



Sequential Number:

**Contract No: UGU-07-1689-2025 - Umzinto Wastewater Treatment Works & Outfall Sewers
Upgrade and Rehabilitation Phase 2A - Upgrade and Extension of the Umzinto Wastewater Treatment Works From 2.5 MI to 4.0 MI**

UGU-07-1689-2025

Construction and commissioning of Civil, Mechanical and Electrical Works

CIDB CONTRACTOR GRADING: 8CE OR HIGHER

VOLUME 1 of 2

COMPILED BY:

S Zoko Consulting

P O Box 668

MARGATE

4275

Tel N^o: +27 39 317 4534

Email: info@szcon.co.za

ON BEHALF OF:

Ugu District Municipality

P O Box 33

PORT SHEPSTONE

4240

+27 39 688 5700

Nokubonga.Malinga@ugu.gov.za

TENDER CLOSING DATE: 12H00, FRIDAY 04 APRIL 2025

NAME OF TENDERER	
ADDRESS OF TENDERER	
TELEPHONE N^o	
FAX N^o	
TENDER SUM (for information only)	R _____

CHECK-LIST FOR TENDER SUBMISSION

The Tenderer is to indicate in the checkboxes provided that he has completed the required section of the tender document. Completion of this checklist will assist the Tenderer in ensuring that he has attended to all the required items for submission with this tender.

Page	Description	Completed		For office use		
		Yes	No	Yes	No	Comments
Cover	Name of Tenderer					
	Contact Details					
	Tender Sum					
TP2	Invitation To Bid – MBD 1					
RD.3	Site Inspection Certificate – Site Information					
RD.4	Relevant Experience / Schedule of Similar Work Undertaken					
RD.5	Key Personnel and Schedule					
RD.13	Schedule of Plant and Equipment					
RD.14	Schedule of Sources of Supply of Material					
RD.18	Contract Participation Goals and Declaration					
RD.22	Alterations by Tenderer					
RD.23	Authority of Signatory					
RD.25	Contractor's Health and Safety Declaration					
RD.27	Contractor's Certificate of Registration with CIDB					
RD.28	Contractor's COID Registration Details					
RD.29	Tenderer's Financial Standing					
RD.30	Proof of Bank Details					
RD.31	Form of Intent to Provide a Performance Guarantee					
RD.32	Tax Status Pin					
RD.33	Company Registration Certificate and Shareholding Details					

Page	Description	Completed		For office use		
		Yes	No	Yes	No	Comments
RD.34	Copies of Directors' / Members' Identity Documents					
RD.35	Preference Points Claim Form – MBD 6.1					
RD.40	Method Statement / Approach Paper					
RD.41	Preliminary Programme and Cashflow					
RD.42	Record of Addenda to Tender Document					
RD.43	Compulsory Enterprise Questionnaire					
RD.46	Bidder's Disclosure – MBD 4					
RD.49	Joint Venture Agreement					
RD.50	Current Commitments Schedule					
RD.51	Proof Of Good Standing with Municipal Accounts					
RD.52	Declaration for Procurement above R10 Million					
RD.54	Central Supplier Database Registration					
RD.55	Tenderer's Financial Position Declaration					
RD.56	Quality Assurance Plan and Control Procedures					
RD.57	Claim With Respect To Ownership By Targeted Groups					
RD.58	BBBEE Compliance Certificate					
RD.59	Schedule of Proposed Subcontractors					
RD.60	Technical Schedules					
C.2	Form of Offer					
C.7	Contract Data (Part 2)					
PD.5	Bill of Quantities					

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		T1.2	Tender Data	Pink	TP.7
		T1.3	Standard Conditions	Pink	TP.35
		Returnable Documents			
		T2.1	List of Returnable Documents	White	RD.1
		T.2.2	Returnable Schedules	White	RD.2
		T2.3	Technical Schedules	White	RD.60
	Contract and Pricing Data	Part 1: Agreement and Contract Data			
		C1.1	Form of Offer and Acceptance	White	C.2
		C1.2	Contract Data	Yellow	C.7
		C1.3	Forms of Guarantee (General)	Yellow	C.24
		C1.4	Agreement in terms of Section 37(2) – OHS Act	Yellow	C.26
		C1.5	Notification of Construction Work	Yellow	C.31
		C1.6	Adjudicator's Agreement	Yellow	C.33
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		Part 2: Pricing Data			
		C2.1	Pricing Instructions	Yellow	PD.3
		C2.2	Bills of Quantities	Yellow	PD.5
VOLUME 2	Scope of Works Site Information	Part 3: Scope of Work			
		C3.1	Standard Specifications	Blue	SW.1
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VOLUME 1

TENDER

TENDERING PROCEDURES

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T1.1 TENDER NOTICE AND INVITATION TO TENDER



CIDB CONTRACTOR GRADING (8CE OR HIGHER)

Contract No: UGU-07-1689-2025 - Umzinto Wastewater Treatment Works & Outfall Sewers

Upgrade and Rehabilitation Phase 2A - Upgrade and Extension of the Umzinto Wastewater

Treatment Works From 2.5 MI to 4.0 MI

Contract No: UGU-07-1689-2025

Construction and commissioning of Civil, Mechanical and Electrical Works

Ugu District Municipality invites competent and experienced tenderers for the Construction and Commissioning of Civil, Mechanical and Electrical Works Including earthworks, building works, pipework and chambers. The Mechanical Works will include the supply, installation and commissioning of steel pipework, valves, fittings, pumps, motors and general Mechanical Works. The Electrical and Instrumentation Works will consist of Supplying, Installing, and Commissioning MCC panels, PLCs, and instrumentation and general electrical works.

Only Tenderers currently registered with the CIDB or registered prior to the evaluation of tenders on a CIDB grading equal to or higher than 8CE or 8ME and those who satisfy the conditions stated in the tender data are eligible to tender. It is a condition of this tender that the 8 CE Main Civil contractor sub-contracts with an Electrical Contractor having a CIDB grading equal to or higher than 6 EP (should they not have this capacity in-house), who will undertake the Electrical and Instrumentation Works that forms a part of this tender. Should the Civil Contractor elect to appoint a Mechanical Sub-Contractor, the Mechanical Contractor shall also have a 6 ME or higher CIDB grading.

The tender will be evaluated based on functionality, price, and preference. A minimum of 70% must be obtained for eligibility. Bids scoring less than 70% will not be evaluated further. The following will form the criteria to be utilised for functionality assessment:

The tender will be evaluated based on functionality, price, and preference. A minimum of 70% must be obtained for eligibility. Bids scoring less than 70% will not be evaluated further. The following will form the criteria to be utilised for functionality assessment: Description	Maximum Allocated Points
Relevant experience (Civil Contractor)	20
Relevant experience (Mechanical and Electrical Main or Sub-Contractor)	15
Financial Resources (Bank Rating)	10
Experience of Key Personnel	20
Quality Assurance Plan and Control Procedures	5
Previous Performance on similar Water or Sanitation Projects (Civil Contractor)	12
Previous Performance on similar Mechanical/Electrical and Instrumentation for Water and Sanitation Projects	8
Method Statement / Approach Paper	5
Preliminary Programme	5
TOTAL MAXIMUM POINTS	100

Ugu District Municipality subscribes to the Preferential Procurement Regulations 2022, pertaining to the Preferential Procurement Policy Framework Act (PPPFA) principles whereby a bidder's submission will be evaluated according to the sum of the award of points with respect to the tender value and Specific Goals.

Price and Preference will be used for evaluation. The 90/10 preferential point system will be applicable, with 90 points for price and 10 points for Specific Goals (See below table), in terms of the revised Preferential Procurement Regulation in effect from 16 January 2023 Gazette Notice No. 47452 dated 04 November 2022.

Points to be allocated will be based on the following:

#	Categories	Weight	90 10
1	Ownership	50%	5
2	Empowerment	20%	2
3	Reconstruction & Development Programme	20%	2
4	Other (Specify)	10%	1
	Total	100%	10
#	Specific Goal(s)	Weight	90 10 PP
	Ownership Categories:		
1	Broad Based Black Economic Empowerment:		
	BBBEE Level 1	100%	5
	BBBEE Level 2	80%	4
	BBBEE Level 3 to 8	40%	2
	Empowerment		
2	Sub-Contracting: [Min 5% for >R5 Million] [Max 30% < R30 Million]		
	1. an EME or QSE which is at least 100% owned by black people;	100%	2
	2. an EME or QSE which is at least 51% owned by black people;	50%	1
	3. an EME or QSE which is at 25% - 50% owned by black people;	25%	0.5
3	Promotion of Local Business(s) - RDP		
	1. Enterprise Located within the District Municipality - Rural	100%	2
	2. Enterprise Located within the District Municipality - Urban	75%	1.5
	3. Enterprise Located within the Province	25%	0.5
4	Other Specific Goals		
	1. Enterprise 100% owned by Youth/Women/Disabled/ Military Veterans	100%	1

Tender documents will be available from the Ugu District Municipality, 28 Connor Street, Port Shepstone, 4240, during office hours between **10h00 to 15h00 from 3 March 2025 until the day before the clarification meeting).**

No documents will be distributed at the tender clarification meeting. A non-refundable document fee of R1,500,00, payable in cash or by bank-guaranteed cheque made out in favor of Ugu District Municipality, is required on collection of the tender documents.

Tender Documents will also be available on the Ugu District Municipality website, www.ugu.gov.za, and the e-Tender Portal for free download by Tenderers as 10h00, from Monday, 03 March 2025. **The document must be compiled according to the CIDB standard colour coding.**

Technical queries may be addressed to **S ZOKO CONSULTING** via email only at szoko@szcon.co.za

A **compulsory clarification** meeting with representatives of the Employer will take place **on Friday, 7 March 2025 at 10:00.**, at the existing Umzinto Wastewater Treatment Works (30°18'10.98"S; 30°41'05.64"E).

The closing time for receipt of tenders is not later than 12h00 on Friday, 04 April 2025.

Only tenders deposited in the official tender box will be accepted by the closing time and date.

Tenders, completed as prescribed, shall be sealed in an envelope marked.

“Contract No: UGU-07-1689-2025 - Umzinto Wastewater Treatment Works & Outfall Sewers Upgrade and Rehabilitation Phase 2A - Upgrade and Extension of the Umzinto Wastewater Treatment Works From 2.5 MI to 4.0 MI – Construction and Commissioning of Civil, Mechanical and Electrical Works”

And deposited in the official tender box in the foyer of Ugu District Municipality at 96 Marine Drive, Phase 2 Building, Oslo Beach.

Tenderers shall take note of the following tender conditions:

Ugu District Municipality does not bind itself to accept the lowest or any tender.

No state employee is permitted to conduct any business whatsoever, either directly or indirectly, with the Ugu District Municipality.

Tenders submitted are to remain valid for 90 days from the closing date for submission of tenders.

Mr. VO Mazibuko
Acting Municipal Manager
Ugu District Municipality

INVITATION TO BID – MBD 1

PART A

YOU ARE HEREBY INVITED TO BID FOR REQUIREMENTS OF THE UGU DISTRICT MUNICIPALITY					
BID NUMBER:	UGU-07-1689-2025	CLOSING DATE:	04 March 2025	CLOSING TIME:	12h00
DESCRIPTION	Contract No: UGU-07-1689-2025 - Umzinto Wastewater Treatment Works & Outfall Sewers Upgrade and Rehabilitation Phase 2A - Upgrade and Extension of the Umzinto Wastewater Treatment Works From 2.5 MI to 4.0 MI - Construction and commissioning of Civil, Mechanical and Electrical Works				
THE SUCCESSFUL BIDDER WILL BE REQUIRED TO FILL IN AND SIGN A WRITTEN CONTRACT FORM (MBD7).					

BID RESPONSE DOCUMENTS MAY BE DEPOSITED IN THE BID BOX SITUATED AT UGU DISTRICT MUNICIPALITY AT 96 MARINE DRIVE, PHASE 2 BUILDING, OSLO BEACH

SUPPLIER INFORMATION					
NAME OF BIDDER					
POSTAL ADDRESS					
STREET ADDRESS					
TELEPHONE NUMBER	CODE		NUMBER		
CELLPHONE NUMBER					
FACSIMILE NUMBER	CODE		NUMBER		
E-MAIL ADDRESS					
VAT REGISTRATION NUMBER					
TAX COMPLIANCE STATUS	TCS PIN:		OR	CSD No:	
B-BBEE STATUS LEVEL VERIFICATION CERTIFICATE [TICK APPLICABLE BOX]	☐ Yes ☐ No		B-BBEE STATUS LEVEL SWORN AFFIDAVIT	☐ Yes ☐ No	
[A B-BBEE STATUS LEVEL VERIFICATION CERTIFICATE/ SWORN AFFIDAVIT (FOR EMES & QSEs) MUST BE SUBMITTED IN ORDER TO QUALIFY FOR PREFERENCE POINTS FOR B-BBEE]					
ARE YOU THE ACCREDITED REPRESENTATIVE IN SOUTH AFRICA FOR THE GOODS / SERVICES / WORKS OFFERED?	☐ Yes ☐ No [IF YES ENCLOSE PROOF]		ARE YOU A FOREIGN BASED SUPPLIER FOR THE GOODS/SERVICES / WORKS OFFERED?	☐ Yes ☐ No [IF YES, ANSWER PART B:3]	
TOTAL NUMBER OF ITEMS OFFERED			TOTAL BID PRICE	R	
SIGNATURE OF BIDDER			DATE		
CAPACITY UNDER WHICH THIS BID IS SIGNED					
BIDDING PROCEDURE ENQUIRIES MAY BE DIRECTED TO:			TECHNICAL INFORMATION MAY BE DIRECTED TO:		
DEPARTMENT	FINANCE		ENGINEER	Ugu District Municipality	
CONTACT PERSON	Ntabiso Mabaso		CONTACT PERSON	Mr S Mbele	
E-MAIL ADDRESS	Ntabiso.mzotho@ugu.gov.za		E-MAIL ADDRESS	Smanga.Mbele@ugu.gov.za	

**PART B
TERMS AND CONDITIONS FOR BIDDING**

BID SUBMISSION:										
BIDS MUST BE DELIVERED BY THE STIPULATED TIME TO THE CORRECT ADDRESS. LATE BIDS WILL NOT BE ACCEPTED FOR CONSIDERATION. ALL BIDS MUST BE SUBMITTED ON THE OFFICIAL FORMS PROVIDED - (NOT TO BE RE-TYPED) OR ONLINE THIS BID IS SUBJECT TO THE PREFERENTIAL PROCUREMENT POLICY FRAMEWORK ACT AND THE PREFERENTIAL PROCUREMENT REGULATIONS, 2022, THE GENERAL CONDITIONS OF CONTRACT (GCC) AND, IF APPLICABLE, ANY OTHER SPECIAL CONDITIONS OF CONTRACT.										
TAX COMPLIANCE REQUIREMENTS										
BIDDERS MUST ENSURE COMPLIANCE WITH THEIR TAX OBLIGATIONS. BIDDERS ARE REQUIRED TO SUBMIT THEIR UNIQUE PERSONAL IDENTIFICATION NUMBER (PIN) ISSUED BY SARS TO ENABLE THE ORGAN OF STATE TO VIEW THE TAXPAYER'S PROFILE AND TAX STATUS. APPLICATION FOR THE TAX COMPLIANCE STATUS (TCS) CERTIFICATE OR PIN MAY ALSO BE MADE VIA E-FILING. IN ORDER TO USE THIS PROVISION, TAXPAYERS WILL NEED TO REGISTER WITH SARS AS E-FILERS THROUGH THE WEBSITE WWW.SARS.GOV.ZA. FOREIGN SUPPLIERS MUST COMPLETE THE PRE-AWARD QUESTIONNAIRE IN PART B:3. BIDDERS MAY ALSO SUBMIT A PRINTED TCS CERTIFICATE TOGETHER WITH THE BID. IN BIDS WHERE CONSORTIA / JOINT VENTURES / SUB-CONTRACTORS ARE INVOLVED; EACH PARTY MUST SUBMIT A SEPARATE TCS CERTIFICATE / PIN / CSD NUMBER. WHERE NO TCS IS AVAILABLE BUT THE BIDDER IS REGISTERED ON THE CENTRAL SUPPLIER DATABASE (CSD), A CSD NUMBER MUST BE PROVIDED.										
QUESTIONNAIRE TO BIDDING FOREIGN SUPPLIERS										
<table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 70%;">IS THE ENTITY A RESIDENT OF THE REPUBLIC OF SOUTH AFRICA (RSA)?</td> <td style="width: 30%; text-align: right;">☐ YES ☐ NO</td> </tr> <tr> <td>DOES THE ENTITY HAVE A BRANCH IN THE RSA?</td> <td style="text-align: right;">☐ YES ☐ NO</td> </tr> <tr> <td>DOES THE ENTITY HAVE A PERMANENT ESTABLISHMENT IN THE RSA?</td> <td style="text-align: right;">☐ YES ☐ NO</td> </tr> <tr> <td>DOES THE ENTITY HAVE ANY SOURCE OF INCOME IN THE RSA?</td> <td style="text-align: right;">☐ YES ☐ NO</td> </tr> <tr> <td>IS THE ENTITY LIABLE IN THE RSA FOR ANY FORM OF TAXATION?</td> <td style="text-align: right;">☐ YES ☐ NO</td> </tr> </table> IF THE ANSWER IS "NO" TO ALL OF THE ABOVE, THEN IT IS NOT A REQUIREMENT TO REGISTER FOR A TAX COMPLIANCE STATUS SYSTEM PIN CODE FROM THE SOUTH AFRICAN REVENUE SERVICE (SARS) AND IF NOT REGISTER AS PER 2.3 ABOVE.	IS THE ENTITY A RESIDENT OF THE REPUBLIC OF SOUTH AFRICA (RSA)?	☐ YES ☐ NO	DOES THE ENTITY HAVE A BRANCH IN THE RSA?	☐ YES ☐ NO	DOES THE ENTITY HAVE A PERMANENT ESTABLISHMENT IN THE RSA?	☐ YES ☐ NO	DOES THE ENTITY HAVE ANY SOURCE OF INCOME IN THE RSA?	☐ YES ☐ NO	IS THE ENTITY LIABLE IN THE RSA FOR ANY FORM OF TAXATION?	☐ YES ☐ NO
IS THE ENTITY A RESIDENT OF THE REPUBLIC OF SOUTH AFRICA (RSA)?	☐ YES ☐ NO									
DOES THE ENTITY HAVE A BRANCH IN THE RSA?	☐ YES ☐ NO									
DOES THE ENTITY HAVE A PERMANENT ESTABLISHMENT IN THE RSA?	☐ YES ☐ NO									
DOES THE ENTITY HAVE ANY SOURCE OF INCOME IN THE RSA?	☐ YES ☐ NO									
IS THE ENTITY LIABLE IN THE RSA FOR ANY FORM OF TAXATION?	☐ YES ☐ NO									

**NB: FAILURE TO PROVIDE ANY OF THE ABOVE PARTICULARS MAY RENDER THE BID INVALID.
NO BIDS WILL BE CONSIDERED FROM PERSONS IN THE SERVICE OF THE STATE.**

SIGNATURE		NAME (PRINT)	
CAPACITY		DATE	
NAME OF FIRM			

T1.2 Tender Data

(Applicable to this Tender)

The Conditions of Tender applicable to this contract are the Standard Conditions of Tender as contained in Annexure C of the CIDB *Standard for Uniformity in Construction Procurement* and as per Annexure C of the CIDB *Standardized Construction Procurement Documents for Engineering and Construction Works (contained in Government Gazette No. 42622 of 08 August 2019)*. A copy of the Standard Conditions of Tender is provided herewith as an Appendix to T1.2. (Refer to T1.3 Standard Conditions of Tender).

The Tender Data makes several references to the Standard Conditions of Tender for details that apply specifically to this tender. **(The Tender Data shall have preference in the interpretation of any ambiguity or inconsistency between it and the Standard Conditions of Tender).**

Each item of Tender Data given below is cross-referenced to the relevant clause in the Standard Conditions of Tender to which it mainly applies.

