

ANNEXURE 1



32269-5W
TRENANCE 3 RESERVOIR UPGRADE:
ETHEKWINI MUNICIPALITY WATER & SANITATION
MINUTES OF CLARIFICATION MEETING
HELD ON THE 13/10/2025 AT 10:00

No.	ITEM
1.	<u>WELCOME & INTRODUCTION:</u> Zakhele Bhengu (ZB) opened the meeting by welcoming all attendees and outlining the purpose of the meeting, which was to clarify matters pertaining to the Tender Document. The meeting consisted of two parts: - Part 1: Review of the Tender Document. - Part 2: Site walk of the Trenchance 3 Reservoir.
1.1	ZB noted that an attendance register was circulated. ZB advised attendees that the meeting was being recorded and no objections were raised.
1.2	ZB introduced the project team: - Client: eThekweni Municipality – Water Services - Represented by: Nischal Nundlall (NN) - Consultant: Naidu Consulting (Pty) Ltd - Represented by: Zakhele Bhengu (ZB), Ashveer Goorun (AG), Neelesh Hira (NH), Dick Govender (DG) and Nonkanyiso Mdunge (NM)
1.3	ZB noted the following conduct during the meeting: - Questions will be taken at the end of the explanation of each section of the Tender Document. - Attendees were to ensure their details in the attendance register were legible and correct. - Once specific items in the Tender Document have been addressed, all present will proceed for a site walk of the Trenchance 3 Reservoir site, where a brief description of the works will be given. - The signing of the "Certificate of Attendance" will be conducted at the end of the meeting.
2.	Tendering Procedures
2.1.	ZB elaborated on the following regarding the Tendering Data: - The Employer is eThekweni Municipality – Water Design Division. - Tenderers are to have a CIDB Contractor grading designation of 7CE (or higher). - Clarifications or contractual queries are to be directed to Sivashan.Pillay@durban.gov.za. - Technical queries are to be directed to Devesh.Ramghulam@naiduconsulting.com - The tender must be submitted as a hard copy and delivered to the tender box located in the foyer of the Municipal Building, 166 KE Masinga Road, Durban. - An electronic submission via the eThekweni Municipality JDE System (SSS Module) is also required. Tenderers are to refer to Part 1.2 of the Tender Document for further details. - The closing date for the tender is Friday, 07 November 2025, on or before 11h00. - The tender will be evaluated on the 80/20 price–preference point system.
3.	Evaluation of Tender Offers
3.1.	ZB emphasised the tender evaluation procedure, which includes Eligibility, Functionality and the Preference Point System. ZB further noted that the maximum possible score for Functionality is 100 points and the minimum required points for this tender is 60 points.



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4.	Functionality		
4.1.	ZB provided an overview of the Tender Functionality Specification (T1.2.3.4) and stipulated that the functionality criteria are outlined as per page 26 of the tender document.		
	Functionality Criteria / Sub Criteria		Maximum Points Score
	Tenderer's Experience		40
	Project Organogram and Experience of Key Staff	Contracts Manager	15
		Construction Manager	15
		Concrete Lead Foreman	10
		Civil Lead Foreman	10
	Preliminary Programme, Construction Methodology & Quality Control		10
	Maximum possible score for Functionality (M _s)		100
	The minimum number of evaluation points for Functionality is 60. Only those Tenderers who achieve the minimum number of Functionality evaluation points (or greater) will be eligible to have their tenders further evaluated.		
4.2.	ZB highlighted the following with respect to the Tenderer's Experience: - To earn maximum points, tenderers must have successfully completed nine (9) or more projects of a similar nature within the past ten (10) years. - Projects of a similar nature that will be considered shall include proven experience as the main or lead Contractor in the construction of reinforced concrete water-retaining structures with a capacity of at least 5 megalitres (ML), completed within the past ten (10) years. "Successfully completed" implies a project has been completed on time and to specification.		
4.3.	ZB highlighted the following with respect to the Tenderers' Key Staff: Contracts Manager: To earn maximum points, the Contracts Manager must have a relevant accredited diploma or degree and a minimum of 10 years' experience in projects of a similar nature. Construction Manager: To earn maximum points, the Construction Manager must have an accredited diploma or degree and a minimum of 10 years' experience in similar projects. Concrete Foreman: To earn maximum points, the Concrete Foreman must have a minimum of 11 years' experience in similar works. Civil Foreman: To earn maximum points, the Civil Foreman must have a minimum of 11 years' experience in similar works. ZB noted that "An accredited diploma or degree refers to a qualification of at least three (3) years within the built environment, obtained from a registered university or institute of technology". ZB stated that a signed declaration from the proposed individual must be provided, confirming that he or she is employed by the tenderer or that he or she would be available for full-time employment on this contract.		



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	ZB mentioned that if a tenderer fails to submit a CV or supporting documents for any of the key personnel, a score of zero (0) points will be awarded for that category.
4.4.	ZB highlighted the following with respect to the Tenderer's Preliminary Programme, Construction Methodology & Quality Control in order to obtain maximum points: • Programme Programme covering all the applicable individual activities which are in an acceptable sequence, with appropriate durations and are in accordance with generally accepted construction practice and are in line with Clause 1.1.1.14 of the Conditions of Contract (time for achieving Practical Completion). Plus: ○ Shows critical path with logical linking of tasks/activities and a Detailed activity and resources breakdown. ○ Cashflow included ○ Detailed Plant and equipment resource breakdown • Methodology ○ The important issues are approached in an innovative and efficient way, indicating that the tenderer has excellent knowledge of working in the project environment and producing the required final product. ○ Plant and equipment proposals and ownership/provision arrangements are most likely to ensure a satisfactory project outcome. Quality control statements are site-specific, covering required sampling and testing for all programmed activities, including a site-specific quality control checklist for all programmed activities.
5	RETURNABLE SCHEDULES
5.1.	ZB noted that all returnable documents must be fully completed and signed.
5.2.	AG noted that the CV format found on section T2.2.18 of the tender document must be followed for each required personnel. ZB added that the CVs must be specific and detailed, particularly with respect to the capacity and sizes of the infrastructure of projects, as well as the duration of involvement.
5.3.	ZB noted that the Certificate of Attendance at Clarification Meeting must be completed and signed at the clarification meeting on-site.
6.	Agreements and Contract Data
6.1.	ZB stated that all tenderers must complete the Form of Offer and Acceptance, which must be signed by an authorised person. The tender will be considered null and void if this form is not completed and signed.
6.2.	NH noted that the time for achieving Practical Completion, from the Commencement Date, is 490 Days. The period as stated in 5.3.2 and the 7 days referred to in 5.3.3, are included in the above time for achieving Practical Completion. The special non-working days as stated in 5.8.1 are included in the above time for achieving Practical Completion.



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7.	CONTRACT PARTICIPATION GOALS
7.1.	ZB noted that Tenderers are required to achieve at least 30% Contract Participation Goals (CPG) of the value of goods, services and Works paid to one or more targeted enterprises to comply with eThekweni Municipality's BBBEE policy initiative. A Project Steering Committee (PSC) will be formed to facilitate the CPG component of the works. ZB highlighted that tenderers are to take note of C1.2.3.3.
7.2.	NN stated that skilled subcontractors would be required to complete the scope of works. Another aspect is that this can be achieved by engaging with black-owned suppliers. Ward (59) based CPG is encouraged on this Contract. NH added that, when referring to CPG (Contract Participation Goals), it is not limited to subcontractors working on-site. It can also include suppliers, security services and people providing materials, provided they meet the criteria to be confirmed as CPG. NH further stated that, to claim the CPG spend amount, tenderers must submit proof of payment. At a later stage of the contract, it will be required that the CPG Contractor or supplier confirm receipt of the payment. CPG participants must meet the criteria and show proof that they have undertaken the work they are proposed to perform.
8.	Scope of Works (Site Walk)
8.1.	ZB stated that the main scope of work includes: C3.1.2.2 MAIN COMPONENTS OF THE WORKS The scope of works to be carried under this Contract is shown on the drawings and described in the specifications and may be described as comprising but not limited to the following: <u>Civil and Structural</u> • Construction of a watertight reinforced concrete reservoir consisting of a single cell with internal dimensions of 38 m x 26 m x 6.6 m high, including the construction of wall bases, column bases and columns, semi-propped cantilever walls, inlet and outlet works, and a reinforced concrete roof. • Under-drainage system beneath the reservoir floor; • Construction of a new pump station building including the telemetry room; • Reinforced concrete chambers; • Brick cladding of the new 6Ml reservoir; • Construction of a 400Kl elevated steel tank with an approximate stand height of 20 m; • Bulk Earthworks for reservoir site and access road where applicable, pipeline and cable trenching; • Laying, bedding, jointing, testing and disinfecting of steel pipes, fittings and valves of diameter up to and including DN 400; • Planning for ordering and ordering of all materials especially long lead items;



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	• Proving and locating existing reservoir inlet and outlet pipes at the reservoir site; • Proving and locating existing elevated tower inlet and outlet pipes at the reservoir site; • Installation of all control valves and isolating valves on the inlets, outlet and scour pipelines; • Barricading all earthworks and trenches; • Accommodation of traffic where works is required in existing roads; • Reinforced concrete chambers; • Repair of chambers at Sherwood and Chatsworth; • Protection of all services affected by the construction of the reservoir, elevated tower, pumpstation and pipe work; • Construction of a new block paving access road; • Dry stack retaining walls; • Top-soiling and grassing; • Repair of existing palisade fencing; • Construction of storm water drainage systems; • Supplying, laying and jointing of gravity drains and overflow pipes with manholes and head walls; • Bulk meter installation on the reservoir and elevated tower inlet and outlet pipelines; • Planning and liaising with eThekwin Operations for shutdowns of reservoir inlet supply pipelines or reservoir outlet pipelines, including all risk assessments and method statements which are to be approved by the Employer's Representative and EWS Operations; • Structural repairs and rehabilitation of all the damaged existing chambers and roof access openings, replacement of all damaged precast chamber access covers, reinstallation of new steel covers and frames, Replacement of padlocks and installation of safety features. • Repair of 2 PRV chambers at Unity Avenue in Chatsworth and Locksley Drive in Sherwood. The repairs will include the following: (a) Unity Avenue PRV Chamber - Removal of the existing roof slab and installation of new roof slab with Lid from Precast. - Breaking down of 6 courses of brick wall on two sides of the chamber and rebuilding of the brick wall, including an air vent on 1x side of the chamber. - Bag wash and paint inside the chamber (b) Locksley Drive PRV Chamber - installation of a new roof slab with Lid from Precast - Breaking down of one course of the brick wall on all 4 sides of the chamber and rebuilding of the brick wall, including three new course of brick wall on all four sides of the chamber. - Bag wash and paint inside the chamber.
8.2.	AG stated that all tenderers are encouraged to review all the drawings, especially regarding the concrete mix design, which is a critical aspect. Tenderers are required to submit the proposed mix design for approval before purchasing concrete. NH added that the mix design must be submitted on a D2 form and must be accompanied by aggregate tests and any other tests specified in the Tender Document to support the D2 form. • Aggregate tests must not be older than three (3) months at the time of submission. • It must be confirmed that the stone, rock and crusher sand all come from the same source rock. • The mix design requirement applies to all concrete, not only the 35 MPa concrete.



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8.3.	NH stated that access to the site is not exclusive to the Contractor. eThekweni Municipality does provide security on site; tenderers are required to provide their own security to safeguard their materials and site facilities.
8.4.	DG stated that the Scope of Works for Mechanical, Electrical and Instrumentation is as follows: <u>Mechanical, Electrical and Instrumentation</u> • Telemetry equipment instrumentation, power supply, all ducting and cabling; • Supply and installation of 2 new horizontal single stage axially split volute casing pumps including motors and baseplates; • Manufacturing of pump outlet manifold; • Supply and installation of new variable speed drives (VSD) and motor control centre (MCC); • New batteries for the UPS section incorporated into the MCC; • Cabling from the MCC to the new VSDs; • Separate motor junction boxes for motor power cabling and sensors/instruments cabling installed locally at the motor for ease of disconnection; • Cabling and cable support systems from the MCC/VSD to the motor junction boxes for power to motors and instrumentation; • New motor cable termination junction boxes at the pump motors; • Cabling and cable support systems for instrumentation equipment including low level float switches, no flow switches, pressure sensors and level instruments in the reservoirs and elevated tank; • Instrumentation including no flow switches on the delivery pipework of each pump and PT100 thermistors for the pumps and motors; • Reservoir (3 in series) low level floats with stainless steel chain and weights. Floats and weights must not contain mercury or lead or other un-safe products used in potable water; • Ultrasonic level sensor and transmitters in the reservoirs (3 No) and elevated tank; • Power supply to the new MCC at the pump station; • Earthing of the complete electrical installation of the MCC and associated electrical installation and pumps. Separate earth wires are to be installed from the MCC to the VSDs and to the motors; • Lightning protection and earthing to the pump station, reservoirs and elevated tank; • Refurbishment of the existing stand-by diesel generator; • New cabling from the stand-by generator change over panel to the new MCC; • New lighting and small power points in the pump station including light fittings; • Cabling and connecting the ultrasonic flow meters; • Telemetry system integration to the SCADA system at EWS Control Room; • Integrating the MCC to new Telemetry system including the new ultrasonic flow meters; • Commissioning of all mechanical, electrical and telemetry equipment;



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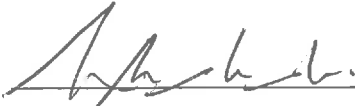
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8.5	ZB stated that the Temporary Works include: C3.1.3 TEMPORARY WORKS The Contractor shall carry out such temporary work, including the necessary access and construction roads, shoring of trenches and excavations etc., as he may require enabling the permanent work to be constructed. He shall allow for the cost of all temporary works, including design and their removal, in his tendered rates. Temporary works are expected to include: • necessary site access and deviations for traffic where the proposed works will disrupt traffic; • shoring, dewatering and related temporary works required during excavation of trenches and excavations as required to enable the permanent works to be constructed. The design of the lateral support is to be undertaken by the Contractors Professional Engineer and included in the tendered rate. The design of the lateral support solution will be dependent on the technique used by the contractor to perform the excavation, as well as programmed to fit into the Contractors construction programme. The Contractor is to submit the detailed design for the approval and acceptance of the project geotechnical engineer; • Any temporary support structures required to protect and maintain services; • Any temporary pipe specials and fittings.
8.6	AG stated that the existing water tanks on site must remain operational until the new Trence 3 reservoir is fully constructed and operational.
9.	General and Questions
9.1.	<u>Question:</u> Would there be enough space on site for stockpiles during excavation? <u>Response:</u> The Contractor is responsible for managing spoil and excavation, as site space is limited on site. The Engineer does not define spoil sites; it is the Contractor's responsibility to identify suitable locations, refer to PS 4.8 on page 170 of the tender document. The Contractor must consider environmental factors when defining spoil sites and ensure that any temporary stockpile areas are agreed upon with the community and ensure that all necessary paperwork is in place.
9.2.	AG encouraged the Contractors to review the geotechnical report in detail and added that there are layer works that must be constructed beneath the reservoir before proceeding with the blinding and subsequent construction.
9.3.	NH stated that, when submitting bids, tenderers must provide information regarding instrumentation in the form of a list specifying the product specifications as requested.
9.4.	ZB stated that all queries must be submitted by 23 October 2025 and consolidated questions and answers must be uploaded on the website on 30 October 2025.
10.	Closure
10.1.	The Clarification Meeting concluded at 11:30 AM.



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These minutes with corrections/amendments (if any) are accepted as a true reflection of the Meeting.



(Signature)

eThekweni Municipality



(Full Name)

(Signature)
Tenderer

(Full Name)



ATTENDANCE REGISTER

CONTRACT NO.: 32269-5W

TRENANCE 3 RESERVOIR: THE CONSTRUCTION OF A 6ML REINFORCED CONCRETE RESERVOIR, PUMP STATION, INLET & OUTLET PIPEWORK, 400KL ELEVATED TANK AND ANCILLARY WORKS: WARD 59

Date: 13 October 2025

No.	Representative Name	Organisation	Email Address	Signature
1	Nonkanyiso Mdungu	Naidu Consulting	Nonkanyiso.Mdungu@naiduconsulting.com	
2	Zakhele Bhengu	Naidu Consulting	zakhele.bhengu@naiduconsulting.com	
3	DICK GOVENDER	DGI CONSULTING	dgovender@dgiconsulting.co.za	
4	Neellesh Hirani	Naidu Consulting	neellesh.hirani@naiduconsulting.com	
5	Ashveer Goorun	Naidu Consulting	ashveer.goorun@naiduconsulting.com	
6	NISCHAL NUNDALL	ENS-WATER DESIGN	nischal.nundall@dwbn.gov.za	
7	VINEENT SAMINVI	ZKD TRADING	LUCKYNTOLOLO@GMAIL.COM	
8	Sakile Cele	KaLethabo Trading 9240	info.kalethabo@gmail.com	
9	SHIKARI	SHIKARI	SHIKARI@SHIKARI.COM	
10	Samukelo Ngema	NAP Holdings CMS LTD	info@napholdings.co.za	
11	Sihombiso Ndlela	Tanjio Civils (PTY) LTD	admin@tanjiocivils.co.za	
12	PATSON TUMBA	LUDE PROTECTS (PTY) LTD	PATSON@LUDE.CO.ZA	
13	PERCY NLAGA	AL-SANDRO CONSTRUCTION	INFO.ALSANDRO.CO.ZA	
14	SIMIE NDABA	EMPILENI TRADING	info@empilenitrading.co.za	
15	Tsepo Mabuza	Grand Connections (PTY) LTD	Grandconnections@gmail.com	
16	Sibosiso Mamba	Soudrite Construction	psydito@soudrite.co.za	
17	Bernard Makhubayi	Makhubayi Civil	bernard.makhubayicivil@gmail.com	
18	FRANK MASHINI	STEN CTA TECH	contracts1@stentech.co.za	
19	SABELO GUMISI	Anandla Bayfire	Sabelosagumisi@gmail.com	
20	FRANK CONSTRUCTION	ANANDLA Mkhayisa	-	



ATTENDANCE REGISTER

CONTRACT NO.: 32269-5W

TRENANCE 3 RESERVOIR: THE CONSTRUCTION OF A 6ML REINFORCED CONCRETE RESERVOIR, PUMP STATION, INLET & OUTLET PIPEWORK, 400KL ELEVATED TANK AND ANCILLARY WORKS: WARD 59

Date: 13 October 2025

No.	Representative Name	Organisation	Email Address	Signature
21	Ayanda Mkhuzozi	Silo Construction SA	bbsilobh.co.za	
22	Ayanda Thusi	Tamasco Trading Projects	tamascoemail@gmail.com	AL Thusi
23	GEORGE MBHALALI	NEW AGE ST & THOSHOLA JV	sthenviso@newagest.co.za	
24	Seelo Shandu	LKHUBA Holdings	tenders@khubaholdings.com	
25	AYANDA MBHELE	MAGUBANE PLANT & CONTRACTORS	info@magubane.com	A. MBHELE
26	Cabo NKWANYANA	MSMANS (PT) LTD	info@msmans.co.za	
27	Shembiso Phungula	WATER & WASTE WATER TECHNOLOGY S.A	Shungula@mbpc.co.za, onlinetenders@wtsafrica	
28	MILANI SIMAMANE	SIMANDLOU TRADING	Tenders@simandlou.co.za	
29	MITHOBISI HLOPHE	RGZ PROTECTS	rgzprojects@mweb.co.za	
30	Fumani Shiluvane	Ojili Pty Ltd	fumani@ojili.co.za	
31	Charlton Botha	Leomat Plant and Civils	kerusha@leomatdbn.co.za	
32	Sonke Buthelezi	Solethu Sandulo JV	info@sandulo.co.za, tenders@solethu.co.za	
33	Vale Mseni Mlondo	KKG Investments	admin@kkgcivils.co.za	
34	TREVYN PILAY	R&B CIVILS	trayn@rbcivils.co.za	
35	Mthobisi Misoana	Mkhokhele Trading Enterprises	info@mkhokhele.co.za	
36	JOB NIXON	AFROSTRUCTURE	Louren@afrostructures.co.za	
37	A. Mchulani	MMP	Anthony@mmpconstruction.co.za	
38	SANTOSH NARAIH	MAGNOL ELECTRICAL	Santosh@magnol.co.za	
39	JOHAN PEUSER	"	JOHANPEUSER@magnol.co.za	
40	Tlabela Madlala	Kgosni Electrical	pebetse@kgosnielectrical.co.za	

ANNEXURE 2

SCHEDULE 2:**ELECTRICAL AND INSTRUMENTATION**

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT (RAND)
12		ELECTRICAL AND INSTRUMENTATION Design, manufacture, work test, supply, deliver to site, off-load , store if necessary and install the following electrical equipment , MCC, PLC etc as specified and indicated on the drawings NOTE : PLC SYSTEM INTEGRATOR MUST BE A REGISTERED AND CERTIFIED SYSTEM INTEGRATOR FOR THE PLC TO BE USED				
12.1	PS ECI 2.4.1 ; SANS10142 ; EWS Standard Specifications GS1 - DBs & MCCs	400 Volt MCC for Trenance 3 Pumpstation as specified (excluding the VSDs)	Sum	1.0		
12.2	PS ECI 2.4.1 ; SANS10142 ; EWS Standard Specifications GS1 - DBs & MCCs	400Volt 37 kW as specified and to EWS standard with high IP rating for dust and moisture ingress	No.	2.0		
12.3	PS ECI 2.4.1 ; IEEE519	Allow an amount to conduct the power quality and harmonic study for all the VSD installations	Sum	1.0		
12.4	PS ECI 2.4.1 ; IEEE519	Allow a provisional amount of R500 000.00 to supply and install harmonic filters and chokes with all cabling, ancillary equipment etc complete as deemed necessary from the harmonic study	Prov Sum	1.0	500,000.00	500,000.00
12.5		Contractor's mark up on item 12.4	%	500,000.00		
12.6	PS ECI 2.4.1; EWS Standard Specification for PLC_Rev06	Batteries , UPS , battery charger etc installed in MCC cubicle as specified (include for anti-theft limit switches on the UPS box, battery box and PLC box)	Sum	1.0		
12.7	PS ECI 4.1.4; EWS Standard Specification for PLC _ Rev06	PLC hardware and HMI as specified under the PLC Specification_Rev 06 (specification enclosed with the tender) [incl ethernet/serial links]	Sum	1.0		
12.8	EWS Standard Specification for PLC_Rev06	Prepare and submit the hard and soft copies for approval of the FDS specification and how the PLC software will be implemented (Provisional item)	Sum	1.0		
Total Carried Forward						

SCHEDULE 2:
ELECTRICAL AND INSTRUMENTATION

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT (RAND)
Brought Forward						
12.9	EWS Standard Specification for PLC_Rev06	Allow for programming of the PLC using IEC-61131-3 coding standards (Ladder Logic) as per the PLC Specification_ Rev 06 (Provisional item)	Sum	1.0		
12.10	EWS Standard Specification for PLC_Rev06	Allow for Thin Slice testing, FATs, SATs and Commissioning Stages- As per Quality Control specification. (To be conducted jointly by the EWS Engineers and staff and their representatives)	Sum	1.0		
12.11	EWS Standard Specification for PLC_Rev06	Allow for PLC and HMI Quality Control as per PLC Specification_ Rev 06	Sum	1.0		
12.12	EWS Standard Specification for PLC_Rev06	Allow a sum for the PLC licenses , including all profit and attendance	Sum	1.0		
12.13	EWS Standard Specification for PLC_Rev06	Allow a provisional sum of R 75 000,00 for PLC OEM Training in terms of PLC programming to EWS staff members at the programmer's offices and which is clearly defined in terms of structure and method and on site training	Prov Sum	1.0	75,000.00	75,000.00
12.14		Contractor's mark up on item 12.13	%	75,000.0		
12.15		Allow a sum for attendance to technical bi-weekly meetings with the EWS staff , Engineer and other contractors for duration of the contract	Sum	1.0		
12.16		Allow a sum for attendance on site and assist with the commissioning of the pumps.	Sum	1.0		
12.17	SANS10142 ; EWS Standard Specifications GS1 - DBs and MCCs	Allow for initial tests ,works test , FAT and final testing and commissioning of all electrical plant, MCC, and other electrical and instrumentation equipment as specified	Sum	1.0		
12.18	SANS10142 ; EWS Standard Specifications GS1 - DBs and MCCs	Test the entire installation including for issue of the compliance certificates in accordance with SANS 10142	Sum	1.0		
Total Carried Forward						

