Tenderers must note that a South African agent must be nominated for all major imported equipment.

This agent must avail himself during the course of the project and must be present at all technical meetings.

The work comprises of the following:

The scope of work includes the following main items. The list does not include all that is required to provide a complete installation. The tenderer shall allow for all items of equipment required to provide a complete installation.

SUPPLY INSTALLATION AND COMMISSIONING:

- Motor control centres.
- Earthing.
- Lightning protection.
- Excavation & backfilling of cable trenches.
- LV cable and termination.
- Fibre optic cable.
- Fibre optic splicing.
- Instrumentation cable and termination.
- Network cable and termination.
- Ethernet switches.
- Motor stop start stations including pedestals.
- Ultrasonic level detectors including support brackets.
- Ultrasonic open channel flow meters including support brackets.
- Magnetic flow meters.
- Analog control valves.
- On line automatic water analysers.
- Junction boxes.
- Earth conductors.
- Cable ladders.
- PLC programming.

- SCADA configuration.
- Lighting and small power.
- AS built drawings & cable schedules.
- Factory accepted tests (FAT) of all equipment and the issuing of relevant test certificates as per specification.
- Removal and transportation of redundant electrical equipment.
- O&M manuals
- Pressure tests of all cables after installation.

Equipment and work shall comply fully with all the requirements given in the applicable Standardised Specifications and drawings.

Tenderers must note that the wastewater treatment works is operational and no disruption of the plant will be allowed during the project.

Equipment shall be of the highest quality and shall be suitable for continuous operation over long periods of time. Minimum maintenance and high, sustained efficiency is essential.

The contract also provides for the servicing and maintenance, by the Contractor, of the installed equipment, from the time that it is put into service, until the final Certificate has been issued.

2. APPLICABLE STANDARDIZED SPECIFICATIONS

NO	DESCRIPTION	DETAILS
1	Hot-dip (galvanised) zinc coatings heavy duty	SANS 763 – 1988
2	Quality systems	SANS ISO 9001, Parts I, II and III
3	National colour standards for paint	SANS 1091
4	Rotating electrical machines (Parts 1 to 18) (Applicable to low voltage motors)	SANS IEC 60034
5	Electric welded low Carbon steel pipes for aqueous fluids (ordinary duties)	SANS 719
6	Electric cables with extruded solid dielectric insulation for fixed installations (300 / 500 V to 1 900/3 300 V)	SANS 1507 : 1990
7	The selection, handling and installation of electric power cables of rating not exceeding 33 kV	SANS 0198 Parts 1-12
8	Induction motors Part 2: Low-voltage three-phase standards motors	SANS 1804-2 :2001
9	Induction motors Part 1: IEC requirements	SANS 1804-1 :2001
10	Code of Practice for the wiring of premises	SANS 0142-1 :2006 (SANS 10142-1: 2006)
11	Low voltage switchgear and control gear assemblies Part 1: Requirements for type-tested and partially type-tested assemblies	SABS 1473-1 (SANS 60439 – 1 : 2004)

12	Safety of distribution boards	SANS 1765
13	Earthing of low-voltage (LV) distribution systems	SANS 0292 :2001
14	Uninterruptible Power Systems (UPS)	SANS 1474 :1988
15	Parts I, II and III: Quality systems	SANS ISO 9001
16	Cable standard	SANS 1507 (Parts 1-3) Electric cables with extruded solid dielectric insulation
17	National colour standards for paint	SANS 1091
18	Low voltage switchgear and control gear assemblies Part 1: Type-tested and partially type-tested assemblies	SANS IEC 60439-1
19	The design and installation of an earth electrode	SANS 0199 :1985
20	Earth rods and couplers	SANS 1063 :1998
21	Specification for ISO metric black hexagon bolts, screws and nuts	BS 4190
22	Low voltage switchgear and control gear assemblies Part 2: Particular requirements for busbar trunking systems (busways)	SANS IEC 60439-2
23	Low Voltage Switchgear and Control Gear Part 1: General Rules	SANS IEC 60947-1
24	Low Voltage Switchgear and Control Gear Part 2: Circuit Breakers	SANS IEC 60947-2
25	Low Voltage Switchgear and Control Gear Part 3: Switches, disconnectors switch-disconnectors and fuse-combination units	SANS IEC 60947-3
26	Low Voltage Switchgear and Control Gear Part 4: Contactors and motor-starters Section 1: Electromechanical contactors and motor-starters	SANS IEC 60947-4-1
27	Specification General requirements for rotating electrical machines. Part 133	BS 4999
28	Classification of insulating materials	IEC 60085
29	Miniature substations	NRS 004
30	Transformers	SANS 780
31	Miniature substations	NRS 004
32	Occupational Health & Safety Act (Act 85 of 1993)	OHS Act

Certification by recognised bodies

Wherever possible, items and materials for construction of the works shall comply with the relevant South African Bureau of Standards Specifications and with the ISO and British Standards where these are applicable in the absence of local standards.

The Contractor, when using materials conforming to a Standard Specification shall, if called upon, furnish the Engineer with certificates of tests showing that the materials do so conform.

3. DRAWINGS

3.1 List of Drawings

The following drawings form part of the Tender document.

These drawings are for tender purposes only, and a set of construction drawings will be issued to the successful Tenderer at the commencement of the project.