Clauses Prefixed by C.1 highlight General obligations

Clauses Prefixed by C.2 highlight Tenderers obligations

Clauses Prefixed by C.3 highlight Employers undertaking

Clause No	Description
C.1	GENERAL
C.1.1	Actions
C.1.1.1	The Employer is Ugu District Municipality P O Box 33, Port Shepstone 4240 Telephone N°: 039 688 5700
C.1.2	Tender Documents The Tender Document issued by the Employer comprises of two volumes: <u>VOLUME 1:</u> Part T1 Tendering Procedures T1.1 Tender Notice and Invitation to Tender T1.2 Tender Data T1.3 Standard Conditions Part T2 Returnable T2.1 List of Returnable Documents T2.2 Returnable Schedules Part C1 Agreements and Contract Data C1.1 Form of Offer and Acceptance C1.2 Contract Data C1.3 Forms of Security C1.4 Agreement in terms of the Occupational Health & Safety Act C1.5 Notification of Construction Work C1.6 Adjudicator's Agreement C1.7 Form of Guarantee (Materials on Site) Part C2 Pricing Data C2.1 Pricing instructions C2.2 Bill of Quantities <u>VOLUME 2:</u> Part C3 Scope of Work C3.1 Standard Specifications C3.2 Project Specifications

Clause No	Description
	C3.3 Variations to Standardised Specification C3.4 Particular Specifications C3.5 List of Drawings and details (Provided on a CD) C3.6 Annexures VOLUME 3 Part C 4: Site Information C4.1 Locality C4.2 Site Conditions Part C5 Drawings C5.1 Drawings (Provided on CD)
	Relevant Standard Specifications: “General Conditions of Contract for Construction Works – 3rd Edition 2015” 3rd Print edition issued by the South African Institution of Civil Engineering (Short title “General Conditions of Contract 2015” or” GCC 2015”). This document is obtainable separately, and Tenderers shall obtain their own copies. “SANS 1200 – Standardized Specification for Civil Engineering Construction”. This document is obtainable separately, and Tenderers shall obtain their own copies. In addition, Tenderers are advised, in their own interest, to obtain their own copies of the following acts, regulations, and standards referred to in this document as they are essential for the Tenderer to get acquainted with the basics of construction management, the implementation of preferential construction procurement policies, and the participation of targeted enterprise and labour. The Occupational Health and Safety Act No 85 and Amendment Act No 181 of 1993, and the Construction Regulations 2014 (Government Gazette No 37305 of 07 February 2014, Notice No R84). The Construction Industry Development Board Act No 38 of 2000 and the Regulations in terms of the CIDB Act 38/2000, Government Notice No 692 of 9 June 2004 and No 464 of 2 July 2013. The Preferential Procurement Policy Framework Act No 5 of 2000, and the Preferential Procurement Policy Framework Act Regulations (2022). SANS 1921:2004 – Construction and Management Requirements for Works Contract, Parts 1 to 3. SANS 1914:2003 - Targeted Construction Procurement, Parts 1 to 6
C.1.4	The Employer’s Agent is S Zoko Consulting, represented by: Name: Sandiso Zoko Physical Address: 19 Valley Road, Margate, 4275 Postal Address: PO Box 668, Margate, 4275 Tel: +27 (0)39 317 4534 Fax: +27 (0)39 312 0320 E-mail: info@szcon.co.za

Clause No	Description
C.1.6.1	General Tenders that fail to meet the Eligibility requirements (C2.1), and/or the minimum Functionally requirements (C3.11.9), will not be considered for award and will not be evaluated in terms of C3.11.
C.2	TENDERER'S OBLIGATIONS
C.2.1	Eligibility Only those Tenderers who satisfy the following eligibility criteria are eligible to submit tenders: • The Tenderer submits a Tax Status Pin issued by the South African Revenue Services and is Tax Compliant with SARS, has made arrangements to meet outstanding tax obligations. • The Tenderer submits a letter of intent from an approved insurer undertaking to provide the Performance Guarantee to the format included in Part C1.3 of this procurement document; • The Tenderer or any of its directors/shareholders is not listed on the Register of Tender Defaulters in terms of the Prevention and Combating of Corrupt Activities Act of 2004 as a person prohibited from doing business with the public sector; The Tenderer has not: • Abused the Employer's Supply Chain Management System; or • Failed to perform on any previous contract and has been given a written notice to this effect; • The Tenderer has completed the Declaration of Interest and the Compulsory Enterprise Questionnaire and there are no conflicts of interest which may impact on the Tenderer's ability to perform the contract in the best interests of the Employer or potentially compromise the tender process and persons in the employ of the state are permitted to submit tenders or participate in the contract; • The Tenderer is registered and in good standing with the compensation fund or with a licensed compensation insurer; • The Tenderer must submit a copy of a joint venture agreement (if applicable); • Tenderers are required to submit a Bank Rating with this tender. Tenderers who receive a Bank Rating E, F, G, H will not be eligible to tender; • The Tender offer is signed by a person authorised on behalf of the Tenderer; • The Tenderer has completed and signed all returnable documents where relevant; • The Tenderer has met the minimum number of evaluation points for functionality (quality), if applicable; • The Employer is reasonably satisfied that the Tenderer has in terms of the Construction Regulations, 2014, issued in terms of the Occupational Health and Safety Act, 1993, the necessary competencies and resources to carry out the work safely. Additional Eligibility Criteria Furthermore, a Tenderer will only be eligible to submit a tender if: • The Tenderer is for a Main Civil Engineering Contractor with a minimum CIDB grading of 8CE or higher. • Should the Contractor elect to enter into a Sub-Contract agreement with an Electrical Contractor to carry out the Electrical and Instrumentation Scope of Works

Clause No	Description
	forming part of this tender, the Electrical Contractor shall have a 6EP or higher CIDB grading. - The Electrical Sub-Contractor is registered with the Electrical Contracting Board of South Africa and their Contract's Manager/ Site Agent is a Competent Person as defined in Regulation 1 of the General Machinery Regulations 1988, or a person registered in a Professional category in terms of the Engineering Act 2000. - Should the Contractor elect to enter into a Sub-Contract agreement with a Mechanical Contractor to carry out the Mechanical Scope of Works forming part of this tender, the Mechanical Contractor shall have a 6ME or higher CIDB grading. Only Tenderers scoring 70 points or more for Functionality, as stated in Clause C3.1.9, will be considered eligible to tender; The Tenderer's health and safety professionals must be registered with SACPCMP; The Tenderer has met the minimum 20% Contract Participation Goals (RD.18-RD.19) The Employer may, in its discretion, subject to the provision of Section 4(1)(d) of the State Tender Board Act (Act 86 of 1968), condone any failure to comply with the foregoing condition.
C.2.7	Clarification Meeting The arrangements for the compulsory clarification meeting are: Location: Umzinto Waste Water Treatment Works (30°18'10.98"S; 30°41'05.64"E), Date: Friday, 7 March 2025 Starting Time: 10h00 Tenderers must sign the attendance list in the name of the tendering entity. Addenda will only be issued to, and tenders will only be received from, those tendering entities appearing on the attendance list.
C.2.8	Accept that failure to request clarification on tender documents in at least 5 working days prior to the closing time stated in the tender data, it shall be deemed that all matters in the tender documents are clearly understood. Accept that the Employer shall not be obligated to respond to any requests for clarification of tender documents submitted in less than 5 working days prior to the closing date.
C.2.11	Alterations to Documents No unauthorised alterations or additions shall be made to any portion of the Tender Document. Any unauthorised alterations, additions or notes will be ignored and only the text as per the Employer's original version will be adhered to. The tender document itself shall not have pages removed or be separated in any way. Should a tender document be submitted in any manner except as meets original sequence and item and as a bound document, it will be liable for rejection by the Employer.
C.2.12	Alternative Tender Offer
C.2.11.1	Unless otherwise stated in the tender data, submit alternative tender offers only if a main tender offer, strictly in accordance with all the requirements of the tender documents, is also submitted as well as a schedule that compares the requirements of the tender documents with the alternative requirements that are proposed.

Clause No	Description
	All alternative tender offers shall be referred to in Section T2.3: Alterations to Tender.
C.2.11.2	Accept that an alternative tender offer must be based only on the criteria stated in the tender data or criteria otherwise acceptable to the employer.
C.2.11.3	An alternative tender offer must only be considered if the main tender offer is the winning tender.
C.2.13	Submitting a Tender Offer
C.2.13.3	Tender offers shall be submitted as an original only. One (1) scanned copy of the document is also required on a memory stick.
C2.13.4	<i>Add the following to the clause:</i> “Only authorised signatories may sign the original and all copies of the tender offer where required in terms of 2.13-3. <u>Accept that failure to submit proof of authorisation to sign the tender shall result in a Tender Offer being regarded as non-responsive.</u> In the case of a ONE-PERSON CONCERN submitting a tender, this shall be clearly stated. In case of a COMPANY submitting a tender, include a certified copy of the Certificate of Incorporation of such company shall, together with a <u>resolution by its board of directors</u> authorising a director or other official of the company to sign the documents on behalf of the company. In the case of a CLOSED CORPORATION submitting a tender, include a certified copy of the Founding Statement of such corporation, together with a <u>resolution by its members</u> authorising a member or other official of the corporation to sign the documents on each member’s behalf. In the case of a PARTNERSHIP submitting a tender, <u>all the partners</u> shall sign the documents, unless one partner or a group of partners has been authorised to sign on behalf of each partner, in which case <u>proof of such authorisation</u> shall be included in the Tender. In the case of a JOINT VENTURE submitting a tender, include <u>a resolution</u> of each company of the Joint Venture together with a resolution by its members authorising a member of the Joint Venture to sign the documents on behalf of the Joint Venture.” <u>Accept that failure to submit proof of authorisation to sign the tender, shall result in a Tender Offer being regarded as non-responsive.</u>
C.2.13.5	The Employer’s address for delivery of Tender offers and identification details to be shown on each Tender offer package is as follows: Location of the tender box: Ugu District Municipality Physical address: 96 Marine Drive, Phase 2 Building, Oslo Beach Identification details: Tender No°: UGU-07-1689-2025

Clause No	Description
	PHASE 2A - UPGRADE AND EXTENSION OF THE UMZINTO WASTEWATER TREATMENT WORKS FROM 2.5 MI to 4.0 MI Construction and commissioning of Civil, Mechanical and Electrical Works Tenderers Name Tenderers contact address
C 2.15	The closing time for submission of Tender offers is 12h00 hours on Friday 04 April 2025. Telephonic, telegraphic, telex, facsimile, late or emailed tender offers will not be accepted. The tenderer is to ensure that couriered/posted tenders are inserted into the tender box before the closing date and time.
C.2.16	Tender Offer Validity The Tender offer validity period is 90 (ninety) days from the date of tender closing. It the tender validity expires on a weekend or public holiday; it shall remain valid until close of business on the next business day.
C.2.17	Clarification of Tender Offer after submission Clarification of a Tender Offer in response to a request to do so from the Employer during the evaluation of Tender Offers must be provided within two working days of the Employer's request, failing which, the Employer may regard the Tender Offer as being non-responsive and not eligible for award.
C.2.18	Provide other Material Should the Tenderer not provide the material, or a satisfactory reason as to why it cannot be provided, within two working days of the Employer's request, the Employer may regard the Tender Offer as being non-responsive and not eligible for award.
2.18.1	Financial Standing Accept that if requested, the Tenderer shall within 7 days of the date upon which he is requested to do so, submit a full report from the Tenderer's banker as to the company's financial standing. The Employer may, in its discretion and subject to the provisions of Section 4(1) (d) of the State Tender Board Act 86 of 1968, condone any failure to comply with the foregoing condition. Accept that the Employer or the Employer's agent reserves the right to approach the Tenderer's banker or guarantor(s) as indicated in the tender document or the bankers of each of the individual members of any joint venture that is constituted for purposes of this Contract, with a view to ascertaining whether the required guarantee will be furnished, and for purposes of ascertaining the financial strength of the Tenderer or of the individual member of such venture.
C.2.23	Certificates The tenderer is required to submit with his tender all certificates as listed under Part T2.2 – Returnable Documents.

Clause No	Description
	Failure to submit all this information will render the Tender non-responsive and not eligible for ward. In cases where the tenderer has failed to submit any of the non-mandatory documents above with the tender, the Employer reserves the right to, at any time after the closure of the tender, but before the award of the tender, request the tenderer to provide the outstanding documents within 7 (seven) calendar days from date of notification.
<i>Add the following new clause:</i> C 2.24	Canvassing and obtaining of additional information by tenderer Accept that no Tenderer shall make any attempt either directly or indirectly to canvass any of the Employers officials or the Employer's agent in respect of his tender, after the opening of the tenders but prior to the Employer arriving at a decision thereon. No Tenderer shall make any attempt to obtain particulars of any relevant information, other than that disclosed at the opening of tenders."
<i>Add the following new clause:</i> C 2.25	Prohibitions on awards to persons in service of the state Accept that the Employer is prohibited to award a tender to a person:- - who is in the service of the state; or - if that person is not a natural person, of which any director, manager, principal shareholder or stakeholder is a person in the service of the state; or - a person who is an advisor or consultant contracted with the municipality <u>or</u> municipal entity. "In the service of the state" means to be – - a member of – - any municipal council; - any provincial legislature; or the National Assembly or the National Council of Provinces; - a member of the board of directors of any municipal entity; - an official of any municipality or municipal entity; - an employee of any national or provincial department; - provincial public entity or constitutional institution within the meaning of the Public Finance Management Act, 1999 (Act No.1 of 1999); - a member of the accounting authority of any national or provincial public entity; or
<i>Add the following new clause:</i> C 2.26	Awards to close family members of persons in the service of the state Accept that the notes to the Employer's annual financial statements must disclose particulars of any award of more than R2000 to a person who is a spouse, child or parent of a person in the service of the state (defined in clause 2.25), or has been in the service of the state in the previous twelve months, including – - the name of that person; - the capacity in which that person is in the service of the state; and - the amount of the award.

Clause No	Description
	In order to give effect to the above, the questionnaire for the declaration of interests in the tender of persons in service of the state in Section T2.2 must be completed.
C3	EMPLOYERS UNDERTAKING
C.3.1.1	Respond to requests from the Tenderer. The Employer will respond to requests for clarification received up to 5 working days before the tender closing time stated in the Tender Data / Tender Notice and Invitation to Tender.
C.3.2	Issue of Addenda: The Employer will issue addenda until 5 working days before the tender closing time stated in the Tender Data, Tender Notice and Invitation to Tender.
C.3.4	Opening of Tenders The time and location for opening of the tender offers are: Time: 12h00 Date: Friday, 04 April 2025 Location of the tender box: Ugu District Municipality Physical address: 96 Marine Drive, Phase 2 Building, Oslo Beach
3.9 3.9.1	"Check responsive Tender Offers for arithmetical errors, correcting them in the following manner: - Where there is a discrepancy between the amounts in figures and in words, the amount in words shall govern. - If a bill of quantities (or schedule of quantities or schedule of rates) applies and there is an error in the line-item total resulting from the product of the unit rate and the quantity, the <u>rate shall govern and the line-item total shall be corrected.</u> - Where there is a discrepancy between the amount indicated in the tender offer and the corrected amount obtained after completing the above steps, the corrected amount shall govern. - Where there is an error in the total of the prices either as a result of corrections required by this checking process or in the Tenderer's addition of prices, the total of the prices shall be adjusted to reflect the arithmetically correct summation of corrected line-item totals. Consider the rejection of a Tender Offer if the Tenderer does not accept the correction of the arithmetical errors in the manner described above.
C.3.11	Evaluation of tender <i>offers</i> .
C.3.11.1	Ugu District Municipality has adopted the tender evaluation methods and associated evaluation criteria and weightings that are specified in C3.11.3 to C3.11.9 below. The procedure for evaluation of responsive Tender Offers will be in accordance with the Ugu District Municipality's Supply Chain Management Policy document that was adopted by full Council with reference to the Participation and Conditions Pertaining to Preferential

Clause №	Description			
	Procurement, the Preferential Procurement Policy Framework Act N° 5 of 2000, and the Preferential Procurement Policy Framework Act Regulations (2022).			
C.3.11.3	Scoring Functionality points Tenders will be evaluated in two stages. Firstly, eligibility will be assessed, whereafter all responsive tenders will be for functionality. Tenders that do not meet the Eligibility Criteria, as stated under Clause C2.1 will be disqualified and not considered any further for tender award. Tenders that fail to achieve the minimum qualifying score for functionality, as stated under C3.11.9, will be disqualified and not considered any further for tender award. The remaining tenders will be evaluated in accordance with C.3.11.7 Method 2: Functionality, Price and Preference. using the 90/10 preference points system, as prescribed in the Preferential Procurement Regulations 5 and 6			
C.3.11.7	Scoring tenders on price and preference			
	The financial offers of the remaining responsive tender offers will be scored using the following formula: Nfo = W ₁ x A Where: Nfo = is the number of tender evaluation points awarded for the financial offer; W ₁ = is the maximum possible number of tender evaluation points awarded for the financial offer, which in this case is 90; A = is a number calculated using Formula 2 and Option 2 in Table C.1 below: TABLE C.1 – FORMULAE FOR THE VALUE OF A			
	FORMULA	BASIS FOR COMPARISON	VALUE OF “A”	
			Option 1	Option 2
	1	Highest price or discount	[1+(P-Pm) / Pm]	P/Pm
	2	Lowest price or percentage commission/fee	[1-(P-Pm) / Pm]	Pm/P
		Pm = is the comparative offer which is the most favourable P = is the comparative offer of the tender under consideration		

C.3.11.9	Scoring Functionality		
Points for quality must be entered here by the Tenderer based on the following Quality Scorecard. Only Tenderers scoring 70% or more for quality will be considered eligible to tender. Tenderers should supply supporting information to prove points claimed where this is not available in other Returnable Schedules. The client reserves the right to do a fiscal verification of the projects completed; failure to provide traceable references will lead to rejection, and the tender will receive a zero score.			
<u>Total Score for Quality</u>			
	Criteria	Possible Full Points	Actual Points Obtained
C.3.11.9.1	Relevant Experience: For Main Civil Contractor related to Water or Sanitation Projects, including concrete water retaining structures, buildings, earthworks, access roads and stormwater, or Mechanical and Electrical Works by a Contractor, applicable in the past 10 years.	20	S1 =
C.3.11.9.2	Relevant Experience: For Electrical/Mechanical Main/Sub-Contractor related to Pumps, transformers, MCC Panels, PLCs, instrumentation and general Electrical Works for Water or Sanitation Projects undertaken as an Electrical Main or Sub-Contractor, applicable in the past 10 years.	15	S2 =
C.3.11.9.3	Financial Resources: Bank Rating	10	S3 =
C.3.11.9.4	Experience of Key Personnel:	20	S4a = S4b = S4c = S4d = S4e =
C.3.11.9.5	Quality Assurance Plan and Control Procedures:	5	S5 =
C.3.11.9.6	Previous Performance on similar Water or Sanitation Projects for Main Civil Contractor: Project 1 (* to be scored by Employer) Project 2 (* to be scored by Employer) Project 3 (* to be scored by Employer)	4 4 4	*S6a = *S6b = *S6c =
C.3.11.9.7	Previous Performance on similar Mechanical and Electrical and Instrumentation Projects for Water or Sanitation Projects: Project 1 (* to be scored by Employer) Project 2 (* to be scored by Employer)	4 4	*S7a = *S7b =
C.3.11.9.8	Method Statement / Approach Paper	5	S8 =
C.3.11.9.9	Preliminary Programme	5	S9 =
	Total Possible Points	100	Total Points Obtained =

C.3.11.9.1	Criteria 1: Relevant Main Civil Contractor Experience applicable to past 10 years only: Maximum Score = 20						
Relevant Experience: Five (5) Projects For Main Civil Contractor related to Water or Sanitation Projects, including concrete water retaining structures, buildings, earthworks, access roads and stormwater, or Mechanical and Electrical Works by a Contractor, applicable in the past 10 years. For full points, the contractor must have completed five (5) projects with a value of more than R50 m. Points are scored at 4 points each for each qualifying project.					Project Value	Points	Score (S)
Contract	Value	Reference					
		Name	Organisation	Tel No			
1.					< R30 million R30 –40 million >R40 – 50 million > R50 million	0 2 3 4	
2.							
3.							
4.							
5.							
					Possible Full Points =	20	
					Actual Points Obtained S1 =		
Note: *Similar work (or Project) means successful construction of civil engineering project/s related to water or sanitation projects over the last 10 years (minimum value of R30 Million per Contract), including concrete water retaining structures, buildings, earthworks, access roads and stormwater, and including mechanical and electrical works by a sub-contractor, as indicated in Section T2.2 Form B: Schedule of Relevant Experience (for Similar Work Undertaken). *The Scoring of Points in the above Table will be based on the Actual Project Value and the associated points prescribed for each project referenced. (i.e. 0 points will be awarded for a project with a value below R30 million, 2 points will be awarded for a project with a value between R30 million and R40 million, 3 points will be awarded for a project with a value between R40 million and R50 million 4 points will be awarded for a project with a value greater than R50 million. *The Tenderer will submit Appointment Letters and Practical Completion Certificates of the claimed Projects and send same for the “Assessment of Performance” form (see example C.3.11.10) for the references listed above. These forms will then be used to score Criteria 6: C.3.11.9.6.1 to C.3.11.9.6.3.							

C.3.11.9.2		Criteria 2: Relevant Mechanical and Electrical Sub-Contractor Experience applicable to past 10 years: Maximum Score = 15					
Relevant Experience: Three (3) Projects For Mechanical and Electrical Sub-Contractor related to Pumps, transformers, MCC Panels, PLCs, instrumentation and general Electrical Works for Water or Sanitation Projects, undertaken as a Mechanical or Electrical Main or Sub-Contractor, applicable in the past 10 years.					Project Value	Points	Score (S)
Contract	Value	Reference					
		Name	Organisation	Tel No			
1.					< R10 million	0	
2.						0	
3.						2	
					>R15 – 20 million	3	
					> R20 million	5	
					Possible Full Points =		15
					Actual Points Obtained S2 =		
Note: *Similar work (or Project) means successful construction of Mechanical and electrical and instrumentation engineering project/s related to water or sanitation works, over the last 10 years (minimum value of R10 Million per Contract) including transformers, MCC Panels, PLC's, instrumentation and general Electrical Works, undertaken as an Electrical Main or Sub-Contractor, as indicated in Section T2.2 Form B: Schedule of Relevant Experience (for Similar Work Undertaken). *The Scoring of Points in the above Table will be based on the Actual Project Value and the associated points prescribed for each project referenced. (i.e. 0 points will be awarded for a project with a value below R10 million, 2 points will be awarded for a project with a value between R10 million and R15 million, 3 points will be awarded for a project with a value between R15 million and R20 million 4 points will be awarded for a project with a value greater than R20 million. *The Tenderer will submit Appointment Letters and Practical Completion Certificates of the claimed Projects and send same for the "Assessment of Performance" form (see example C.3.11.10) for the references listed above. Three replies will then be used to score Criteria 7: C.3.11.9.7.1 to C.3.11.9.7.2.							

C.3.11.9.3	Criteria 3: Financial Resources (Bank Rating): Maximum Score = 10		
Score one of the ratings listed below as reflected on rating received – see Section F1 of T2.2.1		Points	Score (S)
Bank Rating A – Undoubted for the amount of enquiry		10	
Bank Rating B – Good for the amount of enquiry		8	
Bank Rating C – Good for the amount quoted if applied strictly in the way of business		7	
Bank Rating D – Fair trade for the amount of enquiry		5	
Bank Rating E – Figures considered too high Bank Rating F – Financial Position Unknown Bank Rating G – Dishonour on records Bank Rating H – Frequently Dishonoured		Not eligible to tender	
Possible Full Points =		10	
Actual Points Obtained S3 =			
Note: Tenderers are to submit a copy of their bank rating in Section T2.2 Form L: Tenderer's Financial Standing.			

C.3.11.9.4		Criteria 4: Experience of Key Personnel: Maximum Score = 20		
Proposed key Personnel	Experience		Points	Score (S)
Project Director/ Contracts Manager Name:	Min. B Tech Degree in Civil Engineering or Mechanical Engineering and Professional registration with ECSA (Pr. Tech Eng)		7	S4a)
	Years of appropriate experience (score one of the categories)	<5	0	
		5 to 10	4	
		>10	7	
Site Agent / Project Manager (Note the Site Agent may be the same person as the Project Director) Name:	Min. National Diploma in Civil, Engineering or Mechanical Engineering		5	
	Years of appropriate experience (score one of the categories)	<5	0	
		5 to 10	2	
		10 to 15	3	
		>15	5	
Electrical Supervisor / Foreman Name:	Min. Diploma and Trade Certificate in Electrical Engineering		3	
	Years of appropriate experience (score one of the categories)	<5	0	
		5 to 10	2	
		>10	3	
Mechanical Supervisor / Foreman Name:	Trade Test Certificate		3	
	Years of appropriate experience (score one of the categories)	<5	0	
		5 to 10	2	
		>10	3	
Health and Safety Officer Name:	Approved Diploma / NQF Level 5 (SAMTRAC) / equivalent certificate in Health and Safety and SACPCMP registration as per regulations		2	
	Years of appropriate experience (score one of the categories)	<1	0	
		1 to 5	1	
		>5	2	
Possible Full Points =			20	
Actual Points Obtained S4 =				
Note: *Curriculum Vitae to be attached in Section T2.2 Form C: Key Personnel. *Years of appropriate experience means experience in the fields of concrete water retaining structures, buildings, earthworks and including mechanical and electrical works by a sub-contractor, as indicated in Section T2.2 Form B: Schedule of Relevant Experience (for Similar Work Undertaken). *Certified copies of Degrees, Diplomas, Trade Tests to be attached if points are claimed.				