SCHEDULE 2:**ELECTRICAL AND INSTRUMENTATION**

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Brought Forward						
12.19	EWS Standard Specifications GS1 - DBs and MCCs	Allow for provision of the O & M manuals including MCC as- built drawings and wiring diagrams, specifications and parts list of electrical equipment including As Built loop /block diagrams , post and final FDS and cable schedules etc complete	Sum	1.0		
	SANS10142	Supply all materials, deliver to site, unload, store, install, commission and test the domestic electrical installation and ancillary equipment in accordance with the specifications, schedules and drawings as ff:				
12.20	SANS10142; EWS Standard Specifications GS1 - DBs and MCCs	a) Emergency stop locks with stainless steel stand-off brackets fixed adjacent each pump	No.	2.0		
12.21	SANS10142; EWS Standard Specifications GS1 - DBs and MCCs	b) Low level floats with s/steel chain and weights in the existing 3 x clear water reservoirs for the pump low level cut out (wired in series)	No.	3.0		
		Supply and install the following instruments :				
12.22	PS ECI 2.20 ; EWS Standard Specifications for Telemetry and Instruments _ Rev01	a) 100-500KPA range pressure transmitter installed on delivery side of pumps as specified and to EWS standard. To be supplied complete with matching controller installed in MCC and to communicate and interface to PLC	No.	1.0		
12.23	PS ECI 2.20 ; EWS Standard Specifications for Telemetry and Instruments _ Rev01	b) 100-500 KPA range pressure transmitter installed on suction manifold of pumps as specified and to EWS standard. To be supplied complete with matching controller installed in MCC and to communicate and interface to PLC	No.	2.0		
12.24	SANS10142	Supply and install suitable heavy duty 3CR12 cable junction box with links for termination of motor power cables and pump & motor sensor cables to be installed at each pump/motor for maintenance purposes (separate boxes for power and instrument cables)	No.	2.0		
Total Carried Forward						

SCHEDULE 2:
ELECTRICAL AND INSTRUMENTATION

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT (RAND)
Brought Forward						
12.25	SANS10142	Supply and install IP65 weatherproof CCG boxes for termination of instruments	No.	16.0		
	PS ECI 2.15 ; SANS10142	Supply, deliver to site, off-load and store if necessary the following PVC ECC SWA cables(660/1000V grade) to SABS 1507:1990 as amended and specified.				
12.26		a) 95mm ² x 4C PVC/ECC/SWA/PVC (Power Cable from Mini-Sub)	m	60.0		
12.27		b) 70mm ² x 4C PVC/ECC/SWA/PVC (Power Cable from Meter to MCC)	m	50.0		
12.28		c) 25mm ² x 4C PVC/ECC/SWA/PVC	m	30.0		
12.29		d) 16mm ² x 4C PVC/ECC/SWA/PVC	m	25.0		
12.30		e) 1.5mm ² x 4C PVC/ECC/SWA/PVC	m	200.0		
12.31		f) 1.5mm ² x 2C PVC/ECC/SWA/PVC	m	140.0		
12.32		g) Dekron instrument cable	m	200.0		
12.33		h) 1.0mm ² Twisted Pair 4 - 6 Pair individually screened overall screened SWA CAT 6 instrument cable	m	240.0		
12.34		i) 16mm ² x BCEW (to VSDs & motors)	m	50.0		
12.35		j) 10mm ² x 4C PVC/ECC/SWA/PVC	m	15.0		
12.36		k) 70mm ² x BCEW	m	50.00		
12.37		l) 25mm ² x 3C trailing cable to motor terminals	m	10.00		
	PS ECI 2.15 ; SANS10142	Install in trenches, duct, sleeves, cable tray and in manholes the following cables supplied under Item 12.27-12.38				
12.38		a) 95mm ² x 4C PVC/ECC/SWA/PVC	m	60.0		
12.39		b) 70mm ² x 4C PVC/ECC/SWA/PVC	m	50.0		
12.40		c) 25mm ² x 4C PVC/ECC/SWA/PVC	m	30.0		
12.41		d) 16mm ² x 4C PVC/ECC/SWA/PVC	m	25.0		
12.42		e) 1.5mm ² x 4C PVC/ECC/SWA/PVC	m	200.0		
12.43		f) 1.5mm ² x 2C PVC/ECC/SWA/PVC	m	140.0		
Total Carried Forward						

SCHEDULE 2:
ELECTRICAL AND INSTRUMENTATION

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT (RAND)
Brought Forward						
12.44	PS ECI 2.15 ; SANS10142	g) Dekron instrument cable	m	200.0		
12.45		h) 1.0mm ² Twisted Pair 4 - 6 Pair individually screened overall screened SWA CAT 6 instrument cable	m	240.0		
12.46		i) 16mm ² x BCEW	m	50.0		
12.47		j) 10mm ² x 4C PVC/ECC/SWA/PVC	m	15.0		
		Make off ends, connect up, including glands, lugs. etc. test and commission the following cables supplied under Item 12.27-12.38 (outdoor glands shall be CCG weatherproof corrogland type)				
12.48		a) 95mm ² x 4C PVC/ECC/SWA/PVC	No.	4.0		
12.49		b) 70mm ² x 4C PVC/ECC/SWA/PVC	No.	8.0		
12.50		c) 25mm ² x 3 & 4C PVC/ECC/SWA/PVC	No.	8.0		
12.51		d) 16mm ² x 4C PVC/ECC/SWA/PVC	No.	8.0		
12.52		e) 1.5mm ² x 4C PVC/ECC/SWA/PVC	No.	30.0		
12.53		f) 1.5mm ² x 2C PVC/ECC/SWA/PVC	No.	30.0		
12.54	PS ECI 2.15 ; SANS10142	g) Dekron instrument cable	No.	20.0		
12.55		h) 1.0mm ² Twisted Pair 4 - 6 Pair individually screened overall screened SWA CAT 6 instrument cable	No.	20.0		
12.56		i) 16mm ² x BCEW	No.	8.0		
12.57		j) 70mm ² x BCEW	No.	4.0		
12.58		k) 25mm ² x 3C trailing cable to motor terminals	No.	4.0		
12.59		o) Excavate and backfill cable trenches below ground level in all classes of pickable material and backfill (for rate only - future use)	m ³	150.0		
12.60		p) Supply and lay Allen yellow plastic cable marking tape 150mm above cable during backfilling	m	150.0		
12.61	SANS1200	q) Supply and install 20Mpa concrete over the cables and sleeves (150mm thick x 300mm wide) over 140m . (Rate only)	m ²	3.0		
Total Carried Forward						

SCHEDULE 2:**ELECTRICAL AND INSTRUMENTATION**

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT (RAND)
Brought Forward						
12.62	SANS10142	r) Supply and install 3 phase meter box to Ethekwini Electricity Dept. standards for pump station and reservoir sites	m ²	1.0		
12.63	PS ECI 2.15 ; SANS10142	Supply and install LG or similar concrete cable markers to SABS Specifications	m ²	12.0		
	SANS10142	Supply and install galvanised or similar approved cable tray including all sets, bends, etc. fixed to structures, walls, etc. including fixings as ff:				
12.64		a)300mm wide	m	20.0		
12.65		b)100mm wide	m	40.0		
	SANS10142	Supply and install the following uPVC cable sleeves and manhole including bends, etc. :-				
12.66		a) 110-160mm ²	m	15.0		
12.67		b) 50mm ²	m	10.0		
12.68		Allow an amount to seal all cable sleeves in MCC and Telemetry Room on successful commissioning and completion of the works (sum)	Sum	1.0		
		Note : All lighting, sockets, outlets, isolators, etc. to include for conduit, wiring, switches, covers, etc. for a complete working installation				
	PS ECI 2.12 to PS ECI 2.14; SANS10142	(Supply and install the following including PVC conduit, wiring etc complete)				
12.69		a) Surface fluorescent light outlets with junction boxes including conduit and wiring etc complete	No.	12.0		
12.70		b) Bulkhead and floodlight light outlets including conduit and wiring etc complete	No.	6.0		
12.71		c) Photo cell including conduiting and wiring etc complete	No.	1.0		
12.72		d) Double 16A switched socket outlet surface weatherproof and UPS red outlet including conduit and wiring etc complete	No.	6.0		
Total Carried Forward						

SCHEDULE 2:
ELECTRICAL AND INSTRUMENTATION

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT (RAND)
Brought Forward						
12.73	PS ECI 2.21 ; OHS Act	e) Surface 1 and 2 way light switch including conduit and wiring etc complete	No.	4.0		
12.74		f) 1,5m light with carbonate diffuser type Corrosion Proof C2-2 x 26W LED light fitting with 26W LED lamps (1.5m long)	No.	12.0		
12.75		g) Bulkhead lights type B20-2PL9SS screws light fitting with vandal proof glass, wire screen and screws	No.	6.0		
12.76		h) 100W LED floodlight LED lamp and aluminium body	No.	4.0		
12.77		i) 32Amp 3 phase 5 pin welding socket outlet complete	No.	1.0		
12.78		Supply and install the 400V DB for the pump station telemetry room as specified	Sum	1.0		
		Allow for all statutory safety equipment and warning notice etc.				
12.79		a) 9kg DCP fire extinguisher	No.	2.0		
12.80		b) Danger sign Electricity, No Unauthorised Entry	Sum	1.0		
12.81		c) Machine starts automatically warning notice	Sum	1.0		
12.82	PS ECI 2.22	d) Labels and name plates for pumps as specified (number plate type)	No.	2.0		
12.83		High pressure danger and warning signage	No.	1.0		
12.84	PS ECI 2.22	Supply and install smoke detector and siren to Metro Standards including power supply and cabling to MCC and wiring to connect to PLC (To pumpstation and telemetry room)	No.	3.0		
12.85	PS ECI 2.22	Supply and install PIR intruder alarm sensors Metro Standards including cabling to MCC and wiring and connect to PLC (To pumpstation and telemetry room)	No.	3.0		
12.86		Make application for power supply and liaise with and attendance for the power connection by Ethekwini Electricity for the pump station and reservoir (2 sites)	Sum	1.0		
Total Carried Forward						

SCHEDULE 2:
ELECTRICAL AND INSTRUMENTATION

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT (RAND)
Brought Forward						
12.87	PS ECI 2.18	Allow a provisional sum for the Engineer to carry out the MCC FAT and other tests.	Prov Sum	1.0	50,000.00	50,000.00
12.88		Allow for profit and overheads on item 12.87	%	50,000.00		
12.89		Allow a sum for attendance on site and assist with the final testing and commissioning of the pumps, electrics and MCC	Sum	1.0		
12.90		Allow a provisional sum for any unforeseen work on site to be used at the entire discretion of the Engineer or Client.	Prov Sum	1.0	95,000.00	95,000.00
12.91		Allow for profit and overheads on item 12.90	%	95,000.0		
12.92	PS ECI 2.15	TELEMETRY EQUIPMENT (by specialist)				
12.92	PS ECI 2.15	Supply and install of instrument cable for transducers (1.0 mm ² SWA twisted 2 pair shielded and overall shielded) in provided cable routes/trenches by others	m	180.0		
12.93	PS ECI 2.15	Supply and install of instrument cable for flow meters (1.0 mm ² SWA twisted 16 pair shielded and overall shielded) in provided cable trays and routes/trenches by others	m	180.0		
12.94	SANS10142	Supply and install bosal pipe at the reservoir and pump station sites	m	80.0		
12.95	PS ECI 2.16 ; Standard EWS Specification for Telemetry & Instrumentation _ Rev01	Supply and install new telemetry equipment and telemetry panel to include RTU , digital radios etc (Trenance 3 Pump Station) as per specifications.	Sum	1.0		
12.96	PS ECI 2.16 ; Standard EWS Specification for Telemetry & Instrumentation _ Rev01	Supply and install the 100A/hr batteries for telemetry panels	No.	2.0		
Total Carried Forward						

SCHEDULE 2:
ELECTRICAL AND INSTRUMENTATION

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT (RAND)
Brought Forward						
12.97	PS ECI 2.16 ; Standard EWS Specification for Telemetry & Instrumentation _ Rev01	Supply and installation of new Webb radio antenna, with cables with associated mountings and accessories.	Sum	1.0		
12.98	PS ECI 2.16 ; Standard EWS Specification for Telemetry & Instrumentation _ Rev01	Configuration, testing and Commissioning of Telemetry, Instrumentation (Level and Flow), Pump Control and SCADA systems .	Sum	1.0		
12.99	PS ECI 2.16 ; Standard EWS Specification for Telemetry & Instrumentation _ Rev01	Supply and wire optical isolation between serial devices (Moxa TCC120I)	Sum	1.0		
12.100	PS ECI 2.16 ; Standard EWS Specification for Telemetry & Instrumentation _ Rev01	Supply and wire serial surge protection and DC supply surge protection devices	set	4.0		
12.101	PS ECI 2.16 ; Standard EWS Specification for Telemetry & Instrumentation _ Rev01	Allow an amount to integrate the new 4 x mag flow meter to the telemetry panel and to the SCADA system including all hardware , software , relays , cabling between the flow meter and telemetry panel etc complete (allow 40m of cabling for each meter)	Sum	1.0		
12.102	PS ECI 2.16 ; Standard EWS Specification for Telemetry & Instrumentation _ Rev01	Allow an amount to integrate the new MCC and pump status to the telemetry panel and to the SCADA system including all hardware , software , cabling between the MCC and telemetry panel etc complete	Sum	1.0		
12.103	PS ECI 2.20 ; EWS Standard Specification for Instruments	Supply and install the ultrasonic level sensors as specified (10m depth) complete with stainless steel brackets etc complete at the reservoirs and elevated tank	Sum	4.0		
12.104	PS ECI 2.16 ; Standard EWS Specification for Telemetry & Instrumentation _ Rev01	Allow an amount to integrate the new level sensors (4 No) for existing 2 reservoirs , 1 new reservoir and 1 new elevated tank to the telemetry system including all hardware , cabling etc complete	Sum	1.0		
Total Carried Forward						

SCHEDULE 2:
ELECTRICAL AND INSTRUMENTATION

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT (RAND)
Brought Forward						
12.105	Standard EWS Specification for Telemetry & Instrumentation _ Rev01	Allow for existing SCADA upgrade at EWS Control Room , software upgrade, re-programming , configuration and integration	Sum	1.0		
12.106	Standard EWS Specification for Telemetry & Instrumentation _ Rev01	Facilitate training on SCADA, Instrumentation and Telemetry Systems	Sum	1.0		
12.107		Provide project management and attend meetings , testing and commissioning etc	Sum	1.0		
12.108	Standard EWS Specification for Telemetry & Instrumentation _ Rev01	Documentation pack with all drawings, wiring diagrams , block diagrams , loop diagrams, PLC I/O lists, hand-over documentation etc complete for the telemetry system	No.	1.0		
12.109		Allow a sum for OEM training by KSB or their agents for the pumps and pumping plant for all the pumps provided for the Trenance 3 pump station	Sum	1.0		
12.110	SANS10142	Supply and install Luft or similar approved extract fan wall mounted including making opening in brickwork. Fan type Luft LPA500/43F 1350rpm 0,37kW 1,3A with WC500 cowl and insect screen (installed in pump station)	No.	3.0		
12.111	PS ECI 2.11	Allow a provisional for the refurbishment of the existing 100KVA stand-by diesel generator	Prov Sum	1.0	300,000.00	300,000.00
12.112		Allow for profit and attendance on provisional sum item 12.111	%	300,000.0		
12.113	SANS10142	Make safe, disconnect and remove the existing MCC supplying the existing 2 x 7,5kW submersible pumps and deliver to EWS stores in Springfield	Sum	1.0		
12.114	SANS10142	Disconnect and remove all the existing instruments , level sensors, flow meters etc and deliver to EWS stores in Springfield	Sum	1.0		
		Any other item the contractor considers has been omitted and requires separate prices				
Total Carried Forward						

SCHEDULE 2:
ELECTRICAL AND INSTRUMENTATION

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT (RAND)
Brought Forward						
12.115	PS ECI 2.5; SANS10142	a) b) FLOW METERS Supply and install the weatherproof 230Volt DB at the Trenance 3 Reservoir and Pump Station site to power the ultrasonic flow meter (24V DC supply) and to power the telemetry panel	Sum	1.0		
12.116	Standard EWS Specification for Telemetry & Instrumentation _ Rev01	Supply and Install ultrasonic flow meters as shown on the drawings transmitter and install, connect up, test and commission the flow meter supplied under the civil contract (include to configure the meter to communicate and interface with the telemetry and SCADA system , to include meter supplier to be in attendance on site)	Sum	1.0		
	PS ECI 2.15	FLOW METER CABLING Supply and install in trenches 300/500 V XLPE insulated galvanised steel wire armoured (SWA) instrumentation cabling. Conductors plain annealed class 4 bunched copper with numbering , twisted pairs with individual and overall tinned copper drain wire including individual & overall aluminium Mylar screen				
12.117		a) Supply 1.0mm ² 16-core	m	150.0		
12.118		b) Install 1.0mm ² 16 -core	m	150.0		
12.119		c) Terminate 1.0mm ² 16 -core	No.	8.0		
		COMMUNICATION CABLE				
12.120		a) Supply and connect up the comms cable between the transmitter to the flow meter sensor (by instrument specialist)	m	220.0		
12.121		b) Terminate above cables at both ends	No.	8.0		
	Standard EWS Specification for Telemetry & Instrumentation _ Rev01	SURGE PROTECTION				
Total Carried Forward						

SCHEDULE 2:
ELECTRICAL AND INSTRUMENTATION

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT (RAND)
Brought Forward						
12.122	PS ECI 2.25; SANS10313; SANS10199 ; IEC62305	Supply and install DIN rail mounted pre-fused surge arresters and fuses. Arresters to be combined lightning current and surge arrester for protection of power supply and information / signal systems and cabling as ff:	No.	1.0		
		ENCLOSURES & TRUNKING				
		Supply and install the following :				
12.123		a) 200X200x75mm IP65 polycarbonate box surface mounted in equipment kiosk with clear lid and 1 x rows of DIN rail and 20 terminal DIN mount block	No.	4.0		
12.124		b) 40x25mm PVC trunking with cover fixed inside kiosk to hold internal wiring including all necessary fixings and accessories	m	4.0		
		EARTHING AND BONDING				
		Supply and install the following :				
12.125		a) 200x50x6mm thick copper earth bar pre-drilled with 3 holes for 10mm brass bolts fixed to wall of pump station with 50mm insulators	No.	4.0		
12.126		b) 1.8m long 16mm diameter earth rod connected to MCC building earth mat	No.	4.0		
12.127		c) 35mm ² PVC insulated earth wire connected to MCC building earth mat	m	40.0		
12.128		d) 35mm ² PVC insulated earth wire terminations	No.	30.0		
12.129		e) PVC earth inspection pit/well with cover 300x300	No.	4.0		
12.130		f) Test the earth resistance between the earth bar and ground /earth mat and submit results to Engineer together with the compliance certificates(include in manuals)	Sum	1.0		
12.131		Provide as-built drawings and wiring diagrams of the electronic installation for the 4 off meters	Sum	1.0		
Total Carried Forward						

SCHEDULE 2:
ELECTRICAL AND INSTRUMENTATION

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT (RAND)
Brought Forward						
12.132	PS ECI 2.25; SANS10313; SANS10199 ; IEC62305	60 Amp DP isolator / fuses DIN mounted in weatherproof enclosure	No.	4.0		
12.133		Provide the certificate of compliance to SANS101042 for the electrical and electronic systems for the installation of the ultrasonic or mag flow meters and level transmitters	Sum	1.0		
12.134		Allow to supply and install the device plate/s for the above equipment	No.	4.0		
12.135		Allow a sum for configuration and testing and commissioning of the flow meter complete	No.	4.0		
		Any other item the tenderer considers has been omitted and requires separate prices for the lightning protection & earthing installation etc				
		a)				
		b)				
		LIGHTNING PROTECTION AND EARTHING - TO TRENANCE 3 PUMP STATION, ELEVATED TANK RESERVOIRS				
		Supply, install, test and commission the ffg as specified:				
12.136		a) Carry out the earth resistivity survey of all the sites at the reservoir, Elevated Tank, MCC room and Telemetry room (for Trenchance 3 Sites)	Sum	1.0		
12.137		b) Supply and install the 70mm ² bare copper trench ring main	m	340.0		
12.138		c) Trenching and backfilling for earth mat	m	340.0		
12.139		d) 70mm ² PVC insulated earth wires	m	160.0		
12.140		e) 16mm diameter X 1.8m long earth electrodes and 300x300 cast iron wells	No.	30.0		
12.141		f) Earth bushes brass type on concrete plinths or walls connected to reinforcing(include for breaking concrete to expose steel and making good)	No.	30.0		
Total Carried Forward						

SCHEDULE 2:
ELECTRICAL AND INSTRUMENTATION

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT (RAND)
Brought Forward						
12.142	PS ECI 2.25; SANS10313; SANS10199 ; IEC62305	g) 70mm ² PVC connections from earth bushes to reservoir or roof reinforcing	m	80.0		
12.143		h) 25mm dia PVC conduit for earth wires (some cast into walls and roof slabs)	m	80.0		
12.144		i) 300x6mm thick earth bar for adjacent to MCC and connection to MCC	No.	1.0		
12.145		j) 10mm dia solid aluminium earth finials/conductor on MCC/Telemetry room roof and on reservoir roof connected to roof reinforcing steel	m	240.0		
12.146		k) 70mm ² terminations	No.	60.0		
12.147		Test and commission the lightning protection and earthing installation for the entire site (for all structures) and issue of the earth test certificates , as-built layouts and compliance certificates	Sum	1.0		
		Any other item the tenderer considers has been omitted and requires separate prices for the lightning protection and other installations				
		a)				
		b)				
Total Carried Forward To Summary						

SCHEDULE 2:**MECHANICAL EQUIPMENT AND ANCILLARY WORKS**

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT (RAND)
13	PS WPE	MECHANICAL EQUIPMENT AND ANCILLARY WORKS				
		PUMPS AND ANCILLARY WORKS				
13.1		Supply, deliver and install new pumps , baseplates , couplings , coupling guards, mounting / support frames, belts etc including all sensors as specified complete (1 duty, and 1 stand-by) - duty 374m³/hr @ 19.7m head as specified.	No.	2.0		
		Supply, install and connect up the following ancillary equipment :				
13.2		½" BSP sockets with stop-cocks welded on steel pipework	No.	2.0		
13.3		SAT - Test and commission of the new pump sets on site	No.	2.0		
		MOTORS AND ANCILLARY WORKS				
13.4		Supply and install new WEG or similar approved 37kW, 400V motors as specified, including all new galvanised bolts, nuts, washers and relevant ancillary components.	No.	2.00		
13.5		Testing and commissioning as per specifications	No.	2.00		
13.6	PS WPE 11	Allow for laser alignment the new pumps supplied above (provide certificates)	No.	2.0		
13.7	PS WPE 12	Allow for the FAT for the above pumps	Sum	1.0		
13.8	PS WPE 12	Allow for the Engineer and Client to attend the FAT for the above pumps (to include for flights, travel, car hire , accommodation, meals , entertainment etc) . Allowance to be made for 3 persons	Sum	1.0		
Total Carried Forward To Summary						

ANNEXURE 3

D859	5404	60570/024	32269-5W	Standard Details Thrust Block Details	1 of 1
D859	5405	60570/025	32269-5W	Typical DN300 Inline Meter Assembly	1 of 1
ELECTRICAL DETAILS					
D859	5500	60570/029	32269-5W	Electrical & Instrumentation Layout	1 of 1
D859	5501	60570/030	32269-5W	P & ID Diagram	1 of 1
D859	5502	60570/031	32269-5W	Lightning Protection & Earthing Layout	1 of 2
D859	5502	60570/031	32269-5W	Lightning Protection & Earthing Layout	2 of 2
D859	5503	60570/032	32269-5W	Pump Station Electrical, Fire & Intruder Alarm Layout	1 of 1
D859	5504	60570/033	32269-5W	Typical G.A & Line Diagram of Motor Control Panel	1 of 1

PS 1.3.1**PIPING & INSTRUMENTATION DIAGRAMS**

The Contractor shall ensure that all Piping and Instrumentation Diagrams (P&ID) developed for the project conform to the specific requirements by the Employer. The Contractor shall ensure that the P&ID diagrams comply with the following:

- All symbols, notations, and representations must conform to the Employer's standard conventions.
- The P&IDs must clearly indicate all piping systems, flow direction, control systems, instrumentation (separately indicating probe elements, transducers, transmitters, field indicators etc where applicable), control and alarm set points, hard and soft linkages and interlocks, valves, and other equipment, together with all tag numbers, as per the project requirements

The P&ID diagrams must be provided in the following formats:

- CAD Format: All P&ID diagrams must be delivered in AutoCAD or an equivalent 2D CAD format to ensure compatibility with the Employer's systems.
- Pdf Format: All P&ID diagrams must be delivered in Pdf format.
- Plant 3D Format: The P&ID diagrams must also be submitted in Plant 3D format.
 - This format should provide a 3D representation of the piping, equipment, and instrumentation. It should allow the Employer to visualize the systems in three dimensions, facilitating integration with other 3D design models, clash detection, and further design validation. The Plant 3D files must include all relevant components, with accurate spatial relationships, dimensions, and connection points, ensuring that the system layout aligns with the physical design requirements and can be integrated with other engineering disciplines.
- The cost for the P&ID's are deemed included in the tendered rates.