DRAWING NUMBER	DRAWING TITLE
COT-P2-E001	Belt Press MCC Single Line Diagram
COT-P2-E002	Poly Dosing Pump No 1 Schematic Diagram
COT-P2-E003	Poly Dosing Pump No 1 Schematic Diagram
COT-P2-E004	Poly Dosing Pump No 2 Schematic Diagram
COT-P2-E005	Poly Dosing Pump No 2 Schematic Diagram
COT-P2-E006	Belt Press No 1 Top & Bottom Belt Drives Schematic Diagram
COT-P2-E007	Belt Press No 1 Top & Bottom Belt Drives Schematic Diagram
COT-P2-E008	Belt Press No 1 Flocculator Drive Schematic Diagram
COT-P2-E009	Belt Press No 1 Flocculator Drive Schematic Diagram
COT-P2-E010	Belt Press No 1 Bottom Belt Tracking Motor Schematic Diagram
COT-P2-E011	Belt Press No 1 Bottom Belt Tracking Motor Schematic Diagram
COT-P2-E012	Belt Press No 1 Top Belt Tracking Motor Schematic Diagram
COT-P2-E013	Belt Press No 1 Top Belt Tracking Motor Schematic Diagram
COT-P2-E014	Typical DOL Starter Drive
COT-P2-E015	Typical Star Delta Starter Drive
COT-P2-E016	North Works PST MCC Single Line Diagram
COT-P2-E017	Belt Press No 1 System Interconnection Diagram
COT-P2-E018	Belt Press No 1 PLC Input / Output Module Rack
COT-P2-E019	Belt Press No 1 Limit Switches Loop Diagram
COT-P2-E020	Belt Press No 1 Gravity Conductivity Level Probe Loop Diagram
COT-P2-E021	Belt Press No 1 Limit Switches Loop Diagram
COT-P2-E022	Belt Press No 1 Belt Press Control Panel
COT-P2-E023	Belt Press No 1 Control Panel Loop Diagrams
COT-P2-E024	Belt Press No 1 Control Panel Loop Diagrams
COT-P2-E025	Belt Press No 1 Control Panel Loop Diagrams

COT-P2-E026	Belt Press No 1 Control Panel Loop Diagrams
COT-P2-E027	Belt Press No 1 Control Panel Loop Diagrams
COT-P2-E028	Belt Press No 1 Control Panel Loop Diagrams

3.2 As-built drawings

The Contractor shall be required to mark up cable schedules and drawings with the “as built” / record information and return one print to the Engineer with all “as built” information entered thereon.

3.3 Information to be submitted by the successful tenderer in respect of electrical equipment.

The successful Tenderer shall submit three paper prints of each of the following drawings, in respect of the DB's, MCC's, network diagram including switches, FEB's belt press local control panel and belt press local inching / control box to the Engineer for approval prior to manufacture. The format of the schematic line diagrams shall be similar to the format indicated in the tender diagrams.

- a. Outline and general arrangement drawings, showing main overall dimensions and construction details.
- b. Wiring diagrams.
- c. Schematic line diagrams.

Prints of the following shall be supplied by the contractor in respect of each of the final As-built drawings.

- a. Outline and general arrangement drawings of the DB's, MCC's, network diagram including switches, FEB's belt press local control panel and belt press local inching / control box.
- b. Wiring diagrams
- c. Schematic line diagrams.

In general, before commencement of manufacture, electrical / layout drawings must be submitted to the Engineer for approval / comment on all electrical equipment.

4. 400 V MCC's / DB's CIRCUIT BREAKERS AND CONTACTORS

The preferred circuit breakers and contactors are available on request.

5. LOW VOLTAGE MOTOR CONTROL CENTRES

- SCOPE

This specification covers the general technical requirements and the standards of equipment and materials in the design of low voltage (LV) motor control centres (MCC's), where the voltage does not exceed 400 Volts.

- REFERENCES

The construction of MCC's and the equipment therein, shall comply with the latest revisions and amendments of the relevant SABS, IEC and British Standards except that should any conflict occur, the requirements of this specification shall apply.

- GENERAL

The design, construction and layout of the MCC's shall comply fully with the requirements of this specification and any project specification and or schematic drawings issued. Where conflict occurs, the requirements of the project specification and or drawings shall apply.

Each MCC shall be provided with an incoming feeder capable of carrying the connected load of the MCC, and each MCC shall be fully interlocked in the starting and tripping sequences.

The general arrangements of each MCC and of a typical cubicle showing the equipment layout shall be approved by the Engineer, in writing, prior to manufacture, and all MCC's shall be inspected by the Engineer before delivery to site.

The Tenderer shall submit the following information with his Tender.

- General arrangement drawings of each MCC, showing the internal equipment layouts, foundation details and approximate weight. All major dimensions shall be in millimetres.
- A schedule indicating the manufacture, type and rating of all the equipment being offered.

MCC's shall be so constructed that they may be split into smaller sections suitable for transportation, with each section being provided with eyebolts for lifting purposes.

- ENCLOSURE

Motor control centres shall be the product of specialist manufacturers of this type of equipment. They shall be floor standing, bottom or top entry as specified in the project specification, dust, damp and vermin proof, multi-tier, industrial pattern and of multi-section construction. They shall be of folded heavy gauge Stainless Steel steel design, with a recessed plinth of channel or heavy gauge sheet steel angle section, the construction being such that the rigidity of the frame, doors and rear covers is adequate.

Stainless Steel steel used in the construction of MCC's shall be a minimum of 2 mm thickness, folded and braced as necessary to provide a rigid support for all components. Joints of any kind in steel metal work shall be seam welded, and all welding slag ground off and welding pits wiped clean with plumber's metal. All panel doors and covers shall be

properly fitted and square within the frames. Holes in panels for fixing screws shall be accurately positioned to allow entry of screws without distortion of the panels. Only fixing screws of the correct length shall be used, the cutting to length of any screw once installed is not acceptable.

All cover fixings shall be by means of captive screws, dome nuts are not acceptable.

Sheet steel may be drilled and tapped to take fixing screws up to 6 mm diameter. For screws or bolts of larger diameter, hank nuts shall be used. Self threading screws shall not be used in the construction of these boards.