C.3.11.9.5	Criteria 5: Quality Assurance Plan and Control Procedures: Maximum Score = 5 (Civil Contractor only)		
Score one status as listed below.		Points	Score (S)
ISO Accreditation		5	
Own Internal QA Plan		3	
None		0	
Possible Full Points =		5	
Actual Points Obtained S5			=
Note: *Attach current copy of ISO 9001:2015 Accreditation Certificate or copy of internal Quality Management System in Section T2.2 Form FF: Quality Assurance Plan and Quality Control Procedures.			

C.3.11.9.6	Criteria 6: Performance on Three Similar Projects undertaken within the last 10 years: Maximum Score = 15 (Main Civil Contractor only)	
C.3.11.9.6.1	PROJECT 1 – Evaluation Completed by Employer	
Note: *The project scored here will be selected and scored by the Employer from the five projects listed in Criteria 1 – Relevant Experience (Main Civil Contractor for Water or Sanitation Works) *The Tenderer will submit an “Assessment of Performance Form” (C.3.11.10) for all references listed in Criteria 1. *The Employer will then complete these pages and scores will be based on the above Referee’s responses received.		
Project Name: _____ Value of work carried out by Contractor: R_____		
Detail of work carried out by Contractor: _____ Referee Name: _____ Organisation: _____ _____		
Contact Details: _____		
Qualitative Statements as Assessed by Referees (refer to returned forms C3.11.10)	Points	Score
“Contractor’s Management was adequate for the contract.”	Not true 0	
“Contractor provided suitably qualified Site personnel.”	Partially fulfilled 0.5	
“Contractor complied with Health & Safety requirements	Substantially fulfilled 1	
“Contractors provided adequate resources for the contract.”	Completely fulfilled 2	
“Contractor’s communication and compliance to instructions was good”	(Score from returned reference sheet C.3.11.10)	
“Quality of work produced was to drawings and specification.”		
“Contract was completed on time”		
Possible Full Points	14	
Actual Points Obtained S6a = (Total Score / 14 x 4)		

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Signature of Referee

Company Stamp

The client reserves the right to do a fiscal verification of the projects completed; failure to provide traceable references will lead to rejection, and the tender will receive a zero score.

C.3.11.9.6.2	PROJECT 2 – Evaluation Completed by Employer	
Note: <i>*The project scored here will be selected and scored by the Employer from the five projects listed in Criteria 1 – Relevant Experience (Main Civil Contractor for Water or Wastewater Treatment Works)</i> <i>*The Employer will send the “Assessment of Performance Form” (C3.11.10) to two or more of the five references listed in Criteria 1.</i> <i>*The Employer will then complete these pages and scores will be based on the Referee’s responses received.</i>		
Project Name: _____ Value of work carried out by Contractor: R_____		
Detail of work carried out by Contractor: _____		
Referee Name: _____ Organisation: _____		
Contact Details: _____		
Qualitative Statements as assessed by Referees (refer to returned forms C3.11.10)	Points	Score
“Contractor’s Management was adequate for the contract”	Not true 0	
“Contractor provided suitably qualified Site personnel”	Partially fulfilled 0.5	
“Contractor complied with Health & Safety requirements	Substantially fulfilled 1	
“Contractor’s provided adequate resources for the contract”	Completely fulfilled 2	
“Contractor’s communication and compliance to instructions was good”	(Score from returned reference sheet C.3.11.10)	
“Quality of work produced was to drawings and specification”		
“Contract was completed on time”		
Possible Full Points	14	
Actual Points Obtained S6b = (Total Score / 14 x 4)		

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Signature of Referee

Company Stamp

The client reserves the right to do a fiscal verification of the projects completed; failure to provide traceable references will lead to rejection, and the tender will receive a zero score

C.3.11.9.6.3	PROJECT 3 – Evaluation Completed by Employer	
Note: *The project scored here will be selected and scored by the Employer from the five projects listed in Criteria 1 – Relevant Experience (Main Civil Contractor for Water or Sanitation Works) *The Employer will send “Assessment of Performance Form” (C3.11.10) to two or more of the five references listed in Criteria 1. *The Employer will then complete these pages and scores will be based on the Referee’s responses received.		
Project Name: _____		
Value of work carried out by Contractor: R_____		
Detail of work carried out by Contractor: _____		
Referee Name: _____		Organisation: _____
Contact Details: _____		
Qualitative Statements as assessed by Referees (refer to returned forms C3.11.10)	Points	Score
“Contractor’s Management was adequate for the contract”	Not true 0	
“Contractor provided suitably qualified Site personnel”	Partially fulfilled 0.5	
“Contractor complied with Health & Safety requirements	Substantially fulfilled 1	
“Contractor’s provided adequate resources for the contract”	Completely fulfilled 2	
“Contractor’s communication and compliance to instructions was good”	(Score from returned reference sheet C.3.11.10)	
“Quality of work produced was to drawings and specification”		
“Contract was completed on time”		
Possible Full Points	14	
Actual Points Obtained S6c = (Total Score / 14 x 4)		

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Signature of Referee

Company Stamp

The client reserves the right to do a fiscal verification of the projects completed; failure to provide traceable references will lead to rejection, and the tender will receive a zero score

C.3.11.9.7	Criteria 7: Performance on Two Similar Projects undertaken within the last 10 years: Maximum Score = 8 (Mechanical/Electrical Sub-Contractor only)	
C.3.11.9.7.1	PROJECT 1 (Mechanical/Electrical and Instrumentation) – Evaluation Completed by Employer	
Note: <i>*The project scored here will be selected and scored by the Employer from the five projects listed in Criteria 2 – Relevant Experience (Mechanical/Electrical Sub-Contractor for Water or Sanitation Works)</i> <i>*The Employer will send the “Assessment of Performance Form” (C3.11.10) to two or more of the five references listed in Criteria 2.</i> <i>*The Employer will then complete these pages and scores will be based on the Referee’s responses received.</i>		
Project Name: _____ Value of work carried out by Contractor: R_____		
Detail of work carried out by Contractor: _____		
Referee Name: _____ Organisation: _____		
Contact Details: _____		
Qualitative Statements as assessed by Referees (refer to returned forms C3.11.10)	Points	Score
“Contractor’s Management was adequate for the contract”	Not true 0	
“Contractor provided suitably qualified Site personnel”	Partially fulfilled 0.5	
“Contractor complied with Health & Safety requirements	Substantially fulfilled 1	
“Contractor’s provided adequate resources for the contract”	Completely fulfilled 2	
“Contractor’s communication and compliance to instructions was good”	(Score from returned reference sheet C.3.11.10)	
“Quality of work produced was to drawings and specification”		
“Contract was completed on time”		
Possible Full Points	14	
Actual Points Obtained S7a = (Total Score / 14 x 4)		

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Signature of Referee

Company Stamp

C.3.11.9.7.2	PROJECT 2 (Electrical and Instrumentation) – Evaluation Completed by Employer	
Note: *The project scored here will be selected and scored by the Employer from the five projects listed in Criteria 2 – Relevant Experience (Electrical Sub-Contractor for Water or Sanitation Works) *The Employer will send “Assessment of Performance Form” (C3.11.10) to two or more of the five references listed in Criteria 2. *The Employer will then complete these pages and scores will be based on the Referee’s responses received.		
Project Name: _____ Value of work carried out by Contractor: R_____ Detail of work carried out by Contractor: _____ Referee Name: _____ Organisation: _____ Contact Details: _____		
Qualitative Statements as assessed by Referees (refer to returned forms C3.11.10)	Points	Score
“Contractor’s Management was adequate for the contract”	Not true 0	
“Contractor provided suitably qualified Site personnel”	Partially fulfilled 0.5	
“Contractor complied with Health & Safety requirements	Substantially fulfilled 1	
“Contractor’s provided adequate resources for the contract”	Completely fulfilled 2	
“Contractor’s communication and compliance to instructions was good”	(Score from returned reference sheet F.3.11.10)	
“Quality of work produced was to drawings and specification”		
“Contract was completed on time”		
Possible Full Points	14	
Actual Points Obtained S7b = (Total Score / 14 x 4)		

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Signature of Referee

Company Stamp

C.3.11.9.8	<u>Criteria 8:</u> APPROACH PAPER / METHODOLOGY
The approach paper must respond to the scope of work and outline the proposed approach / methodology including proposals for outsourcing (including details for the companies to be used), leading to the delivery of the construction deliverables listed in the scope of the works (Part C3). The approach paper should articulate what value add the tenderer will provide in achieving the stated objectives for the project. Tenderers must explain their understanding of the objectives of the assignment and the Employer's stated and implied requirements, highlight the issues of importance, and explain the technical approach. They would also include a project plan and programme that outlines processes, procedures, and associated resources, indicates how risks will be managed and identifies what contribution can be made regarding value management. Tenderers must attach their approach papers to the page. The approach paper should be no longer than 6 pages.	
Score 5	
Weighing	Description
(Score 0)	No response / no documents submitted
Poor (Score 2)	The approach and / or methodology is poor / is unlikely to satisfy project objects or requirements. The tenderer has misunderstood certain aspects of the scope of work and does not deal with the critical aspects of the project. The programme is poor and has missed critical aspects.
Satisfactory (Score 3)	The approach is tailored to address the specific project objectives and methodology. The approach adequately deals with the critical characteristics of the project. The project plan and manner in which risk is to be managed etc is acceptable. The programme is adequate.
Good (Score 4)	The approach is tailored to address the specific project objectives and methodology and is sufficiently flexible to accommodate changes that may occur during execution. The project plan and approach to managing risk etc is tailored to the critical characteristics of the project. The programme is good and has allowed for all critical aspects.
Very Good (Score 5)	Besides meeting the "good" rating, the important issues are approached in an innovative and efficient way, indicating that the tenderer has outstanding knowledge of state-of-the-art approaches. The programme is well thought out and makes allowance for all the key risk areas.

C.3.11.9.9	<u>Criteria 9:</u> PRELIMINARY PROGRAMME
The preliminary programme must respond to the scope of work and outline the sequencing and duration of the various activities and tasks related to the construction deliverables listed in the scope of the works (Part C3). Tenderers must attach their preliminary programme to the page.	
Weighing	Description
(Score 0)	No response / no documents submitted
Poor (Score 2)	The preliminary programme is poor / is unlikely to satisfy project objects or requirements. The tenderer has misunderstood certain aspects of the scope of work and does not deal with the critical aspects of the project. The programme is poor and has missed critical aspects.
Satisfactory (Score 3)	The preliminary programme is tailored to address the specific project objectives and methodology. The programme adequately deals with the critical characteristics of the project. The programme is adequate.
Good (Score 4)	The preliminary programme is tailored to address the specific project objectives and methodology and is sufficiently flexible to accommodate changes that may occur during execution. The programme is good and has allowed for all critical aspects.
Very Good (Score 5)	The preliminary programme is well thought out and makes allowance for all the key risk areas, indicating that the tenderer has a very good understanding and knowledge of the project objectives, scope and required completion timeframe.

C.3.11.10	Assessment of Performance Form				
Assessment of Contractor's Performance by Independent Reference (The Employer will send this form to at least 3 of the references listed in each of the Criteria 1 and 2; C.3.11.9.1 and C.3.11.9.2 to obtain scores for Criteria 6 and 7 – Performance on Two Similar Projects undertaken in the last 15 years for the Main Civil and Mechanical/Electrical Sub-Contracts respectively.					
Please assess the Contractor (Name:) on his/her performance on the following Contract.					
Contract No.					
Name of Contract:			Year of execution:		
Contract value:		Employer:			
Contract duration:		Engineer:			
Referee's Position in Contract:					
Your assessment of the Contractor's performance in the following areas: <i>(please tick one of the blocks on the right-hand side)</i>		Not true	Partially fulfilled	Substantially fulfilled	Completely fulfilled
"Contractor's Management was adequate for the contract"					
"Contractor provided suitably qualified Site personnel"					
"Contractor complied with Health & Safety requirements"					
"Contractor's provided adequate resources for the contract"					
"Contractor's communication and compliance to instructions was good"					
"Quality of work produced was to drawings and specification"					
"Contract was completed on time"					
Any other comments:					
Name of person completing this assessment form (Referee):					
ECSA Prof Reg No: Representing firm:					
Please return by fax to: or e-mail to:					
Signature of Referee/Validator..... Date of Assessment:					

Price and Preference will be used for evaluation. The 80/20 preferential point system will be applicable, with 80 points for price and 20 points for Specific Goals (See below table), in terms of the revised Preferential Procurement Regulation in effect from 16 January 2023 Gazette Notice No. 47452 dated 04 November 2022.

Preferences

Categories

Up to 20 points (for financial values up to R50 000 000) or 10 points (for financial values over R50 000 000) will be awarded to tenderers who are found to be eligible for the preference claimed.

Points will be awarded to Tenderers for attaining specific goals as determined by Ugu District Municipality. For this tender the preference points will be allocated as follows:

#	Goal	Maximum Possible Score	
		80/20	90/10
1	Specific Goals (Broad-Based Black Economic Empowerment Contribution)	10	5
2	SMME Empowerment	4	2
3	Reconstruction and Development Programme – Promotion of Local Businesses	4	2
4	Enterprise Ownership by targeted designated groups (youths/disabled/women/war veterans)	2	1
	TOTAL	20	10

Specific Goals

For Specific Goals, the Broad Based Black Economic Empowerment Contribution will be utilised and points will be allocated to a maximum of 10/ 5 for the as follows:

BBBEE Level	Points		Verification Method
	80/20	90/10	
1	10	5	BBBEE Certificate or sworn affidavit
2	8	4	
3-8	4	2	
9 and above	Nil	Nil	

Tenderers will be required to submit a sworn affidavit or BBBEE Verification Certificate as detailed in the Returnables.

SMME Empowerment

For this contract, it has been determined that up to 20% of the tendered contract value can be subcontracted to SMME's. Points will be allocated on the basis of maximum points possible, proportioned on the class of SMME, value of work to be subcontracted and the maximum points attainable.

Points for SMME Empowerment will be awarded as follows: Points

$$(\text{SMME Empowerment}) = f_1 \times f_2 \times S_c$$

Please note:

The maximum points for subcontracting to an SMME will be S_c , based on the price/preference points as follows:

Description	Price Preference	
	80/20	90/10
S_c	4	2

2. If the tendered contract amount (excluding provisional sums, contingencies, escalation and VAT) is C, the work agreed to be subcontracted is valued at S, the factor based on value of subcontracted $f_1 = S / (0.2 \times C)$. The maximum value of f_1 is 1.

3. The factor f_2 for the class of SMME will be determined as follows:

#	Class/description of SMME	Factor, f_2	Verification Method
1	An EME or QSE which is 100% owned by black people	100%	Company registration certificate (CK Document), sworn affidavit and audited financial statements (as appropriate)
2	An EME or QSE whose ownership by black persons is over 50% but below 100% owned by black people	50%	
3	A EME or QSE which is 25 to 50% owned by black people	25%	
4	An EME or QSE whose ownership by black persons is less than 25%	0%	

Promotion of Local Business

Preference will be given to tenderers who are locally based, as follows:

#	Description	Price Preference		Verification Method
		80/20	90/10	
1	Enterprise located within the District Municipality - Rural	4	2	Municipal rates or copy of signed Lease agreement Councilor and or affidavit for those residing in rural areas.
2	Enterprise located within the Ugu District Municipality - Urban	2	1	
3	Enterprise located within the province of KwaZulu Natal	1	0.5	

Other Specific Goals

Should the tendering enterprise, be owned 100% by the youth, women, disabled and military war veterans, a further preference points will be awarded as follows:

Price Preference	80/20	90/10	Verification Method
Points to be awarded	2	1	Company registration certificate (CK Document) and ID copies of members ID's/medical certificate/confirmation from WVA

C.3.13	Acceptance of Tender Offer
	Tenderer Offers will only be accepted if, in addition to the conditions listed in the Standard Conditions of Tender, the Tenderer is judged to be Eligible in terms of Clause C2.1 as well as the items listed below. Tender Offers will only be accepted on condition that: • The tender offer is signed by a person authorized to sign on behalf of the Tenderer; • A Tax Status Pin is included with his tender indicating Tax Compliance with SARS; • Tenderer's declaration of compliance with the Occupational Health and Safety Act No 85 of 1993 and the Construction Regulations 2014 is included with his tender submission; • A Tenderer who submitted a tender as a Joint Venture has included an acceptable Joint Venture Agreement with his tender; • The Tenderer or a competent authorised representative of the Contractor who submitted the tender has attended the compulsory clarification meeting or site inspection; • The Contractor who submits the tender is registered with the CIDB in the stated Contractor grading designation; • The Tenderer, or any of its directors, is not listed on the Register of Tender Defaulters in terms of the Prevention and Combating of Corrupt Activities Act of 2004 as a person prohibited from doing business with the public sector; The tenderer has not: • Abused the Employer's Supply Chain Management System; or • Failed to perform on any previous contract and has been given a written notice to this effect • The Tenderer has completed the Compulsory Enterprise Questionnaire, Declaration of Bidders' Past Supply Chain Management Practices and Declaration of Interest, and there are no conflicts of interest which may impact on the tenderer's ability to perform the contract in the best interests of the employer or potentially compromise the tender process; • The Tenderer or any of its principals, directors or managers is not employed in the service of the State or SAFDA. In the event that such principals are involved, official approval from the Executing Authority regarding the carrying out of remunerative work outside of the public service must be included in the tender submission; • The employer is satisfied that the Tenderer or any of his principals have not influenced the tender offer and acceptance by the following criteria: • Having offered, promised or given a bribe or other gift or remuneration to any person in connection with the obtaining or execution of this contract; • Having acted in a fraudulent or corrupt manner in obtaining or executing this contract; • Having approached an officer or employee of the employer or the employer's Agent with the objective of influencing the award of a contract in the Tenderer's favour; • Having entered into any agreement or arrangement, whether legally or not, with any other person, firm or company to refrain from tendering for his contract or as to the amount of the tender to be submitted by either party; • Having disclosed to any other person, firm or company other than the employer, the exact or approximate amount of his proposed tender; • The employer may, in addition to using any other legal remedies, repudiate the tender offer and acceptance and declare the Contract invalid should it have been concluded already. • The Tenderer acknowledged receipt of all addenda and alterations.

	Amendments and clarifications, according to the addenda, have been made and considered. Tenderer submitted recent (not older than 3 months), proof that they are in good standing with their Municipality.
C3.17	Copies of Contract The Employer will provide the successful Tenderer with 1 (one) paper copy of the signed contract.
C.3.19.3	Code of Conduct and Local Labour The Tenderers shall make themselves familiar with their requirements of the following policies of Ugu District Municipality with regard to the recruitment of local labour. Item 4.10.1 of the Contract Data has reference.
C3.19.1	The additional Conditions of Tender are: Appeal Process In terms of Regulation 49 of the Municipal Supply Chain Management Regulations persons aggrieved by decisions or actions taken by the Municipality, may lodge an appeal within 14 days of the decision or action, in writing to the Municipality. In dealing with these appeals, the Municipal Manager will follow the following procedure: All appeals (clearly setting out the reasons for the appeal) and queries with regard to the decision of award are to be directed to: The Municipal Manager Ugu District Municipality 28 Connor Street Port Shepstone 4240 A copy of the appeal will be forwarded to the Chairperson of the Bid Adjudication Committee, who must provide a response in writing within seven working days. In the event that there are allegations made against third parties, they will also be given an opportunity, to respond to the allegations within seven days. These responses will then be sent to the appellant for a reply within five working days. The appeal will be considered on these written submissions, unless the appeal authority is of the view that there is a need for oral submissions, in which case, the appellant will be notified of the date, place and time of such hearing.
C.3.19.2	Prohibition on awards to persons in the service of the state Clause 44 of the Supply Chain Management Regulations states that the Municipality or Municipal Entity may not make any award to a person: Who is in the service of the State; - If that person is not a natural person, of which a director, manager, principal shareholder or stakeholder is a person in the service of the state; or - Who is an advisor or consultant contracted with the municipality or a municipal entity. - Should a contract be awarded, and it is subsequently established that Clause 44 has been breached, the Employer shall have the right to terminate the contract with immediate effect.
C.3.19.3	Joint ventures and joint venture agreements Joint ventures are eligible to submit tenders provided that: Every member of the joint venture is registered with the CIDB;

	• The Lead Member has a Contractor grading designation in the 7CE class of construction work; • The combined Contractor grading calculated in accordance with the Construction Industry Development Regulations is equal to or higher than a Contractor grading designation determined in accordance with the sum tendered for a CE class of construction work; • When the joint venture is dissolved, the Lead Member will remain liable in terms of the Contract including for latent defects. The Lead Member shall be nominated in the returnable document and shall have at least a 7CE classification. The Lead Member accepts all liability in terms of the Contract and that this liability will continue for 10 years, after completion of the Contract. • Included in their tender is a letter from each of the proposed joint venture members stating their undertaking that in the event of the joint venture tender being successful, the said members will enter into a joint venture agreement, which shall be based on and comply with the CIDB Sample Joint Venture Agreement.
C.3.19.4	Claims arising after submission of tender • Unless allowed for in the Contract, no claim for any extras arising out of any doubt or obscurity as to the true intent and meaning of anything shown on the Tender Drawings or contained in the Conditions of Contract, Scope of Work and Pricing Data, will be admitted by the Employer/ Employer's Agent after the submission of any tender and the Tenderer shall be deemed to have: • Inspected the Tender Drawings and read and fully understood the Conditions of Contract, • Read and fully understood the whole text of the Scope of Work and Pricing Data and thoroughly acquainted himself with the nature of the Works proposed and generally of all matters which may influence the Contract, • Visited the site of the proposed Works, carefully examined existing conditions, the means of access to the site, the conditions under which the Works is to be done, and acquainted himself/herself with any limitations or restrictions that may be imposed by the Municipal or other Authorities in regard to access and transport of materials and equipment to and from the site and made the necessary provisions for any additional costs involved thereby, and • Requested the Employer or his/her duly authorized agent to make clear the actual requirements of anything shown on the Tender Drawings or anything contained in the Scope of Work and Pricing Data, the exact meaning or interpretation of which is not clearly intelligible to the Tenderer. • Before submission of any tender, the tenderer should check the number of pages, and if any are found to be missing or duplicated, or the figures or writing indistinct, or if the Pricing Data contain any obvious errors, the tenderer must apply to the Employer/Employer's Agent at once to have the same rectified, as no liability will be admitted by the Employer/Employer's Agent in respect of errors in any tender due to the foregoing.