PS 1.4**EQUIPMENT****PS 1.4.1****GENERAL REQUIREMENTS**

The Contractor shall ensure that all equipment required for the Trenance 3 Reservoir, including process, mechanical, electrical, instrumentation, and control components, is subject to the Employer's acceptance and the Employer's Agent's approval prior to procurement and installation. The equipment planning, review, approval and delivery process must adhere to the following procedure, ensuring compliance with all project and particular specifications.

PS 1.4.2**EQUIPMENT LIST DEVELOPMENT**

The Contractor shall develop and submit a comprehensive Equipment List for all equipment to be utilized on the Contract. The Equipment List shall include, but not be limited to, the following details:

ANNEXURE 4

Item	Description	Co-Ordinates and Levels for the following
		- chamber from centre of crown of pipe - Floor Level
Structures	Position of Reservoir	- All corners of floor - All corners of roof
Equipment	Position of equipment	- All positions of equipment on site - For the pump station these drawings shall include individual mechanical, electrical and C&I equipment/panel layout separately as well a coordinated drawing showing all disciplines on a single set of drawings.
Mechanical	Position of Mechanical equipment	- Centre line (masl) of pumpsets, - All pipework information as specified in "Pipelines" - centre line (masl) of pressure gauges/transmitters
Electrical	Position of Electrical equipment	MCC GA, wiring diagrams, SLD Instrumentation

The Contractor shall show that all infrastructure is located within the servitude boundaries.

For other infrastructure, the Contractor shall ensure that all infrastructure constructed under the Contract is shown on the as built survey.

PS 4.12 MANAGEMENT OF THE ENVIRONMENT

The requirements of the Environmental Management Specifications and where applicable, Environmental Management Programme and the Rehabilitation Specification, shall apply.

The Contractor shall for the construction of the Works, confine his operation to an area as small as possible. No disturbance of vegetation shall commence without approval of the Engineer. The planning for such disturbance shall be captured in the quality control plan for the construction of the Works.

The Contractor shall comply with the statutory and local fire regulations. He shall take all necessary precautions to prevent any fires. In the event of a fire the Contractor shall take active steps to limit and extinguish the fire and shall accept full responsibility for damages and claims resulting from such fires which may have been caused by him or his employees.

PS 4.13 SECURITY

The Contractor is responsible for all security measures required on site and at work fronts of the linear development component of the construction of the Works.

All costs required for security measures taken on site shall be deemed to be covered in the billed rates of the Bill of Quantities.

The Contractor shall provide security watchmen for the contract as he deems fit at no extra cost for the Employer. The Contractor must ensure that all his employees as well as the Employees of his subcontractors are able to identify themselves as members of the construction team.

An item has been included in the Schedule of Quantities for the provision of security.

PS 4.14 SITE PERSONNEL

ANNEXURE 5

NAIDU
CONSULTING

DGI Consulting



**PROJECT PARTICULAR SPECIFICATION: PUMPING
EQUIPMENT**

PS WPE

**TRENANCE 3 RESERVOIR, ELEVATED TANK AND
PUMP STATION PROJECT**

Contract No. 32269-5W

Rev. 2

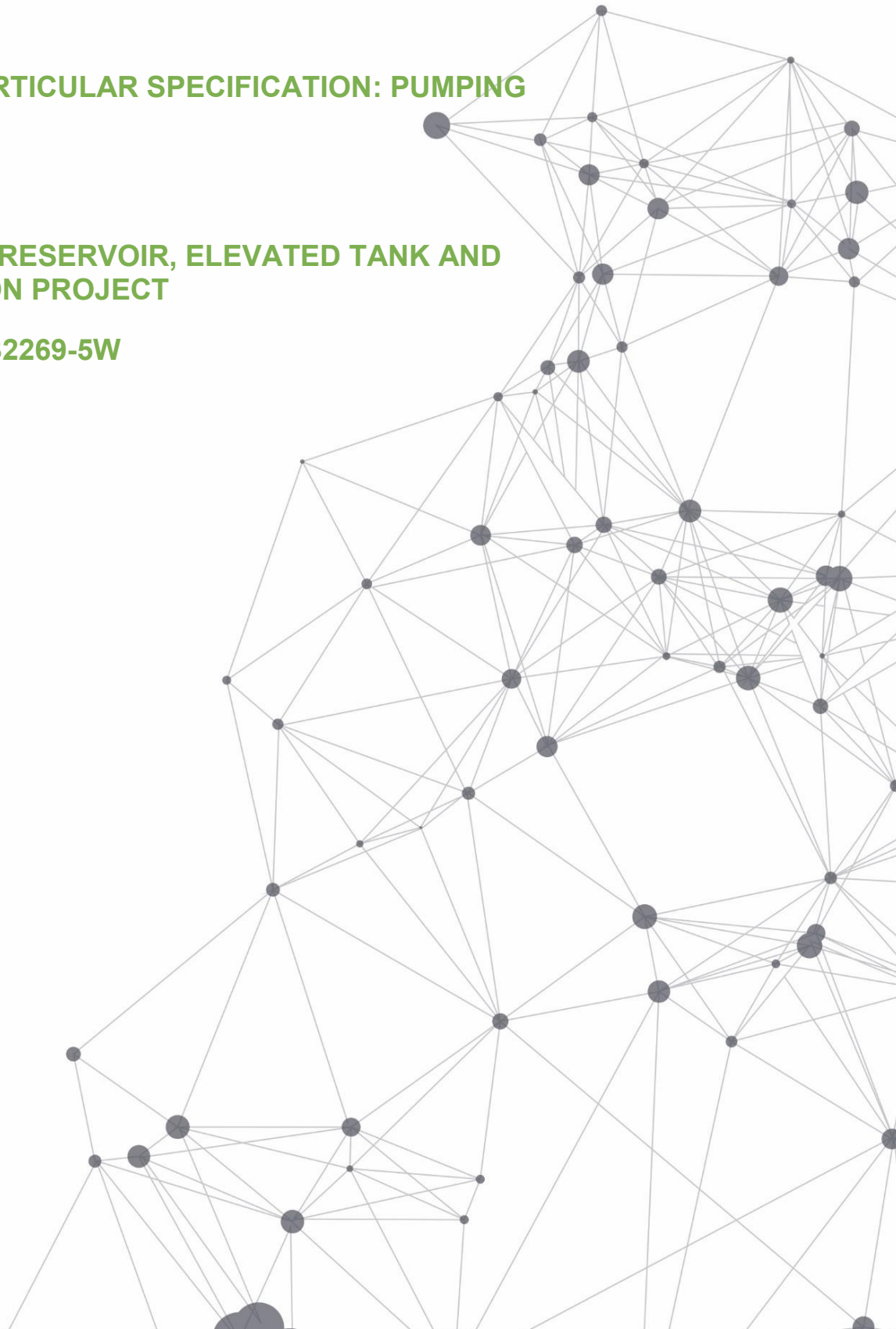


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PREAMBLE

This Project Specification forms an integral part of the contract. This specification shall be read in conjunction with the following specifications:

- 1) Project Particular Specification for Control Panel, Instrumentation and Electrical Installation
- 2) eThekweni Municipality PLC_Specification_Rev06
- 3) eThekweni Municipality Telemetry and Instrument Install Specification_Rev00
- 4) eThekweni Municipality Quality Control Specification_Rev02
- 5) EWS Standard Specifications, GS1 - Standard Specifications for DB's and Motor Control Centres
- 6) EWS Testing & Commissioning Sheets
- 7) EWS Standard Mechanical Specifications

PS WPE 1 SCOPE

This scope defined below is the applicable mechanical works information for all works associated with the assessments, repairs, supply, fabrication, construction, delivery, installation, testing and commissioning of the pumps, motors and associated equipment as specified hereunder.

PS WPE 1.1 PUMPS

- a) Supply and install new pumps. Each pump shall have a duty point of 374m³/hr @ 19.7m head.
- b) Install pumps, laser align with motor, fit coupling and coupling guards.
- c) Testing and commissioning as per specifications.

PS WPE 1.2 MOTORS

- a) Supply and install new 400V motors as specified.
- b) Testing and commissioning of new motors.

PS WPE 2 GENERAL**PS WPE 2.1 STANDARDS**

All plant and equipment shall be SABS approved (or other recognized international specification approved by the Engineer). In addition, the plant & equipment shall comply with the relevant portion of this project specification as well as the Electrical, Control & Instrumentation specifications included in this document as relevant. The terms particular and standard specifications are used interchangeably. In the event of conflict, this project specification shall take precedence over the standard or particular requirements.

PS WPE 2.2 PROPRIETARY MATERIALS

Where the term "or similar approved" is used in connection with proprietary materials or articles, it is to be understood that approval shall be at the discretion of the Employer.

Where brand or trade names are referred to in the Specification and Bills of Quantities, these shall indicate the quality and type of material or fitting required and substitution of materials so specified will only be permitted where the authority of the Employer has been obtained in writing before tender closes or with the submission of alternatives as part of the tender submission. No substitution will be allowed once the contract is awarded.

PS WPE 2.3 STANDARD TYPE AND MAKE OF EQUIPMENT

Once installation has commenced with the appropriate approvals for using any type and make of article or equipment, the same type and make of article or equipment shall be used throughout the project for that specific application unless otherwise specified.

PS WPE 2.4 STANDARD OF MATERIALS

All materials and equipment supplied and/or installed under this contract shall be new and the best of their respective kinds and shall comply with the requirements specified in the latest editions of the relevant SANS or BS standards and their amendments and with the requirements of this specification.

The Contractor shall be responsible for choosing materials for pump manufacture which are compatible with the pumped fluid and suitable for the intended duty under service conditions. The materials specified herein shall generally be acceptable for water, and prior approval will be required for the use of other materials.

PS WPE 3 DESIGN**PS WPE 3.1 OPERATIONAL HEALTH & SAFETY REQUIREMENTS**

In addition to the safety requirements specified in the EWS OHS specifications & BRA (Basic Risk Assessment), the Contractor is responsible for ensuring that all equipment supplied and the complete installation complies with the Occupational health and Safety Act, Act 85 of 1993, and the regulations promulgated thereunder.

Installations which do not comply with the OHS Act shall be corrected by the Contractor at no cost to the Employer.

Equipment which are potentially dangerous shall be designed in accordance with an approved relevant South African or international Standard.

Hazards must be avoided or guarded to the satisfaction of the Engineer. Nip points shall be guarded. Sharp corners shall be rounded off. Items such as operating handles, supports and protrusions shall be kept clear of access ways or marked accordingly.

The Contractor shall cover all unsafe gaps and openings left in structures after installation.

Each motor driven device shall be provided with an emergency stop station in an appropriate position.

PS WPE 3.2 DESIGN PRINCIPLES

Mechanical engineering design shall ensure safety, robust construction, reliability, durability, prevention of avoidable corrosion, neatness as well as ease of maintenance and operation.

The design shall, where applicable, be based on the following:

- a) The full range of duties which can be reasonably anticipated;
- b) The maximum pressure or vacuum which can be produced by pumps, blowers and compressors under all conditions including blocked or closed inlet and outlet circuits;
- c) Conservative service and safety factors based on approved standards;
- d) Twenty four hour per day operation (unless specified otherwise);
- e) A minimum life of 24 months for large items of equipment before repair or major part replacement;
- f) Prevention of serious damage from normal operational problems such as blockages, blinding, jamming, seizure, malfunction and, as far as is practical, maloperation (assuming that these occurrences cannot be avoided by good design).
- g) The power and torque transmitted by the driver system under full load and stalled conditions;
- h) Machines with non-overloading characteristics shall be selected wherever possible; eg: motors shall be sized so that they cannot be overloaded by the driven machine.

PS WPE 3.3 MOUNTING AND ARRANGEMENT

The arrangement and general design shall take the following requirements into consideration:

- a) Lifting eyes, lugs, hooks, etc., shall be provided on heavy or large items to facilitate handling.
- b) Castings or fabrications shall have machined pads for seating and be mounted

on either soleplates or baseplates as appropriate.

- c) Where accurate alignment is required, positioning pins and/or jacking screws shall be provided.
- d) The needs of operation and maintenance including neatness, access, working space, safety, cleaning, adjustment, handling, assembly, alignment, disassembly, removal, etc.
- e) With plant and equipment to be mounted on or against concrete or brick structures built by others, provision shall be made for adjustment in the mechanical design. Any special accuracy requirements must be specified on the Contractor's Documents.
- f) Guide rails for submersible pump applications.

PS WPE 4 WELDING

PS WPE 4.1 STANDARDS

Standards complying with good modern practice, and acceptable to the Engineer, shall be adopted. These include the following:

BS EN 1011	Arc welding carbon and carbon manganese steelwork.
BS 4677	Arc welding austenitic stainless steel pipework.
BS 2633	Class 1 Arc welding of steel pipework.
BS 2971	Class II Arc welding of steel pipework.

Welders shall be experienced artisans approved in accordance with BS 4872 or equivalent.

PS WPE 4.2 CONTINUOUS WELDING AND ELIMINATION OF CREVICES

Welding shall be continuous on all sides of any joint.

Crevice, including those arising from welding on one side only, shall be eliminated. This requirement applies to the welding of all metals and welding procedure shall be designed to prevent unacceptable deformation.

Welds which are only accessible from one side shall be prepared so that the root run provides an acceptable profile and prevents the formation of crevices. Pipework shall be designed so that such welds can be inspected and, where applicable, pickled and passivated.

In special cases only, non-continuous welding might be approved in writing by the Engineer. The resulting crevices shall be sealed with a two part solvent free epoxy which can be applied at thicknesses of up to 600 µm and above such as Sigmaline 523 or Corrocoat Zip E or Sigmacover 1000 or equivalent.

PS WPE 4.3 WELD APPEARANCE

Welding shall be free of blowholes, projections, pinholes, splatter and undercuts and all welding flux, weld spatter and other sharp imperfections shall be removed. Weld beads with a surface irregularity exceeding 3 mm or with sharp crests having a radius under 2 mm shall be ground.

PS WPE 4.4 SITE WELDING

Site welding shall be kept to a minimum and shall only be undertaken with the approval of the Engineer.

PS WPE 4.5 WELDING OF STAINLESS STEEL AND 3CR12 – ADDITIONAL REQUIREMENTS

Fabrication of austenitic stainless steels and 3CR12 shall comply with the

recommendations in "The Stainless Steel User Manual", "The 3CR12 Fabrication Guide" and the general welding requirements in "Pocket Guide – Stainless Steels" issued by Columbus Stainless. Compliance with publications from equivalent authorities will be acceptable.

Stainless steels to be welded shall be of the low carbon grade; e.g. 1.4306 rather than 1.4301 and 1.4404 rather than 1.4401.

The welding rods used shall be the most suitable for the metal and purpose. Only welders qualified and experienced with welding stainless materials shall be used. Welds which are accessible from only one side shall be executed in a manner to prevent heat tint or shall be post-weld treated in order to remove all traces of heat tint.

Type 316 stainless steel welding rods shall be used for welding 3CR12 unless otherwise approved in writing. 3CR12 shall be welded as recommended in "The 3CR12 Fabrication Guide" issued by Columbus Stainless.

All possible steps shall be taken to ensure maximum corrosion resistance and strength of the welds and welded material. Special care shall be taken to avoid prolonged heating. Welds shall be passivated. Discolouration and steel contamination must be removed by pickling or electro cleaning as approved by the Engineer but should rather be avoided by taking the appropriate measures.

PS WPE 4.6 INSPECTIONS

The Contractor shall arrange for all fabrications to be inspected by the Engineer prior to transport from the fabrication workshop

PS WPE 5 MECHANICAL PUMP EQUIPMENT

PS WPE 5.1 SCOPE

This is the mechanical and works information for the supply, fabrication, construction, servicing, delivery, installation, testing and commissioning of the pumps and associated equipment as specified hereunder.

In particular this specification includes for the following pumps:

Pump Description	No.
Trenance 3 Elevated Tank Pumps for High Level Supply Zone	2 off - Duty and Stand-By

PS WPE 5.2 PUMP DESIGN, MATERIALS AND MANUFACTURE

PS WPE 5.2.1 Pump Casings

The pump casings shall be manufactured in normal SG Iron or cast Iron to grade GGG or stronger non- corrodible approved material.

No welding, burning, filling or plugging of defective castings shall be permitted without the Engineer's permission in writing, following an inspection of the defects.

The inspection and testing of castings and test bars shall be in accordance with the Engineers instructions.

All pump casings shall be hydrostatically tested at the Manufacturer's workshop and in the presence of the Engineer or his Representative.

Particular care must be exercised in designing a pump casing which will resist the tendency to crack through the cutwater or guide passage walls during the pressure tests and the Contractor is to indicate clearly in his tender the design features incorporated in his pump to ensure that this requirement is satisfied.

PS WPE 5.2.2 Impellers

All impellers shall be cast in stainless steel with stainless steel shaft as indicated by the Engineer. Alternative materials may be considered subject to the approval by the Engineer.

The castings shall be free of blow-holes and other defects. No welding, burning, filling or plugging of defective castings shall be permitted without prior approval being obtained from the Engineer in writing, following an inspection of the defects.

Impeller shrouds and blades shall be of adequate thickness after they have been dressed, the minimum thickness being equal to : 7,00 (mm) for impeller diameters less than 350 mm and $0,00625 \times \text{diameter of impeller (mm)} + 5 \text{ mm}$ for impeller diameters equal to or greater than 350 mm.

All water passages are to be finished smooth to a template or NC machine finished.

All impellers shall be fitted with replaceable wearing rings of stainless steel or bronze. These rings, which shall be "L" cross-section, shall be secured to the impeller with non-corroding screws and mechanically locked.

Each impeller shall, after final machining and dressing, be independently statically balanced and the completely assembled rotating element with coupling half shall be dynamically balanced.

The critical speed of the rotating element shall be considerably higher (25%) than the running speed.

PS WPE 5.2.3 Pump Shaft, Sleeves and Diffusers

Pump shafts shall be of an approved material, to EN26 or equivalent and of sufficient dimensions to transmit the power to which they will be subjected without undue torsional or bending stresses and deflection.

The shafts shall be stress-relieved after initial machining, and ground to final size. The manufacturer shall take special care to avoid sharp radii. Shaft failures due to corrosion are common and the manufacturer shall indicate which steps he has taken to prevent the occurrence of pitting corrosion in pump shafts.

The shafts shall be suitably designed for the reception of the impeller which shall be adequately secured to the shaft in such a manner as to be readily removable without damage to either the shaft or the impeller.

The Contractor shall ensure that both the critical speed and torsional oscillation characteristics of the combined pump and motor rotating elements are satisfactory for all possible conditions of operation.

The shafts shall be adequately protected with replaceable sleeves of an approved stainless steel or other similar approved non-corrodible material at all areas where wear and/or corrosion could possibly be expected. These sleeves shall be readily removable without causing damage to either the shaft or the sleeves.

If separate diffusers are used, they shall be cast in an approved zinc-free stainless steel and finished smooth all over.

PS WPE 5.2.4 Bearings

The bearings shall be either grease or oil-bath lubricated, or water lubricated for submersible pumps. Where grease is used, a high-quality bearing grease of lithium-soap base, free of resins and acids with an anti-corrosive effect, shall be used. The grease shall have a penetration figure of between 2 and 3, and a drip point of not below 175°C.

A thrust bearing shall be provided to accommodate the end thrust of the impellers. The bearing numbers shall be given for all bearings in the pumps to facilitate replacement.

The lubrication points of the bearings shall be situated in a safe accessible position, so that lubrication can be done without taking the pump out of operation. Thrust bearings for vertical pumps may be located in the drivers.

Bearing housing closures of the labyrinth type slinger are required on horizontal pumps at each point where the shaft projects through a bearing housing, except that a mechanical oil seal is acceptable at the coupling end of the bearing housing. A non-labyrinth type slinger is acceptable on the stuffing box end of a bearing housing when it is combined with a mechanical oil seal. All bearings shall be suitable for shaft rotation in both directions. Bearing housings on vertical centrifugal pumps shall have equally adequate protection.

PS WPE 5.2.5 Stuffing Boxes

All pumps shall be equipped, unless otherwise specified, with soft-packed stuffing boxes of ample depth. Lantern rings shall be used in all pumps with a liquid or grease seal and these shall be provided with inlet and outlet connections.

Stuffing boxes shall have not less than four rings of packing plus the lantern ring and renewable-type non-ferrous throat bushings. Stuffing box glands shall be easily removable and must permit replacement of packing without removal or dis-assembly of any other part of the pump. Glands shall preferably be made with completely enclosed bolt holes. Slotted holes open at one side are acceptable only if studs are provided for securing glands. Gland leakage from the pumps shall be led through suitable tubing to a point immediately outside the pump house or to the nearest floor drain.

PS WPE 5.2.5.1 Mechanical Seals

Alternatively, to stuffing boxes or where ordered, mechanical seals complying with (a), (b) or (c) below, shall be used. The design shall be such that the static head on the pump discharge induces a closing action on the seal to ensure that no leakage occurs during pump shut-down.

a) Treated and Filtered Water

A single self-aligning balanced mechanical seal manufactured in 316 stainless steel and fitted with ceramic on carbon seals.

b) Raw Water

A single self-aligning balanced mechanical seal manufactured in 316 stainless steel and fitted with a least matched solid tungsten carbide (or other approved) rotating and stationary faces shall be supplied.

An external flush shall be provided to ensure heat dissipation through circulation. Where raw water is being pumped, a cyclone separator (or external clear water source) shall be fitted.

c) Abrasive Liquids

A double self-aligning mechanical seal manufactured in 316 stainless steel and fitted with at least either carbon or ceramic (for water lubrication) or carbon on Ni-iron (for oil lubrication) shall be supplied. Should the Contractor consider it necessary, more robust materials shall be fitted.

An independent fresh water (or oil) flush shall be provided where required. Care shall be taken to ensure that the pressure of the flushing fluid is at least 100 kPa greater than the pressure of the liquid on the inboard side of the seal.

PS WPE 5.2.6 Base Plates

PS WPE 5.2.6.1 General

Equipment and drivers shall not be mounted directly onto a concrete base without the use of either a baseplate or soleplate.

Driven equipment and their drivers shall be mounted on common hot dipped galvanised or fabricated steel baseplates of rigid construction. Common baseplates shall be provided for direct coupled and for belt driven machines.

In applications where baseplates are not practical, machined soleplates, suitably fixed and grouted into the concrete plinths, shall be provided.

The Contractor shall provide the baseplate, anchor fasteners and chemical anchor for securing the fasteners.

PS WPE 5.2.6.2 Design Requirements

Baseplates shall prevent pooling of water and shall be grout filled or shall be provided with drain holes in all side members.

The baseplate shall incorporate machined mounting pads at the support and fixing positions of each item of plant and equipment to be mounted on the baseplate. On fabricated baseplates this machining shall be done after fabrication, stress relieving (if applicable) and hot-dip galvanizing are complete. The thickness of the mounting pads shall be not less than 1,25 times the diameter of the holding down bolts. The pads shall not be provided with threaded holes for machine screws but shall be drilled for inserting through bolts and adequate provision shall be made for reaching the nut with a suitable spanner. In the period between machining and installation of the equipment, the machined surface shall be protected against corrosion by a removable coating. After installation, a non-hardening compound, Tectyl or equivalent, shall be applied to exposed machined surfaces and to the crevice formed at the foot of the equipment. The above design may be suitably modified if the Contractor uses a pourable resin based chocking system. Such chocks shall be at least 15 mm thick.

At least two diagonally opposed jacking screws shall be provided for belt tensioning in the case of belt driven units. Direct coupled motors above 10 kW shall be provided with jacking screws for horizontal alignment and direct coupled motors above 150 kW shall be provided with jacking screws for vertical alignment as well. Jacking screws shall be galvanised mild steel or better. Drilled and tapped flat plate is not acceptable for jacking points. A jacking point shall consist of a suitable hot rolled steel section welded to the baseplate and with a captured machine nut to accept the jacking screw.

PS WPE 5.2.6.3 Fabrication

Baseplates shall be manufactured of either:

- hot rolled steel sections.
- bent plate (with the overall length not more than 200 x plate thickness).

Practical requirements for providing accessibility for surface preparation and coating shall be taken into consideration. Inaccessible pockets shall be avoided. Hollow spaces which cannot be accessed by blast and spray equipment shall be avoided or shall be welded closed. All such hidden surfaces shall not be permitted.

Inspections of carbon steel fabrications will generally be done after fabrication is complete.