After fabrication is complete, all metal work shall be derusted, degreased and painted inside and out with at least one coat of metal primer and two coats of epoxy-based enamel. The interiors shall be finished white and the exterior shall be light orange (colour ref. 826 to SANS 1091) unless otherwise stated in the project specification.

All doors and removable covers shall be rendered dust proof by means of suitable seals fixed to the frame. The IP rating of the MCC's shall be IP 65.

- LAYOUT OF EQUIPMENT

The MCC's shall be carefully laid out ensuring ample space for wiring and components giving due consideration to accessibility and operational efficiency and the making-off of incoming and outgoing cables. A minimum of 300 mm clear vertical space shall be allowed between the gland plate and any terminal block. The distance between the wiring channel and any terminal to which the wires from that channel are being made-off, shall not be less than 75 mm.

The equipment shall be arranged within boards to exhibit a neat appearance, with all items of equipment and their labels, mounted level and plumb. Any label shall be mounted on the centre lines of its associated equipment, in an unambiguous position.

Each motor drive shall be housed in a separate cubicle, except where there may be an abundance of fractional kW motors, and therefore for optimum space utilisation, multiple drives are acceptable in a single cubicle.

Each tier and each cubicle shall be physically isolated from the adjacent tier or cubicle.

All cubicle equipment shall be mounted on a removable rigid sheet steel chassis plate, bolted to the supporting frame. Chassis plates shall be so designed as to facilitate easy removal or replacement. All control wiring and wiring external to the chassis, shall terminate on to a single terminal block mounted on the chassis plate. No wiring shall be connected to equipment on the chassis other than via the terminal block.

The layout of all equipment on the chassis plate shall be arranged so that any item of equipment, or any connection to an item of equipment, may be removed and or replaced

with the chassis in situ. The side of any piece of equipment to which connections are made, shall not be closer than 50 mm to the vertical or horizontal partitions.

The layout of chassis plates for each size of cubicle shall be identical to allow for the quick interchange of chassis plates.

All power connections shall terminate onto suitably rated terminals, situated not less than 300 mm and not more than 450 mm above the gland plate and located in the cabling compartment so as to allow easy access to all terminations, even after the installation of all cables.

Where it is possible for personnel to touch live components with the cubicle door open, these components shall be disconnected from the supply before the door can be opened. This shall be achieved by installing a disconnect, operated via a "vari-depth" handle fitted to the cubicle door, so that the door can only be opened when the disconnect is in the "off" position. It shall not be possible to close the disconnect when the cubicle door is open.

Spare cubicles shall be equipped with all necessary connections, terminals, and other fixed accessories to facilitate their future use. Contactors MCB's and controls, however, shall not be fitted. The blank door shall be labelled "Spare".

- BUSBARS

Busbars shall be of high conductivity hard drawn copper, of rectangular and uniform cross-section supported on suitably sized insulators. Busbars and down droppers on all 400 Volt MCC's, shall be rated in accordance with the recommendations of the Copper Development Association, and to withstand the stresses associated with the fault level called for in the Project Specification, for one second duration.

The busbars and down droppers shall be screened to prevent accidental contact when the rear covers are removed. Where this is impractical they shall be completely insulated by means of PVC sleeving or tape. Busbars and down droppers shall be phase colour coded and spaced at not less than 25 mm phase to phase, and 20 mm phase to earth, for a 400 Volt supply.

Busbars shall be joined together by bolted overlaps; the bolt arrangements shall be those recommended by the Copper Development Association. Bolts used for jointing and for fixing take-offs, shall be of high tensile phosphor bronze not less than 9,5 mm in diameter. All bolts shall be provided with wide flat washers at each end, and with spring washers under the nuts. Busbar supports shall be of glazed porcelain or glass fibre reinforced polyester. Spacers where required shall be of "Tufnel" or equivalent. The spacing of bus bar supports shall be adequate for the MVA rating of the MCC.

Multiple busbars shall be arranged with air gaps between individual sections, equal to the section thickness.

Busbar extensions shall be provided on the incoming circuit breaker to facilitate the connections of the incoming cables, and to act as a heat sink in dissipating the heat generated internally, and at the terminals of the circuit breaker.

- WIRING AND TERMINALS

All motor control centres shall be pre-wired in the factory to terminal blocks installed in the cabling compartment of each starter unit and marshalling cubicle. Access to the terminal blocks in the starter cubicle shall be gained by removal of the cable compartment cover. With the exception of the terminal blocks, no live parts shall be accessible.

Wiring channels shall be provided in all boards, running both horizontally and vertically, and of sufficient capacity for all main and sub-circuit wiring. Internal wiring run via slotted plastic trunking shall not occupy more than 50% of the trunking cross sectional area.

All secondary wiring between the various units of the MCC shall be provided using 600/1000 Volt grade, PVC insulated stranded copper conductor, of minimum size 1,5 mm². The wiring shall be run neatly and harnessed with an approved strapping and secured to substantial supports. A suitable strain relieving clamp system shall be provided on both the panel and door side of the harness.

Compression crimp type terminations shall be used for all wiring connections to instruments, relays and other devices. Where clamp type terminals are provided pin type ferrules shall be used. Spade or "C" type lugs shall be used elsewhere.

All crimping shall be done with the maker's special tools which shall not release until the full crimping pressure has been achieved. The ends of the conductors of 50 mm² cross-sectional area and upwards shall be crimped by hydraulic machine.

Wiring shall be provided with a neoprene sleeve or ferrule at each end indicating the respective wire numbers. All cable and wire markers shall be so positioned that positive identification can be achieved without the need for manual adjustment or alignment. Split type ferrules will not be accepted.

Where an MCC is to be split for transportation, the wiring shall be continuous with the wires being disconnected at the relevant terminal blocks and rolled back.