T1.3: STANDARD CONDITIONS OF TENDER

(As per Annexure C of CIDB Standard for Uniformity in Engineering and Construction Works Contracts (Aug 2019))

General

Actions

C1.1.1 The employer and each tenderer submitting a tender offer shall comply with these conditions of the tender. In their dealings with each other, they shall discharge their duties and obligations as set out in C.2 and C.3, timeously and with integrity, and behave equitably, honestly and transparently, comply with all legal obligations and not engage in anticompetitive practices.

C1.1.2 The employer and the tenderer and all their agents and employees involved in the tender process shall avoid conflicts of interest and, where a conflict of interest is perceived or known, declare any such conflict of interest, indicating the nature of such conflict. Tenderers shall declare any potential conflict of interest in their tender submissions. Employees, agents and advisors of the employer shall declare any conflict of interest to whoever is responsible for overseeing the procurement process at the start of any deliberations relating to the procurement process or as soon as they become aware of such conflict and abstain from any decisions where such conflict exists or recuse themselves from the procurement process, as appropriate.

Note:

1) A conflict of interest may arise due to a conflict of roles, which might provide an incentive for improper acts in some circumstances. A conflict of interest can create an appearance of impropriety that can undermine confidence in the ability of that person to act properly in his or her position, even if no improper acts result.

2) Conflicts of interest in respect of those engaged in the procurement process include direct, indirect or family interests in the tender or outcome of the procurement process and any personal bias, inclination, obligation, allegiance or loyalty which would in any way affect any decisions taken.

C1.1.3 The employer shall not seek, and a tenderer shall not submit a tender without having a firm intention and the capacity to proceed with the contract.

C1.2 Tender Documents

The documents issued by the employer for the purpose of a tender offer are listed in the tender data.

C1.3 Interpretation

C1.3.1 The tender data and additional requirements contained in the tender schedules that are included in the returnable documents are deemed to be part of these conditions of tender.

C1.3.2 These conditions of tender, the tender data and tender schedules which are required for tender evaluation purposes, shall form part of any contract arising from the invitation to tender.

C1.3.3 For the purposes of these conditions of tender, the following definitions apply:

- a) conflict of interest means any situation in which:
someone in a position of trust has competing professional or personal interests which make it difficult to fulfil his or her duties impartially;
an individual or tenderer is in a position to exploit a professional or official capacity in some way for their personal or corporate benefit; or
incompatibility or contradictory interests exist between an employee and the tenderer who employs that employee.
- b) comparative offer means the price after the factors of a non-firm price and all unconditional discounts it can be utilised to have been taken into consideration.
- c) corrupt practice means the offering, giving, receiving or soliciting of anything of value to influence the action

- of the employer or his staff or agents in the tender process.
- d) fraudulent practice means the misrepresentation of the facts to influence the tender process or the award of a contract arising from a tender offer to the detriment of the employer, including collusive practices intended to establish prices at artificial levels.

C1.4 Communication and employer's agent

Each communication between the employer and a tenderer shall be to or from the employer's agent only, and in a form that can be readily read, copied and recorded. Communications shall be in the English language. The employer shall not take any responsibility for non-receipt of communications from or by a tenderer. The name and contact details of the employer's agent are stated in the tender data.

C1.5 Cancellation and Re-Invitation of Tenders

C1.5.1 An employer may, prior to the award of the tender, cancel a tender if-

- due to changed circumstances, there is no longer a need for the engineering and construction works specified in the invitation;
- funds are no longer available to cover the total envisaged expenditure or
- no acceptable tenders are received.
- there is a material irregularity in the tender process.

C1.5.2 The decision to cancel a tender invitation must be published in the same manner in which the original tender invitation was advertised.

C1.5.3 An employer may only with the prior approval of the relevant treasury cancel a tender invitation for the second time.

C1.6 Procurement procedures

C1.6.1 General

Unless otherwise stated in the tender data, a contract will, subject to C.3.13, be concluded with the tenderer who in terms of C.3.11, is the highest ranked or the tenderer scoring the highest number of tender evaluation points, as relevant, based on the tender submissions that are received at the closing time for tenders.

C1.6.2 Competitive negotiation procedure

Where the tender data require that the competitive negotiation procedure is to be followed, tenderers shall submit tender offers in response to the proposed contract in the first round of submissions. Notwithstanding the requirements of C.3.4, the employer shall announce only the names of the tenderers who make a submission. The requirements of C.8 relating to the material deviations or qualifications which affect the competitive position of tenderers shall not apply.

All responsive tenderers or at least a minimum of not less than three responsive tenderers that are highest ranked in terms of the evaluation criteria stated in the tender data shall be invited to enter into competitive negotiations based on the principle of equal treatment, keeping confidential the proposed solutions and associated information.

Notwithstanding the provisions of C.2.17, the employer may request that tenders be clarified, specified and fine-tuned in order to improve a tenderer's competitive position provided that such clarification, specification, fine-tuning or additional information does not alter any fundamental aspects of the offers or impose substantial new requirements which restrict or distort competition or have a discriminatory effect.

At the conclusion of each round of negotiations, tenderers shall be invited by the employer to revise their tender offer based on the same evaluation criteria, with or without adjusted weightings. Tenderers shall be advised when they are to submit their best and final offer.

The contract shall be awarded in accordance with the provisions of C.3.11 and C.3.13 after tenderers have been requested to submit their best and final offer.

Proposal procedure using the two stage-system:

Option 1

Tenderers shall in the first stage submit technical proposals and, if required, cost parameters around which a contract may be negotiated. The employer shall evaluate each responsive submission in terms of the method of evaluation stated in the tender data, and in the second stage negotiate a contract with the tenderer scoring the highest number of evaluation points and award the contract in terms of these conditions of tender.

Option 2

Tenderers shall submit in the first stage only technical proposals. The employer shall invite all responsive tenderers to submit tender offers in the second stage, following the issuing of procurement documents. The employer shall evaluate tenders received during the second stage in terms of the method of evaluation stated in the tender data, and award the contract in terms of these conditions of tender.

Tenderer's obligations

Eligibility

Submit a tender offer only if the tenderer satisfies the criteria stated in the tender data and the tenderer, or any of his principals, is not under any restriction to do business with employer.

Notify the employer of any proposed material change in the capabilities or formation of the tendering entity (or both) or any other criteria which formed part of the qualifying requirements used by the employer as the basis in a prior process to invite the tenderer to submit a tender offer and obtain the employer's written approval to do so prior to the closing time for tenders.

Cost of tendering

Accept that, unless otherwise stated in the tender data, the employer will not compensate the tenderer for any costs incurred in the preparation and submission of a tender offer, including the costs of any testing necessary to demonstrate that aspects of the offer complies with requirements.

The cost of the tender documents charged by the employer shall be limited to the actual cost incurred by the employer for printing the documents. Employers must attempt to make available the tender documents on its website so as not to incur any costs pertaining to the printing of the tender documents.

Check documents

Check the tender documents on receipt for completeness and notify the employer of any discrepancy or omission.

Confidentiality and copyright of documents

Treat as confidential all matters arising in connection with the tender. Use and copy the documents issued by the employer only for the purpose of preparing and submitting a tender offer in response to the invitation.

Reference documents

Obtain, as necessary for submitting a tender offer, copies of the latest versions of standards, specifications, conditions of contract and other publications, which are not attached but which are incorporated into the tender documents by reference.

Acknowledge addenda

Acknowledge receipt of addenda to the tender documents, which the employer may issue, and if necessary apply for an extension to the closing time stated in the tender data, in order to take the addenda into account.

Clarification meeting

Attend, where required, a clarification meeting at which tenderers may familiarize themselves with aspects of the proposed work, services or supply and raise questions. Details of the meeting(s) are stated in the tender data.

Seek clarification

Request clarification of the tender documents, if necessary, by notifying the employer at least five (5) working days before the closing time stated in the tender data.

Insurance

Be aware that the extent of insurance to be provided by the employer (if any) might not be for the full cover required in terms of the conditions of contract identified in the contract data. The tenderer is advised to seek qualified advice regarding insurance.

Pricing the tender offer

Include in the rates, prices, and the tendered total of the prices (if any) all duties, taxes except Value Added Tax (VAT), and other levies payable by the successful tenderer, such duties, taxes and levies being those applicable fourteen (14) days before the closing time stated in the tender data.

Show VAT payable by the employer separately as an addition to the tendered total of the prices.

Provide rates and prices that are fixed for the duration of the contract and not subject to adjustment except as provided for in the conditions of contract identified in the contract data.

State the rates and prices in Rand unless instructed otherwise in the tender data. The conditions of contract identified in the contract data may provide for part payment in other currencies.

Alterations to documents

Do not make any alterations or additions to the tender documents, except to comply with instructions issued by the employer, or necessary to correct errors made by the tenderer. All signatories to the tender offer shall initial all such alterations.

Alternative tender offers

Unless otherwise stated in the tender data, submit alternative tender offers only if a main tender offer, strictly in accordance with all the requirements of the tender documents, is also submitted as well as a schedule that compares the requirements of the tender documents with the alternative requirements that are proposed.

Accept that an alternative tender offer must be based only on the criteria stated in the tender data or criteria otherwise acceptable to the employer.

An alternative tender offer must only be considered if the main tender offer is the winning tender.

Submitting a tender offer

Submit one tender offer only, either as a single tendering entity or as a member in a joint venture to provide the whole of the works identified in the contract data and described in the scope of works, unless stated otherwise in the tender data.

Return all returnable documents to the employer after completing them in their entirety, either electronically (if they were issued in electronic format) or by writing legibly in non-erasable ink.

Submit the parts of the tender offer communicated on paper as an original plus the number of copies stated in the tender data, with an English translation of any documentation in a language other than

English, and the parts communicated electronically in the same format as they were issued by the employer.

Sign the original and all copies of the tender offer where required in terms of the tender data. The employer will hold all authorized signatories liable on behalf of the tenderer. Signatories for tenderers proposing to contract as joint ventures shall state which of the signatories is the lead partner whom the employer shall hold liable for the purpose of the tender offer.

Seal the original and each copy of the tender offer as separate packages marking the packages as "ORIGINAL" and "COPY". Each package shall state on the outside the employer's address and identification details stated in the tender data, as well as the tenderer's name and contact address.

Where a two-envelope system is required in terms of the tender data, place and seal the returnable documents listed in the tender data in an envelope marked "financial proposal" and place the remaining returnable documents in an envelope marked "technical proposal". Each envelope shall state on the outside the employer's address and identification details stated in the tender data, as well as the tenderer's name and contact address.

Seal the original tender offer and copy packages together in an outer package that states on the outside only the employer's address and identification details as stated in the tender data.

Accept that the employer will not assume any responsibility for the misplacement or premature opening of the tender offer if the outer package is not sealed and marked as stated.

Accept that tender offers submitted by facsimile or e-mail will be rejected by the employer, unless stated otherwise in the tender data.

Information and data to be completed in all respects

Accept that tender offers, which do not provide all the data or information requested completely and in the form required, may be regarded by the employer as non-responsive.

Closing time

Ensure that the employer receives the tender offer at the address specified in the tender data not later than the closing time stated in the tender data. Accept that proof of posting shall not be accepted as proof of delivery.

Accept that, if the employer extends the closing time stated in the tender data for any reason, the requirements of these conditions of tender apply equally to the extended deadline.

Tender offer validity

Hold the tender offer(s) valid for acceptance by the employer at any time during the validity period stated in the tender data after the closing time stated in the tender data.

If requested by the employer, consider extending the validity period stated in the tender data for an agreed additional period with or without any conditions attached to such extension.

Accept that a tender submission that has been submitted to the employer may only be withdrawn or substituted by giving the employer's agent written notice before the closing time for tenders that a tender is to be withdrawn or substituted. If the validity period stated in C.2.16 lapses before the employer evaluating tender, the contractor reserves the right to review the price based on Consumer Price Index (CPI).

Where a tender submission is to be substituted, a tenderer must submit a substitute tender in accordance with the requirements of C.2.13 with the packages clearly marked as "SUBSTITUTE".

Clarification of tender offer after submission

Provide clarification of a tender offer in response to a request to do so from the employer during the evaluation of tender offers. This may include providing a breakdown of rates or prices and correction of arithmetical errors by the adjustment of certain rates or item prices (or both). No change in the competitive position of tenderers or substance of the tender offer is sought, offered, or permitted.

Note:

Sub-clause C.2.17 does not preclude the negotiation of the final terms of the contract with a preferred tenderer following a competitive selection process, should the Employer elect to do so.

Provide other material

Provide, on request by the employer, any other material that has a bearing on the tender offer, the tenderer's commercial position (including notarized joint venture agreements), preferencing arrangements, or samples of materials, considered necessary by the employer for the purpose of a full and fair risk assessment.

Should the tenderer not provide the material, or a satisfactory reason as to why it cannot be provided, by the time for submission stated in the employer's request, the employer may regard the tender offer as non-responsive.

Dispose of samples of materials provided for evaluation by the employer, where required.

Inspections, tests and analysis

Provide access during working hours to premises for inspections, tests and analysis as provided for in the tender data.

Submit securities, bonds and policies

If requested, submit for the employer's acceptance before formation of the contract, all securities, bonds, guarantees, policies and certificates of insurance required in terms of the conditions of contract identified in the contract data.

Check final draft

Check the final draft of the contract provided by the employer within the time available for the employer to issue the contract.

Return of other tender documents

If so, instructed by the employer, return all retained tender documents within twenty-eight (28) days after the expiry of the validity period stated in the tender data.

Certificates

Include in the tender submission or provide the employer with any certificates as stated in the tender data.

The employer's undertakings

Respond to requests from the tenderer

Unless otherwise stated in the tender Data, respond to a request for clarification received up to five (5) working days before the tender closing time stated in the Tender Data and notify all tenderers who collected tender documents.

Consider any request to make a material change in the capabilities or formation of the tendering entity (or both) or any other criteria which formed part of the qualifying requirements used to prequalify a tenderer to submit a tender offer in terms of a previous procurement process and deny any such request if as a consequence:

an individual firm, or a joint venture as a whole, or any individual member of the joint venture fails to meet any of the collective or individual qualifying requirements;

the new partners to a joint venture were not prequalified in the first instance, either as individual firms or as another joint venture; or

in the opinion of the Employer, acceptance of the material change would compromise the outcome of the prequalification process.

Issue Addenda

If necessary, issue addenda that may amend or amplify the tender documents to each tenderer during the period from the date that tender documents are available until three (3) working days before the tender closing time stated in the Tender Data. If, as a result a tenderer applies for an extension to the closing time stated in the Tender Data, the Employer may grant such extension and, shall then notify all tenderers who collected tender documents.

Return late tender offers

Return tender offers received after the closing time stated in the Tender Data, unopened, (unless it is necessary to open a tender submission to obtain a forwarding address), to the tenderer concerned.

Opening of tender submissions

Unless the two-envelope system is to be followed, open valid tender submissions in the presence of tenderers' agents who choose to attend at the time and place stated in the tender data. Tender submissions for which acceptable reasons for withdrawal have been submitted will not be opened.

C.3.4.2 Announce at the meeting held immediately after the opening of tender submissions, at a venue indicated in the tender data, the name of each tenderer whose tender offer is opened and, where applicable, the total of his prices, number of points claimed for its BBBEE status level and time for completion for the main tender offer only.

C.3.4.3 Make available the record outlined in C.3.4.2 to all interested persons upon request.

Two-envelope system

Where stated in the tender data that a two-envelope system is to be followed, open only the technical proposal of valid tenders in the presence of tenderers' agents who choose to attend at the time and place stated in the tender data and announce the name of each tenderer whose technical proposal is opened.

Evaluate functionality of the technical proposals offered by tenderers, then advise tenderers who remain in contention for the award of the contract of the time and place when the financial proposals will be opened. Open only the financial proposals of tenderers, who score in the functionality evaluation more than the minimum number of points for functionality stated in the tender data, and announce the score obtained for the technical proposals and the total price and any points claimed on BBBEE status level. Return unopened financial proposals to tenderers whose technical proposals failed to achieve the minimum number of points for functionality.

Non-disclosure

Not disclose to tenderers, or to any other person not officially concerned with such processes, information relating to the evaluation and comparison of tender offers, the final evaluation price and recommendations for the award of a contract, until after the award of the contract to the successful tenderer.

Grounds for rejection and disqualification

Determine whether there has been any effort by a tenderer to influence the processing of tender offers and instantly disqualify a tenderer (and his tender offer) if it is established that he engaged in corrupt or fraudulent practices.

Test for responsiveness

Determine, after opening and before detailed evaluation, whether each tender offer properly received:

- complies with the requirements of these Conditions of Tender,
- has been properly and fully completed and signed, and
- is responsive to the other requirements of the tender documents.

A responsive tender is one that conforms to all the terms, conditions, and specifications of the tender documents without material deviation or qualification. A material deviation or qualification is one which, in the Employer's opinion, would:

- detrimentally affect the scope, quality, or performance of the works, services or supply identified in the Scope of Work,
- significantly change the Employer's or the tenderer's risks and responsibilities under the contract, or
- affect the competitive position of other tenderers presenting responsive tenders, if it were to be rectified.

Reject a non-responsive tender offer and not allow it to be subsequently made responsive by correction or withdrawal of the non-conforming deviation or reservation.

Arithmetical errors, omissions and discrepancies

- check responsive tenders for discrepancies between amounts in words and amounts in figures. Where there is a discrepancy between the amounts in figures and the amount in words, the amount in words shall govern.
 - check the highest-ranked tender or tenderer with the highest number of tender evaluation points after the evaluation of tender offers in accordance with C.3.11 for:
 - the gross misplacement of the decimal point in any unit rate;
 - omissions made in completing the pricing schedule or bills of quantities; or arithmetic errors in: line item totals resulting from the product of a unit rate and a quantity in bills of quantities or schedules of prices; or the summation of the prices.
- Notify the tenderer of all errors or omissions that are identified in the tender offer and either confirm the tender offer as tendered or accept the corrected total of prices.
- Where the tenderer elects to confirm the tender offer as tendered, correct the errors as follows:
- If bills of quantities or pricing schedules apply and there is an error in the line-item total resulting from the product of the unit rate and the quantity, the line-item total shall govern, and the rate shall be corrected. Where there is an obviously gross misplacement of the decimal point in the unit rate, the line-item total as quoted shall govern, and the unit rate shall be corrected.
 - Where there is an error in the total of the prices either as a result of other corrections required by this checking process or in the tenderer's addition of prices, the total of the prices shall govern, and the tenderer will be asked to revise selected item prices (and their rates if bills of quantities apply) to achieve the tendered total of the prices.

Clarification of a tender offer

Obtain clarification from a tenderer on any matter that could give rise to ambiguity in a contract arising from the tender offer.

Evaluation of tender offers

The Standard Conditions of Tender standardize the procurement processes, methods and procedures from the time that tenders are invited to the time that a contract is awarded. They are generic in nature and are made project specific through choices that are made in developing the Tender Data associated with a specific project.

Conditions of tender are by definition the document that establishes a tenderer's obligations in submitting a tender and the employer's undertakings in soliciting and evaluating tender offers. Such conditions establish the rules from the time a tender is advertised to the time that a contract is awarded and require employers to conduct the process of offer and acceptance in terms of a set of standard procedures.

The CIDB Standard Conditions of Tender are based on a procurement system that satisfies the following system requirements:	
Requirement	Qualitative interpretation of the goal
Fair	The process of offer and acceptance is conducted impartially without bias, providing simultaneous and timely access to participating parties to the same information.
Equitable	Terms and conditions for performing the work do not unfairly prejudice the interests of the parties.

Transparent	The only grounds for not awarding a contract to a tenderer who satisfies all requirements are restrictions from doing business with the employer, lack of capability or capacity, legal impediments and conflicts of interest.
Competitive	The system provides for appropriate levels of competition to ensure cost-effective and best-value outcomes.
Cost-effective	The processes, procedures and methods are standardized with sufficient flexibility to attain best value outcomes in respect of quality, timing and price, and least resources to effectively manage and control procurement processes.

The activities associated with evaluating tender offers are as follows:

- Open and record tender offers received
- Determine whether or not tender offers are complete
- Determine whether or not tender offers are responsive
- Evaluate tender offers
- Determine if there are any grounds for disqualification
- Determine acceptability of preferred tenderer
- Prepare a tender evaluation report
- Confirm the recommendation contained in the tender evaluation report

General

The employer must appoint an evaluation panel of not less than three persons conversant with the proposed scope of works to evaluate each responsive tender offer using the tender evaluation methods and associated evaluation criteria and weightings that are specified in the tender data.

Insurance provided by the employer

If requested by the proposed successful tenderer, submit for the tenderer's information the policies and / or certificates of insurance which the conditions of contract identified in the contract data, require the employer to provide.

Acceptance of tender offer

Accept the tender offer; if in the opinion of the employer, it does not present any risk and only if the tenderer:

- is not under restrictions, or has principals who are under restrictions, preventing participating in the employer's procurement;
- can, as necessary and in relation to the proposed contract, demonstrate that he or she possesses the professional and technical qualifications, professional and technical competence, financial resources, equipment and other physical facilities, managerial capability, reliability, experience and reputation, expertise and the personnel, to perform the contract;
- has the legal capacity to enter into the contract;
- is not; insolvent, in receivership, under Business Rescue as provided for in chapter 6 of the Companies Act No. 2008, bankrupt or being wound up, has his/her affairs administered by a court or a judicial officer, has suspended his/her business activities or is subject to legal proceedings in respect of any of the foregoing;
- complies with the legal requirements, if any, stated in the tender data; and
- is able, in the opinion of the employer, to perform the contract free of conflicts of interest.