PS WPE 5.2.6.4 Materials

Baseplates shall be fabricated from Grade X42 steel.

PS WPE 5.2.6.5 Corrosion Protection

Steel baseplates shall be hot dip galvanized in an approved factory specialising in hot dip galvanising.

PS WPE 5.2.6.6 Fasteners

Anchor fasteners shall be galvanised mild steel or similar approved.

A minimum of six anchors shall be provided for pumps with an inlet of DN 150 and smaller or to suit the existing mounting arrangement. Eight or more anchors shall be provided for pumps with an inlet larger than DN 150 or to suit the existing mounting arrangement.

Pumps with an inlet of DN 100 or smaller shall have anchor bolts of at least 12 mm or to suit the existing mounting arrangement. Pumps with an inlet larger than DN 100 shall have anchor bolts with a diameter no less than $12 + (\varnothing-100)/25$ or to suit the existing mounting arrangement.

PS WPE 5.2.6.7 Installation

Not more than three shims may be used at any point and these must be made of a corrosion resistant material.

Concrete surfaces under baseplates shall be scabbled before the baseplate is placed and shall be blow clean using compressed air immediately before grouting.

Baseplates shall be designed and grouted to eliminate collection points for water or dirt. Except where otherwise approved in writing by the Engineer, all baseplates on concrete plinths shall be fully grouted in. Grouting holes must be provided on baseplates having a continuous top plate. Tapped holes and fixing setscrew protrusions shall be suitably protected. The material used for grouting shall be a non-shrink, cementitious grout (ABE DuragROUT 1000, or equivalent). ABE Epidermix 324, or equivalent, is acceptable if the Contractors' design requires an epoxy grout to be used. The initial grouting shall be overseen by the grout supplier's technical representative.

Preliminary alignment of equipment mounted on baseplates shall be done at the factory to ensure that the baseplate has been correctly manufactured, but final alignment shall always be done on Site after installation and grouting has been completed. Alignment shall be accurate and to the approval of the Engineer and a final alignment check witnessed by the Engineer must be carried out by the Contractor prior to start up.

PS WPE 5.2.6.8 Inspections

The Contractor shall arrange for the Engineer to inspect the fabrication of the baseplate before it is hot dip galvanised.

PS WPE 5.2.7 Auxiliary Pipe Systems

Recirculating piping systems for gland oil, gland leakage, lubrication oil and accessories such as gauges and valves, shall be provided by the Contractor, fully assembled to facilitate easy maintenance.

Material used for all auxiliary piping and valves shall be suitable for the designed duty of the pumps, and all items shall be properly cleaned before assembly. They shall be installed in a manner which prevents vibration of the pump.

PS WPE 5.2.8 Pressure Gauges

Glycerine-filled pressure gauges ("Wika or similar approved") with a dial at least 120 mm in diameter and with a full-scale reading of 1.5 times the maximum pressure shall be provided on each pump suction and discharge. Gauges shall be supplied with SANAS accredited calibration certificates.

Gauges connected on the delivery pipework on suitable half inch BSP welded socket and an in-line stopcock/bleeder-valve shall be provided before each pressure gauge to isolate it from the mains.

Pressure gauge installation shall comply in all respects to the standard specification.

PS WPE 5.2.9 Pump Vent and Drain Fittings

Stainless steel vent cocks shall be provided and fitted at all local high points on each

pump casing. These cocks shall be of adequate size to enable the entrapped air to be released freely. Copper/Stainless Steel drain pipes shall be neatly led from priming cocks, gland and casing drain points to a suitable discharge point/drain. Galvanised drainage pipework of adequate size shall be provided and installed to collect the water from each pumpset and to lead it to the pumphouse sump. Drain pipework shall be fitted with T sections at every bend to enable rodding in the event of a blockage occurring.

PS WPE 5.2.10 Drip Tray

Each pump shall be equipped with a condensate drip pan manufactured from 3CR12 sheeting. The pan shall be installed on the bedplate of the pump and shall be big enough to cover the drip area under the pump.

A drain connection shall be installed at the bottom of the drain pan and a drainpipe shall be run from each drain connection to a discharge point/channel/sump.

PS WPE 6 COUPLINGS

Shaft couplings shall be selected to reduce transmission of misalignment forces and of torsional oscillations between the driving and driven machine. Couplings shall, wherever practical, be of the rubber tyre or rubber compression type, keyed to the shafts.

Elastomeric elements shall be urethane based. Flexible metallic elements shall be of stainless steel. Couplings shall not require lubrication.

Spacer couplings shall be used in all cases where this will assist maintenance.

PS WPE 6.1 GENERAL

The pumps and motors shall be direct coupled with a suitable type of coupling which will take up minor misalignment or off-setting of the motor and pump shaft satisfactorily. Couplings shall be statically and dynamically balanced.

The coupling shall be designed in such a manner that no axial or radial loads will be imposed on the motor and pump bearings in excess of the loads approved by the motor and pump manufacturers respectively for the installation offered. Spacer couplings shall be provided with pumps of the back pull out type or where frequent maintenance is likely to be required.

The couplings shall be robust, shall be readily dismantled and reassembled, and shall have a service factor of at least 1,5.

Elastomeric elements shall be urethane based. Flexible metallic elements shall be of stainless steel. Couplings shall not require lubrication.

Coupling guards shall comply with the requirements of the OHS Act and shall be to the approval of the Engineer.

Pulley belts are to comply in accordance with the OHS Act 85 of 1993 and are to be approved by the Engineer. Pulley belts are to be a like for like replacement or/and to comply with industry standards. Tensioning and lining of belt to be completed as per the Engineers instruction.

After installation, the alignment of all couplings shall be checked by the Contractor in the presence of the Engineer or a person delegated by him. Laser Alignment shall be accurate and to the approval of the Engineer.

PS WPE 6.2 MACHINE GUARDS

Guards shall comply in all respects with the Occupational Health and Safety Act of 1993 as amended and the following points shall also be noted:

Guards are required to cover all moving or revolving components of machinery. Guards

which do not adequately cover moving protrusions such as keys, lock nuts, lockwashers, setscrews, etc., or irregularities such as keyways, will under no circumstances be accepted.

Guards shall be neatly and rigidly constructed and fixed and shall not vibrate or cause noise during operation.

Guards shall completely enclose drives and shall entirely prevent a person from touching any moving protrusion. Allowance must be made for adjustment on belt guards or where adjustment will be required. It shall be possible to remove the guard easily for maintenance purposes.

Guards shall preferably be fabricated of 1.6mm steel sheeting hot dip galvanized or 3CR12 epoxy powder coated (colour to be determined prior to painting). Guards are to be primed and painted. Fasteners shall be M10 or larger and shall be hot dipped galvanized.

PS WPE 7

PS WPE 7.1

SELF PRIMING PUMPS (BACKWASH RECYCLE PUMPS)

PERFORMANCE CRITERIA

The pump manufacturer must be ISO 9001:2015 certified, with scope of registration including design control and service after sales activities.

The pump manufacturer must be registered to the ISO 14001 Environmental Management System standard and as such is committed to minimizing the impact of its activities on the environment and promoting environmental sustainability using best management practices, technological advances, promoting environmental awareness and continual improvement.

PS WPE 7.2

PUMP SET FOR TRENANCE 3:

Make:	KSB or similar and equal approved
Type:	Omega 150-290B (GC Std) or similar
	T3C60SC-B/FM or similar and equal and equal approved, horizontal single stage axially split volute casing pump approved
No of Stages	1
Speed	1470 (TBC by supplier)
Impellor Diameter	TBC by supplier
Efficiency	TBC by supplier
Impeller and shaft:	Stainless Steel
Free passage:	Potable Water
Casing:	Cast Iron
Seal:	Gland Packing
NPSH required	TBC by supplier
Suction and discharge port diameters	TBC by supplier
Sensors	Pump Case Temp Sensors DE & NDE Bearing Temp Sensors DE & NDE Bearing Vibration Sensors

PS WPE 7.3

OPERATING DATA:

Fluid handled:	Water
Flow rate:	374.0 m ³ /h
Head:	19.7 m
Max. fluid temperature:	20 °C

PS WPE 7.4

DRIVE:

Drive Rating:	37kW
Nominal voltage:	400V
Nominal frequency:	50Hz
Motor Speed:	1470 RPM
Starting method:	VSD
Rating:	IP65

Explosion protection:	Without
Max. fluid temperature:	20 °C
Thermal motor protection:	Pt100 (1Per Phase)
Efficiency class:	Equivalent min. IE3 to IEC Standard
Insulation Class:	Class F
Nominal motor power P2:	TBC by pump supplier
Nominal motor power P1:	TBC by pump supplier
Motor efficiency:	TBC by pump supplier
Nominal current:	TBC by pump supplier
Speed:	TBC by pump supplier
Seal Cable gland Submersible motor:	n/a
Cable supplied with motor:	n/a
Motor heaters:	Yes 220Volts
Other sensors provided with motor:	DE & NDE Bearing Temp Sensors DE & NDE Bearing Vibration Sensors

PS WPE 7.4.1 Pump Performance Certifications

The pump to be supplied shall be a KSBS Omega 150-290B or similar and equal approved designed for pumping potable water and should operate free from any solids or blockage material.

All internal passages, impeller vanes, and recirculation ports etc shall pass the full flow without any hinderance. Smaller internal passages that create a maintenance nuisance or interfere with priming and pump performance shall not be permitted. Upon request from the engineer, manufacturer's certified drawings showing size and location of the recirculation port(s) shall be submitted for approval.

PS WPE 7.4.2 Reprime Performance (Applicable for re-prime pumps only)

Consideration shall be given in which debris is expected to lodge between the suction check valve and its seat, resulting in the loss of the pump suction leg, and siphoning of liquid from the pump casing to the approximate center line of the impeller. Such occurrence shall be considered normal, and the pump must be capable of automatic, unattended operation with an air release line installed.

During unattended operation, the pump shall retain adequate liquid in the casing to ensure automatic repriming while operating at its rated speed in a completely open system. The need for a suction check valve or external priming device shall not be required.

- a. No restrictions in the pump or suction piping will prevent the siphon drop of the suction leg
- b. Impeller clearances shall be set as recommended in the pump service manual.
- c. Repeatability of performance shall be demonstrated by testing five consecutive reprime cycles. Full pump capacity (flow) shall be achieved within five minutes during each cycle.
- d. Liquid to be used for reprime test shall be water.
- e. Upon request from the engineer, certified reprime performance test results, prepared by the manufacturer, and certified by a registered professional engineer, shall be submitted for approval prior to shipment.

PS WPE 7.4.3 Certified Pump Performance Test

Tests shall be conducted in accordance with ISO 9906 2012 at the specified head, capacity, rated speed, and horsepower. The performance tests will validate the correct performance of the equipment at the design head, capacity, and speed.

For pumps utilizing up to (13 HP) motors; but larger than (1.3 HP), tests shall be conducted in accordance with Hydraulic Institute Standards 14.6.3.4.1, as the specified head, capacity, rated speed, and horsepower.

PS WPE 7.4.4 OEM Warranty

1. The pump manufacturer shall warrant the pump equipment to be of quality construction, free of defects in material and workmanship. A written warranty shall include specific details described below.
2. All equipment, apparatus, and parts furnished shall be warranted for twelve (12) months starting from the date of the commissioning, excepting only those items that are normally consumed in service, such as oils, grease, packing, gaskets, O rings, etc. The pump manufacturer shall be solely responsible for warranty of the pump equipment and all components.
3. Components failing to perform as specified by the engineer, or as represented by the manufacturer, or as proven defective in service during the warranty period, shall be replaced, repaired, or satisfactorily modified by the manufacturer.

PS WPE 7.5 PUMP**PS WPE 7.5.1 General**

1. The specifications and project drawings depict equipment and materials manufactured by KSB or similar and equal approved which are deemed most suitable for the service anticipated. It is not intended, however, to eliminate other products of equal quality and performance. The contractor shall prepare his bid based on the specified equipment for purposes of determining low bid. Award of a contract shall constitute an obligation to furnish the specified equipment and materials.
2. After execution of the contract, the contractor may offer substitutions to the specified equipment for consideration. The equipment proposed for substitution must be superior in construction and performance to that specified in the contract, and the higher quality must be demonstrated by a list of current users of the proposed equipment in similar installations.
3. In event the contractor obtains engineer's approval for equipment substitution, the contractor shall, at his own expense, make all resulting changes to the enclosures, buildings, piping or electrical systems as required to accommodate the proposed equipment. Revised detail drawings illustrating the substituted equipment shall be submitted to the engineer prior to acceptance.
4. It will be assumed that if the cost to the contractor is less for the proposed substitution, then the contract price shall be reduced by an amount equal to the savings.

PS WPE 7.5.2 Pump Design

Pumps shall be horizontal single stage axially split volute casing type, designed specifically for handling potable water. Pump capability and performance criteria shall be in accordance with requirements listed under **PS WPE 7.**

The pump manufacturer must be ISO 9001:2008 revision certified, with scope of registration including design control and service after sales activities.

PS WPE 7.5.2.1 Materials and Associated Construction Features**PS WPE 7.5.2.1.1 Pump Casings**

Pump casing shall be cast iron Class 30 with integral volute. Casing shall incorporate following features:

- a. Mounting feet sized to prevent tipping or binding when pump is completely disassembled for maintenance.
- b. Fill port cover plate, 3 1/2" diameter, shall be opened after loosening a hand nut/clamp bar assembly. In consideration for safety, hand nut threads must provide

slow release of pressure, and the clamp bar shall be retained by detente lugs. A Teflon gasket shall prevent adhesion of the fill port cover to the casing.

- c. Casing drain plug shall be at least 1 1/4" NPT to insure complete and rapid draining.

PS WPE 7.5.2.1.2 Coverplate assembly

Coverplate assembly shall be cast iron Class 30. Design must incorporate following maintenance features:

- a. A lightweight inspection coverplate, retained by acorn nuts, for access to pump interior for removal of stoppages. Designs that require removal of complete coverplate assembly for access to the impeller will not be accepted.
- b. Retained by acorn nuts for complete access to pump interior. Back coverplate removal must allow service to the impeller, seal, wear plate or check valve without removing suction or discharge piping. Back coverplate shall incorporate an obstruction free flow path by combining four support posts into a two-point "webbed" plate design for increased durability, reduced clogging, and increased operational efficiency.
- c. Aggressive Self-Cleaning Wear Plate
 - i. A replaceable wear plate secured to the back cover plate by studs and nuts. Wear plate shall be self-cleaning design ensuring that debris is cleared away and does not collect on the impeller vanes.
 - ii. The nature of the conveyed medium poses significant challenges to the continuous operation of the pump. Of particular concern is the clogging of the impeller by debris in the pumped medium including but not limited to long rags, fibers, and like debris which are able to wrap around the impeller vanes, stick to the center of the vanes or hub, or lodge within the spaces between the impeller and the housing.
 - iii. The aggressive self-cleaning wear plate shall have integral laser cut notches and grooves in combination with a "tooth" designed to disturb and dislodge any solids which might otherwise remain on the impeller in dynamic operation. Wear plate is designed to clear the eye of the impeller constantly and effectively without the use of blades or cutters.
- d. In consideration for safety, a pressure relief valve shall be supplied in the inspection coverplate. Relief valve shall open at 75-200 PSI.
- e. One O-ring of Buna-N material shall seal inspection coverplate to back coverplate.
- f. Two O-rings of Buna-N material shall seal back coverplate to pump casing.
- g. Pusher bolt capability to assist in removal of inspection coverplate or back coverplate. Pusher bolt threaded holes shall be sized to accept same retaining cap screws as used in rotating assembly.
- h. Easy-grip handle shall be mounted to face of inspection coverplate.

PS WPE 7.5.2.1.3 Rotating Assembly

Rotating assembly, which includes impeller, shaft, mechanical shaft seal, lip seals, bearings, seal plate and bearing housing, must be removable as a single unit. Design shall incorporate following features:

- a. Seal plate and bearing housing shall be cast iron Class 30. Separate oil filled cavities, vented to atmosphere, shall be provided for shaft seal and bearings. Cavities must be cooled by the liquid pumped. Three lip seals will prevent leakage of oil.

- i. The bearing cavity shall have an oil level sight gauge and fill plug check valve. The clear sight gauge shall provide easy monitoring of the bearing cavity oil level and condition of oil without removal of the fill plug check valve. The check valve shall vent the cavity but prevent introduction of moist air to the bearings.
 - ii. The seal cavity shall have an oil level sight gauge and fill/vent plug. The clear sight gauge shall provide easy monitoring of the seal cavity oil level and condition of oil without removal of the fill/vent plug.
 - iii. Double lip seal shall provide an atmospheric path providing positive protection of bearings, with capability for external drainage monitoring.
- b. Impeller shall be stainless steel single stage, non-clog, with integral pump out vanes on the back shroud. Stainless steel impellers are required for this application.
 - c. Shaft shall be AISI 4150 alloy steel unless otherwise specified by the engineer, in which case AISI 17-4 pH stainless steel or bronze shall be supplied. Stainless steel shafts will be a requirement for this application or project.
 - d. Bearings shall be anti-friction ball type of proper size and design to withstand all radial and thrust loads expected during normal operation. Bearings shall be oil lubricated from a dedicated reservoir. Pump designs which use the same oil to lubricate the bearings and shaft seal shall not be acceptable.
 - e. Shaft seal shall be cartridge oil lubricated mechanical type. The stationary and rotating seal faces shall be tungsten titanium carbide alloy. Each mating surface shall be lapped to within three light bands flatness (35 millionths of an inch), as measured by an optical flat under monochromatic light. The stationary seal seat shall be double floating by virtue of a dual O-ring design; an external O-ring secures the stationary seat to the seal plate, and an internal O-ring holds the faces in alignment during periods of mechanical or hydraulic shock (loads which cause shaft deflection, vibration, and axial/radial movement). Elastomers shall be Viton; cage and spring to be stainless steel. Seal shall be oil lubricated from a dedicated reservoir. The same oil shall not lubricate both shaft seal and shaft bearings.
 - f. Pusher bolt capability to assist in removal of rotating assembly. Pusher bolt threaded holes shall be sized to accept same caps crews as used for retaining rotating assembly.

PS WPE 7.5.2.1.4 Other

Spool flanges shall be one-piece cast iron, class 30 fitted to suction and/or discharge ports. Each spool shall have one 1-1/4" NPT and one 1/4" NPT tapped hole with pipe plugs for mounting gauges or other equipment.

PS WPE 7.5.2.2 Serviceability

- i. The pump manufacturer shall demonstrate to the engineer's satisfaction that consideration has been given to reducing maintenance costs.
- ii. No special tools shall be required for replacement of any components within the pump.

PS WPE 7.6 INSTALLATION

The following is to be undertaken by the Contractor, but not limited to:

1. Install, level, align, and lubricate pump(s) as indicated on project drawings. Installation must be in accordance with written instructions supplied by the manufacturer at time of delivery.
2. Suction pipe connections are vacuum tight. Fasteners at all pipe connections must be tight. Install pipe with supports and thrust blocks to prevent strain and vibration on pump piping. Install and secure all service lines (level control, air

release valve or pump drain lines) as required in wet well.

3. Check motor and control data plates for compatibility to site voltage. Install and test the station ground prior to connecting line voltage to control panel.
4. Prior to applying electrical power to any motors or control equipment, check all wiring for tight connection. Verify that protective devices conform to project specifications. Verify line voltage, phase sequence and ground before actual start-up.
5. After all anchor bolts, piping and control connections are installed, completely fill the grout dam in the pump station base with non-shrink grout.

PS WPE 7.7 FIELD QUALITY CONTROL

Prior to acceptance of the installation by Engineer, an operational test of all pumps, drives, and control systems shall be conducted to determine if the installed equipment meets the purpose and intent of the specifications. Tests shall demonstrate that all equipment is electrically, mechanically, structurally, and otherwise acceptable; it is safe and in optimum working condition; and conforms to the specified operating characteristics.

After construction debris and foreign material has been removed from the suction manifold and the reservoir, contractor shall supply clear water volume adequate to operate station through several pumping cycles. Observe and record operation of pumps, suction and discharge gage readings, ampere draw, pump controls, and liquid level controls. Check calibration of all instrumentation equipment, test manual control devices, and automatic control systems.

PS WPE 8 ELECTRIC MOTORS EQUIPMENT

This specification shall be read in conjunction with the Electrical, Control & Instrumentation Particular Specification.

PS WPE 8.1 SPECIFICATION FOR ELECTRIC MOTORS

The supply, installation and erection of all items of electrical equipment shall be carried out by qualified electrical contractors and shall conform to the Specification below and to be in accordance with the Code of Practice for the wiring of premises, SANS 10142: Latest Amendment.

Motors:

- a) Uninstall applicable existing pumps with motors and deliver to Employers Stores in Springfield.
- b) Supply new motors for driving of the new pumps as per specifications.
- c) Install new motors, align with pump, fit coupling and coupling guard. (where applicable)
- d) Testing and commissioning as per specifications.

PS WPE 8.2 GENERAL

Motors shall be AC squirrel cage induction type electric motors of the ratings specified or to match the pumping or other load. The motors shall be framed totally enclosed forced fan cooled with cooling fins. The motors shall be low voltage (LV) operation suitable for operation on a 400V 3 phase supply at a frequency of 50Hz. The motors shall be cast iron continuously rated drip proof IP54 rated, duty class S1. Motors shall comply with IEC/EN standards. The connection / cable termination boxes shall have an IP55 rating. Motors are to be WEG or similar approved or other approved motor supplied as an integral unit with the pump.

Preference will be for motors with a speed of 1500 r/min and below as agreed to by the

Engineer and Employer.

The motors shall be capable of operating continuously under actual service conditions at their rated output without exceeding the specified temperature rises, determined by resistance, at any frequency between 45 and 52 Hertz, together with any voltage between $\pm 5\%$ of the nominal value.

Unless otherwise specified, the slip in speed of the motors at 80 percent (80%) of the nominal voltage at 50 Hertz shall not exceed the percentage stated by the manufacturer and the motors shall be capable of operating at this voltage for a period of five minutes without injurious heating.

Rotors shall be statically and dynamically balanced.

All motors shall operate with the least practicable amount of noise to the relevant IES/EN standards. Motors larger than 100 kW shall be subjected to sound level tests in accordance with IEC/EN 60034-9.

All dimensions and design parameters shall be in accordance with the International Metric System (SI).

The motor design and construction shall be such that no damage to the motor will result from a supply voltage recovery, following on a brief supply voltage interruption. The designer or manufacturer should bear in mind that the supply voltage may be 180 degrees out-of-phase with the rotor induced voltage when the supply voltage is restored. Special attention shall be given to effects of electrical and mechanical stresses imposed on the motor over this period.

The guarantee efficiency of each motor shall be determined in accordance with IEC/EN 60034-30.

All motors shall be premium efficiency (minimum IE3) to IEC60034-30-1.

PS WPE 8.3 REFERENCE SPECIFICATION, STANDARDS AND CODES

All electric motors shall comply fully with the relevant IEC/EN standard specifications.

PS WPE 8.4 ENCLOSURE

Motors shall be provided with suitable means of drainage to prevent accumulation of water due to condensation.

Motors shall be supplied with anti-condensation heaters suitable for 230 V AC supply. Heater terminal boxes shall be fitted in an approved position and shall have an approved cable gland. Cable termination or connection boxes shall be IP55 rated.

The motors shall be provided with two machined bosses each tapped for a bolt, of suitable size, for earthing purposes. The machined bosses shall be located on opposite sides of the motor frame. The motors and parts thereof including auxiliary equipment supplied under the Contract shall be provided with suitable arrangements for lifting.

Painting of the motor casings shall comply with industry standards and to RAL5009be electric orange (B26). The paint colour shall match pumping applications and must be confirmed with the Employer prior to painting.

PS WPE 8.5 MOTOR STARTING GENERAL REQUIREMENTS

The motors are to be suitable for VSD starting at full voltage and at 50 Hz frequency.

Additionally, the motors shall be capable of accelerating the load specified from zero to full speed when supplied with 0,9 p.u. of normal voltage at 50 Hz.

All motors shall be suitable for starting under specified load conditions with 75% of the rated voltage at the motor terminals

Motors shall be capable of the following minimum starting conditions:

STARTS	MINIMUM NUMBER OF CONSECUTIVE STARTS
Number of consecutive start-ups with initial temperature of the motor at ambient level (cold)	3
Number of consecutive start-ups with initial temperature of the motor at full load operating level (hot)	2

PS WPE 8.6 MOTOR WINDING DETAILS AND INSULATION

The winding insulation shall be minimum Class F, with temperature rise limited to that specified for Class B insulation to IEC/EN 60034-1.