Terminal blocks shall be used for conductors up to 10 mm² only, and shall be of nylon construction, flexible to avoid damage to screw holes, and clamped to rolled metal sections allowing for the addition or movement of terminal units. The terminal screws shall be of tinned non-ferrous metal, captive in the blocks, and shall operate through serrated copper clamping washers onto the conductors. Terminal blocks shall be similar and equal to "Klippon" type SAK series.

Short circuiting type terminal blocks shall be fitted for all current transformer secondary leads.

Where the cross-sectional area of conductors differs considerably, the terminal strips shall be provided with a suitable proportion of the correctly sized terminal ways. No strands shall be cut from the larger conductors to permit termination into an undersized terminal.

No more than one conductor shall be connected to anyone terminal and if several conductors are to be common this shall be achieved by means of bridging pieces on the terminal strip.

No isolating link type terminals shall be used for motor or earth connections.

Ample space shall be provided for incoming and outgoing cable tails and for access to cable terminations.

Terminal blocks shall be formed with channels to accept snap-in plastic labels bearing the circuit designations, and all terminal blocks shall be clearly identified with the terminals being numbered from the top in descending order. Connection diagrams shall indicate the connection numbers, and terminal numbers.

- COMPONENTS

Indicating instruments shall be flush panel instruments to BS 89, of first grade accuracy, with not less than 96 mm dials. Current transformers shall be to BS 3938, of suitable grade and burden in each case. Where a current transformer serves also for metering purposes it shall be of Class 1.

Current transformers shall be so mounted as to ensure adequate ventilation and easy replacement. A duplicate transformer nameplate label shall be fixed to the chassis plate should the current transformer label be obscured from the front.

Hours run meters shall be provided where called for on the drawings. These shall be 48 mm square, flush mounted, operating on 220 Volts, 50 Hz, with a minimum capacity 999999 hours. A key operated reset shall be a standard feature.

LED cluster lamps are preferred for indicating lamps in place of filament lamps.

- CONTROL VOLTAGE

The control voltage shall be 230 Volts AC, single phase. This 220 Volt supply shall be provided from the red phase and neutral and shall be protected by a double pole moulded case circuit breaker or as indicated in the relevant schematic diagram.

- INCOMING FEEDER

A separate cubicle shall be provided in each MCC to accommodate the main incoming feeders. This shall comprise circuit breakers suitably rated, incorporating a manually operated spring assisted closing mechanism, shunt trip coil, thermal overcurrent and instantaneous short circuit tripping devices with facilities for padlocking in the "off" position.

The live side of the circuit breakers shall be suitably screened to ensure that no live conductors are exposed when the panel cover is removed.

The following shall also be provided for each feeder:

One motorised draw out air circuit breaker.

One power meter including Ethernet port.

One 96 mm flush fitting voltmeter, scaled 0 to 400 Volts, and connected to the busbar side of the circuit breaker.

One set of HRC fuses for voltmeter protection

Three 96 mm flush fitting, thermal maximum demand ammeters, suitably scaled

Three current-transformers for ammeter operation.

One set of main circuit labels and drilled cable glands to accommodate the cables detailed in the schedules, if applicable.

If required, earth leakage protection shall be provided by means of a 2 000 mA, IDMT earth leakage relay, complete with core balance current transformer.

Test blocks for current and voltage circuits with inherent current transformer short circuiting features shall be provided on all incoming feeders.

The preferred main incomer draw-out air circuit breaker is available on request.

The preferred power meter is available on request.

- BASIC DIRECT ON-LINE (DOL) MOTOR STARTER

The basic DOL motor starter cubicles shall be equipped as follows. The final details and ratings of equipment will be given in the project Specification or on the schematic diagrams.

One triple pole moulded case circuit breaker, as specified, capable of interrupting the maximum through fault current. The circuit breaker shall be operated by a "vari-depth" handle, pad-lockable in the "off" position, and having a safety interlock so that the

compartment door may only be opened when the circuit breaker is in the "off" position. The circuit breaker shall also be equipped with an auxiliary switch to isolate the control supply within the cubicle when the circuit breaker is opened.

One triple pole, air break, heavy duty contactor with inherent undervoltage release feature and fitted with auxiliary contacts as indicated in the typical schematic diagram.

One triple pole, combined thermal overload and differential action single phasing protection relay, equipped with hand reset feature. The relay shall be equipped with double break normally open and normally closed auxiliary contacts for interlocking and indication purposes.

One 96 mm flush fitting, direct or current transformer operated ammeter suitably scaled, if required.

One current transformer for ammeter operation, if required. To be provided where the rating of the circuit exceeds 25 Amperes. Outgoing terminals shall be provided where remote ammeter indication is required.

One rotary type change over switch, "Manual / PLC"

One amber "Overload Trip" indicator lamp

One green "Run" indicator lamp

One red "Stop" indicator lamp

One running hour meter

An earth leakage protection shall be provided by means of a 250 mA instantaneous earth leakage protection relay with core balance transformer and hand reset relay.

The basic DOL starter must also be equipped with a motor stop button and motor start button.

The control of the DOL starter must be by hard wiring between the DOL starter and PLC. Allowances must be made for the following PLC I/O per drive.

24V DC input

- Motor running
- Motor overload trip.
- Pump trip (if thermistors are installed on the pump)
- Motor trip (if thermistors are installed in the motor)
- PLC selected.

Digital output.

- Motor start

The preferred switchgear is Schneider or similar approved.

- BASIC VARIABLE SPEED DRIVE (VSD) MOTOR STARTER

The basic VSD starter drive is indicated on the various belt press schematic diagrams.

The VSD starter cubicle must be equipped with an extraction fan, filter, line chock, output chock,

graphic display, manual / PLC selector switch, motor stop button, motor start button, instantaneous earth leakage protection relay with core balance transformer and hand reset relay, overload trip indication lamp, run indicator lamp, stop indicator lamp and running hour meter.