Prepare contract documents

If necessary, revise documents that shall form part of the contract and that were issued by the employer as part of the tender documents to take account of:

- addenda issued during the tender period,
- inclusion of some of the returnable documents and
- other revisions agreed between the employer and the successful tenderer
- Complete the schedule of deviations attached to the form of offer and acceptance, if any.

Complete adjudicator's contract

Unless alternative arrangements have been agreed or otherwise provided for in the contract, arrange for both parties to complete formalities for appointing the selected adjudicator at the same time as the main contract is signed.

Registration of the award

An employer must, within twenty-one (21) working days from the date on which a contractor's offer to perform a construction works contract is accepted in writing by the employer, register and publish the award on the CIDB Register of Projects.

Provide copies of the contracts

Provide to the successful tenderer the number of copies stated in the Tender Data of the signed copy of the contract as soon as possible after completion and signing of the form of offer and acceptance.

Provide written reasons for actions taken

Provide upon request written reasons to tenderers for any action that is taken in applying these conditions of tender but withhold information which is not in the public interest to be divulged, which is considered to prejudice the legitimate commercial interests of tenderers or might prejudice fair competition between tenderers.



VOLUME 1

TENDER

RETURNABLE DOCUMENTS

T2.1 LIST OF RETURNABLE DOCUMENTS

FORM	PAGE
Invitation To Bid – MBD 1	TP5

T2.2 Returnable Documents	RD.2

A.	Site Inspection Certificate – Site Information	RD.3
B.	Relevant Experience / Schedule of Similar Work Undertaken	RD.4
C.	Key Personnel and Schedule	RD.5
D.	Schedule of Plant and Equipment	RD.13
E.	Schedule of Sources of Supply of Material	RD.14
F.	List of Subcontractors and Suppliers	RD.15
G.	Contract Participation Goals and Declaration	RD.16
H.	Alterations by Tenderer	RD.22
I.	Authority of Signatory	RD.23
J.	Contractor's Health and Safety Declaration	RD.25
K.	Contractor's Certificate of Registration with CIDB	RD.27
L.	Contractor's COID Registration Details	RD.28
M.	Tenderer's Financial Standing	RD.29
N.	Proof of Bank Details	RD.30
O.	Form of Intent to Provide a Performance Guarantee	RD.31
P.	Tax Status Pin	RD.32
Q.	Company Registration Certificate and Shareholding Details	RD.33
R.	Copies of Directors' / Members' Identity Documents	RD.34
S.	Preference Points Claim Form – MBD 6.1	RD.35
T.	Method Statement / Approach Paper	RD.40
U.	Preliminary Programme and Cashflow	RD.41
V.	Record of Addenda to Tender Document	RD.42
W.	Compulsory Enterprise Questionnaire	RD.43
X.	Bidder's Disclosure – MBD 4	RD.46
Y.	Joint Venture Agreement	RD.49
Z.	Current Commitments Schedule	RD.50
AA.	Proof Of Good Standing with Municipal Accounts	RD.51
AB.	Declaration for Procurement above R10 Million	RD.52
BB.	Central Supplier Database Registration	RD.54
CC.	Tenderer's Financial Position Declaration	RD.55
DD.	Quality Assurance Plan and Control Procedures	RD.56
EE.	Claim With Respect To Ownership By Targeted Groups	RD.57
FF.	BBBEE Compliance Certificate	RD.58
GG.	Schedule of Proposed Sub-Contractors	RD.59

T2.3 Technical Schedules	RD.60

PART 1 – AGREEMENT AND CONTRACT DATA

C1.1	Form of Offer	C 2

PART 2 – PRICING DATA

C2.2	Bill of Quantities	PD 5
C2.3	Summary of Bill of Quantities	PD 88

Failure to complete the forms as directed may lead to the Tender being rejected.

T2.2 Returnable Documents

I/We the undersigned do hereby certify as follows:

Inspection of Site and Examination of Site Data

I/We have inspected and examined the Site and its surroundings. (Not Applicable)

I/We have examined the Site Data made available by the Employer (Applicable).

Comprehension of Documents

I/We have acquainted myself/ourselves with the Tendering Procedures, General Conditions of Contract, Contract Data, Scope of Work, Site information, Drawings, and Specifications for the above Contract for which I/We have submitted this Tender.

I/We note that the UGU DISTRICT MUNICIPALITY is not bound to accept the lowest or any tender that may be received.

I/We note that the UGU DISTRICT MUNICIPALITY may for any reason withdraw this tender and re-tender without having to furnish any reason thereof.

Signature(s)

Name(s)

For the Tenderer

(Name and address of organisation)

Name and
signature of
witness

Date _____

A. SITE INSPECTION CERTIFICATE - SITE INFORMATION

This is to certify that (*tenderer*)
of (*address*)
..... was represented by the person(s) named
below at the compulsory meeting held for all tenderers at (*location*)
..... on (*date*)..... starting at (*time*)

I / We acknowledge that the purpose of the meeting was to acquaint myself / ourselves with the site of the works and / or matters incidental to doing the work specified in the tender documents in order for me / us to take account of everything necessary when compiling our rates and prices included in the tender.

Particulars of person(s) attending the meeting:

Name: Signature:

Capacity: Date:

Name: Signature:

Capacity: Date:

Attendance of the above person(s) at the meeting is confirmed by the Employer's representatives, namely:

Name: Signature:

Capacity: Date:

Name: Signature:

Capacity: Date:

Ugu District Municipality SCM Stamp

B. RELEVANT EXPERIENCE / SCHEDULE OF SIMILAR WORK UNDERTAKEN

The Tenderer shall attach hereto the relevant experience for water/wastewater treatment works for the main contractor and the electrical and instrumentation subcontractor.

The above information will be used to evaluate the following Functionality criteria under C.3.11.9.1 and C.3.11.9.2 in Section T1.2:

Criteria 1: Relevant Experience of the Main Civil Contractor related to Water or Sanitation Projects, including concrete water retaining structures, buildings, earthworks, and Mechanical and Electrical Works by a Sub-Contractor, applicable in the past 15 years.

Criteria 1: Relevant Experience of the Mechanical/Electrical Sub-Contractor related to Pumps, transformers, MCC Panels, PLCs, instrumentation and general Electrical Works for Water or Sanitation Projects undertaken as the Mechanical/Electrical main or Sub-Contractor, applicable in the past 15 years.

C. KEY PERSONNEL AND SCHEDULE

In terms of the Project Specification and the Conditions of Tender, unskilled workers may only be brought in from outside the local community if such personnel are not available locally.

The Tenderer shall list below the personnel which he intends to utilize on the Works, including key personnel which may have to be brought in from outside if not available locally.

CATEGORY OF EMPLOYEE	NUMBER OF PERSONS					
	KEY PERSONNEL, PART OF THE CONTRACTOR'S ORGANISATION		KEY PERSONNEL TO BE IMPORTED IF NOT AVAILABLE LOCALLY		UNSKILLED PERSONNEL TO BE RECRUITED FROM LOCAL COMMUNITY	
	HDI	NON-HDI	HDI	NON-HDI	HDI	NON-HDI
Project Director / Contracts Manager (Civil or Mechanical)						
Site Agent / Project Manager (Civil or Mechanical)						
Site Supervisor / Foreman: Civil						
Site Supervisor / Foreman: Electrical						
Site Supervisor / Foreman: Mechanical						
Health and Safety Officer						
Quality & Environmental Site Officer(s)						
Artisans and other Skilled workers						
Plant Operators						
Unskilled Workers						
Others:						

The Tenderer shall attach hereto the *curricula vitae*, in the form included hereafter, of the Project Director / Contracts Manager, the Site Agent / Project Manager, the Site Supervisor / Concrete Foreman and the Health and Safety Officer. The information is necessary for evaluation of the tender.

The above information will be used to evaluate **Criteria 4: Experience of Key Personnel** for Functionality under C.3.11.9.4 in Section T1.2.

SIGNATURE: **DATE:**
(of the person authorised to sign on behalf of the Tenderer)

C. KEY PERSONNEL AND SCHEDULE (continued)

[illegible]

Certified copies of qualifications are to be attached to this schedule.

Certification:

I, the undersigned, certify that to the best of my knowledge and belief this data correctly describes me, my qualifications and my experience.

SIGNATURE OF THE INCUMBENT IN THE SCHEDULE

DATE _____

C. KEY PERSONNEL AND SCHEDULE (continued)

SITE AGENT / PROJECT MANAGER	
Name:	Date of birth:
Profession:	Nationality:
Qualifications:	
Professional Registration Number:	
Name of Employer (firm):	
Current position:	Years with firm:
<u>Employment Record:</u>	
<u>Experience Record Pertinent to Required service:</u>	
* Include Certified Copy (Not older than 3 months) of Qualification	

Certified copies of qualifications are to be attached to this schedule.

Certification:

I, the undersigned, certify that to the best of my knowledge and belief this data correctly describes me, my qualifications and my experience.

.....
SIGNATURE OF THE INCUMBENT IN THE SCHEDULE

.....
DATE

C. KEY PERSONNEL AND SCHEDULE (continued)

ELECTRICALSITE SUPERVISOR/ FOREMAN:	
Name:	Date of birth:
Profession:	Nationality:
Qualifications:	
Professional Registration Number:	
Name of Employer (firm):	
Current position:	Years with firm:
<u>Employment Record:</u>	
<u>Experience Record Pertinent to Required service:</u>	

Certified copies of qualifications and relevant experience are to be attached to this schedule.

Certification:

I, the undersigned, certify that to the best of my knowledge and belief this data correctly describes me, my qualifications and my experience.

.....
SIGNATURE OF THE INCUMBENT IN THE SCHEDULE

.....
DATE

C. KEY PERSONNEL AND SCHEDULE (continued)

MECHANICAL SITE SUPERVISOR / FOREMAN	
Name:	Date of birth:
Profession:	Nationality:
Qualifications:	
Professional Registration Number:	
Name of Employer (firm):	
Current position:	Years with firm:
<u>Employment Record:</u>	
<u>Experience Record Pertinent to Required service:</u>	

Certified copies of qualifications and relevant experience are to be attached to this schedule.

Certification:

I, the undersigned, certify that to the best of my knowledge and belief this data correctly describes me, my qualifications and my experience.

.....
SIGNATURE OF THE INCUMBENT IN THE SCHEDULE

.....
DATE

C. KEY PERSONNEL AND SCHEDULE (continued)

HEALTH AND SAFETY OFFICER	
Name:	Date of birth:
Profession:	Nationality:
Qualifications:	
Professional Registration Number:	
Installation Electrician No.:	
Name of Employer (firm):	
Current position:	Years with firm:
<u>Employment Record:</u>	
<u>Experience Record Pertinent to Required service:</u>	

Certification:

I, the undersigned, certify that to the best of my knowledge and belief this data correctly describes me, my qualifications and my experience.

.....
SIGNATURE OF THE INCUMBENT IN THE SCHEDULE

.....
DATE

C. KEY PERSONNEL AND SCHEDULE (continued)

The details below refer to the Electrical Sub-Contractor's Representative who will be authorised to act as the Electrical Sub-Contractor's Representative:

FULL NAME: _____ AGE: _____

DURATION OF EMPLOYMENT WITH ELECTRICAL SUB-CONTRACTOR: _____

FULL TIME ON THIS CONTRACT: YES/NO

ATTEND ALL REGULAR SITE MEETINGS: YES/NO

QUALIFICATIONS OF MECHANICAL/ELECTRICAL SUB-CONTRACTORS REPRESENTATIVE:

DETAILS OF RELEVANT EXPERIENCE OF MECHANICAL/ELECTRICAL SUB-CONTRACTOR'S REPRESENTATIVE - PAST PROJECTS

YEAR	CONTRACT	CLIENT COMPANY	CLIENT NAME	TEL. NO.

D. SCHEDULE OF PLANT AND EQUIPMENT

The Tenderer must state below what plant, and equipment will be available for the work should he be awarded the contract.

DESCRIPTION, SIZE, CAPACITY	YEAR OF MANUFACTURE	NUMBER

NB: After the award of the contract, the Contractor must satisfy the Engineer that all the above plant and equipment or equivalent plant and equipment will be on the site at all times when required. The Contractor shall maintain all plant and equipment in a good working order for the duration of the contract.

The Contractor also undertakes to bring onto the site, without additional costs to the Employer, any additional plant and equipment which, in the opinion of the Engineer, is necessary for completing the contract within the tendered contract period.

.....
SIGNATURE OF TENDERER

E. SCHEDULE OF SOURCES OF SUPPLY OF MATERIALS

The Tenderer shall list below the proposed type, source or trade name of the materials he wishes to use.

The acceptance of this tender shall not be construed as approval of all or any of the listed materials. Should any or all of the materials not be approved subsequent to acceptance of tender, this shall in no way invalidate this tender and the tendered unit rates for the various items of work shall remain final and binding.

MATERIAL	TYPE OR TRADE NAME	SOURCE
SAND (Concrete)		
SAND (Mortar)		
SAND (Bedding)		
STONE		
CEMENT		
STEEL PIPES		
uPVC PIPES		
HDPE PIPES		
VALVES		
PUMPS		
OTHER		
OTHER		
OTHER		

MECHANICAL/ELECTRICAL ITEM CONTINUE OVER THE NEXT PAGE

F - LIST OF SUB-CONTRACTORS AND SUPPLIERS – MECHANICAL/ELECTRICAL AND INSTRUMENTATION

The Suppliers name, BBB-EE rating and approximate value of work is to be completed for every item specified and which is applicable to this particular Contract and on which the Contract Sum was determined.

	SUB- CONTRACTOR/SUPPLIER	BBB-EE RATING	Value of Work
Pumps			
Cables			
Cable Glands			
Luminaires			
Type A			
Type AE			
Streetlight			
Conduit System			
Motor Control Centre			
Soft starters			
Circuit Breakers			
Fire Detection and Intruder Alarm			
UPS			
SCADA SYSTEM			
PLC			
GPRS			
Earthing Bonding & Lightning Protection			
Other (Specify)			
a)			
b)			
c)			
d)			
e)			

NOTE: Under no circumstances will the Sub-Contractor be permitted to deviate from the materials specified unless agreed in writing, by the Engineer, prior to tender closing.

.....
SIGNATURE OF TENDERER

G. CONTRACT PARTICIPATION GOALS AND DECLARATION

Objective

The objective of UGU District Municipality's empowerment initiative is to bring about meaningful transformation in all procurement projects and in particular in the built environment/construction and consulting industry through achieving one or more of the following objectives:

- Meaningful Economic Participation;
- Local Economic Development;
- Transfer of Technical, Management and Entrepreneurial Skills; and
- Creation of sustainable Black Enterprises

Contract Participation Goals

Contract Participation Goal (CPG) – the final value of services paid to the CPG Partner/s based on the final contract value. At the time of awarding the contract the 20% maximum CPG amount will be based on the contract award value exclusive of the following:

- VAT, CPA, PC sums and Contingencies.

During contract implementation, adjustments relating to Provisional Sums and Contingencies linked to the CPG allocation will be agreed upon between the parties to the contract, as and when the need arises.

- 20% excludes VAT, CPA, PC sums and Contingencies.
- The tenderer will be required to achieve the actual Rand value committed for CPG, adjusted according to the following:
 - Variation Orders – Each VO will be evaluated by the Employer's Agent and the Project Manager to determine whether it should be counted, in its entirety or partially, as part of CPG or not.
 - Re-measurable Items (including CPA, and provisional sums) – Each re-measurable item change will be evaluated by the Employer's Agent and the Project Manager to determine whether it should be counted as part of CPG or not.

Within two (2) weeks of the award of the contract, the tenderer will be required to submit a cash flow projection for the main contractor and the CPG Partner/s.

Applicability

The CPG target is applicable to all contracts to be adjudicated through the UGU District Municipality procurement process and shall be achieved through the following mechanisms:-

- Value of the work to be sub-contracted shall be at most 20% of the total contract value excluding VAT, CPA, PC sums and Contingencies.
- CPA is payable to the CPG Partner/s as per the indices stipulated in the contract document.
- The main supplier shall not substitute any CPG Partner/s without the written approval of UGU District Municipality.

- The working capital arrangements between the main supplier and the CPG Partner/s must be agreed upon between the two parties prior to commencement of works to ensure that the CPG Partner does not have cash flow challenges during contract implementation.
- The CPG Partner must be paid within reasonable time but no later than 7 working days after UGU District Municipality has paid the Main Supplier; and
- The submission from the Supplier must include a schedule that clearly shows the following:
 - Scope of work
 - Total Contract Sum
 - Total amount payable to CPG Partner/s excluding current month
 - Amount payable to CPG Partner for the current month
 - % split of the Total amount payable to the Main supplier and CPG Partner/s
- Performance management
 - Within fourteen(14) days from the date of award, submit the agreement between development and targeted partner clearly providing the targeted enterprise's detailed work packages, including proposed payment certificates, indicating work packages.
 - If Requested by the Client or Engineer at any stage of the contract, the contractor shall submit within seven (7 days) of a formal request all necessary documentation required to confirm the accuracy of the information provided in the monthly progress reports. Documentation shall include but not be limited to :
 - a. Tax invoices
 - b. Wage Sheets
 - c. Salary advices
 - d. Orders
- Penalties for not achieving the minimum CPG or finishing late
In the case where the minimum CPG of 20 % is not achieved, the contractor will be penalised as follows:
 - a. The CPG amount not achieved in Rand will be multiplied by 0.7. The factored amount in Rand will be deducted from the contractor's final certificate.
 - b. The contractor will support and mentor the targeted Enterprise(s) to achieve the project milestones as part of the objectives to transfer technical, management, and entrepreneurial skills.
- For this contract, it has been determined that up to 20% of the tendered contract value can be subcontracted to SMMEs./Targeted Enterprises. For ease of reference, the item/work has been identified in the marked schedule of quantities (CPG). This clause shall be used as a guide for incorporating subcontracting to SMMEs into your tender documents. However, it's important to note that the tenderer is ultimately responsible for ensuring that the work is completed on time and to the required standards

Eligibility Criteria

For tenders where the CPG target is applicable, those that do not offer a minimum CPG participation of 20% according to the abovementioned requirements will be deemed ineligible.

DECLARATION REGARDING CONTRACT PARTICIPATION GOALS

I, the undersigned, in submitting the accompanying bid:

(Bid Number and Description)

in response to the invitation for the bid made by:
UGU DISTRICT MUNICIPALITY

do hereby make the following declaration and certify the statements contained herein to be true and complete in every respect:

I certify, on behalf of: _____ that:
(Name of Bidder)

1. I have read, and I understand the contents of this Declaration and the fully completed bid document accompanying this declaration;
2. I understand and declare that the accompanying bid will, and must, be disqualified if this Declaration is found not to be true and complete in every respect;
3. I understand and declare that in the event that this bid is successful, I will be required to, and shall, fully implement the commitments that are submitted with this bid, in particular regarding the Bidder's contract participation goals and commitments towards the allocation of certain portion of the contract to small and emerging entities. Failure to implement such commitments as outlined in the bid document (in particular, as detailed in the bill of quantities) and or failure to provide the relevant information within the prescribed period as determined in the Letter of Intention to Award the Bid, shall automatically disqualify this bid from further consideration and the Employer has the right to, and must, then award the bid to the next highest ranked bidder; and as a result I or the bidder or any of its directors shall have no recourse against Umgeni Water.
4. I am authorised by the bidder to sign this Declaration and to submit the accompanying bid, on behalf of the bidder;
5. Each person whose signature appears on the accompanying bid has been authorised by the bidder to determine the terms of, and to sign the bid, on behalf of the bidder;
6. I consent that should my company (the Bidder) deviate from the commitments and the spirit of the CPG objectives as agreed to, shall amount to a repudiation of the contractual arrangement between the two parties (UGU District Municipality's and the Bidder); and UGU District Municipality shall have the right to terminate the contract with immediate effect and without giving my company (the Bidder) prior notice to remedy the breach.

Full Names & Surname
(Duly authorized)

Signature

Date

Position

Name of Bidder

Mechanical/Electrical Sub-Contractor's Schedule of Information

COMPANY DETAILS

Name: _____

Address: (Street) _____

(Postal) _____

Telephone No: _____

Telefax No: _____

Cell No. _____

Type of Establishment (Company, Corporation etc.)

Years since Establishment under Present Management

STAFF (Please state number in each category)

LICENSED ELECTRICIANS _____

ARTISAN ELECTRICIANS _____

LABOURERS _____

TRANSPORT (Please state numbers and types of vehicles).

WORKSHOP FACILITIES

Please state if available:

YES

☐

NO

☐

Address of Workshops

INSTRUMENTS

(Please details all measuring, testing and commissioning instruments available)

MAINTENANCE FACILITIES

(Please state facilities available for providing 24-hour emergency service if required)

Cell No.

EXPERIENCE

The Mechanical/Electrical Sub-Contractor shall, in the schedule hereunder, list work of a similar nature to that called for in this Tender which has been executed by him during the recent years and which is at present being executed by him.

NOTE: If no similar work has been carried out, the above schedule is to be marked "Nil" by the Electrical Sub-Contractor.

PROJECT	CLIENT	VALUE	COMPLETION DATE

Number of years of relevant experience of the Tendering Firm years.

WORK IN HAND

(Please state brief details of all projects that are currently in progress)

PROJECT	CLIENT	VALUE	COMPLETION DATE

WORKMANSHIP

(Please state details of 3 projects where the quality of your workmanship can be inspected if necessary).

H. ALTERATIONS BY TENDERER

1. Should the Tenderer not be able to meet any requirement of the Tender Documents, he shall state below:

Qualifications to Tender

And set out details of the requirements which he cannot meet and his proposal.

Note: A qualified tender is a non-conforming tender and may be rejected.

2. Should the Tenderer have completed a full conforming tender but wishes in addition to submit an alternative offer, he shall state below.

Alternative Offer

And set out details of the items for which he proposes an alternative.

In both cases, the Tenderer may prepare the details under a covering letter and refer to them on this form.

Page or Item	Alteration Proposed by Tenderer

.....
SIGNATURE OF TENDERER

I. AUTHORITY OF SIGNATORY

Indicate the status of the tenderer by ticking the appropriate box hereunder. The tenderer must complete the certificate set out below for the relevant category.

A Company	B Partnership	C Joint Venture	D Sole Proprietor	E Close Corporation

A. Certificate for Company

I, ..., chairperson of the board of

....., hereby confirm that by resolution of the board

(copy attached) taken on 20...., Mr/Ms

acting in the capacity of, was authorised to sign all documents in connection with this tender for Contract No. UGU-07-1689-2025 and any contract resulting from it on behalf of the company.