Details of the stator insulation shall be to the relevant standard approvals. The outside of all end windings shall be coated with oil resisting non-hygroscopic varnish or compounds, and the coils shall be supported to prevent injurious movement. The stator winding tails shall be of sufficient cross-sectional area and adequately braced to withstand the nominal three-phase symmetrical short circuit specified and the current density under these conditions shall not exceed 400 A/mm². The power frequency voltage withstand level of the interturn insulation of the stator windings as well as the impulse withstand level as a whole shall be stated by the Tenderer.

Provision shall be made, for the inclusion of the imbedded temperature detectors (thermocouple or platinum resistance or thermistor type) in the windings for motors.

All motors above 11kW rating shall have embedded in their stator windings, one PT100 thermistors per phase, suitable for Class B temperature rise. All motors rated 110kW and larger, shall have embedded in their stator windings, one PT100 thermistors per phase.

The motors shall be supplied complete with DE and NDE bearing temperature sensors and DE and NDE bearing vibration sensors.

The bearing detectors shall touch the outer bearing race, shall be spring-loaded and shall be of the screw type. The characteristics of these temperature detectors shall match the thermal limitations of the motor electrical installation.

Motors above 11kW shall be supplied and wired with 230 Volt anti-condensate heaters.

The leads from the temperature detectors and heaters shall be brought out to a separate approved terminal box fitted in an approved accessible position onto the motor. This terminal box shall be provided with labels indicating clearly to which detector each terminal is connected. Flexible connections shall be used to avoid damage to the leads by vibration.

During type testing the relationship between the temperature indicated by the detectors and the winding temperature as determined by resistance measurement shall be established for the purpose of alarm and trip settings. This information shall be recorded on the motor test certificate.

The stator windings shall be fully insulated such that the supply leads may be connected to either the "start" or "finish" ends of the winding.

PS WPE 8.7 STATOR FRAME AND CORE

The stator core stampings shall be built up in such a way that the spacing, keying and clamping of the stampings shall result in a uniformly tight core.

The design shall be such that the temperature of all parts of the winding and core is kept as uniform as possible throughout. The frame size shall be to IEC/EN 60072-1, 60034 and EN 50347 standards with the motor being minimum IP65 rated.

When pedestal type bearings are provided the motor shall be complete with base frame.

PS WPE 8.8 ROTOR AND SHAFT DETAIL

The rotor bars or windings shall be locked to avoid longitudinal movement in the slots under starting conditions and shall be designed to minimise the possibility of conductors breaking.

The minimum locked rotor thermal withstand time at rated voltage shall be minimum 10 seconds under cold conditions and minimum 8 seconds under hot conditions.

The rotors shall be properly balanced in accordance with the vibration limits specified in IEC/EN 60034-14. All rotor shaft extensions shall be provided with keys and shall receive an anti-corrosive protection coating despatch from the manufacturer's works.

The shaft shall be manufactured from chrome steel with 316 stainless steel shaft sleeve.

PS WPE 8.9 TERMINAL ARRANGEMENTS ON MOTORS

As required, three or six phase ends of the motor windings shall be brought out to terminal boxes.

All terminal boxes shall be to approval and of the totally enclosed type designed to prevent the ingress of dust and moisture and sealed for the internal air circuit of the motor. All joints shall be flanged and sealed with gaskets of neoprene or other approved material. Motors having fabricated frames shall have terminal boxes, including removable covers fabricated from mild steel plate with fully insulated terminals or connectors. Where specified the terminal boxes shall be of the phase segregated type.

The terminal boxes of motors over 300 kW shall be fitted with an approved phase segregated cable sealing and dividing box and cable gland or adapter plate together with the necessary fittings, including crimping lugs, to suit the cable. Only one cable box shall be provided per motor and this shall be interchangeable between terminal boxes. Terminal box positions are to match the existing arrangement.

The cable box shall be suitable for the termination of three-core high voltage cross-linked polyethylene insulated cables with copper conductors of the specified cross-sectional area. Where star delta starting is used, facilities shall be made in the cable box for termination of two power cables to suit the sizes of cables to be used. Motor terminal box to match existing position to align with cable duct routing. Contractor to verify on site before ordering the motors.

Terminals shall be of substantial design and connections having pinch screws bearing directly on cable cores will not be accepted. The terminal arrangement shall be suitable for the reception of copper cables and permit the motor to be disconnected from its supply cable without disturbing any sealing compound or damaging of cable tails and shall allow separate testing of the supply cable and motor windings. The insulation of the terminals or connectors terminal leads and intermediate disconnecting leads shall be of approved moisture resistant homogeneous material and, in particular, where leads enter any sealing compound, this insulation shall be waterproof. Natural rubber insulation shall not be used.

The electrical clearance and creepage distances with the correct terminations in position shall comply with the requirements of the relevant IEC/EN standards.

Terminal marking shall be made in a clear and permanent manner and shall comply with the relevant IEC/EN standards, where for three-phase motors, irrespective of the rotation required on site, the connections shall be such that then the supply leads L1 - L2 - L3, are connected to motor terminals U1 - V1 - W1 respectively the motor shall rotate in a clockwise direction when looking at the driving end. A permanently attached diagram or instruction sheet shall be provided giving the connections for the required case of motors suitable for both directions of rotation. Motors suitable for one direction of rotation only shall be clearly marked to indicate this.

High voltage line terminal boxes shall be suitable for connection to an electrical system with a nominal three-phase symmetrical short circuit capacity as stated in the Project Specification for a minimum fault clearance type of 0,25s. Unless satisfactory documentary evidence is provided, a prototype of each line terminal box design complete with cable sealing chamber shall be tested under internal short circuit conditions to demonstrate that the terminal box does not suffer damage (other than rupturing of the pressure release diaphragm or jeopardise the safety of personnel). In addition, through fault current tests shall be made to demonstrate that the box is suitable for the short circuit MVA specified.

Cable terminations or connection boxes shall be IP55 rated.

PS WPE 8.10 BEARINGS

Motors shall generally be fitted with heavy duty ball or roller bearings. Re-greaseable bearings are accepted.

The grease lubrication of ball or roller bearings shall be to approval. Grease lubricated bearings shall have relief holes to ensure that the bearings have been correctly packed and these holes shall be positioned so that excess grease can easily be removed.

The manufacturer or supplier of the motors shall recommend if bearing vibration or temperature sensors or RTDs are required for the bearings if failure of the bearings will be at risk. Suitable sensors shall be fitted should they be required. Similarly, requirements for bearing cooling be provided should the bearings require forced cooling or other cooling mediums.

PS WPE 8.11 PUMP MOTOR RATINGS

All fixed speed pump motors shall be continuously rated at a power output equal to at least 110% (with Zero Tolerance) of that required by the pump or other mechanical load when operating at the highest power consumption conditions.

Motors which will be driven from variable frequency inverters shall be rated at a power output of 110% - 115% of that required by the pump when operating at the highest power consumption conditions.

The motor and the load shall be correctly matched. The speed of the motor shall suit the pump load or other load as determined by the pump supplier or other load supplier.

The motor shall be rated for the following operating conditions:

DESIGN OPERATING CONDITIONS	REQUIRED
Altitude	94 - 100 msl
Ambient Temperature (min)	-5°C
Ambient Temperature (max)	40°C
Humidity	40-90%

PS WPE 8.12 SURGE PROTECTION AND EARTHING

Earthing of motors shall comply to SANS10142 and SANS60034-1 latest amendments. Motors bearings shall be fitted with earthing rings on the DE and NDE for earthing due to eddy currents cause by VSDs.

Where required, surge suppression devices of the zorc type, shall be fitted into a compartment forming part of the cable terminal box and shall be connected to the motor terminals.

PS WPE 8.13 SERVICE FACTOR

Motors shall be supplied with a minimum service factor of 1.00.

PS WPE 8.14 GUARANTEES AND GENERAL PARTICULARS**PS WPE 8.14.1 Guarantees**

The Contractor shall guarantee certain specified aspects of the performance of the plant, and compliance with these tendered guarantees will be judged on the results of the witnessed factory tests specified for the motors.

Should the witnessed tests for any motor be unsatisfactory, the Purchaser shall have the right to refuse acceptance of such motor. For a period which will still enable the motor in question to be delivered to site in accordance with the requirements of the Contract allowing for normal transportation times, the Contractor shall then be allowed to effect refinements or adjustments in order to overcome the deficiencies of the motor.

If the motor still does not give satisfactory witnessed test results, the Contractor shall be required to replace such motor with a new one which will be subject to the same conditions regarding tests and guarantees as specified herein. Whilst awaiting a replacement motor the Client shall have the right to demand the delivery to site (and erection if required in terms of the Specification) and the use of such unsatisfactory motor.

PS WPE 8.14.2 Samples, Operating and Maintenance Instructions & Installation**PS WPE 8.14.2.1 Operating Instructions**

Not less than two weeks before the specified Completion Date of the first motor, the Contractor shall supply Operating and Maintenance Instructions covering all aspects of the motors for discussion with the Engineer and shall submit a further five copies in a form approved by the Engineer.

PS WPE 8.15 TESTS

The manufacturer shall have the type of tests and certification reports for all relevant motors required for Low Voltage Motors and this Specification readily available for the Engineer for inspection.

Not less than fourteen day's notice of all tests shall be given to the Engineer in order that he may be present if he so desires. As many tests as possible shall be arranged together in accordance with a programme to be agreed with the Engineer. Five copies of the Contractor's records of all tests shall be furnished to the Engineer.

All material which is specified for tests at the Manufacturer's Works shall satisfactorily pass such tests before being painted.

All instruments shall be approved and if required shall be calibrated at the expense of the Contractor by the South African Bureau of Standards or such other body as may be approved.

The following tests shall be carried out in order to determine whether the materials and apparatus comply for Low Voltage Motors and this Specification.

PS WPE 8.15.1 Type Tests

No.	DESCRIPTION	ACCORDING TO STANDARD
1	Temperature rise test	IEC 60034-1
2	Load test	IEC 60034-2-1
3	Breakdown torque test	IEC 60034-1
4	Speed – Torque curve	-
5	Measurement of efficiency and power factor at 100%, 75%, 50% and 30% load	-

PS WPE 8.15.2 Batch Tests

All batch tests carried out by manufacturer shall be under his care and his expense. Upon request from the Engineer, the supplier shall supply the batch test reports. Batch tests shall be carried out by the manufacturer as part of their quality control procedure as per table below.

No.	DESCRIPTION	ACCORDING TO STANDARD
1	Winding resistance – cold	IEC 60034-1
2	Tests with locked rotor	IEC 60034-1
3	No-load tests	IEC 60034-2
4	Withstand Voltage test / Dielectric test	IEC 60034-3
5	Insulation resistance test (before and after dielectric test)	-
6	General visual checks, nameplate details, mounting, terminal box location and gland sizes	-
7	Measurement of shaft centre height dimensions	-
8	Measurement of clearances in terminal box	-
9	Verification of direction of rotation	-
10	Verification of type of terminals	-

PS WPE 8.15.3 Basic Tests

The motor shall be subjected to Basic Tests, Type Tests and Batch Tests in accordance with IEC 60034-1-2. and other relevant tests. Noise level tests to prove compliance shall be in accordance with IEC/EN 60034-9.

In addition to the above, the guarantee of slip at 80 percent normal voltage shall be proved.

These tests may also be carried out on randomly selected additional motors where such selection and additional number of motors shall be determined by the Engineer. The tenderer shall therefore quote a unit price per such additional test.

Apart from the basic tests, test measurements and/or calculation to obtain values for the following parameters, shall be carried out.

Inertia of rotor (Im) in kg m², i.e. mass in kg x (radius of gyration in m²) Winding ratio (q).

- Stator resistance per phase at 75°C (r1) in ohm.
- Stator reactance per phase (x1) in ohm.
- Rotor resistance per phase at 75°C (r2) in ohms.
- Full load speed (nn) in radians per second.
- Break-away torque in Newton meter.
- Pull-out torque in Newton meter.

PS WPE 8.15.4 Duplicate Tests

Each motor shall be subjected to duplicate Tests in accordance with the relevant IEC/EN standards with the following additional tests:

- 1) Measurement of winding resistance (cold).
- 2) On over-voltage test at 1,5 times rated voltage applied with the machine running at no load for a period of 3 minutes to test inter-turn insulation.
- 3) Insulation tests and measurements as described in the relevant IEC/EN or other standards) shall be carried out on each motor. The Test results shall be recorded in the form as given by Table 2 of the abovementioned report.
- 4) Vibration measurements shall include measurements taken on each bearing housing and shall consist of at least three readings as follows:-
 - a. Vibration in the horizontal plane perpendicular to the shaft axis.
 - b. Vibration in the horizontal plane parallel to the shaft axis.
 - c. Vibration in the vertical plane perpendicular to the shaft axis.
- 5) Measurement of the air gap between rotor and stator shall be taken and recorded for each motor before and after the heat run.

PS WPE 8.15.5 Material tests on component parts

Test specimens shall be taken from the main forgings and castings; drawings giving the positions of all test pieces are to be submitted to the Engineer for approval. Before removing test pieces, these together with the forgings and castings which they represent, shall be hard branded in the presence of the Engineer. Forgings and castings shall be in the final heat treated condition before detaching test specimen.

All test specimens shall be tested in the presence of the Engineer. All mechanical test certificates shall include full details of chemical analysis and heat treatment. The materials used shall include chemical analysis and mechanical properties tests as appropriate.

PS WPE 8.15.6 Non-Destructive Testing

PS WPE 8.15.6.1 General

The Contractor shall submit for approval, well in advance of the commencement of forging, casting, rolling or fabrication, details of the techniques and procedures of examination to be employed on the principal and other times which shall include the following:

PS WPE 8.15.6.2 Rotor

- Examination prior to brazing of end rings.
- Witness brazing of first rotor end rings.
- Witness ultrasonic test of brazing first rotor end rings.
- Examine reports of ultrasonic tests on subsequent rotors and carry out spot checks if necessary.

PS WPE 8.15.6.3 Stator

Investigate quality of welding and proposed procedures. Examine assemblies before welding and after completion and check stress relieving evidence. Check loading dimensions and concentricity of bearing locations in relation to stator bore.

PS WPE 8.15.6.4 Bearings

Examine bearing housings after machining and check dimensions. Check bond of white metal to shells (ultrasonic test certificate acceptable).

PS WPE 8.15.6.5 Windings

Examine stator and rotor windings before assembly of motor.

PS WPE 8.15.6.6 Bearing Housings

Bearing housings shall be subjected to leak testing using oil or paraffin.

PS WPE 8.15.7 Routine Tests on Site

The following tests shall be carried out on Site on each motor and in the following order:

PS WPE 8.15.7.1 Drying out

The motors shall be dried out by the Contractor before any voltage is applied to them. The dry out shall be achieved by any approved method but the only evidence of dry conditions which the Engineer will accept is an insulation resistance curve against time together with a polarisation index curve against time obtained during the drying out.

PS WPE 8.15.7.2 High Voltage Tests

The high voltage tests shall be carried out at voltages to be approved by the Engineer.

PS WPE 8.15.7.3 Direction of Rotation and No-Load Tests

Test to ascertain correct sense of shaft rotation followed by a 24-hour continuous no-load run during which the following will be monitored:

- 1) Winding temperature as registered by the embedded detectors.
- 2) Bearing temperatures (where applicable).
- 3) Vibration on each bearing.

PS WPE 8.16 INSTALLATION AND TERMINAL BOXES

The motor shall be foot mounted and shall be on a common base plate with the pump or other load or shall be on a separate base plate. Other mounting arrangements shall suit the pump or other load requirements and shall be confirmed with the Employer.

The motor and pump or other load shall be laser aligned by the pump/motor supplier to prevent vibration, bearing damage or shaft damage. Approved type couplings and guards shall be fitted between the motor and pump or other mechanical load.

The positions of the terminal boxes shall be confirmed with the Employer. The position shall suit the incoming cable supply or cable duct layouts.

PS WPE 8.17 SPECIAL REQUIREMENTS

- 1) The motor shall be supplied with new coupling and coupling guard to align and fit with the new pump shaft alignment and size.
- 2) The motor is to suit the speed of the pump.

PS WPE 9 MATERIAL, TRANSPORT, OFF-LOADING AND STORAGE

The Contractor must take due allowance in their tenders for the transport, off-loading of materials and the storage and safe custody thereof according to manufacturers' specifications on or off site until such can be accommodated or is required on site.

The motors shall be wired into temporary power supply and switched on during storage to prevent condensation forming in the motor windings.

PS WPE 9.1 INSPECTION OF LOCALLY MANUFACTURED SUPPLIES

Where locally manufactured plant or materials are offered, the Employer reserves the right to inspect such plant or goods during manufacture and to reject items that do not conform to the owner's requirements. Where a number of units are ordered by the owner the contractor shall notify the representative of the Employer when one unit has been completed so that the representative of the Employer may inspect and approve it.

PS WPE 9.2 ORDERING MATERIALS

The Contractor shall order the applicable mechanical equipment within 2 weeks of commencement of works and is warned to place all orders for materials or special materials as early as possible as he will be held solely responsible for any delay in the delivery of such goods.

PS WPE 9.3 PACKING

The contractor will be held responsible for packing all plant and other goods in such a manner as to ensure any loss or damage in transit. Unless otherwise specifically agreed upon, receptacles will not be returned or paid for and no additional charges will be allowed for packing or packing materials.

PS WPE 10 PUMP AND MOTOR INFORMATION PLATES

Each pump shall be provided with a substantial information plate, preferably chromed or stainless steel, securely fastened to the pump casing in a readily visible position, and clearly and indelibly marked with the following details:

- Maker's name, pump type, serial number,
- Year of manufacture
- Rated duty of pump in litres per second,
- Head in metres at rated duty,
- Pump speed in rpm,
- Mass of upper casing in kg, (for horizontal split casing pumps,)
- Mass of lower casing in kg, (for horizontal split casing pumps,)
- Mass of complete rotating element in kg,
- Mass of completely assembled pump in kg.

Each motor shall be provided with a substantial information plate, preferably chromed or stainless steel, securely fastened to the motor in a readily visible position, and clearly and indelibly marked with the following details:

- Maker's name, motor type, serial number,
- Year of manufacture,
- kW rating of power and current,
- Motor efficiency and power factor,
- Motor speed in rpm,
- Details of sensors provided,
- Details of motor heaters provided,
- Wiring diagrams provided,
- Mass of motor in kg,

Letters and figures shall be engraved, or embossed, NOT STAMPED.

Number plate: in addition, each pumping unit shall be provided with a chromium plated or stainless steel number designation plate not less than 100 mm square indicating "1", "2", etc., mounted in a position readily visible from the control console area. Pumps are normally numbered from the loading bay of the pump station (No 1 closest to the loading bay) but number order shall be confirmed by the Engineer.

PS WPE 11 ALIGNMENT

The pump and motor shall be laser aligned. Before turning on the pump and motor on site, the laser alignment shall be re-checked to ensure it has not shifted during delivery and installation of the pump set.

The pump unit shall be accurately aligned and levelled on Site by the Contractor, should the Contractor dismantle the pump set at the factory for transport, using which ever means necessary. The anchor nuts shall then be drawn tight against the base. The pump and motor shall then be checked for alignment. If alignment needs improvement, metal shims or wedges shall be added at the appropriate places under the base. The Contractor shall align the units using laser alignment and shall ensure that the measured deviations nowhere exceed those recommended by the manufacturers of the motors, pumps and flexible couplings respectively. The readings shall be made available to the Engineer upon request.

Where required, the Contractor shall then grout up the units solidly, filling the voids inside and under the baseplate with an approved non-shrink grout.

After the pumps have been in operation at least one day, the foundation bolts shall be finally tested for tightness, the alignment checked and dowel pins fitted in the pump and motor feet in the approved manner.

When the grout has thoroughly dried (about 14 days after grouting), the exposed edges shall be painted using an approved oil paint of the same colour as the pump baseplate.

Both the suction and discharge piping shall be supported over the pumps with rigid supports and/or anchors to prevent strain from the pipework acting directly on the pump.

The suction pipework shall be completely airtight and installed in a manner to ensure that no air can be trapped in the suction pipe (and manifold).

PS WPE 12 PERFORMANCE GUARANTEE

The Contractor shall guarantee that each pump unit shall achieve the duty specified to within a tolerance of -0% and +3 % on flow and 5 % on power absorbed when operating under the specified head and pumping water of the specified quality. The Engineer will require that the contractor perform site tests to demonstrate the pump compliance.

The contractor shall take whatever steps are necessary to achieve the specified pump performance in accordance with the Engineer's instructions. The Engineer will not accept the pump units unless the specified performance is adequately and reliably demonstrated.

Pumps may be required to be witnessed tested for performance at the factory or assembly plant and test results submitted to the engineer prior to delivery to site.

The Engineer is to witness the FAT of the pumps at the manufacturer's premises. All costs associated with these tests are to be borne by the contractor.

PS WPE 13 TESTING AND COMMISSIONING

The entire installation shall be tested and commissioned in a well-documented procedure to be submitted by the contractor for approval by the Engineer. All test and commissioning data shall be recorded for inclusion in the O & Manuals. The Engineer shall be invited to witness and participate in all tests. One day notice shall be given for these tests.

This testing shall include inter alia the following:

- 1) The pumps shall be factory assembled and performance tested along with the supplied motor as per ISO 9906 2012.
- 2) Hydrostatic test should be at least 1.5 times of the rated pressure
- 3) Pump performance test report in accordance to ISO9906 shall be furnished by the manufacturer along with the supply of the pump. The pump performance shall be tested at no less than 3 points.
- 4) The pump test report shall bear the stamp of the factory and shall be signed by the testing engineer. The test report shall also bear the complete pump model description and part number/identification number of the supplied pump.
- 5) Witness performance testing of the pumps shall be arranged.

- 6) Commissioning activities as per particular specifications.

PS WPE 14 REFERENCE STANDARDS

The following standards are referred to:

- 1) ISO 9906:2012 – International Standards Organizations hydraulic performance tests for customers' acceptance of rotodynamic pumps.
- 2) EN-JL1040 / DIN W.-Nr. 2.1050.01 / DIN W.-Nr 0.6025 - European Standard for materials:
- 3) WRAS- conformance mark with the requirements of the drinking Water Supply (Water Fittings) Regulations 1999 and amendments of UK.
- 4) NEMA- American standard for Electrical equipment's
- 5) IEC - International Electrotechnical Commission

Compliance:

- 1) Pump shall be energy efficient and comply with the EuP Directive (Commission Regulation (EC) No 547/2012) for the minimum efficiency requirement

PS WPE 15 SENSORS

Pump casing temperature sensors (Pt100, one per phase) are to be fitted to all pumps. These are to be supplied as per the pump OEM requirements.

Pump DE and NDE bearing temperature sensors are required for all pumps. The sensors supplied are to be as per the pump OEM requirements.

Motor winding temperature sensors are required only as specified. Motor bearing temperature sensors are not required.

PS WPE 16 DATA SHEETS

The Tenderer shall complete in full the information on the following data sheets in respect of the following:

- Equipment offered for each motor.
- Pump testing data.
- Applicable coupling data.