The control of the VSD must be by hard wiring between the VSD and PLC.

Allowances must be made for the following PLC I/O per drive.

24V DC input:

- Motor running
- VSD healthy
- Motor overload trip.
- Pump trip (if thermistors are installed on the pump).
- Motor trip (if thermistors are installed in the motor).
- PLC selected.

Analog output:

- Speed reference.

Analog input:

- Speed feedback.

Digital output:

- Motor start.

The preferred VSD (below 15 kW) is available on request including, EMC filter for industrial environments, line chock, output chock and graphic display or similar approved. Allowances must be made for one multi loader for programming.

The preferred VSD (above 15 kW) is available on request including, EMC filter for industrial environments, line chock, output chock and graphic display or similar approved. The VSD must be mounted inside the starter cubicle, and the graphic display must be mounted on the door of the starter drive. The VSD and the graphic display must communicate with each other via a communications cable.

- BASIC SOFT STARTER MOTOR STARTER

The basic soft starter must be equipped with an extraction fan, graphic display, manual / PLC selector switch, motor stop button, motor start button, instantaneous earth leakage protection relay with core balance transformer and hand reset relay, overload trip indication lamp, run indicator lamp, stop indicator lamp and running hour meter.

The control of the soft starter must be by hard wiring between the soft starter and PLC.

Allowances must be made for the following PLC I/O per drive.

24V DC input:

- Motor running
- Soft start healthy
- Motor overload trip.
- Pump trip (if thermistors are installed on the pump)
- Motor trip (if thermistors are installed in the motor)
- PLC selected.

Digital output:

- Motor start.

The preferred soft starter type is available, including graphic display or similar approved.

- TYPE 2 CO-ORDINATION

All starter drives must have protective / switching devices that are selected to be compliant to type 2 co-ordination (circuit breaker, contactor, overload relay, soft start or VSD).

- OUTGOING FEEDERS

The outgoing feeder panels shall be equipped as follows:

One Triple pole moulded case circuit breaker with thermal and magnetic overcurrent protection, capable of interrupting the maximum through fault current. The circuit breaker shall be operated by a "vari-depth" handle, pad-lockable in the "off" position, and having a safety interlock so that the compartment door may only be opened when the circuit breaker is in the "off" position.

One 96mm flush fitting, direct or current transformer operated ammeter suitably scaled.

One current transformer for ammeter operation. To be provided where the rating of the circuit exceeds 25 Amperes.

If required, earth leakage protection shall be provided by means of a 250 mA instantaneous earth leakage protection relay with core balance transformer and hand reset relay.

- MARSHALLING CUBICLE

A marshalling cubicle shall be provided in each MCC, all "hard wire" field and starter interlocking and PLC control shall be done via the marshalling cubicle, which shall also house the PLC and all interposing relays.

- CABLING

Cables shall be top or bottom entry as indicated on the drawings. A base / plinth of 100 mm shall be located at the bottom of the MCC, and glanding cubicles of 275 mm shall be located between the plinth and various tiers. A vertical cable tier / way of 400 mm shall be located between the tiers that house starter drives to allow for easy installation of cables and connections to the terminals.

- EARTHING

Each cubicle in the MCC shall be provided with an earthing stud connected directly to the MCC earth bar. This main earth bar shall preferably be copper, alternatively copper clad steel or mixed type metal can be considered, with a minimum cross-section of 20 mm x 6 mm, running the entire length of the MCC and be complete with two terminal studs, one at each end for connection to the main earthing system.

- PANEL NUMBERING SYSTEM AND LABELS

- a) The tiers on each MCC shall be numbered consecutively from left to right, when facing the front of the MCC. The cubicles in each tier will then be allocated consecutive letters of the alphabet, starting with the letter A and reading from top to bottom. Each letter shall be prefixed with the tier number.
- b) The top of each rear access cover shall be clearly labelled with the tier number. Each cubicle shall be fitted with a circuit designation label on its front cover.
- c) In addition to the identifying label mounted on the front panel for each starter cubicle, a similar label shall be mounted at the rear of each cubicle to be visible when the rear covers are removed and shall indicate the tier number, cubicle letter and the circuit designation.
- d) Components such as circuit breakers, isolators, indicating lamps, switches, relays, instruments, test blocks, fuses, etc., shall be clearly identified with engraved labels indicating their function.
- e) Where a multiple drive cubicle is supplied, a label listing all the drives in that cubicle shall be provided on the door of that cubicle
- f) Labels shall be of plastic "sandwich" board material, the legends being engraved through the front layer to the contrasting inner layer. The lettering shall not be less than 6 mm high in sans-serif capitals, black lettering on a white background shall be selected to ensure maximum legibility. All labels shall be secured by at least two bolts, or rivets per label, and shall be accurately level and on the centre line of their subjects.
- g) Glued labels, adhesive embossed plastic tape or paper labels are not acceptable.
- h) All label inscriptions shall be in English, unless otherwise stated in the project

specification, and all label designation lists shall be approved by the Engineer prior to engraving.

- INSPECTION AND TESTING

All MCC's shall be inspected by the Engineer or his representative, when fully assembled and complete with all equipment, prior to despatch from the suppliers' works.

The following tests will be required, at the Inspectors' discretion, prior to despatch from the suppliers' works:

- a) High voltage pressure tests
- b) Primary current injection tests of all protection relays
- c) "Megger" insulation tests
- d) I/O testing of all PLC I/O.
- e) Complete functional and operational tests.

- DELIVERY AND ERECTION

The electrical Contractor shall be responsible for the delivery to site, off-loading, erection and cold commissioning of all the MCC's.