As witnesses:

..... Chairman:

..... Date:

B. Certificate for Partnership

We, the undersigned, being the key partners in the business trading as hereby authorise Mr/Ms, acting in the capacity of....., to sign all documents in connection with this tender for Contract No. UGU-07-1689-2025 and any contract resulting from it on our behalf.

Name	Address	Signature	Date

Note: This certificate is to be completed and signed by all key partners upon whom rests the direction of the affairs of the Partnership as a whole.

C. Certificate for Joint Venture

We, the undersigned, are submitting this tender offer in Joint Venture and hereby

authorise Mr/Ms, authorised signatory of the company

....., acting in the capacity of lead

partner, to sign all documents in connection with this tender for Contract No. UGU-07-1689-2025 and any contract resulting from it on our behalf.

This authorisation is evidenced by the attached power of attorney signed by legally authorised signatories of all the partners to the Joint Venture.

Name of Firm	Address	Authorising Name and Capacity	Authorising Signature
Lead Partner:			

D. Certificate for Sole Proprietor

I, ..., hereby confirm that I am the sole owner of the business trading as

As witnesses:

..... Sole Owner:

..... Date:

E. Certificate for Close Corporation

We, the undersigned, being the key members in the business trading as

....., hereby authorise Mr/Ms acting in the capacity of, to sign all to sign all documents in connection with this tender for Contract No. UGU-07-1689-2025 and any contract resulting from it on our behalf.

Name	Address	Signature	Date

Note: This certificate is to be completed and signed by all key partners upon whom rests the direction of the affairs of the Partnership as a whole.

J. CONTRACTOR'S HEALTH AND SAFETY DECLARATION

In terms of Clause 4(4) of the OHSA 1993 Construction Regulations 2014 (referred to as "the Regulations" hereafter), a Contractor may only be appointed to perform construction work if the Employer is satisfied that the Contractor has the necessary competencies and resources to carry out the work safely in accordance with the Occupational Health and Safety Act No 85 of 1993 and the OHSA 1993 Construction Regulations 2014.

To that effect a person duly authorised by the tenderer must complete and sign the declaration hereafter in detail.

Declaration by Tenderer

1. I the undersigned hereby declare and confirm that I am fully conversant with the Occupational Health and Safety Act No 85 of 1993 (as amended by the Occupational Health and Safety Amendment Act No 181 of 1993), and the OHSA 1993 Construction Regulations 2014.
2. I hereby declare that my company has the competence and the necessary resources to safely carry out the construction work under this contract in compliance with the Construction Regulations and the Employer's Health and Safety Specifications.
3. I hereby confirm that adequate provision has been made in my tendered rates and prices in the Bill of Quantities to cover the cost of all resources, actions, training and all health and safety measures envisaged in the OHSA 1993 Construction Regulations 2014, including the cost of the specific items listed in the tables hereafter.

Table 1: Safety Personnel

Personnel
Construction Supervisor
Construction Safety Officer
Health and Safety Representatives
Health and Safety Committee

Table 2: Safety Equipment (As applicable)

Equipment
Hard Hats
Safety Boots
Masks
Gloves
Personal Protective Equipment
Other items deemed necessary due to the nature of the contract/site

4. I hereby undertake, if my tender is accepted, to provide, before the commencement of the works under the contract, a suitable and sufficiently documented Health and Safety Plan in accordance with Regulation 5(1) of the Construction Regulations, which plan shall be subject to approval by the Employer.
5. I confirm that copies of my company's approved Health and Safety Plan, the Employer's Safety Specifications as well as the OHSA 1993 Construction Regulations 2014, will be provided on site and will at all times be available for inspection by the Contractor's personnel, the Employer's personnel, the Engineer, visitors, and officials and inspectors of the Department of Labour.
6. I hereby confirm that, I will be liable for any penalties that may be applied by the Employer in terms of the said Regulations (Regulation 30) for failure on the Contractor's part to comply with the provisions of the Act and the Regulations.
7. I agree that my failure to complete and execute this declaration to the satisfaction of the Employer will mean that I am unable to comply with the requirements of the OHSA 1993 Construction Regulations 2014 and accept that my tender will be prejudiced and may be rejected at the discretion of the Employer.

SIGNATURE: DATE:
(of person authorised to sign on behalf of the Tenderer)

K. CONTRACTOR'S CERTIFICATE OF REGISTRATION WITH CIDB

The Tenderer shall attach hereto the Contractor's Certificate of Registration with CIDB or insert his CRS No. Failure to submit the certificate or number with the tender document will lead to the conclusion that the Tenderer is not registered with the CIDB, and the tender offer will be deemed as not valid/incomplete. The certificate must be valid by close of tender.

L. CONTRACTOR'S COID REGISTRATION DETAILS

The Tenderer shall attach hereto their COID Registration details. Failure to submit the Letter of Good Standing (COID) with the tender document will lead to the conclusion that the Tenderer is not registered.

M. TENDERER'S FINANCIAL STANDING

In terms of the Tender Data the tenderer must obtain a bank rating from the Tenderer's bank.

To that end the Tenderer must provide with his tender a bank rating, certified by his banker, to the effect that he will be able to successfully complete the contract at the tendered amount within the specified time for completion and attach the documentation/rating certificate to this page.

Name of account holder:

Name of Bank: _____ Branch: _____

Account number: _____ Type of account: _____

Telephone number: _____ Facsimile number: _____

Name of contact person (at bank): _____

Failure to provide the required bank details and a certified bank rating with his tender, will lead to the conclusion that the Tenderer does not have the necessary financial resources at his disposal to complete the contract successfully within the specified time for completion. Tenderers who receive a Bank Rating $\leq$ D will be disqualified.

The Employer undertakes to treat the information thus obtained as confidential, strictly for the use of evaluation of the tender submitted by the Tenderer.

Note that the Tenderer should have a Bank Rating of C or above to be considered eligible to Tender. Tenderers with a Bank Rating of E and below will be disqualified.

SIGNATURE:
(of person authorised to sign on behalf of the Tenderer)

DATE:

N. PROOF OF BANK DETAILS

Tenderers are to attach a letter from their bank confirming their banking details

O. FORM OF INTENT TO PROVIDE A PERFORMANCE GUARANTEE

The Tenderer must attach hereto a letter from the bank or financial institution with whom he has made the necessary arrangements, to the effect that the said bank or institution will be prepared to provide the required performance guarantee when asked to do so.

Only a Performance Guarantee in the format indicated in Section C1.3 (Page C.15) will be accepted by the Employer.

P. TAX STATUS PIN

The Tenderer shall submit their 'Tax Status Pin' obtained from SARS.

Each party to a Consortium/Joint Venture/Sub-contractors must submit a separate Tax Status Pin.

Failure to submit a Tax Status Pin indicating Tax Compliance with SARS, will invalidate the tender.

TAX STATUS PIN No.

[Tax Status Pin obtained from SARS to be inserted here.]

Q. COMPANY REGISTRATION CERTIFICATE AND SHAREHOLDING DETAILS

The Tenderer’s Company Registration details are to be attached here, including shareholding details.

R. COPIES OF DIRECTORS' / MEMBERS' IDENTITY DOCUMENTS

Certified copies of Identity Documents of all Directors/Members of a Close Corporation are to be attached here.

S. PREFERENCE POINTS CLAIM FORM – MBD 6.1

MBD 6.1

PREFERENCE POINTS CLAIM FORM IN TERMS OF THE PREFERENTIAL PROCUREMENT REGULATIONS 2022

This preference form must form part of all tenders invited. It contains general information and serves as a claim form for preference points for specific goals.

NB: BEFORE COMPLETING THIS FORM, TENDERERS MUST STUDY THE GENERAL CONDITIONS, DEFINITIONS AND DIRECTIVES APPLICABLE IN RESPECT OF THE TENDER AND PREFERENTIAL PROCUREMENT REGULATIONS, 2022

GENERAL CONDITIONS

The following preference point systems are applicable to invitations to tender:

- the 80/20 system for requirements with a Rand value of up to R50 000 000 (all applicable taxes included); and
- the 90/10 system for requirements with a Rand value above R50 000 000 (all applicable taxes included).

To be completed by the organ of state

(delete whichever is not applicable for this tender).

The applicable preference point system for this tender is the **90/10** preference point system.

Points for this tender (even in the case of a tender for income-generating contracts) shall be awarded for:

- (a) Price; and
- (b) Specific Goals.

To be completed by the organ of state:

The maximum points for this tender are allocated as follows:

	POINTS
Price	90
Specific Goals	10
Total points for Price and Specific Goals	100

Failure on the part of a tenderer to submit proof or documentation required in terms of this tender to claim points for specific goals with the tender, will be interpreted to mean that preference points for specific goals are not claimed.

The organ of state reserves the right to require of a tenderer, either before a tender is adjudicated or at any time subsequently, to substantiate any claim in regard to preferences, in any manner required by the organ of state.

DEFINITIONS

- (a) **“tender”** means a written offer in the form determined by an organ of state in response to an invitation to provide goods or services through quotations, competitive tendering process or any other method envisaged in legislation;
- (b) **“price”** means an amount of money tendered for goods or services, and includes all applicable taxes less all unconditional discounts;
- (c) **“rand value”** means the total estimated value of a contract in Rand, calculated at the time of bid invitation, and includes all applicable taxes;
- (d) **“tender for income-generating contracts”** means a written offer in the form determined by an organ of state in response to an invitation for the origination of income-generating contracts through any method envisaged in legislation that will result in a legal agreement between the organ of state and a third party that produces revenue for the organ of state, and includes, but is not limited to, leasing and disposal of assets and concession contracts, excluding direct sales and disposal of assets through public auctions; and
- (e) **“the Act”** means the Preferential Procurement Policy Framework Act, 2000 (Act No. 5 of 2000).

FORMULAE FOR PROCUREMENT OF GOODS AND SERVICES

POINTS AWARDED FOR PRICE

THE 80/20 OR 90/10 PREFERENCE POINT SYSTEMS

A maximum of 80 or 90 points is allocated for price on the following basis:

80/20	or	90/10	
$Ps = 80 \left(1 - \frac{Pt - Pmin}{Pmin} \right) \text{ or } Ps = 90 \left(1 - \frac{Pt - Pmin}{Pmin} \right)$			

Where

Ps = Points scored for price of tender under consideration

Pt = Price of tender under consideration

Pmin = Price of lowest acceptable tender

FORMULAE FOR DISPOSAL OR LEASING OF STATE ASSETS AND INCOME GENERATING PROCUREMENT

POINTS AWARDED FOR PRICE

A maximum of 80 or 90 points is allocated for price on the following basis:

80/20	or	90/10
$Ps = 80 \left(1 - \frac{Pt - P_{min}}{P_{min}} \right)$	or	$Ps = 90 \left(1 - \frac{Pt - P_{min}}{P_{min}} \right)$

Where

- Ps = Points scored for price of tender under consideration
Pt = Price of tender under consideration
Pmin = Price of lowest acceptable tender

POINTS AWARDED FOR SPECIFIC GOALS

In terms of Regulation 4(2); 5(2); 6(2) and 7(2) of the Preferential Procurement Regulations, preference points must be awarded for specific goals stated in the tender. For the purposes of this tender the tenderer will be allocated points based on the goals stated in table 1 below as may be supported by proof/ documentation stated in the conditions of this tender:

In cases where organs of state intend to use Regulation 3(2) of the Regulations, which states that, if it is unclear whether the 80/20 or 90/10 preference point system applies, an organ of state must, in the tender documents, stipulate in the case of—

- an invitation for tender for income-generating contracts, that either the 80/20 or 90/10 preference point system will apply and that the highest acceptable tender will be used to determine the applicable preference point system; or
- any other invitation for tender, that either the 80/20 or 90/10 preference point system will apply and that the lowest acceptable tender will be used to determine the applicable preference point system,
- then the organ of state must indicate the points allocated for specific goals for both the 90/10 and 80/20 preference point system.

Table 3: Specific goals for the tender and points claimed are indicated per the table below.

(Note to organs of state: Where either the 90/10 or 80/20 preference point system is applicable, corresponding points must also be indicated as such.

Note to tenderers: The tenderer must indicate how they claim points for each preference point system.)

The specific goals allocated points in terms of this tender	Number of points allocated (90/10 system) (To be completed by the organ of state) PART A	Number of points claimed (90/10 system) (To be completed by the tenderer)
BBBEE Contribution		
BBBEE Level 1	5	
BBBEE Level 2	4	
BBBEE Level 3-8	2	
Empowerment		
1. an EME or QSE which is at least 100% owned by black people;	2	
2. an EME or QSE which is at least 51% owned by black people;	1	
3. an EME or QSE which is at 25% - 50% owned by black people;	0.5	
1. Enterprise Located within the District Municipality - Rural	2	
2. Enterprise Located within the District Municipality - Urban	1.5	
3. Enterprise Located within the Province	0.5	
Other Specific Goal		
1. Enterprise 100% owned by Youth/Women/Disabled/ Military V	1	

DECLARATION WITH REGARD TO COMPANY/FIRM

Name of company/firm.....

Company registration number:

TYPE OF COMPANY/ FIRM

- ☐ Partnership/Joint Venture / Consortium
- ☐ One-person business/sole propriety
- ☐ Close corporation
- ☐ Public Company
- ☐ Personal Liability Company
- ☐ (Pty) Limited
- ☐ Non-Profit Company
- ☐ State Owned Company

[TICK APPLICABLE BOX]

I, the undersigned, who is duly authorised to do so on behalf of the company/firm, certify that the points claimed, based on the specific goals as advised in the tender, qualifies the company/ firm for the preference(s) shown and I acknowledge that:

- i) The information furnished is true and correct;
- ii) The preference points claimed are in accordance with the General Conditions as indicated in paragraph 1 of this form;
- iii) In the event of a contract being awarded as a result of points claimed as shown in paragraphs 1.4 and 4.2, the contractor may be required to furnish documentary proof to the satisfaction of the organ of state that the claims are correct;
- iv) If the specific goals have been claimed or obtained on a fraudulent basis or any of the conditions of the contract have not been fulfilled, the organ of state may, in addition to any other remedy it may have –
 - (i) disqualify the person from the tendering process;
 - (ii) recover costs, losses or damages it has incurred or suffered as a result of that person’s conduct;
 - (iii) cancel the contract and claim any damages which it has suffered as a result of having to make less favourable arrangements due to such cancellation;
 - (iv) recommend that the tenderer or contractor, its shareholders and directors, or only the shareholders and directors who acted on a fraudulent basis, be restricted from obtaining business from any organ of state for a period not exceeding 10 years, after the *audi alteram partem* (hear the other side) rule has been applied; and
- (v) forward the matter for criminal prosecution, if deemed necessary.

.....

SIGNATURE(S) OF TENDERER(S)

SURNAME AND NAME:

DATE:

ADDRESS:

.....

.....

.....

.....

.....

T - METHOD STATEMENT / APPROACH PAPER

The Tenderer shall attach a detailed method statement / approach paper for the implementation of the construction works for this Contract. The method statement / approach paper shall be in accordance with the information supplied in the Contract, requirements of the Project Specifications and with all other aspects of this Tender.

Method statements based on the scope of work and other information provided in the document which must briefly describe the following:

- Construction procedures / methodology
- Resources (personnel) to be used
- Materials and plant to be used
- Quality control measures
- Storage of materials
- Risk management
- Health and Safety measures to be taken
- Environmental control measures to be taken

The above information will be used to evaluate

Criteria 8: Method Statement / Approach Paper for Functionality under C.3.11.9.8 in Section T1.2.

SIGNATURE: DATE:
(of person authorized to sign on behalf of the Tenderer)

U - PRELIMINARY PROGRAMME AND CASHFLOW

The Tenderer shall attach a preliminary programme reflecting the proposed sequence and duration of the various activities comprising the work for this Contract. The programme shall be in accordance with the information supplied in the Contract, requirements of the Project Specifications and with all other aspects of this Tender.

Note: The programme must be based on the completion time as specified in the Contract Data. No other completion time that may be indicated on this programme will be regarded as an alternative offer, unless it is listed on Form G: Alterations by Tenderer, in the Returnable Schedules section and supported by a detailed statement to that effect, all as specified in the Tender Data.

The above information will be used to evaluate **Criteria 9: Programme** for Functionality under C.3.11.9.8 in Section T1.2.

SIGNATURE: DATE:
(of person authorized to sign on behalf of the Tenderer)

V - RECORD OF ADDENDA TO TENDER DOCUMENT

We confirm that the following communications received from the Employer's Agent before the submission of this tender offer, amending the tender documents, have been taken into account in the tender offer

Add No	Date	Title or Details
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

*Attach additional pages if more space is required.

SIGNATURE: DATE:
(of person authorised to sign on behalf of the Tenderer)

W - COMPULSORY ENTERPRISE QUESTIONNAIRE

The following particulars must be furnished. In the case of a joint venture, separate enterprise questionnaires in respect of each partner must be completed and submitted.			
Section 1: Name of Enterprise:			
Section 2: VAT registration number, if any:			
Section 3: CIDB registration number, if any:			
Section 4: Particulars of sole proprietors and partners in partnerships			
	Name *	Identity Number *	Personal Income Tax Number*
* Complete only if sole proprietor or partnership and attach separate page if more than 3 partners			
Section 5: Particulars of companies and close corporations			
Company registration number			
Close corporation number			
Tax reference number			
Section 6: Record in the services of the state			
Indicate by marking the relevant boxes with a cross, if any sole proprietor, partner in a partnership or director, manager, principal shareholder or stakeholder in a company or close corporation is currently or has been within the last 12 months in the service of any of the following:			
A member of any municipal council	☐ an employee of any provincial dept, national or provincial public entity or constitutional institution within the meaning National Council of Province of the Public Finance Management Act (Act 1 of 1999)		
A member of any provincial legislature			
A member of the National Assembly or the			
A member of the board of directors of any	☐ a member of an accounting Municipal entity authority of any national or provincial		
An official of any municipality or municipal public entity employee of Parliament or a provincial legislature entity	☐ an Entity		
If any of the above boxes are marked, disclose the following:			

	Name of sole proprietor, partner, director, manager, principal shareholder or stakeholder	Name of Institution, public office, board or organ of state and position held	Status of service (tick appropriate column)	
			Current	Within last 12 months

* Insert separate page if necessary

Section 7: Record of spouses, children and parents in the service of the state

Indicate by marking the relevant boxes with a cross, if any spouse, child or parent of a sole proprietor, partner in a partnership or director, manager, principal shareholder or stakeholder in a company or close corporation is currently or has been within the last 12 months been in the service of any of the following:

A member of any municipal council ☐ an employee of any provincial dept,
A member of any provincial legislature ☐ national or provincial public entity or
A member of the National Assembly or the ☐ constitutional institution within the
National Council of Province
meaning of the Public Finance
Management Act (Act 1 of 1999)

A member of the board of directors of any ☐ a member of an accounting of any authority
Municipal entity

An official of any municipality or municipal ☐ Entity
national or provincial public entity employee
of Parliament or a provincial
legislature

	Name of spouse, child or parent	Name of institution, public office, board or organ of state and position held	Status of service (tick appropriate column)	
			Current	Within last 12 months

* Insert separate page if necessary

The undersigned, who warrants that he/she is duly authorised to do so on behalf of the enterprise:

- Authorises the Employer to obtain a tax clearance from the South African Revenue Services that my/our tax matters are in order;
- Confirms that neither the name of the enterprise nor the name of any partner, manager, director or other person, who wholly or partly exercises, or may exercise, control over the enterprise appears on the Register of Tender Defaulters established in terms of the Prevention and Combating of Corrupt Activities Act of 2004;
- Confirms that no partner, member, director or other person, who wholly or partly exercises, or may exercise control over the enterprise appears, has within the last five years been convicted of fraud or corruption;
- Confirms that I/we are not associated, linked or involved with any other tendering entities submitting tender offers and have no other relationship with any of the tenderers or those responsible for compiling the scope of work that could cause or be interpreted as a conflict of interest; and
- Confirms that the contents of this questionnaire are within my personal knowledge and are to the best of my belief both true and correct.

Signed: _____ Date: _____

Name: _____ Position: _____

Enterprise Name: _____

X - BIDDER'S DISCLOSURE – MBD 4

BIDDER'S DISCLOSURE

1. PURPOSE OF THE FORM

Any person (natural or juristic) may make an offer or offers in terms of this invitation to bid. In line with the principles of transparency, accountability, impartiality, and ethics as enshrined in the Constitution of the Republic of South Africa and further expressed in various pieces of legislation, it is required for the bidder to make this declaration in respect of the details required hereunder.

Where a person/s are listed in the Register for Tender Defaulters and / or the List of Restricted Suppliers, that person will automatically be disqualified from the bid process.

2. BIDDER'S DECLARATION

- 2.1 Is the bidder, or any of its directors / trustees / shareholders / members / partners or any person having a controlling interest¹ in the enterprise, employed by the state?

YES/NO

- 2.1.1 If so, furnish particulars of the names, individual identity numbers, and, if applicable, state employee numbers of sole proprietor/ directors / trustees / shareholders / members / partners or any person having a controlling interest in the enterprise, in table below.

Full Name	Identity Number	Name of State institution

- 2.2 Do you, or any person connected with the bidder, have a relationship with any person who is employed by the procuring institution?

YES/NO

¹ the power, by one person or a group of persons holding the majority of the equity of an enterprise, alternatively, the person/s having the deciding vote or power to influence or to direct the course and decisions of the enterprise.

2.2.1 If so, furnish particulars:

.....
.....

2.3 Does the bidder or any of its directors / trustees / shareholders / members / partners or any person having a controlling interest in the enterprise have any interest in any other related enterprise whether or not they are bidding for this contract? YES/NO

2.3.1 If so, furnish particulars:

.....
.....

3. DECLARATION

I _____, the
(name)

undersigned in submitting the accompanying bid, do hereby make the following statements that I certify to be true and complete in every respect:

- 3.1 I have read and I understand the contents of this Disclosure;
- 3.2 I understand that the accompanying bid will be disqualified if this disclosure is found not to be true and complete in every respect;
- 3.3 The bidder has arrived at the accompanying bid independently from, and without consultation, communication, agreement or arrangement with any competitor. However, communication between partners in a joint venture or consortium² will not be construed as collusive bidding.
- 3.4 In addition, there have been no consultations, communications, agreements or arrangements with any competitor regarding the quality, quantity, specifications, prices, including methods, factors or formulas used to calculate prices, market allocation, the intention or decision to submit or not to submit the bid, bidding with the intention not to win the bid and conditions or delivery particulars of the products or services to which this bid invitation relates.
- 3.5 The terms of the accompanying bid have not been, and will not be, disclosed by the bidder, directly or indirectly, to any competitor, prior to the date and time of the official bid opening or of the awarding of the contract.
- 3.6 There have been no consultations, communications, agreements or arrangements made by the bidder with any official of the procuring.