PS WPE 16.1 PUMP DATA SHEET

Note : Complete one for each equipment supplied

Contractual Duty Point specified (PS WPE 1)		
Number of pumps required	No	
Type of pump		
Manufacturer of Pump		
Country of Manufacture		
Make and Model of Pump		
SANS, BS , ISO or IEC Standards the pump is manufacture to		
Type of impeller		
Number of impellers/ stages		
Mass of fully assembled pump	kg	
Maximum allowable operating speed of pump	RPM	
Speed of pump at the specified duty point above	RPM	
Diameter of impeller offered	mm	

Will the impeller offered enable the pump to meet a duty point ranging from: 262 m ³ /hr × 23.6 m to 374 m ³ /hr × 19.7 m	State YES or NO	
Factory test pressure applicable to pump with suction and delivery flanges blanked off	kPa	
Pump efficiency at Duty Point	%	
Closed valve head of pump	m	
Moment of inertia of rotation assembly	kgm ²	
Power Absorbed		
Power absorbed by pump at specified Duty Point	kW	
Power absorbed by pump at a run point.	kW	
Power absorbed at best efficiency point:	kW	
Maximum power absorbed by pump at run out point of coupling	kW	
Voltage (400V for all pumps)	Volts	
NPSH		
NPSH requirement at specified Duty Point	m head of water	
NPSH requirement at a run point of _____ m ³ /hr	m head of water	
NPSH requirement at a run out point	m head of water	
Diameter of Pump Components:		
Suction inlet waterway and flange size	mm	
Delivery outlet waterway and flange size	mm	
Shaft (state minimum and maximum diameter if applicable)	mm	
Full size impeller diameter	mm	
Minimum size impeller	mm	
Type and Material of Pump Components:		
NDE bearing		
DE bearing		
Impeller		
% Chrome in impeller		
Shaft		
Shaft sleeves		
Volute Casing		
Diffusers		
Wear Ring		
Mechanical Seals:		

Manufacturer		
Type/model		
Seal materials		
Packed Glands:		
Type		
Packing materials		
PT100 pump casing temperature sensors for all pumps		

PS WPE 16.2 COUPLING DATA SHEET

Note : Complete one for each equipment supplied

Type of coupling and fixing method		
Mass of coupling	kg	
Type of coupling guard		
Approximate mass of coupling guard	kg	
Type of coupling bushing (where applicable)		
Type of coupling pins (where applicable)		

PS WPE 16.3 MOTOR DATA SHEET

Note : Complete one for each equipment supplied

Manufacturer		
Place of Manufacture		
SANS, BS, ISO or IEC Standards the motors are manufactured to		
Type Insulation (Class) and temperature Rise Class		
Rated output power (indicate rating such as 37 kW but a different rating may be offered provided there is always the specified minimum margin at the run out point)	kW	
Frame size and reference specifications		
Mass of fully assembled motor	kg	
Confirm integrally cooled	YES or NO	
Maximum allowable ambient temperature to prevent overheating	°C	
Weatherproof rating (IP)		
Motor efficiency class		

Rated maximum speed	RPM	
Initial starting current	Amps	
Full load current	Amps	
Starting current	Amps	
Minimum starting voltage	Volts	
Mounting type, enclosure and cooling method		
Stator winding material, insulation class and temperature rise		
Slip at full load % of synchronous speed.	%	
Starting torque in star as a % full load torque.	%	
Starting current in star as a % of full load current.	%	
Power drawn from electricity supply at pump duty point	kW	
Power drawn from electricity supply at pump run out point	kW	
Type of DE and NDE bearings and sizes		
Bearing lubrication type and grade		
Efficiency by summation of losses in accordance with BS 269:		
At full load	% / %	
At 3/4 load	% / %	
At 1/2 load	% / %	
Power factor:		
At full load	cos ϕ	
At 3/4 load	cos ϕ	
At 1/2 load	cos ϕ	

Anti-Condensation Heater and Thermistors:		
Heater Voltage	V	
Heater Power	kW	
Type of Pt100 Temp sensor and number per phase		
Pt100 Temp sensor Voltage	V	
Operation of Pt100 Temp sensor		
Drawing Nos of the drawings supplied by Tenderer with the tender:		
Pump-motor assembly		
Pump characteristics H, Q, Efficiency, NPSH and Power drawn versus Q) for various speeds and impeller sizes		
Drawing Nos of the drawings supplied by Tenderer with the tender:		

ANNEXURE 6

DGI Consulting

NAIDU
CONSULTING



**PROJECT PARTICULAR SPECIFICATION:
ELECTRICAL, CONTROL & INSTRUMENTATION**

PS ECI

**TRENANCE 3 RESERVOIR, ELEVATED TANK AND
PUMP STATION PROJECT**

Contract No. 32269-5W

Rev. 2

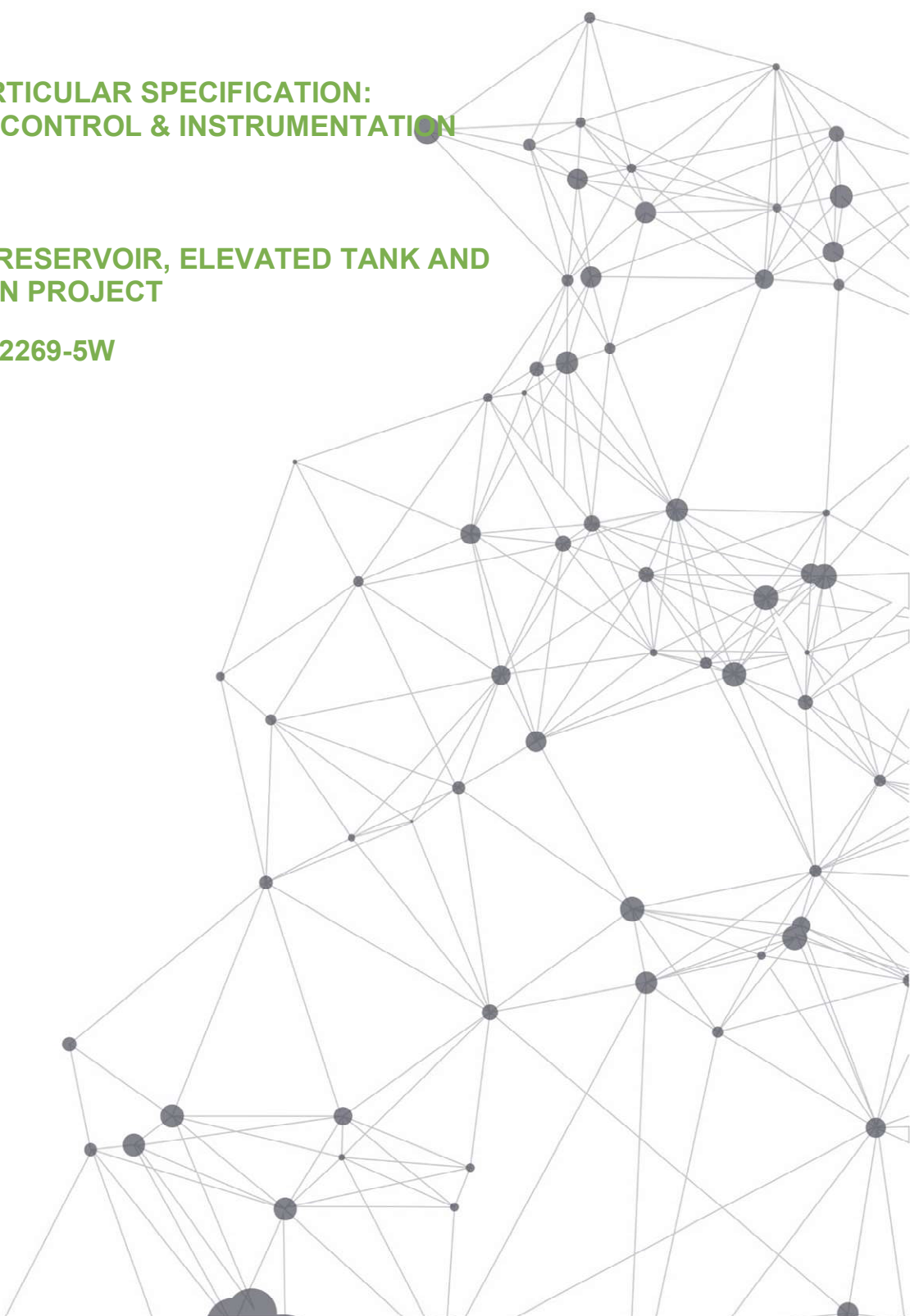


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PREAMBLE

This Project Specification forms an integral part of the contract and supplements the Standard eThekwin Electrical and Instrumentation Specifications where relevant.

In the event of any discrepancy between a part or parts of the Standard or Particular Specifications and the Project Specification, the Project Specification shall take precedence. In the event of a discrepancy between the Specifications, (including the Project Specifications) and the drawings and / or the Bill of Quantities, the discrepancy shall be resolved by the Engineer before the execution of the work under the relevant item.

PS ECI 1 GENERAL

One motor control panel, telemetry and electrical installations are required for the pump station, reservoirs and elevated tank at Trenance 3. The pumps draw water from the on site reservoir/s and pump to the elevated steel tank feeding the high-level zone.

Standalone telemetry systems are required for the site for the control of the pumping systems and for level monitoring of reservoirs and elevated tank levels.

PS ECI 2 PROJECT DESCRIPTION AND SCOPE OF CONTRACT**PS ECI 2.1 BACKGROUND AND SITE**

Water to the Trenance 3 Pump Station will be fed from the new and existing reservoir outlets via gravity interlinked pipelines. Electronic mag flow meters will be installed on the gravity supply inlets to the existing and new reservoirs as per the specifications. Flow meters will also be installed on the outlets to the reservoirs and elevated tank.

A new elevated steel tank will be constructed at the Trenance 3 reservoir site. Two pumps will be installed in the pump station, one duty and the other stand-by. They will draw water from the on-site reservoirs and pump to the on-site elevated tank for the high level draw off system.

The pumps will be automatically operated via level call signals from the elevated tank.

PS ECI 2.2 ELECTRICAL, INSTRUMENTATION & MECHANICAL REGULATIONS, STANDARDS AND SPECIFICATIONS

The design and installation of the electrical, control and instrumentation work shall conform to the following regulations, standards, and specifications:

PS ECI 2.2.1 Standards & Regulations:

- a) SANS 10142 - 1 & 2: "Codes of practice for the wiring of premises" as amended.
- b) SANS 10400: "The application of the National Building Regulations" as amended.
- c) SANS 60439 - Parts 1 & 2 LV Switchgear and Control Assembly.
- d) SANS 1765 and SANS 60947 - Low Voltage Switchgear and Control Gear Assemblies, Contactors and Motor Starters.
- e) SANS 1973-1,3 - Low Voltage Distribution Boards and Control Gear Assemblies.
- f) IEEE519 - Standard for Harmonic Control in Electrical Power Systems.
- g) SANS 10199 - The Design and Installation of an Earth Electrode as amended.
- h) SANS 10313 - The Protection of Structures against Lightning.
- i) IEC62305 - Lightning Protection.
- j) The Occupational Health and Safety Act (85 of 1993) as amended and contingent regulations and including the following:
 - o Electrical Machinery Regulations; latest amendment
 - o Driven Machinery Regulations; 2015 latest amendment
- k) The regulations and standards of eThekweni Municipality.
- l) Applicable NRS and SANS codes for electrical equipment.
- m) BS or IEC codes where South African codes are non-existent.
- n) Local or eThekweni Municipal Electrical Department standards and regulations.
- o) Government and local authority's ordinances or other supply authority governing its use.
- p) Any other applicable by-laws or local authority by-law and amendments.
- q) Eskom standards and regulations where applicable.
- r) The regulations and standards as described under the relevant sections in the Standard Specifications.

The following eThekweni Municipality Standard Specifications shall apply and take precedence over all other specifications:

- a) eThekweni Municipality - MSS: Mechanical Standard Specification _Ver 2 (Aug 2023)

- b) eThekweni Municipality PLC_Specification_Rev06.
- c) eThekweni Municipality Telemetry and Instrument Install Specification_Rev01.
- d) eThekweni Municipality Quality Control Specification_Rev03.
- e) EWS Standard Electrical Specifications, 19.05.2020: GS1 - Standard Specifications for DB's and Motor Control Centres.
- f) Commissioning _ Fat Forms 19112020 Test Reports FAT Combined.
- g) EWS List of Preferred Instrumentation Equipment 7.

PS ECI 2.3 SCOPE OF CONTRACT

This electrical contract comprises the design, supply, manufacture, delivery, testing and commissioning and guarantee of the following:

PS ECI 2.3.1 TRENANCE 3 Pump Station and MCC 01 (MCC & VSD To Comply With IEEE 519)

- a) New motor control panel for two horizontal single stage axially split volute casing pumps to supply the elevated tank for the high-level supply zone. The MCC and VSD installation shall comply with IEEE 519.
- b) Separate wall mounted VSDs for the two pumps
- c) Include a harmonic study of the installation since VSDs will be used for all starters. VSD filters must be installed if the installation does not comply with IEEE 519. Perform power quality tests and confirm that there are no electrical interferences outside the limits of IEEE and NRS codes are present.
- d) New batteries for the UPS section incorporated into the MCC
- e) Design and submission of the MCC drawings prior to any panel construction work commencing
- f) PLC and HMI as per EWS specifications. Refer PLC_Specification_Rev06
- g) Cabling from the MCC to the new externally mounted VSDs
- h) Separate motor junction boxes for motor power cabling and sensors/instruments cabling installed locally at the motor for ease of disconnection
- i) Cabling and cable support systems from the MCC/VSD to the motor junction boxes for power to motors and instrumentation
- j) New motor cable termination junction boxes at the pump motors
- k) Cabling and cable support systems for instrumentation equipment including low level float switches, no flow switches, pressure sensors and level instruments in the reservoirs and elevated tank.
- l) Instrumentation including no flow switches on the delivery pipework of each pump and PT100 thermistors for the pumps and motors
- m) Reservoir (3 in series) low level floats with stainless steel chain and weights. Floats and weights must not contain mercury or lead or other un-safe products used in potable water.
- n) Ultrasonic level sensor and transmitters in the on-site reservoirs (3 No) and elevated tank
- o) Power supply to the new MCC at the pump station.
- p) Earthing of the complete electrical installation of the MCC and associated electrical installation and pumps. Separate earth wires are to be installed from the MCC to the VSDs and to the motors.
- q) Lightning protection and earthing to the pump station, reservoirs and elevated tank
- r) Application for an upgrade of the power supply to the pump station
- s) Liaison with eThekweni Electricity for the electricity supply isolation and facilitate connection of the new MCC to the supply network
- t) Metering from Durban Electricity
- u) Cabling from the electricity meter to the new MCC
- v) Refurbishment of the existing stand-by diesel generator
- w) New cabling from the stand-by generator change over panel to the new MCC
- x) New lighting and small power points in the pump station including light fittings
- y) Submit a preliminary schedule showing all tasks leading up to final commissioning within the stipulated timelines
- z) Supply 5 hard copies and 5 soft copies of the O & M manuals consisting of datasheets of all equipment, drawings and PLC program (electronic and printed copies). The PLC programs shall be the property of EWS.
- aa) The electrical installation with testing and commissioning to comply to

SANS10142.

- bb) Issuing of the Electrical Certificate of Compliance (COC)
- cc) Cabling and connecting up the ultrasonic flow meter on the delivery main of the two pumping systems (flow meters supplied and installed by the civil contractor)
- dd) Telemetry system as indicated and integration to the SCADA system at EWS Control Room
- ee) Integrating the MCC to new Telemetry system including the new mag flow meter which are to be installed under the civil works

PS ECI 2.3.2 EXISTING PUMP STATION & EQUIPMENT

- a) Disconnect and remove the existing MCC from the existing concrete tower and deliver to EWS stores in Springfield
- b) Disconnect and remove the existing telemetry equipment and deliver to EWS stores in Springfield
- c) Disconnect and remove the existing instruments (level sensors, flow meters etc) and deliver to EWS stores in Springfield
- d) Disconnect and remove the existing generator change over panel from the existing concrete tower and store for re-use. To be installed in existing generator control panel.
- e) Disconnect and remove the existing cabling systems, lighting and power outlets from the existing concrete tower and deliver to EWS stores in Springfield

PS ECI 2.3.3 TECHNICAL DATA

Background

For the pump station, the pumps specified for each system consists of two horizontal single stage axially split volute casing pump sets, tested and factory approved at the contractor's or supplier's stores. The pumps will be installed in the new pump stations and deliver potable water through a rising main to the steel elevated tank.

Of the pump system to be installed, under the normal conditions only one pump will be operating as the duty pump, the second pump acting as a standby.

The pumps require an electrical panel to control the new pump operating philosophy. The pumps and pipework will be supplied and installed by others.

The pump sets shall be capable of pumping potable water without solid particles or fibres.

PS ECI 2.3.3.1 Trenance 3 Pump

The horizontal single stage axially split volute casing pumps specified are rated at a flow of 374,00m³/hr at a head of 19,7m and is model KSB Omega 150-290B or similar and equally approved and is to be supplied complete with 37kW WEG motors or similar and equal approved. Refer to mechanical pump specifications for final pumps selected and specified.

The pump casing is manufactured of cast iron with 316 stainless impellor and shaft sleeve. The motor shall be IP55 cast iron min IE3 TEFC W22 premium efficiency with 37kW 3 phase 400 V 50 Hz 1470 RPM motor and shall be designed and wired for VSD starting. The motor power cables must be terminated in separate suitably sized cable junction box with links for termination of power cables.

Motors and Pump Sensors

All the motors are to be fitted with built-in PT100 winding temperature transmitter including DE and NDE bearing temperature sensors. The PT100 sensors are to be connected individually to a temperature transmitter or the analogue expansion card of the PLC.

Anti-condensate heaters are to be fitted to the motors.

The pumps are to be fitted with DE & NDE bearing PT100 temperature sensors and pump casing temperature sensors. The pump casing is to be fitted with vibration sensors. The EWS C & I team is to confirm whether the transmitters are local and whether the output is RTD or 4-20mA.

The above must be catered for by the contractor in the control circuitry.

PS ECI 2.4 TRENANCE 3 PUMP STATION

PS ECI 2.4.1 400 Volt Mcc01 For Trenance 3 Pumps (To Comply With IEEE 519)

General

The MCC design shall be undertaken by personnel who are able to demonstrate experience in the field of water treatment and pumping plant including PLC control and telemetry systems. The motor control panel components and installation methods and associated electrics shall comply strictly to the eThekwini Water standards and requirements all as specified in the detailed specification or elsewhere in the general specification. All equipment shall comply with the requirements of the EWS Standard Specifications included with this tender enquiry. Power shall be taken from the eThekwini Electricity metering panel.

The MCC shall be floor mounted with 300mm-500mm high steel pedestals and fitted within the pump room and generally in accordance with the Standard Specification. The panel shall be manufactured from 3CR12 material. The panel shall be designed for 2 off feeders for externally wall mounted VSD starters and control equipment. The installation of the MCC, VSD and requirements for harmonic filters and chokes shall comply with IEEE 519.

The contractor is to include a harmonic study of the installation since VSDs will be used for all starters. Filters must be installed if the installation does not comply with IEEE 519.

The contractor is to also perform power quality tests and confirm that there are no electrical interferences outside the limits of IEEE and NRS codes are present.

The harmonic study, power quality tests and installation of filters and chokes must be included in the tender prices.

The panel shall comprise the following):

PS ECI 2.4.1.1 Panel No. 1 – Incomer

This panel shall contain:

One set of suitable sized three phase and neutral copper bus bars complete with support insulators in accordance with the Standard eThekwini Specification. One substantial copper earthing bar complete with sufficient number of studs or bolts, nuts, and washers for the incoming and outgoing earth conductors.

One 250 Amp 400 Volts or suitably rated four pole switch with LSIG ETU protection and shall be compliant with type 2 co-ordination. All live parts of the switch shall be shrouded to prevent inadvertent contact by maintenance personnel.

3 No. HRC Voltmeter fuses

3 No. Current transformers

1 No. Power meter Allen Bradley PM5000 with facilities for phase / phase / neutral voltages and current on all 3 phases. To include frequency, THDi & THDv.

1 No. Set fuses with mains and phase failure relays incorporating phase loss, phase reversal, under voltage, over voltage and phase imbalance

4 No. Surge arresters as specified in the Standard Specification

PS ECI 2.4.1.2 Panel No. 2

Distribution and Domestic:

This panel shall be equipped with suitably rated 60 Amp TP main switch isolator with 3 phase HRC fuses to feed the following station lighting, plugs and distribution to comply with SANS10142:

Domestic:

- 3 No. 10Amp SP MCB for station lighting
- 1 No. 63Amp/30mA DP earth leakage circuit breaker for plug circuits
- 2 No. 20Amp SP MCB for socket outlets
- 1 No. 5Amp SP CB for photocell for external light circuit
- 1 No. 5Amp By-pass switch to control external light
- 1 No. 5Amp SP MCB for power supply to telemetry equipment
- 1 No. 10Amp SP MCB for power supply to flow meter
- 1 No. 30Amp TP MCB (welding socket outlet)
- 2 No. 5Amp TP CB with DOL contactors and stop/start push buttons with run/stop/trip indication lights for extract fan circuits
- 2 No. Surge arrestors application dependant (type 2 or similar) for power supply to telemetry cubicle and flow meter as specified

Control Transformer:

- Suitably Rated Control Voltage Transformer (3 kVA or similar)
- 6 No. Suitably rated SP MCBs for power supply to flow meters, pressure transducer, level sensors, other sensors and spares etc
- Suitable surge arrestors for power supply to telemetry cubicle, flow meters and other instruments etc as specified

Make allowance and space for future spare ways. A typed legend card must be installed in the DB compartment.

Domestic DB

PS ECI 2.4.1.3 Panel No. 3 - Trenance 3 Pump 1

400 Volt VSD Feeder Panel for 37 kW VSD for Pump No. 1 (Horizontal single stage axially split volute casing pump)

The panel shall be generally as described in the Standard Specification and shall have padlock or fuse pad lockable and contain:

- 1 No. Suitably rated four pole fuse switch isolator mechanically interlocked with the panel door. All Live parts shall be fully shrouded.
- 1 No. HRC control fuse
- 1 No. Control link
- 1 No. 400V VSD Feeder Motor Protection Breaker for 37 kW VSD or similar approved to eThekweni standards
- (Note: The 37 kW 400 Volt VSD is to be externally wall mounted separately with a IP54 or better IP rating for dust and moisture prevention. The VSD is to be priced separately)
- 1 No Suitably rated control voltage transformer with supply to motor heaters
- 1 No Manual/Auto/Off selector switch
- 2 No Manual stop/start buttons
- 1 Set Power on / run / trip & inhibit indicator lights (4 off)
- 1 No. Suitably rated ammeter with 96mm dial and current transformer
- 1 Set Motor 230V heater power and control circuit
- 1 Set Control equipment, telemetry/PLC relays, contacts, etc. to automatically start, stop, trip and protect the pump from dry run no flow, low suction pressure and reservoir low level protection as described in the control section.
- Sets of controls wired to PLC for pump and motor temperature protection (built in temperature sensor fitted with the pump and motor). The motor shall be fitted with PT100 winding temperature sensors and the pump casing shall be fitted with PT100 temperature sensors and DE & NDE PT100 bearing temperature sensors for the pump and motors. The pumps shall also be fitted with casing vibration sensors
- Set of controls wired to PLC to trip the pumps in the event of low pressure on the suction side of the pumps.
- 1 Set Circuitry for emergency stop
- 1 Set 3 phase links for the VSD supply

This panel shall be labelled " Pump No. 1"

PS ECI 2.4.1.4 Panel No. 4 - Trenance 3 Pump 2

Feeder Motor Protection Breaker for 37kW 400 Volt VSD Starter for Pump No.2
(Horizontal single stage axially split volute casing pump)

This panel shall be identical to the panel No. 3 for Pump No. 1

(Note: The 37 kW 400 Volt VSD is to be externally wall mounted separately with a high IP rating
for dust and moisture prevention. The VSD is to be priced separately)

This panel shall be labelled "Pump No. 2"

PS ECI 2.4.1.5 Panel No 5

PLC Auto Control & HMI

The panel shall be equipped as follows:

- 1 No. Control circuit HRC fuse
- 1 No. Neutral link

PS ECI 2.4.1.6 Panel No. 6

UPS and backup batteries

The UPS, battery charger and batteries as specified under the standard specification shall be installed in this cubicle. The battery shall be installed in a separate cubicle within the MCC all to eThekwini standard specifications. The battery shall be 45 Amp Hour 12V DC Deltec deep cycle battery as per the standard specification.

The contractor shall provide the cabling between the MCC and the battery cabinet. A limit switch shall be provided in the battery box and UPS compartment for intruder alarm and wired to the PLC for remote monitoring via the telemetry system. The limit switch shall form part of the supply of the UPS and batteries

PS ECI 2.5 DB PUMP STATION & RESERVOIR SITES

The DBs for the pump stations and reservoir sites shall be surface mounted manufactured of 3CR12 sheeting with lockable doors and painted orange and be in accordance with SANS10142.

The DB shall feed the telemetry panel and the MCC building lighting and socket outlets. The telemetry panel shall also supply the new level sensors to be installed in the existing reservoirs.

The DB shall be equipped as follows :

- 1 No. 30 Amp DP main switch
- 3 No. 10Amp SP MCB for station lighting (with spare)
- 1 No. 60Amp/30mA DP earth leakage circuit breaker for plug circuits
- 2 No. 20A SP MCB for socket outlet circuits
- 1 No. 5A SP MCB for photocell for external light circuits
- 1 No. 10Amp By-pass switch to control external light
- 1 No. 5Amp SP MCB for power supply to telemetry equipment
- 1 No. 10Amp SP MCB for power supply to flow meter (2 No)
- 2 No. Surge arrestors for power supply to telemetry cubicle and flow meter as specified

Make allowance and space for future spare ways. A typed legend card must be installed in the DB compartment.

PS ECI 2.6 OPERATING AND CONTROL PHILOSOPHY OF THE PUMPS**a) Trenance 3 Pumps**

This specification covers the operating and control philosophy for the horizontal single stage axially split volute casing pumps for the Trenance 3 pumps.

Any deviations or changes from the operating and control features described here must be agreed upon between EWS and the Contractor in writing. The finally agreed upon operating and control philosophy must be included in the O&M manuals which will be submitted by the Electrical Contractor to EWS at the end of the contract.

The MCC will have two feeders, one each feeder for 2 x VSD pump starters for the Trenance 3 pumps which will be controlled by the PLC. Two wall mounted VSD starters per pump will control the duty pumps that will pump water to the Trenance 3 Elevated Tank.