6. EARTHING

The earthing of the transformers, mini substations and lightning protection of buildings must be undertaken by a specialist earthing vendor.

The specialist vendor must initially undertake a soil resistivity survey (Wenner Method) and determine the corrosiveness and resistivity of the soil. The results of this survey will ultimately determine the size of BCEW and the number of copper electrodes.

However, a guide that must be followed in regards to the earth conductor and earth spikes is as follows.

Earth conductor: 70 mm² BCEW.

The earth conductor between the relevant earth electrode and the transformer must be 70 mm² black insulated copper conductor.

Earth spikes: 16 mm (OD) x 3 m (L) mild steel, A grade copper coated electrodes.

CAD welding must be used to connect the earth conductor to the earth spikes.

The final resistance of the earthing systems must be less than 1 Ohm.

The specialist earthing vendor must issue a certificate of compliance (resistance test certificate) for the earthing systems.

The following specifications will apply.

SANS 62305. 2007

SANS 10199. 2004

SANS 10313. 2008
SANS 10142-1 2003.

The separate earth conductors installed alongside 600/1000 V PVC/SWA/PVC cables must be BCEW.

7. PVC/SWA/PVC AND PVC/PVC CABLES

The Electrical Contractor shall supply, install, connect and test all the cables called for in the schedules and where shown on the drawings. Cables shall be 600/1000 Volt grade, PVC insulated, steel wire armoured and PVC sheathed, with stranded copper conductors or as called for in the cable schedules, constructed in accordance with SANS 150. The armouring of any armoured cable is not acceptable as an earth conductor. Single core cables shall be un-armoured and run in trefoil formation.

All PVC/SWA/PVC or PVC/PVC cable terminations shall be Exe corrosion guard cable glands (IP68) similar and equal to those manufactured by "Pratley" or "CCG". Glands shall be complete with earthing ferrules, locknuts, bushes and shrouds.

Conductors shall be terminated onto equipment using compression lugs of the correct size and suitable for the application. Manual crimping shall be done with the maker's special tools which will not release until the full crimping pressure has been achieved, the ends of conductors of 50 mm² cross sectional area and greater shall be crimped by hydraulic machine.

Each and every run of cable shall be a single length without joints, save that where a run exceeds the standard drum length or where the length of cable is increased after installation, a through box will be permitted.

Cable joints shall be made by using kits approved by the cable manufacturer, and by personnel trained in the use of these kits. Tenderers shall specify in the appropriate schedule the type of cable joint to be used.

If epoxy resin filled boxes are to be used, preference will be given to transparent resin types. The type of joint used shall not impair the mechanical and electrical properties of the cables. All conductor and armouring wires shall be carried through the joint, and adequately crimped ferrules and lugs shall be used. The Engineer reserves the right to cut open any made joint to ensure the integrity of the joint, and should such an inspection reveal inadequate jointing procedures, the right to insist the re-jointing of all cables at the electrical Contractor's expense. This applies to joints in all types of cable. Adequate measures shall be taken to prevent the ingress of moisture into any joint.

Drums of cable shall be delivered to site with the end seals intact and shall be off-loaded and stored in an approved manner. Any damaged cable shall be removed from site and replaced with undamaged cable at the electrical Contractor's expense.

Cable drums shall be supported on an axle and supporting jacks, and when the cable is unreeled, the direction of rotation indicated on the drum flanges shall be observed. Rolling of drums along the ground is not permitted.

8. FIBRE OPTIC CABLE

The fibre optic cable must be PVC/SWA/PVC 4-core multi-mode.
Multimode 10/100 Mbits, 1300 nm, 50/125 µm.

Characteristics:

- PVC / SWA / PVC.
- Core binder.
- Aramid strength member.
- Interstitial water blocking material.
- Gel filled loose tubes.
- GRP centre strength member.

Installation:

All splices shall be done using fusion splicing (i.e. the process of using localised heat to fuse the ends of two optical fibres together).

OTDR tests shall be performed on all cores from both ends of the cable and be submitted to the Engineer for approval.

All splices with a loss of more than 0.1 dB shall be rejected by the Engineer.

3 to 6 m of slack shall be allowed for at each terminating point on the fibre optic cable.

Each section of cable shall have a label indicating the cable number at each end.

The contractor shall ensure that all cable routes are marked up correctly and comprehensively on the respective plant layout drawing.

Testing:

The contractor shall use an OTDR to test the fibre optic cable.

The contractor shall ensure that the OTDR is within the calibration period as recommended by the manufacturer.

The test result information for each link shall be recorded in the memory of the OTDR upon completion of the test.

A paper copy of the test results shall be provided to the Engineer that lists all the links that have been tested with the following information.

- The overall Pass / Fail evaluation of the link under test including the Attenuation worst case margin (margin is defined as the difference between the measured value and the test limit value).
- The date and time of when the test results were saved in the memory of the equipment.

Accessories:

For each core that is spliced, the contractor shall supply all connectors, accessories and ancillaries required to ensure the correct operation of the equipment. This shall include but not be limited to all mid couplers, pigtails and patch leads.

Cable markers:

The cable markers shall be manufactured from concrete. Two aluminium plates must be mounted to the concrete marker (one on top and the other on the side).

The letters FO must be moulded on the side of the cable marker.

Cable marker size: 900 mm high, 250 x 150 x 50 mm.

Cable markers shall be painted with yellow Plascon Hi sheen road marking paint, SANS 731, Ref TP41.

Cable markers shall be installed every 50 m and at each cable bend or turn.

The bottom tapered section of the cable marker must be firmly compacted into the ground.

Cable direction must be indicated with an arrow on top of the aluminium plate.

Cable numbers must be engraved on the side aluminium plate.

Standards:

All IEEE Standards.

All SABS Standards.