² Joint venture or Consortium means an association of persons for the purpose of combining their expertise, property, capital, efforts, skill and knowledge in an activity for the execution of a contract. institution in relation to this procurement process prior to and during the bidding process except to provide clarification on the bid submitted where so required by the institution; and the bidder was not involved in the drafting of the specifications or terms of reference for this bid.

3.7 I am aware that, in addition and without prejudice to any other remedy provided to combat any restrictive practices related to bids and contracts, bids that are suspicious will be reported to the Competition Commission for investigation and possible imposition of administrative penalties in terms of section 59 of the Competition Act No 89 of 1998 and or may be reported to the National Prosecuting Authority (NPA) for criminal investigation and or may be restricted from conducting business with the public sector for a period not exceeding ten (10) years in terms of the Prevention and Combating of Corrupt Activities Act No 12 of 2004 or any other applicable legislation.

I CERTIFY THAT THE INFORMATION FURNISHED IN PARAGRAPHS 1, 2 and 3 ABOVE IS CORRECT.

I ACCEPT THAT THE STATE MAY REJECT THE BID OR ACT AGAINST ME IN TERMS OF PARAGRAPH 6 OF PFMA SCM INSTRUCTION 03 OF 2021/22 ON PREVENTING AND COMBATING ABUSE IN THE SUPPLY CHAIN MANAGEMENT SYSTEM SHOULD THIS DECLARATION PROVE TO BE FALSE.

.....
Signature

.....
Date

.....
Position

.....
Name of bidder

Y - JOINT VENTURE AGREEMENT

The Tenderer must attach to this page a joint venture agreement, if applicable.

Z - CURRENT COMMITMENTS SCHEDULE

[illegible]

SIGNATURE:
(of person authorised to sign on behalf of the Tenderer)

DATE:

AA - PROOF OF GOOD STANDING WITH MUNICIPAL ACCOUNTS

The tenderer is to affix to this page:

Proof that they are not in arrears for more than 30 days with municipal rates and taxes and municipal service charges. The latest municipal account statement is to be attached.

If business premises are rented, a valid Lease Agreement must be attached.
An affidavit for businesses operating in the rural area whereby tenderer is not liable for payment for any municipal account.

Note:

Failure to affix such documentation as prescribed to this page shall result in this tender not being further considered for the award of the contract.
Should this tender be considered for award of the contract, based on proof of submission and should proof of such submission be found to be invalid, erroneous or inaccurate, this tender will no longer be considered for the award of the contract.

Attach latest municipal account statement to this page.

SIGNATURE: DATE:
(of person authorised to sign on behalf of the Tenderer)

**AB - DECLARATION FOR PROCUREMENT ABOVE R10 MILLION
(ALL APPLICABLE TAXES INCLUDED)**

For all procurement expected to exceed R10 million (all applicable taxes included), bidders must complete the following questionnaire:

1 Are you by law required to prepare annual financial statements for auditing?

* YES / NO

1.1 If yes, submit audited annual financial statements for the past three years or since the date of establishment if established during the past three years.

.....

.....

2 Do you have any outstanding undisputed commitments for municipal services towards any municipality for more than three months or any other service provider in respect of which payment is overdue for more than 30 days?

* YES / NO

2.1 If no, this serves to certify that the bidder has no undisputed commitments for municipal services towards any municipality for more than three months or other service provider in respect of which payment is overdue for more than 30 days.

If yes, provide particulars.

.....

.....

.....

3 Has any contract been awarded to you by an organ of state during the past five years, including particulars of any material non-compliance or dispute concerning the execution of such contract?

* YES / NO

If yes, furnish particulars

.....

.....

* Delete if not applicable

4 Will any portion of goods or services be sourced from outside the Republic, and, if so, what portion and whether any portion of payment from the

municipality / municipal entity is expected to be transferred out of the Republic? * YES / NO

If yes, furnish particulars.

.....
.....

CERTIFICATION
(Please use block capitals when completing the section below)

I, THE UNDERSIGNED (NAME)

CERTIFY THAT THE INFORMATION FURNISHED ON THIS DECLARATION FORM IS CORRECT.

I ACCEPT THAT THE STATE MAY ACT AGAINST ME SHOULD THIS DECLARATION PROVE TO BE FALSE.

SIGNATURE: DATE:
(of the person authorised to sign on behalf of the Tenderer)

NAME:

POSITION:

* Delete if not applicable

BB - CENTRAL SUPPLIER DATABASE REGISTRATION

Name of Tenderer:

Database Registration Number:

No awards will be made to a tenderer who is not registered on the Central Supplier Database (CSD).

The establishment of a Central Supplier Database (CSD) will result in one single database to serve as the source of all supplier information for all spheres of government. The purpose of centralising government’s supplier database is to reduce duplication of effort and cost for both supplier and government while enabling electronic procurement processes.

Registration on the Central Supplier Database must be done online via the website:

<https://secure.csd.gov.za/>

SIGNATURE: DATE:
(of person authorised to sign on behalf of the Tenderer)

CC - TENDERER’S FINANCIAL POSITION DECLARATION

In terms of the tender requirements, the tender shall not be insolvent, in receivership, bankrupt or being wound up, have their affairs administered by a court or judicial officer, have suspended their business activities, or be subject to legal proceedings;

To that effect a person duly authorised by the tenderer must complete and sign the declaration hereafter in detail.

Declaration by Tenderer:

I hereby declare that my company shall not be insolvent, in receivership, bankrupt or being wound up, have their affairs administered by a court or judicial officer, have suspended their business activities, or be subject to legal proceedings during the time of tender.

I agree that my failure to complete and execute this declaration to the satisfaction of the Employer will mean that I am unable to comply with the requirements of the tender, and accept that my tender will be prejudiced and may be rejected at the discretion of the Employer.

SIGNATURE: DATE:
(of person authorised to sign on behalf of the Tenderer)

DD - QUALITY ASSURANCE PLAN AND CONTROL PROCEDURES

The Tenderer shall attach here a current copy of ISO 9001:2015 Accreditation Certificate or copy of internal Quality Management System, applicable for the implementation of the construction works for this Contract.

The above information will be used to evaluate **Criteria 5: Quality Assurance Plan and Control Procedures** for Functionality under C.3.11.9.5 in Section T1.2.

SIGNATURE: DATE:
(of person authorised to sign on behalf of the Tenderer)

EE. CLAIM WITH RESPECT TO OWNERSHIP BY TARGETTED GROUPS

The Employer will give preference to targeted designated groups. Should tenderers wish to claim the relevant preference points for this goal they may attach supporting documents with respect to ownership by targeted designated groups.

Name of Shareholder	%-age Interest	Indicate Designated Group (Women, youth, disabled, war veterans)

The following evidence must be attached as proof of belonging to the designated group:

Designated group	Evidence Required
Women, Youth	Certified copy of ID Documents
Disabled	Copy of medical report
War Veterans	Confirmation by War Veteran Association of South Africa

Tenderers are to attach evidence of certified copies of documents in support of claims for preference points for targeted designated groups.

FF. BBEE Compliance Certificate

Tenderers are required to attach their BBEE compliance certificate on this page or in the case of a joint venture, certificates of individual firms making up the joint venture, should they wish to claim for scores for BBEE Compliance.

GG. Schedule of Proposed Sub-Contractors

We notify that it is our intention to employ the following Subcontractors for work in the contract.

If we are awarded a contract we agree that this notification does not change the requirement for us to submit the names of proposed Subcontractors in accordance with requirements in the contract for such appointments, if there are no such requirements in the contract, then your written acceptance of this list shall be binding between us.

We inform that all subcontractors who are contracted to construct a house are registered as home builders with the National Home Builders Registration Council.

[illegible]

SIGNATURE:
(of person authorised to sign on behalf of the Tenderer)

DATE:

UGU DISTRICT MUNICIPALITY

TENDER No: UGU-07-1689-2025

Umzinto Wastewater Treatment Works – Phase 2

UPGRADE AND EXPANSION OF UMZINTO WASTEWATER TREATMENT WORKS

PART T2.3: TECHNICAL SCHEDULES

SECTION T2.3 TECHNICAL SCHEDULES (Mechanical Works)

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Nr.	Item	Units	Technical Particulars
1	BIOLOGICAL REACTOR		
1.1	Vertical shaft stirrers		
	General Information		
	Installed motor power	kW	
	Manufacturer		
	Country of manufacture		
	Type of stirrer		
	Material of stirrer shaft		
	Material of stirrer blades		
	Speed of rotation	rpm	
	Diameter of impeller	mm	
	Tip speed of stirrer blades	m/s	
	Gearboxes		
	Installed motor power	kW	
	Manufacturer		
	Country of manufacture		
	Type number		
	AGMA rating	kW	
	Thermal rating	kW	
	Maximum torque capacity	Nm	
	Maximum allowable radial load	N	
	Maximum allowable bending moment	Nm	
	Electric Motors		
	Installed power	kW	
	Name of manufacturer		
	Place of manufacture		
	Class of insulation		
	Type of motor		
	Type of frame		
	Splash protection		
	Speed of rotation	rpm	
	Efficiency at full load	%	
	Power factor at full load		
	Mass of complete unit	kg	
Nr.	Item	Units	Technical Particulars
1.2	VERTICAL SHAFT AERATORS		
	General Information		
	Installed motor power	kW	
	Manufacturer		
	Country of manufacture		
	Type of stirrer		
	Material of stirrer shaft		

	Material of stirrer blades		
	Speed of rotation	rpm	
	Diameter of impeller	mm	
	Tip speed of stirrer blades	m/s	
	Gearboxes		
	Installed motor power	kW	
	Manufacturer		
	Country of manufacture		
	Type number		
	AGMA rating	kW	
	Thermal rating	kW	
	Maximum torque capacity	Nm	
	Maximum allowable radial load	N	
	Maximum allowable bending moment	Nm	
	Electric Motors		
	Installed power	kW	
	Name of manufacturer		
	Place of manufacture		
	Class of insulation		
	Type of motor		
	Type of frame		
	Splash protection		
	Speed of rotation	rpm	
	Efficiency at full load	%	
	Power factor at full load		
	Mass of complete unit	kg	
Nr.	Item	Units	Technical Particulars
1.3	Pumps		
1.3.1	General information		
	Manufacturer		
	Type		
	Model		
	Country of origin		
1.3.2	Duty point – <u>guaranteed figures</u>		
	Discharge	l/s	
	Head	m	
	Efficiency (pump)	%	
	Speed	rpm	
	Power required	kW	
	Maximum power under any condition	kW	
1.3.3	Mechanical information		
	Number of stages		
	Casing material		

	Impeller material		
	Impeller diameter	mm	
	Shaft material		
	Shaft diameter	mm	
	Type of bearings		
	Bearing lubricant		
	Mass of pump unit complete including motor	kg	
1.4	Pipe fittings and Specials		
1.4.1	Steel		
	Country of origin		
	Manufacturer		
	Place of manufacture		
	Supplier		
	Material grade		
1.4.2	Stainless steel		
	Country of origin		
	Manufacturer		
	Place of manufacture		
	Supplier		

Nr.	Item	Units	Technical Particulars
2	SECONDARY CLARIFIER		
2.1	Ras Pumps		
2.1.1	General information		
	Manufacturer		
	Type		
	Model		
	Country of origin		
2.1.2	Duty point – <u>guaranteed figures</u>		
	Discharge	l/s	
	Head	m	
	Efficiency (pump)	%	
	Speed	rpm	
	Power required	kW	
	Maximum power under any condition	kW	
2.1.3	Mechanical information		
	Number of stages		
	Casing material		
	Impeller material		
	Shaft diameter	mm	
	Type of bearings		

	Bearing lubricant		
	Mass of pump unit complete including motor	kg	
2.2	WAS Submersible Pumps		
2.2.1	General information		
	Manufacturer		
	Type		
	Model		
	Country of origin		
2.2.2	Duty point – <u>guaranteed figures</u>		
	Discharge	l/s	
	Head	m	
	Efficiency (pump)	%	
	Speed	rpm	
	Power required	kW	
	Maximum power under any condition	kW	
2.2.3	Mechanical information		
	Number of stages		
	Casing material		
	Impeller material		
	Shaft diameter	mm	
	Type of bearings		
	Bearing lubricant		
	Mass of pump unit complete including motor	kg	
2.3	Biofilter Recycle Pumps		
2.3.1	General information		
	Manufacturer		
	Type		
	Model		
	Country of origin		
2.3.2	Duty point – <u>guaranteed figures</u>		
	Discharge	l/s	
	Head	m	
	Efficiency (pump)	%	
	Speed	rpm	
	Power required	kW	
	Maximum power under any condition	kW	
2.3.3	Mechanical information		
	Number of stages		
	Casing material		
	Impeller material		
	Shaft diameter	mm	

	Type of bearings		
	Bearing lubricant		
	Mass of pump unit complete, including motor	kg	
2.4	Sludge Return Pumps		
2.4.1	General information		
	Manufacturer		
	Type		
	Model		
	Country of origin		
2.4.2	Duty point – <u>guaranteed figures</u>		
	Discharge	l/s	
	Head	m	
	Efficiency (pump)	%	
	Speed	rpm	
	Power required	kW	
	Maximum power under any condition	kW	
2.4.3	Mechanical information		
	Number of stages		
	Casing material		
	Impeller material		
	Shaft diameter	mm	
	Type of bearings		
	Bearing lubricant		
	Mass of pump unit complete, including motor	kg	

Nr.	Manufacturer	Units	Technical Particulars
3	CHLORINE DOSING SYSTEM		
3.1	Dosing system		
	Country of origin		
	Manufacturer		
	Place of manufacture		
	Supplier		

Nr.	Manufacturer	Units	Technical Particulars
4	Digester mixing system		
4.1	Sludge mixing pump		
	Manufacture		
	Country of origin		
	Year of manufacture		
	Type		

	Model		
	Is unit non clog		
	Service		
4.2	General technical details		
	CFD analysis submitted		
	Normal direction of flow		
	Is unit reversible		
	Frequency of reversal	hr	
	Mass of complete mixer	kg	
	Static load on digester roof	kN	
	Dynamic load on digester roof	kN	
	Installed Power	kW	
	Absorbed power normal operation	kW	
	Absorbed power reversal operation	kW	
	Screw type		
	Diameter of screw	mm	
	Diameter of draft tube	mm	
	Draft tube inlet diameter	mm	
	Draft tube outlet diameter	mm	
	No of draft tube support stays	No	
	Pumping capacity normal operation	m3/hr	
	Pumping capacity in reversed operation	m3/hr	
	Digester volume turn over time	hr	
4.3	Gearbox details		
	Manufacture		
	Digester volume turn over time	hr	
	Country of manufacture		
	Type of gears/lubrication method		
	Gearbox output coupling details and how fixed to gearbox shaft		
	Model		
	Transmission ration		
	Oil capacity	Liters	
	Rating AGMA	kW	
	Thermal rating at 30°C		
4.4	Material of construction		
	Housing		
	Shaft		
	Screw		
	Mounting Plate		

	Holding down bolts		
	Draft tube		
	Draft tube support stays		
	Support stays anchor bolts		
4.5	Sludge mixing pump and motor		
	Manufacturer		
	Place of manufacture		
	Type		
	Type of frame		
	Insulation Class		
	Compliance with SANS 948		
	Speed of rotation	rpm	
	Rated output at site	kW	
	Full load current	A	
	Efficiency at:		
	Full load	%	
	½ load	%	
	Power factor at:		
	Full load	%	
	½ load	%	
	Operating voltage	V	
4.6	Starting method		
	Starting current	A	
	Starting time for starting with connected load	Sec	
	Number of consecutive starts at its specified load	No	
	Temperature detectors in windings		
	Type		
	Number		
	Position in winding		
	Temperature detectors on bearing		
	Type		
	Number		
	Anti-condensation heaters		
	Total wattage	W	
	Voltage	V	
	Physical detail of electrical motors		
	Mass of motor	Kg	

Nr.	Manufacturer	Units	Technical Particulars
5	Pipe coating and lining		
5.1	Material		

	Country of origin		
	Manufacturer		
	Place of manufacture		
	Manufacturers type designation		
	Epoxy paint		
	UV-Resistant multi-purpose epoxy		
	Re-coatable polyurethane		
	Fusion-bonded epoxy		
5.2	Coating factory		
	Name of factory		

Nr.	Manufacturer	Units	Technical Particulars
6	PROCESS MONITORING EQUIPMENT		
6.1	pH Probes		
6.1.1	General information		
	Manufacturer		
	Type		
	Country of origin		
	Range	pH Units	
	Accuracy	pH Units	
	Body Material		
6.2	Level Sensors		
6.2.1	General information		
	Manufacturer		
	Type		
	Model		
	Country of origin		
	Range	m	
	Accuracy	%	
6.3	Flow Meter		
6.3.1	General information		
	Manufacturer		
	Type		
	Model		
	Country of origin		
	Maximum Velocity	m	
	Maximum Pressure Drop (at Max Flow)	kPa	

	Accuracy	%	
6.4	Pressure Transmitter		
6.4.1	General information		
	Manufacturer		
	Type		
	Model		
	Country of origin		
	Range	kPa	
	Maximum Transducer Pressure	kPa	
	Accuracy	%	
6.5	Densitometer		
6.5.1	General information		
	Manufacturer		
	Type		
	Model		
	Country of origin		
	Range	mg/l	
	Accuracy	%	
6.6	Temperature Transmitter		
6.6.1	General information		
	Manufacturer		
	Type		
	Model		
	Country of origin		
	Accuracy	%	
6.7	Dissolved oxygen probe		
6.7.1	General information		
	Manufacturer		
	Type		
	Model		
	Country of origin		
	Accuracy		



VOLUME 1

CONTRACT

PART 1:

AGREEMENT AND CONTRACT DATA

C1.1 Form of Offer and Acceptance	C 2
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C1.1 FORM OF OFFER AND ACCEPTANCE (Agreement)

Offer

The Employer, identified in the Acceptance signature block, has solicited offers to enter a contract in respect of the following works:

Tender No: UGU-07-1689-2025

PHASE 2A - UPGRADE AND EXTENSION OF THE UMZINTO WASTEWATER TREATMENT WORKS FROM 2.5 MI to 4.0 MI

Construction and Commissioning of Civil - Mechanical and Electrical Works

The Tenderer, identified in the Offer signature block below, has examined the documents listed in the Tender Data and addenda thereto as listed in the Tender Schedules, and by submitting this Offer has accepted the Conditions of Tender.

By the representative of the Tenderer, deemed to be duly authorised, signing this part of this Form of Offer and Acceptance, the Tenderer offers to perform all of the obligations and liabilities of the Contractor under the Contract including compliance with all its terms and conditions according to their true intent and meaning for an amount to be determined in accordance with the Conditions of Contract identified in the Contract Data.

THE OFFERED TOTAL OF THE PRICES INCLUSIVE OF VALUE ADDED TAX IS

_____ Rand (in words); R _____ (in figures),

This offer may be accepted by the Employer by signing the Acceptance part of this Form of Offer and Acceptance and returning one copy of this document to the Tenderer before the end of the period of validity stated in the Tender Data, whereupon the Tenderer becomes the party named as the Contractor in the Conditions of Contract identified in the Contract Data.

Signature

Name

Capacity

For the Tenderer

(Name and address of organisation)

Name and
signature of
witness

Date _____

Acceptance

By signing this part of the Form of Offer and Acceptance, the Employer identified below accepts the Tenderer's Offer. In consideration thereof, the Employer shall pay the Contractor the amount due in accordance with the Conditions of Contract identified in the Contract Data. Acceptance of the Tenderer's Offer shall form an agreement between the Employer and the Tenderer upon the terms and conditions contained in this Agreement and in the Contract that is the subject of this Agreement.

The terms of the contract are contained in

T1.2 Tender Data

Part T2 Returnable

T2.1 List of Returnable Documents

T2.2 Returnable Schedules

Part 1 Agreement and Contract Data (which includes this Agreement)

Part 2 Pricing Data

Part 3 Scope of Work

Part 4 Site Information (if applicable)

and drawings and documents or parts thereof, which may be incorporated by reference into Parts 1 to 4 above.

Deviations from and amendments to the documents listed in the Tender Data and any addenda thereto listed in the Tender Schedules as well as any changes to the terms of the Offer agreed by the Tenderer and the Employer during this process of offer and acceptance, are contained in the Schedule of Deviations attached to and forming part of this Agreement. No amendments to or deviations from said documents are valid unless contained in this Schedule, which must be duly signed by the authorised representative(s) of both parties.

The Tenderer shall within two weeks after receiving a completed copy of this Agreement, including the Schedule of Deviations (if any), contact the Employer's agent (whose details are given in the Contact Data) to arrange the delivery of any bonds, guarantees, proof of insurance and any other documentation to be provided in terms of the Conditions of Contract identified in the Contract Data at, or just after, the date of this Agreement comes into effect. Failure to fulfil any of these obligations in accordance with those terms shall constitute a repudiation of this Agreement.

Notwithstanding anything contained herein, this Agreement comes into effect on the date when the Tenderer receives one fully completed original copy of this document, including the Schedule of Deviations (if any). Unless the Tenderer (now the Contractor) within five days after the date of such receipt notifies the Employer in writing of any reason why he cannot accept the contents of this Agreement, this Agreement shall constitute binding contract between the parties,

Signature(s)

Name(s)

Capacity

For the Employer

(Name and address of organisation)

Name and
signature of
witness

Date _____

SCHEDULE OF DEVIATIONS

Notes:

The extent of deviations from the tender documents issued by the employer prior to the tender closing date is limited to those permitted in terms of the Conditions of Tender,

A Tenderer's covering letter shall not be included in the final contract document. Should any matter in such letter, which constitutes a deviation as aforesaid become the subject of agreements reached during the process of offer and acceptance, the outcome of such agreement shall be recorded here,

Any other matter arising from the process of offer and acceptance either as a confirmation, clarification or change to the tender documents and which it is agreed by the Parties becomes an obligation of the contract shall also be recorded here,

Any change or addition to the tender documents arising from the above arrangements and recorded here shall also be incorporated into the final draft of the Contract.