The Pumps shall operate in three distinct modes of control, namely Automatic, Manual and Tele-override.

The duty and stand-by pump call shall be cycled after every start. Interlocking shall be provided that only one pump shall start at any time in both manual and tele-control modes.

PS ECI 2.6.1 Automatic Mode

The pump/s shall operate automatically via level start and stop signals from the on-site elevated tank. Ultrasonic level transmitters will be installed in the elevated tank for this wired to the PLC in the MCC. The pumps must operate on a duty- standby philosophy. In both manual and tele-control mode, only one pump must run at a time and there must be an interlock programmed into the PLC to prevent the second pump from starting while the one is running. The interlock must only inhibit the pump when a start attempt is made. The duty pump must be automatically rotated by the PLC after every start.

PS ECI 2.6.2 Manual Mode

In Manual Mode, the pumps shall operate when they are locally selected to do so, using the Auto/Manual/Off selector switch and the push buttons on the panel door.

All VSD protection must be active including "Overload Trip", "Under-Current Protection", and "Earth Leakage Trip" etc where applicable. All pump trip signals must be taken to the PLC to de-energize a "Pump Inhibit" relay which will trip the pump.

A no-flow switch shall be installed on the delivery side of each pump to trip the pump should a no flow condition arise. This is to protect the pump from dry running. Low level floats shall be installed in the 3x clear water suction reservoirs (wired in series) to cut out the pump should any of the reservoir levels below. These levels shall be determined on site later. A pressure transmitter shall be installed on the common delivery lines of the pumping system. A pressure transmitter shall be installed on the suction side of each pump and shut down the pump should the pressure drop below certain set-points (settings to be determined later). The pressure shall also be displayed on the local PLC/HMI. There should be no hard-wired trip signals (besides the inhibit, low level cut-out etc) wired into the pump control circuit (unless agreed with EWS during review of the electrical drawings).

When the pump inhibit relay is activated, the inhibit indication lamp on the pump panel must also be activated and the stand-by pump started if required and is being called, and if available. In auto mode only, the pumps must automatically start up after a trip has been reset/cleared. Also should any pump fail to start, after a period of 10 seconds, the next available pump should be requested to do so.

In auto mode only, the duty pump/s must automatically start up after power is restored in the event of a power failure. All pumps must be limited to a maximum of ten starts per hour (to be set on the HMI). All other protection and other features, as mentioned in

the contract document and standard specifications must be incorporated as required.

PS ECI 2.6.3 Telemetry

A "Telemetry Control" feature must be incorporated into the design which will provide remote control (starting and stopping of pumps) from the Water Control Room. This feature will only be applicable when the pumps are in Automatic mode on the MCC selector switch. The Control Room shall be capable of remotely switching telemetry control on/off, and capable of starting/stopping each pump individually when telemetry control is on. If only one pump can run at anytime, tele-override should have a duty start command. The pump interlocks must still be active in the tele-control mode.

Telemetry communications from the PLC to the Telemetry unit will be via Ethernet IP. Refer to the PLC specification for the requirements and typical draft I/O list. The final list shall be prepared and submitted by the contractor.

Provision should be made in the PLC program to ensure that when the "phase fail" signal is active it does not result in every other signal erroneously being sent through to Telemetry as well.

The pumps shall be automatically controlled by levels in the on-site elevated tank for the high level zone feed and automatically via the telemetry system from the EWS control room.

PS ECI 2.6.3.1 Marshalling:

Signals shall include but are not limited to what is required below. Refer to the typical I/O lists under the EWS PLC specifications for the full requirements.

The following minimum signals shall be provided as specified in the project and Standard Specification for local control and display/alarms on the PLC/HMI and to the remote SCADA system for control and remote alarms:

PS ECI 2.6.3.2 Pump Signals:

- Auto / manual/ off selected
- Mains fail, phase fail, over and under voltage
- Pumps run/stop
- Pumps trips
- E-Stop activated
- Inhibit
- Pumps run hours
- No flow or low-level trip
- Temperature trip (PT100 or thermistors)
- Pressure trip (optional if installed)
- Motor and pump temperature trips (all)
- Motor and pump vibration trips (optional if installed)

PS ECI 2.6.3.3 Instrumentation Signals

- Operator start/stop
- Flow meter signals (instantaneous and total) - All
- Pressure
- Local Reservoir or Tank low level trip
- Local Reservoir (3 No) or Elevated Tank levels
- Local Reservoir high level and alarms
- Local Reservoir low level and alarms
- Local Elevated Tank high level and alarms
- Local Elevated Tank low level and alarms
- MCC/Pump Room intruder alarm and battery box intruder alarm (wire into panel/plc)
- Fire Alarm (wire into panel/plc)
- 24V DC fuse fail
- Other signals as determined with EWS and the contractor

Note: Detectors and PIR shall be supplied by the electrical contractor.

The above signals shall also be transferred via telemetry and integrated to the EWS SCADA system at the EWS Control Room.

PS ECI 2.7 OPERATING PHILOSOPHY OF THE PUMP STATIONS

1. TRENANCE 3 PUMP STATION

The control philosophy for the Trenance 3 Pumping Station is fully described under the PLC and MCC auto control section.

- a) The pump station consists of two sets of pumps, both sets pumping to the on-site elevated tank operating on a duty and stand-by basis.
- b) The pump system consists of new horizontal single stage axially split volute casing pumps with motors rated at 37kW drawing from the clear reservoirs on the site.
- c) The pumps and MCC shall be installed in the new pump station.
- d) The automatic starting and stopping of the pumps shall be controlled by level control from the on-site elevated tank
- e) A new MCC room and telemetry room within the pump station building is to be constructed to house the MCCs and telemetry equipment.
- f) The new pumps (duty and standby) will be fully automated, operating on the level sensor calling system and monitored by the telemetry & SCADA system. The PLC will be programmed to carry out this function.

PS ECI 2.8 PLC & HMI SPECIFICATION AND REQUIREMENTS

Refer to PLC_Specification_Rev06 for the PLC and HMI to EWS requirements and details. The PLC and HMI shall be installed and connected in the PLC cubicle of the MCC in accordance with the standard specifications.

PS ECI 2.8.1 Program / Schedule/ Management

The electrical contractor must provide the programs or project schedules clearly indicating the start dates from award of contract and the estimated completion dates. The program must address the following as a minimum:

- Logical flow of activities, milestones and deliverables
- The schedule must be realistic in relation to provided key resources and sub contractors. (WBS)
- Include verifiable milestones, e.g. PLC development complete, equipment ordering complete, Factory Acceptance testing etc.
- Clearly indicate the critical path on the program (if applicable).
- The schedule must be resource loaded to show which resources (OEM, Tenderer, sub-contractor, EWS and others) will be completing each activity. (RACI Matrix)
- Make provisions for lead times (hardware ordering times, Client approval times, etc.) Include schedule assumptions to help the evaluation team understand how certain durations were estimated or arrived at and others.

The contractor must provide a Project Communications Plan, Implement a Change Management Request Process as well as a Lessons learnt Register on Handover.

PS ECI 2.8.2 Intellectual Property

All Intellectual Property developed in the course of a contractual relationship with the Municipality during this project shall remain in full control of the Municipality in terms of ownership and control rights. Intellectual Property rights assigned to the Municipality shall include but not be limited to the following:

PS ECI 2.8.2.1 Works Related Design and Documentation

The Contractor grants the Municipality the right in accordance with the provisions of

Section 22 of the Copyright Act 1978:

- The PLC Code shall not be protected or locked in any way
- To copy any plan, diagram, drawing, document, specification, bill of quantities, design, calculations, works specific software developments and configurations, e.g. standard templates, mimics, reports, etc. or any other similar document made by the Contractor in connection with the works;
- To make free and unrestricted use thereof for its own purposes, modify same or have it modified by a third party for any reasons, without obtaining permission from the Contractor;
- To provide copies thereof to others (third party Contractors or Consultants of the Municipality) to be used by them for purposes of tendering, consultancy or service delivery.

PS ECI 2.8.2.2 Testing/ Commissioning

Refer to QualityControl_Rev03 Specification for the testing and commissioning procedures, specifications and details.

It is a requirement that the designer and manufacturer of the MCC be present for the FAT and for the site testing and commissioning of the MCC and associated electrical installations.

The contractor is to also perform power quality tests on the installation and confirm that there are no electrical interferences outside the limits of IEEE and NRS codes are present. The above specifications are restricted to the VSD and not the installation as a whole.

PS ECI 2.9 OTHER

The PLC will be programmed by a specialist system integrator employed by the supplier of the motor control panel in consultation with EWS Mechanical and Electrical Branch and the Control and Instrumentation Branch.

The project will not be signed off for payment before all snags identified in the preliminary inspection are complete and a compliance certificate and test report is issued.

PS ECI 2.10 OPERATING PHILOSOPHY OF THE PUMP STATION

The control philosophy for the potable water pumping systems are fully described under the PLC auto control section for each MCC and under the telemetry sections.

PS ECI 2.11 GENERATOR SUPPLY

The existing site is installed with an outdoor canopy type generator supplied by Sinabo. The gen-set comprises a Perkins four cylinder in-line motor and Leroy-Somer generator rated at 100kVA, 1500rpm 400Volt, 50Hz. The generator is operational.

The capacity of the existing generator after de-rating is adequate to power one duty pump with a motor rated at approx. 37 kW on the proviso that VSDs are used to start and ramp up the pump to full speed. A new generator rated at 150kVA will be required in the event the existing unit is too costly to repair or refurbish.

The controller on the gen-set control panel is in good condition. The auto change-over panel situated in the existing tower on the ground floor is also in a good condition. This change over panel will have to be moved to the existing generator control panel. New cables between the gen-set control panel and the new MCC in the new pump station is required.

An on-site meeting was arranged for the 29 May 2025 with the OEM (Sinabo) to conduct an assessment of the existing generator. A senior technical manager from Sinabo was present together with representatives from the Client, Naidu Consulting and DGI

Consulting.

The generator could not be started and run as it had run out of fuel, however a visual assessment was done without the set running. Attempts to get some diesel to run the generator were unsuccessful.

A second on-site meeting was arranged for the 4th June 2025. A technician from Sinabo was present together with representatives from the Client, Naidu Consulting and DGI Consulting. Sinabo brought some fuel in a container and temporarily connected it to the fuel system just to run the set so that the assessments could be done.

After bleeding the fuel system of air due to the low fuel level, the gen-set was run for a short while and the visual inspections and operational assessments revealed the following:

- There was a mixture of water and diesel fuel in the bund of the set, presumably from rainwater and diesel leaks whenever the diesel tank was being manually filled. This is to be investigated further
- The cooling water radiator shows signs of corrosion
- Leak on the one injector line
- The battery did not have a battery box or any locking arrangement to prevent theft
- There is surface rust on the diesel motor and alternator which needs to be de-rusted.
- The locks on the canopy doors are not vandal proof and access could be easily gained into the canopy
- The gen-set requires a shelter to protect it from the elements
- A concrete bund is required around the set to contain spillages

The diesel motor and generator ran smoothly and there were no issues that were identified. There was no evidence of diesel smoke (due to engine wear) or noises coming from the motor or alternator. The OEM indicated that the motor and alternator are in fairly good working order, however it should be monitored and inspected regularly.

PS ECI 2.12 DOMESTIC ELECTRICAL, LIGHTING & POWER INSTALLATION

The electrical contractor shall be responsible for the supply, installation, testing and commissioning of the light points, switches, socket outlets, isolators, light fittings, conductors and wiring in the MCC and Telemetry buildings, pump stations and telemetry rooms all as directed by the Engineer to the Contractor on site or as specified and quantified in the Schedule of Quantities.

PS ECI 2.12.1 Wiring:

Lighting - 1,5 mm² + earth
Sockets - 2,5 mm² + earth.

The entire electrical supply and installation work shall be in accordance with SANS 10142-1 latest amendment and the regulations of the OSH Act (Act 85 of 1993) and any contingent regulations. All work to be neat, parallel, level, uniform etc. Wiring shall be in galvanised bosal conduit.

PS ECI 2.12.2 Internal Lighting and Power Outlets:

Light fittings are to be installed in the pump station/MCC rooms and telemetry room and are to be wall mounted or as shown on the drawings or as directed on site. The lighting shall be wired back to the local DB in bosal or PVC conduit. One lever one way light switches are to be installed inside the pump station near the door at a height of 1.4 meters above FFL.

One double socket outlet is to be installed within one meter of the MCC and telemetry room at a height of 1.2 meters above FFL. All lights and plugs are to be wired using GP wire in 20mm bosal or PVC conduit in accordance SANS 10142-1.

New lighting and socket outlets or power points are to be installed in the new pump stations/ MCC Rooms or Telemetry Rooms all as indicated on the electrical drawings. Switched socket outlets, isolators and other dedicated or specialised power points are to be provided as require all as shown on the electrical drawings.

A local distribution board (DB) shall be installed in each pump station or telemetry room.

Internal lighting is to be 1,5m 2 tube corrosion resistant lights with LED lamps.

All circuits must be clearly marked on the face of the DB panel.

PS ECI 2.13 OUTSIDE LIGHTING

External lighting shall consist of external bulkhead light fittings with LED lamps as specified in the SOQ. The luminaires shall be operated by means of a photocell and a by-pass switch in the MCC building and in MCC or DB, all in accordance with the standard specification.

PS ECI 2.14 LIGHT FITTING

The light luminaries as specified in the schedule of quantities shall be supplied and installed complete with lamps, etc. All luminaires shall be guaranteed for a period of 12 months from the date of the completion certificate. Alternatives shall be considered if similarly approved. Lamps and control gear shall bear the SABS mark of approval. All lamps shall be energy efficient LED type.

PS ECI 2.15 CABLES, CABLE TRAY, TRENCHING AND CABLE MARKERS

PS ECI 2.15.1 GENERAL

All power cabling shall be PVC/SWA/ECC/PVC, with copper conductors to SANS 1507. Cables shall be buried at a depth of min 500mm. Power cable glands and shrouds shall comply with SANS 1213 type Pratley or similar approved. Cables shall be full length point to point, no joints will be permitted.

All instrumentation cabling shall be multi strand copper braided cable or multi strand twisted pair cable. Installed in a sleeve or fixed to cable tray.

Instrumentation cable glands and shrouds shall be type Pratley or similar approved brass compression or as approved by the Client or Engineer. Each cable end shall be labelled with a Bowthorpe Hellerman or similar type PK tag showing the cable details as indicated in Appendix A in the standard specification.

Cable tray shall be of the Cabstrut or as approved pre-galvanised epoxy painted, medium duty tray supported on the wall by galvanised P2000 at intervals not exceeding one meter on the vertical or 750 mm on the horizontal, or P2000 cantilever arm if secured to the floor. All trenches for low voltage and control cables are to be 600mm deep and 400mm wide.

Cable marking tape 150mm wide is to be installed at a depth of 300mm below ground line. All trenches must be inspected before they are backfilled. The trench must be back filled and compacted with a plate compactor in layers not exceeding 150mm. Ducts must be installed complete with 1.6mm galvanised draw wire. Two ducts may be laid in the same trench at a minimum distance of 150mm apart. All bends must be the long radius type. No more than 500 metres of excavation may be left open at a time. Excavations may not be left open especially over the December / January builders shut down period.

Cable markers shall be LG Green or similar and are to be installed at distances not exceeding 10 meters and at every change of direction. Markers are to consist of a concrete block 100mm c 100mm x 300mm and installed in the vertical position. An aluminium plate 75 x 75mm is to be embedded in the concrete or secured to the top of

the block by means of two ram set screws 25mm long. The plate is to be punched with numbers and arrows on smaller than 10mm.

Installed cabling shall be made vandal proof which includes encasing the cables in concrete by the civil contractor.

PS ECI 2.15.2 Cables to MCC, Motors and Other Equipment

The electrical contractor shall supply, deliver to site, lay in cable ducts or sleeves and in ground or on surfaces the power and associated control cables for the various motors, between panels of the distribution board, the isolators, motor junction boxes, associated stop push buttons, motors, motor heaters, level electrodes, flow switches, etc. Cables to motors and instruments shall terminate in separate suitably sized junction boxes installed adjacent the pumps and motors and then terminated onto the equipment.

He shall connect up the cables at all ends and then test and commission the various plant electrical installations.

Refer to Telemetry and Instrument Specification Revision 00, Section 17.

PS ECI 2.15.3 Cable Schedule

The contractor shall be responsible to provide the correct size and rated cabling for each application to be measured on site. Cables shall be full length and jointed cables will not be permitted. All lengths are re-measurable and payment will be made for actual lengths installed.

Note each operating / safety device is to be supplied with a separate cable to a IP65 CCG box or weatherproof isolator at the device. Multi-core cables run to two or more devices will not be acceptable.

The following minimum cables are required and as itemised in the schedule of quantities:

A. TRENANCE 3 PUMP STATION, ELEVATED TANK AND RESERVOIRS

NO	DESCRIPTION	FROM	TO	FUNCTION	LENGTH (m)
1	95 mm ² x 4C PVC ECC SWA PVC	Ethekwini transformer / mini-sub LV Panel	New Meter	Power	50
2	70 mm ² x 4C PVC ECC SWA PVC	New Meter	Generator Change Over Panel	Power	40
3	70 mm ² x 4C PVC ECC SWA PVC	Generator Change Over Panel	New MCC	Power	20
4	25mm ² x 3C PVC ECC SWA PVC	MCC	Pump 1 - 37kW VSD	Power	20
5	25mm ² x 3C PVC ECC SWA PVC	Pump 1 VSD	Pump 1 motor 37kW Junction box	Power	10
5a	25mm ² x 3C Flexible H07 Trailing Cable	Pump 1 Junction box	Pump 1 motor 37kW	Power	10
6 a-b	16mm ² PVC insulated earth wire	MCC	VSD 1 and to pump motor 1	Earth	20
7	25 mm ² x 3C PVC ECC SWA PVC	MCC	Pump 2 - 37kW VSD	Power	10
8	25mm ² x 3C PVC ECC SWA PVC	Pump 2 VSD	Pump 2 motor 37kW Junction	Power	10

			box		
8a	25mm ² x 3C Flexible H07 Trailing Cable	Pump 2 Junction box	Pump 2 motor 37kW	Power	10
9 a-b	16mm ² PVC insulated earth wire	MCC	VSD 2 and to pump motor 2	Earth	20
10 a-b	1,5mm ² x 2C PVC ECC SWA PVC	MCC	Pump 1 & 2 no-flow switch	Control	10
11 a-b	1.5mm ² x 2C PVC ECC SWA PVC	MCC	Pump 1 & 2 motor heater	Power	10
12 a-b	1.5mm ² x 2C PVC ECC SWA PVC	MCC	Pump 1 & 2 motor winding temp sensors	Control	10
13 a-b	1.5mm ² x 2C PVC ECC SWA PVC	MCC	Pump 1 & 2 casing temp sensors	Control	10
14 a-d	1.5mm ² x 2C PVC ECC SWA PVC	MCC	Pump 1 & 2 motor bearing temp sensors	Control	10
Power	1.5mm ² x 2C PVC ECC SWA PVC	MCC	Pump 1 & 2 bearing temp sensors	Control	10
16 a-c	1,5mm ² x 4C PVC ECC SWA PVC	MCC	Reservoir 1 -3 low level floats	Control	Varies
17 a-d	1,5mm ² x 2C PVC ECC SWA PVC	MCC	Inlet/outlet mag flow meters 1 - 4	Power	Varies
18 a-b	1,5mm ² x 2C PVC ECC SWA PVC	MCC	Pump 1 & 2 stop lock	Control	10
19 a-b	1,5mm ² x 4C PVC ECC SWA PVC	MCC	Pressure transmitter on pump discharge	Control	10
20 a-b	1,5mm ² x 4C PVC ECC SWA PVC	MCC	Extract fan 1 & 2	Power	20
21	16mm ² x 4C PVC ECC SWA PVC	MCC	Lighting DB	Power	15
22	1,5mm ² x 2C PVC ECC SWA PVC	MCC	Telemetry panel	Power	10
23	10mm ² x 4C PVC ECC SWA PVC	Lighting DB	Welding socket	Power	15
24	1,0mm ² 4 or 6 pair individually screened overall screened instrument cable	MCC	All sensors , flow meters, level transmitters , pressure transmitters etc	Control & signal	Varies
25	1mm ² 2 pair PVC overall screened Dekoron cable	MCC	Telemetry panel	Signal	10
26	Modbus cabling	MCC	Telemetry panel	Signal	10

Note :

- The cables required for the telemetry system are shown under the telemetry scope of work and the BOQ.
- The cable numbering above is indicative and for tender purpose only. The contractor shall determine and provide the final cable schedule and numbering to suit. Although all the cables required may not be in the above schedule, there is sufficient cables measured in the bill of quantities to cover all the cable requirements.
- All cables are re-measurable and only cables actually installed shall be claimed for payment. Cable lengths shall be physically measured on site prior to ordering.

PS ECI 2.16

TELEMETRY

1.0 Project overview

This project involves the supply and installation of new telemetry systems at the following sites forming part of the Trenance 3 Scheme with the affected sites being:

- Site 1 - Trenance 3 Pump Station, Elevated Tank and Reservoirs
- Site 2 - EWS SCADA at Pinetown Control Room

The new infrastructure will be constructed and or installed in each of these sites. With the new infrastructure being installed, there is a need for the installation of the new telemetry or the improvement of the existing telemetry systems and instrumentation to ensure for adequate monitoring and control.

The project also involves, inter alia, the supply, installation, configuration, testing and commissioning of the new telemetry and instrumentation equipment. It also involves the integration to the MCC and SCADA configuration at the EWS Control Room. The scope of work for each site is detailed below.

a) Site 1 - Trenance 3 Reservoir, Elevated Tank and Pump Station:

Scope of work

- Integration of the three reservoirs (3 No) new mag flow meter (4 No) at the new pump station and reservoir site to the new telemetry system. The new mag flow meter will be installed on separate inlets to the existing reservoirs and on the outlets to the reticulation mains
- Integration and monitoring of the new pumps (2 total) for automatic starting and stopping from the on-site elevated tank
- Supply, install and commission a new telemetry panel as per specification. Power supply to the telemetry panel will be provided by the electrical contractor
- The panel must include the RTU and digital radio amongst other equipment with 100 amp hour batteries complete
- Supply and incorporate two Dual point transmitters (type Siemens 7ML50331AB102A) in the elevated tank and reservoirs (4 No)
- Supply and install the XPX10 four ultrasonic-level transducers (7ML11153CA30) with stainless steel brackets and housings as per agreed positions (4 No)
- Supply and installation of new omni directional Webb radio antenna, cables and antennae cables, mounting brackets and accessories.
- Supply and wire optical isolation between serial devices (Moxa TCC120I) (4 sets)
- Supply and wire serial surge protection and DC surge protection devices for all telemetry equipment
- Supply and install new level instrument cables and any additional installation accessories
- Enabling monitoring of the intruder alarm, fire alarm and battery box alarm for the new Pump Station, MCC and Telemetry Rooms.
- SCADA configuration and integration
- Provide project management

Deliverables

- A fully functional and integrated telemetry system, enabling monitoring of all alarms and events of the reservoirs, elevated tank and pump controls (start / stop) etc on the existing SCADA.
- Enabling monitoring of the 4 new mag flow meters on the inlets and outlets of the gravity or pumped mains:
 - DN200 - Inlet to Existing Reservoirs 1 & 2, and the new reservoir
 - DN200 - Outlet from Existing Reservoirs 1
 - DN250 - Outlet from Existing Reservoirs 1 & 2, and the new reservoir
 - DN200 - Outlet from New Elevated Tower
- The meters will be installed in chambers or bunkers within the pump station or reservoir sites.
- Enabling monitoring of the intruder alarm, fire alarm and battery box alarm for

- the new Pump Station, MCC and Telemetry Rooms.
- Re-established communication between sites and front end
- Detailed Project Documentation and Safety File (Hard Disk)
- Documentation pack with all drawings, wiring diagrams, loop diagrams, I/O lists, as-builts, O & M manuals etc complete
- Integrated MCC/PLC, enabling the monitoring of all alarms and events, on the existing GeoSCADA at the EWS Control Room.
- Testing of all signals to the existing GeoSCADA at the EWS Control Room.
- Booked training on SCADA, Instrumentation and Telemetry Systems provided by specialist equipment supplier

b) Overview of the control and instrumentation system

1. Trenance 3 Pump Station:

The control philosophy for the Trenance 3 Pumping Station is fully described under the PLC and MCC auto control section.