9. NETWORK CABLE

The Ethernet IP cable shall be Cat 6e FTP 0.515 mm² 4 pair Ethernet IP cable.

10. INSTRUMENTATION CABLE AND WIRING

Instrumentation power cabling shall be PVC/SWA/PVC.

Instrumentation signal cabling shall be Dekoron type M872 individually and overall screened pairs and Dekoron type M755 multi cores or similar approved.

Instrumentation signal cable shall have 500 mm of orange heat shrink fitted over the outer sheath of the cable where the cable enters or exists an instrument junction box, field equipment box or MCC.

11. CONTROL CABLES

Control cables shall have a minimum cross section of 1,5 mm² for each core. All cables shall be PVC/SWA/PVC 600/1000 Volt type.

The pilot cable that will be installed between Pyramid Substation and the Treatment works must be in accordance with the City of Tshwane specification and must be manufactured by ATC (CBI) Britz or similar approved.

The cable must be 19 pair 1,12 mm² copper, polyethylene insulation, petroleum jelly filled, APL screened, PVC/SWA/PVC sheathed pilot cable.

12. CABLE NUMBERING

The contractor shall fit a cable number at each cable gland. The cable number shall be in accordance with the CoT's Specification.

13. CABLE ROUTE MARKERS

Approved concrete proprietary cable markers indicating the voltage must be planted above all cable runs and bends.

The cable markers shall be supplied by the Contractor.

14. CABLE LADDER

Cable ladders shall be O-Line Stainless Steel OL55 & 76 cable ladder or similar approved. All nuts and bolts must be stainless steel. Cable ladder must be duplex coated (exterior polyester) and the colour must be electric orange.

Wherever possible all cable racks shall be installed in a vertical orientation to prevent accumulation of spillage and dust. Adequate space being provided behind the rack for the fixing of nuts and cable ties, etc.

Cable racks shall be fixed to the building structure by means of stand-off supports at approximately two metre intervals, and also at the ends (joints) of each fabricated length. Supports shall be galvanised after fabrication.

Each run of cable rack shall be bonded across all sections and be electrically continuous throughout. Where the electrical continuity cannot be guaranteed, a continuous bare copper conductor shall be provided for each run of cable tray and each section shall be bonded to this conductor. In addition, all cable racks shall be bonded to the switchboard to which the cables it carries are connected.

15. LAYING OF CABLES

When laying cables in trenches excavated in soft or hard rock or containing sharp stones, rocks or other items most likely to injure cables, the following precautions shall be taken:

- a. Before laying the cables all rocks, stones, etc shall be removed from the bottom of the trench. The floor of the trench shall be evenly covered with a layer of sifted backfill or sand to a level which is 100 mm above the highest unevenness of the trench. The cost of this work shall be included in the contractor's price. The laying of cables shall not be commenced until the trenches have been inspected and approved. The cable shall be removed from the drum in such a way that no twisting, tension or mechanical damage is caused, and must be adequately supported at short intervals during the entire operation. Particular care must be exercised where it is necessary to draw cables through pipes and ducts to avoid abrasion, elongation or distortion of any kind. The ends of such pipes and ducts shall be sealed in an approved manner after drawing in of cables.
- b. The cable shall be covered with a 150 mm layer of sifted backfill of sand. All trenches shall be backfilled with damp soil, in layers not more than 150 mm thick. Each layer shall be individually compacted in order to obtain the same degree of permeability as that of the surrounding undisturbed soil.
 - d)
- c. A distance of 300 mm shall exist between instrumentation and power cable.

Tenderers are to note that:

Pickable material -shall mean ground or rock that can be loosened by handpick and includes hard shale, compact oukclip and boulders from 75 mm in diameter up to 0.03m² in volume.

16. POWER METERS

The power meters that must be fitted to the 11 kV panel must include for an Ethernet port and the supply voltage must be 110 V AC (from 11 kV / 110 V VT).

The preferred meter type is available on enquiry.

17. Human Machine Interface (HMI)

The preferred HMI that must be mounted on the front panel of the dewatering plant belt press MCC.

18. PLC'S

The PLC CPU (4 MB internal memory including an 8 MB SD card) must incorporate an Ethernet port, and the number of I/O modules must be able to accommodate the I/O indicated on the drawings. 20% spare I/O is required.

All spare I/O must be wired to the terminals in the marshalling tier.

Allowances must be made for PLC I/O for all instrumentation and valve actuators that are indicated on the various MCC single line diagrams.

The PLC I/O required for the valve actuators that are indicated on the single line diagrams are as follows:

24V DC input:

- End position closed.
- End position opened.
- Torque closed.
- Torque opened.
- Collective fault.
- Local / PLC.

Analog input:

- Position feedback.

Analog output:

- Open / close.

19. SCADA CONFIGURATION

Allowances for the SCADA configuration has been made in the schedule of materials under provisional sums

20. PLC PROGRAMMING

Allowances for the PLC programming has been made in the schedule of materials under provisional sums

21. ULTRASONIC LEVEL DETECTORS

Each sump / wet level meter will have the following minimum specification:

Each meter will consist of a separate transmitter and temperature compensated transducer. The transmitter shall be mounted in the MCC while the transducer will be installed over the sump. The transducer shall be installed on a robust stainless steel mounting bracket, which will support the transducer at a fixed height above the sludge and allowing the transducer a clear "view" right to the bottom of the sump.

The meter shall have a range of up to 10 m. The cable between the transducer and the transmitter in the MCC shall be 3 core screened cable with a maximum length of 20 m (supplied by vendor).

The meter shall have a continuous digital display of height, bar graph display of percentage of how full the sump is.