- a) The pump station consists of two sets of pumps, both sets pumping to the on-site steel elevated tank for the high level supply zone
- b) The pump system consists of two horizontal single stage axially split volute casing pumps rated at 37kW (duty and standby) drawing from the 3 x interlinked clear water reservoirs on the site.
- c) The pumps and MCC shall be installed in the new pump station.
- d) The automatic starting and stopping of the pumps shall be controlled by level control from the Elevated Tank within the Pump Station site
- e) A new MCC room and telemetry room within the pump station building is to be constructed at the pump station to house the MCCs and telemetry equipment.
- f) The new pumps (duty and standby) will be fully automated, operating on the level sensor calling system and monitored by the telemetry and SCADA system. The PLC will be programmed to carry out this function.

The pumps shall be controlled by radio telemetry for starting and stopping signals system from the EWS Control Room.

New mag flow meters will be installed as follows:

- DN200 - Inlet to Existing Reservoirs 1 & 2, and the new reservoir
- DN200 - Outlet from Existing Reservoirs 1
- DN250 - Outlet from Existing Reservoirs 1 & 2, and the new reservoir
- DN200 - Outlet from New Elevated Tower

These flow rates and totaliser signals shall be transmitted via telemetry to the EWS Water Control Room.

All the signals for the pump/s status, reservoir levels, flow, pressure etc shall be relayed via telemetry to the EWS Water Control Room. The "Pump Call" signals will be received from the level sensor/s installed in the on-site Elevated Tank.

In order to monitor and control the new and existing infrastructure, there is a need to install a new Telemetry and Instrumentation systems for these sites. The telemetry and SCADA system at the EWS Water Control Room needs to be upgraded to include for the new sites, new pumps, new reservoir and elevated tank levels, new flow meters, intruder and fire alarms etc.

2.0 Dependencies

Access - Ethekwini Water or their appointed civil contractor to provide site access when required

Transducer Coring - Civil contractor to ensure that the transducer cores and associated galvanized enclosures are provided in advance of installation.

Civil Structures - Civil contractor to ensure that the civil structures such as Telemetry Room and Pump Rooms are ready for installation of equipment.

Civil Contractor to ensure that trenching for transducer cabling is carried out and that

cables are concreted in as per requirements.

Routing - Agreement on the positions for equipment mounting and the routing of cabling.
Power - Power should be installed and made available in the Telemetry room before Telemetry work can proceed.

Commissioning - An authorized person from the telemetry contractor must be available to sign off all testing, delivery, site installation and handover/commissioning and documentation for the project.

Communication Process

Communication process for the project to follow EWS guidelines as per the table below:-

Communication	Medium	Delivery Date	Frequency	Description/Notes	Audience	Owner
Project Team Communication	Meeting	Ongoing	Weekly	Weekly status meeting to discuss schedule, communications, actions, risks & issues	Project Team	PM
EWS Communication	Email	Ongoing	Weekly	Weekly status report for overview of the project progress	EWS	PM
	Meeting	Ongoing	Monthly	Monthly executive overview of the project progress	EWS	PM
	Email/Phone	Ongoing	As required	Queries	EWS	PM
	Meeting	Ongoing	As required	Safety File	EWS	Safety Officer
Main Contractor Communication	Email	Ongoing	Bi-monthly	Bi-monthly status report for overview of the project progress	Main Contractor	PM
	Email/Phone	Ongoing	As required	Queries	Main Contractor	PM
	Meeting	Ongoing	Monthly	Monthly overview of the project progress	Main Contractor	PM

A 1mm² 2 pair PVC overall screened cable such as a DEKORON cable is to be installed within a telemetry encasement and cable tray from the main panel or MCC to the telemetry panel.

Refer to eThekweni Telemetry and Instrument Install Specification Revision 01 & 02 included with the tender

PS ECI 2.17 EARTHING

The entire installation must be properly and effectively earthed as prescribed in the Standard Regulations of the Wiring Premises SANS 10142-1 and to the requirements of the relevant supply authority.

Earthing of the buildings and electrical installations shall meet the requirements of SANS 10313 as amended and SABS/IEC 61024 as amended. The main earth from the Supply Authority must not be relied upon as an effective ground earth.

The testing of the earthing system must be witnessed by the EWS representatives and the Engineer.

PS ECI 2.18 METERING & POWER SUPPLY

When applying for a new or upgraded electrical supply, the contractor may be given or obtain a property key number from the survey department. This number must be used when applying for the electrical supply. The incoming supply is to be sized to suit the full load of the operational duty pump/s and associated ancillaries. Cabling from the meter box to the MCC and telemetry DB shall form part of the internal electrical installation. The contractor will be required to liaise closely with the Supply Authority to ensure a timely mains connection to the meter cubicle/s.

The application for the power supply or connection to each site including the completion and submission of the application forms etc is to be made by the contractor (main civil and electrical contractor) on behalf of the Employer.

Completion certificates, COC's and meter cards shall be submitted to the Supply Authority to enable the Supply Authority to energise the mains where required.

PS ECI 2.19 MCC DISTRIBUTION BOARD

The electrical installation at the pump station/MCC building and telemetry room/s shall comply with the latest requirements of SANS 10142-1 and a compliance certificate with

test report shall be issued at the completion of the project. The local distribution board may form part of the main MCC in new installations.

DB circuit breakers shall be clearly marked with the item they are feeding eg. lights, plugs, external lights. A typed legend card shall be installed in the domestic cubicle indicating all equipment, circuit breakers etc.

If there is more than one lighting circuit, each circuit shall be marked lights 1, light 2, etc. the light fittings that are fed by light circuit 1 shall be clearly marked LC1... to identify where they are feed from. Plug and all other circuits must be marked in the same manner.

PS ECI 2.20 INSTRUMENTATION

Refer to EWS Telemetry Specification Rev 02 and Instrument Specification Rev 01 included as a separate document issued with the tender

PS ECI 2.20.1 Pressure Transducer

The pressure transducer is to be mounted on the delivery main pipeline within the pump stations and shall be the type WIKA S-10, 0-40 bar 4-20mA loop powered (2cwire) unit supplied complete with a PTFE pressure washer. A pressure transducer shall also be installed on the suction side of each pump and trip the pumps should the pressures deviate above or below the set points. The max pressure rating is to be confirmed and the operating pressure setting will be given later. The contractor is to obtain prior approval if he intends using a transducer from another supplier.

Where specified, the pressure switch shall be used to automatically control the pumps via the PLC depending on the set point pressure settings in the pumping system.

The delivery pressure transmitter shall be wired to the PLC which shall relay the signal to the SCADA system.

PS ECI 2.20.2 Temperature Transducer (Supplied with Pump and motor)

Approved motor PT100 thermistors and controllers shall be supplied with the pumps. The installation of the controllers and wiring in the MCC shall be undertaken by the electrical contractor.

PS ECI 2.20.3 Pump Casing Transducer, No Flow Switch, Float Switches and Pump Casing or Bearing Temperature Sensors

An IFM electronic or similar approved no flow switch or similar and equal approved shall be installed on the delivery line on the discharge of the pumps where specified. An ½ inch BSP socket shall be welded on the pipework for this. The controller shall be installed and wired in the MCC.

PT100 or other approved temperature sensors shall be installed for all the motor windings and for the pump casings as specified similar or equal to the IFM sensors.

Pump and motor bearing temperature sensors shall be installed in the pumps and motors as supplied with the pump sets.

Pump casing vibration sensors shall be provided to all pumps.

Float switches shall be as supplied by AC/DC or similar and equal approved and installed on stainless steel chain with weights to keep the floats in position. The floats are not to contain mercury and is to be safe for use in portable water. The weights are not to contain any lead or any unsafe product for use in potable water.

PS ECI 2.20.4 Magnetic Ultrasonic and Mechanical Flow Meter

Ultrasonic or Mag Flow Meter

All electronic mag flow meters for this project will be supplied and installed by the main contractor under the civil works. The electrical contractor will only be responsible to provide power to the units and install the power and signal cabling and connect up at

their respective devices. Earthing of the flow meter will form part of the electrical scope.

The following in-line flanged mag flow meters are required:

- DN200 - Inlet to Existing Reservoirs 1 & 2, and the new reservoir
- DN200 - Outlet from Existing Reservoirs 1
- DN250 - Outlet from Existing Reservoirs 1 & 2, and the new reservoir
- DN200 - Outlet from New Elevated Tower

The flow sensors will be installed on their respective pipelines. The flow transmitters will be installed adjacent the telemetry cabinet.

The flow meters shall be supplied with factory supplied cable of 20m length between the sensor and transmitter/converter.

The flow meter shall consist of primary head sensor IP68 rated with grounding rings and terminal box complete with flow converter 24V DC power supply with RS485 modbus communication capability with 20m factory supplied instrument cable complete with all other accessories etc.

A 16C screened signal cabling will be required from the flow meter to the telemetry panel.

The rate of flow and total flow signals shall be transmitted via telemetry to the existing EWS Control Room SCADA system.

The flow meter shall be installed and fitted to pipework and flanges to be provided by the civil contractor.

The rate of flow and total flow from these shall be converted and be transmitted via telemetry to the existing EWS Control Room SCADA system.

Mechanical Flow Meter

Mechanical meters are not required.

PS ECI 2.21 SIGNAGE

Signage inside and on the outside of the door to the pump station shall be provided in compliance with OHS Act (85 of 1995) and SANS 10142-1. In addition, a sign with the designation of the relevant pump station shall be fixed above the pump station door and a sign on the outside of the door shall read "UNAUTHORISED ENTRY NOT PERMITTED" It shall be on black PVC board with yellow lettering.

A label no smaller than 80mm high shall be mounted adjacent to each pump to identify it as a "PUMP 1 or "PUMP 2".

Other standard signage and labels to SANS requirements will be installed as follows:

- " Warning machine starts automatically " signage
- " Danger - No Unauthorised Entry " signage
- " Electricity Danger " signage
- Name of Pump Station
- Fire extinguisher signage

PS ECI 2.22 SECURITY

PS ECI 2.22.1 Fire Detection:

A detector type photoelectrical smoke detector of type Regal Altro Type (photoelectric smoke detector model No. JIC-636AR) must be installed on the ceiling or roof slab near the MCC panel, telemetry room and pump rooms only in accordance with the suppliers specification and in a position where the smoke will accumulate if there is a fire in the pump station and other rooms. The detector must be wired back to the main panel in 4 core 0.25mm² telephone cable and must be wired directly to the isolation relay and PLC. The unit may not be installed near ventilation fans, florescent lights or in the A frame roof space.

PS ECI 2.22.2 Intruder Alarm:

An intruder alarm system shall be provided inside the pump station MCC Room and the Telemetry Room (where applicable) consisting of a single passive infra red and microwave detector (IR AND MW) in each room, directly wired to the isolation relay and PLC for remote monitoring through the telemetry system. Cabling shall be a 0.25mm² 4 core telephone type cable. The detector shall be wall mounted at a height of 2.6 meter from floor level opposite the door and shall be a Regal Altro Type (Rokonet digital Zodiac PIR/QUAD RK-410QD0000A).

PS ECI 2.23 OPERATING PHILOSOPHY OF THE PUMP STATIONS

Refer to Clause PS ECI 2.7 for details on the operational philosophy for both pump stations and as described elsewhere in these specifications

PS ECI 2.24 OTHER REQUIREMENTS`

- a) The PLC will be programmed by a specialist employed by the supplier of the motor control panel in consultation with EWS Mechanical and Electrical Branch and the Control and Instrumentation Branch.
- b) The PLC system integrator must be a Recognized Certified Siemens System Integrator. Proof of this must be submitted with the tender.
- c) The project will not be signed off for payment before all snags identified in the preliminary inspection are complete and a compliance certificate and test report is issued.
- d) All cables are to be numbered according to the standard specification. Wiring colour codes must be adhered to in accordance with the standard specification. All light and plug circuits are to be labelled in accordance with the standard specification.
- e) Signage of the pump station must be done in accordance with the standard specification.
- f) All equipment supplied and installed shall be in accordance with the project specifications and as laid out under the standard specification.
- g) All documentation such as insurances, compliance with Dept of Labour and OHS Act requirements, construction programme, cash flow schedule and approved MCC shop drawings must be completed before work on site may begin.
- h) The complete O & M manuals as detailed in the enclosed documents must be submitted for comments and approval prior to the commissioning. The final documents shall be submitted on approval.

PS ECI 2.25 LIGHTING PROTECTION AND EARTHING TO PUMP STATION/MCC ROOM, TELEMTRY ROOM, ELEVATED TANKS AND RESERVOIRS AT THE TRENANCE 3 SITES

The lightning protection and earthing installation shall comprise the following:

- a) The Pump Stations/MCC Rooms and Telemetry Rooms will be constructed of brickwork with a concrete roof over. They may be independent separate buildings or in some cases may be constructed on top of the reservoirs.
The elevated steel tanks will be constructed on concrete plinths / bases and pads. The reservoirs will be constructed of concrete walls and concrete roof where applicable.
- b) A lightning protection and earthing system is required for the electrical room, MCC/ telemetry room, reservoir and elevated tanks and shall be installed in accordance with IEC62305, SANS1013 and SANS 10199 standards.
- c) The earth resistivity survey shall determine the final number and spacing of the earth electrodes.
- d) An earth mat consisting of 70mm² bare copper earth conductor shall be installed around the reservoirs/elevated tank and Pump Station/MCC Rooms and Telemetry Rooms with earth electrodes installed in positions shown on the drawings or as directed by the Engineer on site. A 10dia solid aluminium roof terminal conductor shall be installed around the roof of the reservoir or Pump Station and

MCC/Telemetry Rooms and connected to the reinforcing steel. This conductor shall be connected to the earth mat using 70 mm² PVC insulated earth conductors in PVC conduit. Test points shall be installed on all down conductors to the earth mat.

- e) The pump station, MCC Room, Telemetry Room and Reservoirs roofs shall be connected to the earthing ring main using 70mm² PVC insulated earth conductors. installed in positions shown on the drawings or as directed by the Engineer on site. A 10dia solid aluminium roof terminal conductor shall be installed around the roof of the buildings or structures and connected to the reinforcing steel in the reservoir. This conductor shall be connected to the earth mat.
- f) The steel columns or supporting structures of the elevated steel tank shall be bonded to the earthing system. 70mm² insulated earth wires installed in PVC conduit shall connect the steel bases and connected to the earth mat
- g) All underground connections to the earth electrodes or other earth conductors shall be exothermic welds and denso wrapped.
- h) All exposed earth wires shall be installed in conduit.
- i) The final resistance required for each site is 7 ohm or less.
- j) A 300mm x 6mm earth bar shall be installed adjacent the MCC and connected via 70mm² insulated earth wire to the earth mat.
- k) All steel handrailing, staircases, catladders or other metal structures shall be bonded to the earthing system.
- l) The integrity of the any existing earth mat is to be checked and tested
- m) The installation shall be undertaken as shown on the drawings or as directed by the Engineer on site. The installation and testing shall be witnessed by the Engineer and a full test and compliance certificate shall be submitted by the contractor.
- n) An as built layout shall be provided to the Engineer and Employer.

PS ECI 2.26

DRAWINGS AND MCC REQUIREMENTS

- a) The contractor will be required to provide schematic and wiring and layout drawings with parts list of the MCC for approval prior to manufacture. The I/O list and diagrams, FDS (functional design specification), cable terminations, cable block diagrams, tag numberings, network diagrams and architecture, cable schedule and instrument loop diagrams shall be included and supplied with the wiring diagrams (also refer to the EWS standard specifications). These shall be updated to as built and included in the O & M manuals.
- b) The contractor shall provide 3 sets of final as-built record drawings. Three sets of manuals with technical leaflets of only the equipment supplied shall be bound into a hard covered hinged binder together with contact details of the contractor and MCC manufacturer. The manuals shall also be provided in electronic format to the Client and Engineer.
- c) It is the contractor's responsibility to design the motor control centre power and control circuitry installation in accordance with the specification and good engineering practice.
- d) The design shall be undertaken by personnel who are able to demonstrate experience in the field of water pumping plant including control systems, PLC and telemetry systems.
- e) The testing and commissioning of the MCC and control systems shall be undertaken by the MCC designer and manufacturer in conjunction with the electrical contractor. The designer and manufacturer shall be present for both the FAT and on site SAT testing and commissioning.

PS ECI 2.27

PUMPSTATION INSTALLATIONS

PS ECI 2.27.1

REQUIREMENTS FROM THE ELECTRICAL & C & I CONTRACTOR

The following documentation is required from the tenderer:

- a) Company profile and company registration documents
- b) Tax clearance certificates
- c) VAT registration documents
- d) CSD documents
- e) Letter of Good Standing (COID)

- f) Compulsory CIDB registration of minimum CIDB grading of 5EB,
- g) BEE Certificates
- h) Registration with Department of Labour
- i) Experience report with list of at least five completed projects and values of similar nature (ie Motor Control & Instrumentation Installations for Pump Stations & Water Reservoir). Three reference letters are to be provided.
- j) Qualifications and CVs of key personnel. Criteria to be assessed will be qualifications of the design engineer, site agent and site supervisor. NQF qualification of minimum NQF Level 5 will be required for each personnel in key positions for the project
- k) References
- l) Documentation of the MCC equipment and electrics (returnable schedule)
- m) Meeting with EWS Mechanical and Electrical Branch and the Employer's Representative (Consulting Engineer) to discuss the dynamics of the project
- n) The complete installation must be guaranteed for 12 months from the date of the completion certificate.
- o) The contractor shall insure the entire works for the duration of the contract.

PS ECI 2.27.2 PAYMENT & RETENTION

Payment will be in accordance with the items included in the Schedule of Quantities and will be on successful completion of the activity.

The tendered rate is to include for all mobilisation costs, company overheads, insurances, guarantees, overtime (where applicable), transport, profit, site supervision for the duration of the works, reporting and printing requirements, computer and associated data costs.

PS ECI 3 STANDARD ETHEKWINI SPECIFICATIONS APPLICABLE TO THIS PROJECT

The following eThekwini standard specifications enclosed with this document shall apply and be read with this specification at all times;

- eThekwini Municipality PLC_Specification_Rev06
- eThekwini Municipality Telemetry and Instrument Install Specification_Rev01
- eThekwini Municipality Quality Control Specification_Rev03
- EWS Standard Electrical Specifications, 19.05.2020: GS1 - Standard Specifications for DB's and Motor Control Centres
- Commissioning _ Fat Forms 19112020 Test Reports FAT Combined
- EWS List of Preferred Instrumentation Equipment 7

PS ECI 4 TYPICAL FACTORY ACCEPTANCE AND SITE ACCEPTANCE TESTING (FAT AND SAT) PROCEDURE

Refer to Latest Working Revision of the EWS Quality Control Specification included with this tender.

PS ECI 4.1 PROCEDURES

PS ECI 4.1.1 Project Flow (PF)

- a) Receive control philosophy from EWS (included in specifications)
- b) Review above philosophy
- c) Raise queries to EWS
- d) Receive final control philosophy from EWS (Signed)
- e) PLC Quality Control FDS, Processes and Procedures
- f) Program PLC
- g) Create HMI Screens
- h) Send HMI screens for approval
- i) Review and finalise screens with EWS
- j) Factory acceptance test

- k) Site acceptance test

PS ECI 4.1.2 Factory Acceptance Test (FAT)

- a) Visual inspection to confirm that the drawing matches the physical panel.
- b) Input & output testing (Confirm correct wiring to and from PLC) – Refer to Annexure1
- c) Verify HMI signals correspond to item 1 – Refer to Annexure2
- d) Verify telemetry signals
- e) Operating and control philosophy – Refer to Annexure3
- f) All external signals to be simulated

PS ECI 4.1.3 Site Acceptance Test (SAT)

- a) Input & output testing of field wiring and marshalling
- b) Test all signals as per FAT including no flow and overload tests

Note: The designer and manufacturer of the motor control panel together with the electrical contractor shall be present on site to carry out the site testing and commissioning of the complete MCC, electrical and associated systems.

PS ECI 4.1.4 PLC HARDWARE & FAT CHECK LIST

The electrical contractor and panel builder shall confirm the equipment for the PLC and HMI for the equipment and parts as outlined below and confirm with EWS before submitting the tender and ordering the equipment.

PLC Hardware

The below list of minimum hardware to be installed within the PLC cubicle of the MCC;

Item	Description	Tag Name (Ref. to DWG)	Supplier	Part Number	Quantities
1	PLC Controller	CPU	Siemens	6ES7214-1AG40-0XB0	1
2	Digital Input Module	Digital Input Card	Siemens	6ES7221-1BH32-0XB0	2
3	Digital Output Card	Digital Output Card	Siemens	6ES7222-1HH32-0XB0	2
4	Analog Input Card	Analog Input Card	Siemens	6ES7231-4HF32-0XB0	2
5	HMI	HMI TP1500	Siemens	6AV2124-0QC02-0AX0	1
6	Ethernet Switch	8 PORT EHERNET SWITCH	DELTA	DVS-008I00	1
8	Wireless Router	WIFI	D-Link	N150	1

Note : Ethernet Switch, Modbus Serial Module, Power Monitor , Wireless Router etc as required shall be determined by the contractor and approved obtained from EWS C & I Department prior to procurement.

Also refer to the EWS Standard Specifications included with the tender for the detailed specifications and other requirements.

ANNEXURE A

COMPULSORY RETURNABLE DATA SHEETS**TECHNICAL DATA SHEET: MCC PANELS (Complete one for each MCC)****NAME OF SITE:** _____**RATING OF MCC PANEL:** _____

No	ITEM	SPECIFIED	OFFER
1	Manufacturer	Unspecified	
1A	Applicable Standards & IEEE 519 Compliance	Contractor to Specify	
2	Floor/Wall Mounted	Yes (floor)	
3	Front & Side Access	Yes	
4	Form Type & kA rating	2b/4b (manufacturer to confirm)	
5	Material	2mm 3CR12 SS	
6	Finish	Painted Electric Orange (epoxy coated)	
7	Cable Entry	Bottom	
8	Base	Hot dipped galvanised	
9	Doors	Lockable	
10	IP Rating	IP 44	
11	Electrical Details	400V, 50Hz, Full Neutral	
12	Earthing Details	Full Length	
12A	Instrument Earth	Full Length	
13	Busbar Chamber	Top	
14	Grouping of Equipment	Individual	
15	Door Interlocks	Isolator Interlocks	
16	Panel tiers	Bolted together transportable sections - no more than 1.5m in length. Extensible and modular	
17	Dielectric Barriers	Yes	
18	Busbar Supports	Epoxy Insulators on Steel	
19	Compliance with detailed technical specification	Yes/No	
20	SANS Approved	Yes/No	
21	Busbar Material	Copper	
22	Mouldered Case Circuit Breakers	Schneider, ABB or similar	
	Manufacturer	Yes/No	
	In Accordance with Spec	Yes/No	
23	Main Circuit Breakers	Schneider, ABB or similar	
	Manufacturer	Yes/No	
	In Accordance with Spec	Yes/No	
24	Selector Switches	Unspecified	
	Manufacturer	Yes/No	
	Type	Rotary	
	In Accordance with Spec	Yes/No	

NAME COMPANY: _____ **SIGNATURE OF REP:** _____**DATE** _____

ANNEXURE A**COMPULSORY RETURNABLE DATA SHEETS****TECHNICAL DATA SHEET: MCC PANELS (Complete one for each MCC)****NAME OF SITE:** _____**RATING OF MCC PANEL:** _____

No	ITEM		SPECIFIED	OFFER
25	HRC / Semi Conductor Fuses			
	Manufacturer	Unspecified		
	Type	Visible Link		
	In Accordance with Spec	Yes/No		
26	Contactors			
	Manufacturer	Unspecified		
	Type	AC3		
	In Accordance with Spec	Yes/No		
27	Variable Speed Drives-Low Harmonics	Yes/No		
	Harmonic study and report to be included	Yes		
	Manufacturer of Harmonic Filters & Chokes	Unspecified		
	Type	AC3		
	In Accordance with Spec and IEEE 519	Yes/No		
	Soft Starters	Yes/No		
	Manufacturer	Unspecified		
	Type	AC3		
	In Accordance with Spec	Yes/No		
28	Ancillary Relays			
	Manufacturer	Unspecified		
	Type	Plug-In		
	Field convertible contact configuration	Yes/No		
	In Accordance with Spec	Yes/No		
29	Push Buttons			
	Manufacturer	Unspecified		
	Type	As per spec		
	In Accordance with Spec	Yes/No		
30	Indicator Lamps			
	Manufacturer	Unspecified		
	Type	As per specs		
	In Accordance with Spec	Yes/No		
31	Emergency Stop Button			
	Manufacturer	Unspecified		
	Type	As per specs		
	In Accordance with Spec	Yes/No		
32	Automatic Change over Equipment			
	Manufacturer	Unspecified		
	Type	As per specs		
	In Accordance with Spec	Yes/No		
	Power Safe as per specs	Indicator Lamps		
		Manufacturer	Unspecified	
		Type	As per specs	
		In Accordance with Spec	Yes/No	

NAME COMPANY: _____ **SIGNATURE OF REP:** _____**DATE** _____