The meter shall have six built-in relays which can be programmed for pump control, alarms, auto pump cycling at desired levels. The meter shall have an isolated 4-20 mA output linear to level over the calibrated range. Each meter will be supplied with an approved lightning protection unit for the 230 V AC supply and output signal lines. The lightning protection units will be installed and wired to the manufacturer's specifications.

22. INSTRUMENTATION LIGHTNING SURGE PROTECTION.

Each core (excluding the earth core) of the instrumentation signal and power cables for the ultrasonic level detector / flow transmitters, magnetic flow meters, chlorine residual analyser, chlorine leak detector, pH meter, dissolved oxygen (DO) meter, air flow meter & pressure transmitter shall be terminated at each end on a lightning surge arrestor.

The terminal strips in the PLC panel shall be fitted with the arrestors.

23. LOCAL EMERGENCY STOP STATIONS

Local emergency stop stations shall be installed next to motors. These enclosures shall be manufactured from Stainless Steel steel and powder coated with a protection rating of IP55.

The enclosure shall be equipped with a mushroom head emergency stop push button (push and latch / turn to release) with a protection rating of IP65.

The complete stop station shall have a protection rating of IP55 after all equipment and cables have been installed. The final colour shall be in accordance with the NOSA recommendations.

Support Steel Work (Local Stop / Start Stations).

The support steel work for local stop stations must be manufactured from PFC 100 x 50 x 6 mm Stainless Steel U-channel. This vertical 1600 mm U channel must be anchored to a 250 x 10 mm Stainless Steel base plate. The base plate must be strengthened by 8 x 100 mm Stainless Steel gusset plates.

The entire frame must be coated with a polyester powder coating.

24. LIGHTNING PROTECTION

The electrical Contractor must employ the services of a specialist lightning protection vendor to undertake the lightning protection of the various buildings. Drawings must be submitted to the Engineer for approval before the installation commences. Upon completion of the installation a certificate of compliance must be issued to the Engineer.

25. LUMINAIRES

All luminaires shall bear the SANS S mark and the specific SANS A mark.

26. ETHERNET SWITCHES

The preferred approved Ethernet switch.

27. MOTORS

Motors must have a minimum protection rating of IP55.

Four pole motors (1500 rpm, frame size 225) that are 37 kW and above must be fitted with thermistors.

Two pole motors (3000 rpm, frame size 225) that are 45 kW and above must be fitted with thermistors.

A total of three 155° Celsius thermistors must be fitted per motor.

One thermistor must be fitted per phase.

The thermistors must be wired in series and two conductors (red & blue) must be brought out of the motor and terminated in a motor terminal box.

The above is for motors with a standard insulation.

Thermistors must be wired to thermistor relays in the MCC starter cubicles and a digital input trip signal must be wired to the PLC.

28. ON LINE AUTOMATIC WATER ANALYSER

On-line measuring system for continuous determination of phosphate, ammonium, nitrate, nitrite and chemical oxygen demand (COD) in automatic operation on site, designed for control and supervision of a waste water treatment plant, expandable up to 6 measuring points

The analyser must consist of an analyser section, control section and a reagent cabinet, separately integrated, splash-proof in a DD- varnished steel cabinet.

- UV-VIS-Diode array spectrometer
Wavelength range 200 - 700 nm
- low reagent consumption by diminished flow-cell volume (30-40%) and speed controlled flexible tube pumps (with 4 rolls to minimize pulsation)
- any dilution ratio possible
- integrated PC with linux-based software
- easy update of the firmware or download of the data by USB flash drive
- graphical user interface with interactive touch screen operation
- full network functionality by direct LAN connection
- all current interfaces are supported (RS232, LAN, modem, USB, profibus)
- error message via sms practicable
- up to 100 external sensors connectable.

Technical data:

Number of measuring points: 6 (= max. extension)

Measuring range (free selectable): 0 - 2 ... 0 - 16 mg/l PO 4 -P

0 - 4 ... 0 - 25 mg/l NH 4 -N

0 -10 ... 0 - 25 mg/l NO 3 -N

0 -50 ... 0 -100 mg/l COD

0 - 3 mg/l NO 2 -N

Measuring cycle for all 5 parameters: 15 min per measuring point

Measuring procedure: UV/VIS-spectroscopy

Calibration: automatic, free selectable

Sample pressure: pressure-free ($\pm 0,05$ bar overpressure)

Sample temperature: 15 ... 35°C

Sample requirement: 2 ... 10 l/h, free of suspended matter

Ambient temperature: 15 ... 35°C

Accuracy: ± 3 % of measurement

Power supply: 230 V, 50 cps, approx. 150 VA Protection classification: IP 54

Complete with two reagent cabinets

Ethernet IP or Modbus TCP communication ports.

Tenderers to note that the electrical bill item for on line automatic water analysers excludes pumps, piping, filters and aux equipment.

29. FIELD EQUIPMENT BOXES (FEBs)

FEB's shall be constructed of:

Stainless Steel steel, powder coated.

The FEB shall be equipped with a removable chassis plate upon which the field instrumentation equipment including surge arrestors etc shall be mounted.

The front door of the FEB shall be a hinged door with an armour plate glass window mounted in a rubber seal. The equipment mounted in the FEB shall be located such that the display can be read without opening the door. The door shall be fitted with a lockable latch.

The FEB shall be equipped with removable, bottom entry, gland plate. All cabling to and from the equipment mounted in the FEB shall be glanded off on these gland plates.

Power and signal cable cores shall be terminated on rail mounted surge arrestors mounted in the FEB.

The FEB's shall be numbered using white / black / white traffolyte labels with 10 mm high lettering. Each FEB shall carry a five digit number – being the number of the transmitter housed therein.

A prototype of the FEB proposed shall be submitted to the Engineer for approval before purchasing / manufacturing.

FEB's shall contain the lightning arrestors for the power and signal cables to the field mounted instrument transmitters.