1	Subject	_____
	Details	_____
2	Subject	_____
	Details	_____
3	Subject	_____
	Details	_____
4	Subject	_____
	Details	_____
5	Subject	_____
	Details	_____
6	Subject	_____
	Details	_____
7	Subject	_____
	Details	_____
8	Subject	_____
	Details	_____

By the duly authorised representatives signing this Schedule of Deviations, the Employer and the Tenderer agree to and accept the foregoing Schedule of deviations as the only deviations from and amendments to the documents listed in the Tender Data and addenda thereto as listed in the Tender Schedules, as well as any confirmation, clarification or change to the terms of the offer agreed by the Tenderer and the Employer during the process of offer and acceptance.

It is expressly agreed that no other matter whether in writing, oral communication or implied during the period between the issue of the tender documents and the receipt by the Tenderer of a completed and signed copy of this Agreement shall have any meaning or effect in the contract between the parties arising from this Agreement.

For the Tenderer:

Signature _____

Name _____

Capacity _____

(Name and address of organisation)

Name and signature of witness _____ Date _____

For the Employer:

Signature _____

Name _____

Capacity _____

(Name and address of organisation)

Name and signature of witness _____ Date _____

CONFIRMATION OF RECEIPT

The Tenderer (now Contractor), identified in the Offer part of this Agreement hereby confirms receipt from the Employer, identified in the Acceptance part of this Agreement, of one fully completed original copy of this Agreement, including the Schedule of Deviations (if any) today:

The (Day) of (Month) 20..... (Year)
at (Place)

FOR THE CONTRACTOR
Print clearly

Signature(s)

Name(s)

Capacity

Witness Signature

..... Date

C1.2 CONTRACT DATA

A. CONDITIONS OF CONTRACT

The General Conditions of Contract for Construction Works Third Edition (2015), published by the South African Institution of Civil Engineering, is applicable to this Contract. Contract Document. Copies of these conditions of contract may be obtained from the South African Institution of Civil Engineering (Tel. 011 805 5947). Drawings also forms part of the single volume

B. CONTRACT SPECIFIC DATA

The General Conditions of Contract for Construction Works make several references to the Contract Data for specific data, which together with these conditions collectively describe the risks, liabilities and obligations of the contracting parties and the procedures for the administration of the Contract. The Contract Data shall have precedence in the interpretation of any ambiguity or inconsistency between it and the general conditions of contract.

Clause numbers refer to Clauses in the General Conditions of Contract for Construction Works (2015)

DESCRIPTION	CLAUSE	DETAILS
Bill of Quantities	1.1.1.2	Add the following after "Bill of Quantities", also referred to as Bills of Quantities,
Certificate of Completion	1.1.1.3	Delete the contents of the clause and insert the following: "Certificate of Completion" means the certificate issued by the Employer's Agent stating the date on which completion of the Works was achieved. Certificates of Completion will not be issued for portions or phases of the Works.
Commencement Date	1.1.1.5	"Commencement date" means a date determined by the Employer and communicated to the Contractor at the "Site Handover Meeting", which meeting is to take place within fourteen (14) days from the date that the Agreement, made in terms of the Form of Offer and Acceptance, comes into effect. Such Commencement Date is to be within fourteen (14) days from the date of the Site Handover Meeting. "Site Handover Meeting" means a meeting arranged by the Engineer to communicate the Commencement Date to the Contractor, to instruct the Contractor to commence the execution of the Works on the Commencement Date as per Clause 5.3.1, to provide the Contractor with the necessary details and documentation to execute the Works and for the Employer to give the Contractor right of access to the Site, as per Clause 5.4.1.
Defects Liability Period	1.1.1.13	12 months from the date of issue of the Certificate of Completion
Due Completion Date	1.1.1.14	Employers' Time for Completion is 15 months.

DESCRIPTION	CLAUSE	DETAILS								
		This clause shall apply mutatis mutandis to any portion or phase of the Works that may be described in the Scope of Works or in the Contract Data or agreed subsequently between the Contractor and the Employer and committed to writing. The time for achieving Practical Completion including the allowance of 14 days for finalisation of documentation in terms of Clause 5.3.2 and Clause 5.3.3, is 456 days, inclusive of the 28-day Trial Operation Period (refer to Clause 7.4.3.1 below), and inclusive of non-working days referred to in Clause 5.8.1 below, but exclusive of special non-working days (Clause 5.8.1), calculated from the Commencement Date. Two months will be a float period for the employer to accommodate potential employer delays due to unforeseen circumstances and the work permit application.								
Name of Employer	1.1.1.15	UGU District Municipality								
Delivery of Notices	1.2.1	Add the following to the clause: 1.2.1.3 Sent by electronic mail irrespective of it being during office hours or otherwise. 1.2.1.4 Posted to the Contractor’s address, and delivered by the postal authorities. 1.2.1.5 Delivered by a courier service or messenger, and signed for by the recipient or his representative.								
Address of Employer	1.2.1.2	<table><tr><td>Physical Address:</td><td>Postal Address</td></tr><tr><td>Connor Street</td><td>P O Box 33</td></tr><tr><td>Port Shepstone</td><td>Port Shepstone</td></tr><tr><td>4240</td><td>4240</td></tr></table> Tel No: 039 688 5700 E-mail: Smanga.Mbele @ugu.gov.za	Physical Address:	Postal Address	Connor Street	P O Box 33	Port Shepstone	Port Shepstone	4240	4240
Physical Address:	Postal Address									
Connor Street	P O Box 33									
Port Shepstone	Port Shepstone									
4240	4240									
Name of Employers Agent	1.1.1.16	S Zoko Consulting								
Contract Pricing Strategy	1.1.1.26	Re-measurement Contract								

DESCRIPTION	CLAUSE	DETAILS
Address of Employers Agent	1.2.1.2	Physical Address: 19 Valley Road, Margate, 4275 Postal Address: PO Box 668, Margate, 4275 Tel: +27 (0)39 317 4534 Fax: +27 (0)39 312 0320 E-mail: info@szcon.co.za
Ambiguity or Discrepancy	2.4.1	Delete the contents of the clause and insert the following: The documents forming the Contract are to be taken as mutually explanatory of one another. For the purposes of interpretation, the priority of the documents shall be in accordance with the following sequence, listed from highest to lowest priority: (a) Form of Offer and Acceptance (b) Contract Data (c) General Conditions of Contract (d) Drawings (e) Variations and Additional Clauses to Particular Specifications and Standard Specifications (f) Particular Specifications (g) Standard Specifications (h) Bill of Quantities (i) Any other documents forming part of the Contract If an ambiguity or discrepancy between the documents is found, the Employer's Agent shall provide the necessary clarification or instruction.
Employers Health and Safety Agent	3.2.4	Delete the contents of the Clause and insert the following: The Employer's Health and Safety Agent, appointed in terms of the Construction Regulations promulgated under the Occupational Health and Safety Act, is authorised to act as his representative relating to the responsibilities imposed by the Occupational Health and Safety Act on the Employer. Such an agent shall be responsible to the Employer's Agent in terms of these Conditions of Contract.
Employer's Agent approval	3.2.5	Add the following clause: Any approval, check, certificate, consent, examination, inspection, instruction, notice, proposal, request, test, or similar act by the Employer's Agent (including the absence of disapproval) shall not relieve the Contractor from any responsibility he has under the Contract,

DESCRIPTION	CLAUSE	DETAILS
		including responsibility for errors, omissions, discrepancies and non-compliance.
Contractor's Liability for Own Design Errors	4.1.2	Add the following to the clause: The Contractor shall provide the following to the Employer's Agent for retention by the Employer or his assignee in respect of all works designed by the Contractor: 4.1.2.1 A Certificate of Stability of the Works signed by a registered Professional Engineer confirming that all such works have been designed in accordance with the appropriate codes of practice. 4.1.2.2 Proof of registration and of adequate and current professional indemnity insurance cover held by the designer(s). 4.1.2.3 Design calculations should the Employer's Agent request a copy thereof. 4.1.2.4 Engineering drawings and workshop details (both signed by the relevant professional engineer), in order to allow the Employer's Agent to compare the design with the specified requirements and to record any comments he may have with respect thereto. 4.1.2.5 "As-Built" drawings in DXF electronic format after completion of the Works. The Contractor shall be responsible for the design of the Temporary Works.
New Clause	4.3.3	Add the following new clause: - The Contractor shall comply with the Occupational Health and Safety Specification prepared by the Employer in terms of the Construction Regulations, 2014 promulgated in terms of Section 43 of the Occupational Health and Safety Act (Act No. 85 of 1993). - Without limiting the Contractor's obligations in terms of the Contract, the Contractor shall before commencement of the Works or any part thereof, be in the possession of an approved Health and Safety Plan. - The Contractor shall submit an approved Health and Safety Plan to the Employer's

DESCRIPTION	CLAUSE	DETAILS
		Agent within 14 days from the Commencement Date.
New Clause	4.3.4	Add the following new clause: Contractor's liability as mandatory Notwithstanding any actions which the Employer may take, the Contractor accepts sole liability for due compliance with the relevant duties, obligations, prohibitions, arrangements and procedures imposed by the Occupational Health and Safety Act, 1993 (Act 85 of 1993), and all its regulations, including the Construction Regulations, 2014, for which he is liable as mandatory. By entering into this Contract it shall be deemed that the parties have agreed in writing to the above provisions in terms of Section 37 (2) of the Act.
New Clause	4.3.5	Add the following new clause: The contractor to notify the Employer The Employer retains an interest in all inquiries conducted under this Contract in terms of Section 31 and/or 32 of the Occupational Health and Safety Act, 1993 (Act 85 of 1993) and its Regulations following any incident involving the Contractor and/or Sub-Contractor and/or their employees. The Contractor shall notify the Employer in writing of all investigations, complaints or criminal charges which may arise pursuant to work performed under this Contract in terms of the Occupational Health and Safety Act, 1993 (Act 85 of 1993) and Regulations.
New Clause	4.3.6	Add the following new clause: Contractor's Designer The Contractor and his designer shall accept full responsibility and liability to comply with the Occupational Health and Safety Act, 1993 (Act 85 of 1993) and the Construction Regulations, 2014 for the design of the Temporary Works and those part of the Permanent Works which the Contractor is responsible to design in terms of the Contract.
Contractor's default in Payment to Labourers and Employees:	4.10.1	Any dispute between the Contractor and labourers regarding delayed payment or default in payment of fair wages, if not resolved immediately, may compel the Employer to intervene. The Employer may, upon the Contractor defaulting payment, pay the money due to the workers not honoured in time, out of any money due or which may become due to the Contractor under the Contract.

DESCRIPTION	CLAUSE	DETAILS
Documentation Required Before Commencement with Works Execution	5.3.1	The documentation required before commencement with Works Execution are: • Health and Safety Plan (Refer to Clause 4.3.3) • Initial programme (Refer to Clause 5.6) • A detailed cashflow forecast (Refer to Clause 5.6.2.6) • Security (Refer to Clause 6.2) • Insurance (Refer to Clause 8.6) The time to deliver the Form of Guarantee within 14 days of the Commencement Date. The Form of Guarantee is to contain the wording of the document. The liability for the guarantee shall be for 10% of the Contract Price.
Time to Submit Documentation Required Before Commencement with Works Execution	5.3.2	The time to submit the documentation required before the commencement of Works execution is fourteen (14) days from the date that the Agreement, made in terms of the Form of Offer and Acceptance, comes into effect.
Access to Site	5.4.2	The access and possession of the site shall be <u>Not</u> be exclusive to the Contractor. The Contractor shall coordinate its activities with the operation and maintenance team and any other parties authorised to access the Site to ensure the safe and efficient operation of the Plant.
Time for Practical Completion	5.5.1	Employers' Time for Completion is 15 months. This clause shall apply mutatis mutandis to any portion or phase of the Works that may be described in the Scope of Works or in the Contract Data or agreed subsequently between the Contractor and the Employer and committed to writing. The time for achieving Practical Completion, including the allowance of 14 days for finalisation of documentation in terms of Clause 5.3.2 and Clause 5.3.3, is 456 days, inclusive of the 28-day Trial Operation Period (refer to Clause 7.4.3.1 below), and inclusive of non-working days referred to in Clause 5.8.1 below, but exclusive of special non-working days (Clause 5.8.1), calculated from the Commencement Date. Two months will be a float period for the employer to accommodate potential employer delays due to

DESCRIPTION	CLAUSE	DETAILS
		unforeseen circumstances and the work permit application.
Programme of Works	5.6.1	The contractor shall deliver his work programme within fourteen (14) days from the Commencement Date. Note: For information about the required format, etc., refer to the project specifications.
Non-Working days Year-end break	5.8.1	Sundays, Public Holidays Special non-working days are the year-end break and public holidays
Amount of Penalty	5.13.1	The penalty for failing to complete the Works by the Due Completion Date shall be 0.0125% of the Accepted Contract Amount per day to a maximum of 10% of the Contract Amount.
Latent Defect Period	5.16.3	10 years
Delivery of Security	6.2.1	The security to be provided by the Contractor shall be a Performance Guarantee of 10% of the contract sum (delivered within the time stated in 5.3.2 above), plus retention of 5% of the value of the Works. The liability of the Guarantee shall be up to the issue of the Certificate of Completion when the Guarantee shall be returned to the Contractor. Retention monies shall be deducted at 10% per payment claim to a maximum of 5% of the value of Works.
Validity of Performance Guarantee	6.2.3	No expiry date to be specified
Validity of Performance Guarantee	6.2.3	A Bank or Insurance Company approved by the Employer will provide the performance guarantee. Guarantees submitted must be issued by either an insurance company duly registered in terms of the Short-Term Insurance Act, 1998 (Act 35 of 1998) or by a bank duly registered in terms of the Banks Act, 1990 (Act 94 of 1990) on the pro forma attached as Annexure A to the Contract Data. No alterations or amendments of the wording of the pro forma will be accepted.
Duration of Guarantee	6.2.3	Until the date of issue of Certificate of Completion

DESCRIPTION	CLAUSE	DETAILS
Percentage allowances for day works	6.5.1.2.3	The percentage allowances to cover overhead charges for daywork, which has not been included in the Daywork Schedule, are as follows: 50% of the gross remuneration of workmen and foremen actually engaged in the daywork. 15% on the net cost of materials actually used. No allowance will be made for work done, or for materials and equipment for which daywork rates have been quoted at tender stage.
Provisional Sums	6.6.1.2.1	Commission will not be paid if no percentage is stated by the Contractor.
Price Adjustment Factor	6.8.2	$x = 0.10$ $a = 0.25$ $b = 0.15$ $c = 0.53$ $d = 0.07$ "F" shall be the weighted average of the fuel indices for "diesel before deduction of refund" and "diesel previously refunded" weighted in a ratio of 1 to 1, for Gauteng. "L" is the "Labour Index" for the KZN.
Percentage advance on material not yet built into the Permanent Works	6.10.1.5	80 per cent
Percentage Retention	6.10.3	10 per cent
Limit of Retention Money	6.10.3	10 per cent of the completed work, to a maximum of 5% of the contract value.
(New Sub -Clause)	7.4.3	Add the following Clause: 7.4.3.1 Tests on Completion The Contractor shall carry out the Tests on Completion in accordance with this Clause, after submission of As-Built Documents and the required Operation and Maintenance Manuals. The Contractor shall give to the Employer's Agent not less than 21 days' notice of the date after which the Contractor will be ready to carry out each of the Tests on Completion. Unless otherwise agreed, Tests on Completion shall be carried out within 14 days after this date on such day or days as the Employer's Agent shall instruct. Unless otherwise stated in the Particular Conditions, the Tests on Completion shall be carried out in the following sequence:

DESCRIPTION	CLAUSE	DETAILS
		(a) pre-commissioning tests, which shall include the appropriate inspections and (“dry” or “cold”) functional tests to demonstrate that each item of Plant can safely undertake the next state, (b) commissioning tests, which shall include the specified operational tests to demonstrate that the Works or Section can be operated safely and as specified, under all available operating conditions. (c) trial operation, which shall demonstrate that the Works or Section perform reliably and in accordance with the contract. During trial operation, when the Works are operating under stable conditions, the contractor shall give notice to the Employer’s Ageng that the Works are ready for any other Tests on Completion, including performance tests to demonstrate whether the Works conform with criteria specified in the Employer’s Requirements. Trial operation shall not constitute a Certificate of Completion under Clause 5.14. Unless otherwise stated in the Particular Conditions, any product produced by the Works during trial operation shall be the property of the Employer. The Contractor shall provide all necessary tests equipment, materials and tools and competent staff for the performance of the specified performance acceptance tests and shall submit for the approval of the Employer’s Agent certified copies of the calibration certificates for the test equipment. When all tests have been successfully completed to the satisfaction of the Employer’s Agent, a Trial Operation Period shall start and shall consist of a continuous period of operation of 28 days free from trouble. During the Trial Operation Period the Contractor shall carry out all necessary servicing and any adjustments required. The Council’s site staff will assist the Contractor in operating the Works or Section during this period and at this time the Contractor shall train the Council’s operational staff in the starting, operating and stopping of the Works or Section, and the Council’s maintenance staff on the maintenance requirements and procedures. When an extended performance test period is specified, the Trial Operation Period will run concurrently with the first 28 days of the performance acceptance test period.

DESCRIPTION	CLAUSE	DETAILS
		Before the end of the Trial Operation Period the Contractor shall arrange for an acceptance inspection to be carried out together with the Employer's Agent to take over the Works or Section in terms of Clause 5.14.6. In considering the results of the Tests on Completion, the Employer's Agent shall make allowances for the effect of any use of the Works by the Employer on the performance or other characteristics of the Works. As soon as the Works, or a Section, have passed each of the Tests on Completion described in sub-paragraph (a), (b) or (c), the Contractor shall submit a certified report of the results of these Tests to the Employer's Agent. 7.4.3.2 Delayed tests If the Tests on Completion are being unduly delayed by the Employer resulting in the Contractor suffering a delay and/or incurring costs from complying with these instructions or as a result of a delay for which the Employer is responsible, the Contractor shall be entitled to make a claim in accordance with Clause 10.1, for which purpose the 28 days provided in Clause 10.1.1.1 shall commence to run only from the time when compliance with the said terms has actually taken place. If the Tests on Completion are being unduly delayed by the Contractor, the Employer's Agent may by notice require the Contractor to carry out the Tests within 21 days after receiving the notice. The Contractor shall carry out the Tests on such day or days within that period as the Contractor may fix and of which he shall give notice to the Engineer. If the Contractor fails to carry out the Tests on Completion within the period of 21 days, the Employer's Personnel may proceed with the Tests at the risk and cost of the Contractor. The Tests on Completion shall then be deemed to have been carried out in the presence of the Contractor and the results of the Tests shall be accepted as accurate. <u>7.4.3.3 Retesting</u> If the Works or a Section fail to pass the Tests on Completion, the Employer's Agent or the Contractor may require the failed Tests and Tests on Completion on any related work to be repeated under the same terms and conditions.

DESCRIPTION	CLAUSE	DETAILS
		<u>7.4.3.4 Failure to Pass Tests on Completion</u> If the Works, or a Section, fail to pass the Tests on Completion repeated under Sub Clause 7.4.3.3, the Employer's Agent shall be entitled to: (a) order further repetition of Tests on Completion under Sub Clause 7.4.3.3; (b) if the failure deprives the Employer of substantially the whole benefit of the Works or Section reject the Works or Section (as the case may be) in which event the Employer shall have the same remedies as are provided in Clause 7.8.3 or (c) issue a Certificate of Completion if the Employer so requests In the event of Clause 7.8.3 the Contractor shall proceed in accordance with all other obligations under the Contract, and the Contract Price shall be reduced by such amount as shall be appropriate to cover the reduced value to the Employer as a result of this failure. Unless the relevant reduction for this failure is stated (or its method of calculation is defined) in the Contract the Employer may require the reduction to be agreed by both Parties (in full satisfaction of this failure only) and paid before this Certificate of Completion is issued. Testing of the new plant shall be undertaken in accordance with the Specification.
	7.10	<i>Add the following clause after Clause 7.9.1:</i> The Contractor shall institute a quality assurance system to demonstrate compliance with the requirements of the Contract. The system shall be in accordance with the details stated in the Contract. The Employer's Agent shall be entitled to audit any aspect of the system. Details of all procedures and compliance documents shall be submitted to the Employer's Agent for information before each design and execution stage is commenced. When any document of a technical nature is issued to the Employer's Agent, evidence of the prior approval by the Contractor himself shall be apparent on the document itself.

DESCRIPTION	CLAUSE	DETAILS
		Compliance with the quality assurance system shall not relieve the Contractor of any of his duties obligations or responsibilities under the Contract.
Insurance of the Works	8.6.1	Required
Insured Sum	8.6.1.1.1	Contract price
Insured Sum	8.6.1.1.2	The Value of the Plant and materials supplied by the Employer to be included in the insurance sum is Nil.
Insured Sum	8.6.1.1.3	The amount to cover professional fees for repairing damage and loss to be included in the insurance sum is Nil.
Special Risks Insurance	8.6.1.2	Required
Minimum Amount of Liability Ins	8.6.1.3	R20 000 000.00 for each and every claim
Adjudication	10.5.1	Dispute resolution shall be by standing adjudication.
Settlement of disputes to be by	10.5.2	Ad-hoc adjudication followed by Arbitration (following the Rules for Conduct of Arbitrations published by the Association of Arbitrators)
No of Adjudication Board Members	10.5.3	One
Arbitration	10.7.1	Ad-hoc adjudication followed by Arbitration (following the Rules for Conduct of Arbitrations published by the Association of Arbitrators)

C: DATA PROVIDED BY THE CONTRACTOR

COMPULSORY DATA	
GCC Ref Clause No	
1.1.1.9	The name of the Contractor:
1.2.1.2	The address of the Contractor: Physical: Postal: Tel No: Fax No: Email:
6.2.1	Security Security is to be provided as stipulated in the data provided by the Employer in sub-clause 6.2.1

D. CONTRACT PRICE ADJUSTMENT SCHEDULE

VARIATION IN COST OF SPECIAL MATERIALS: See Clause 6.8.3.

**To be completed by Tenderer*

*Special materials, items or portions of the Works concerned	*Method by which variations shall be determined	*Rate or Price for the base month

Period of validity of tender is ninety (90) days from closing date of tenders.

Signature:

On behalf of:

Date:

E. SPECIAL CONDITIONS OF CONTRACT

CLAUSE	CONTENTS	PAGE No.
3.2.3	SPECIFIC APPROVAL OF EMPLOYER REQUIRED	C 21
4.3	LEGAL PROVISIONS	C 21
5.8	NON-WORKING HOURS AND SPECIAL NON-WORKING DAYS	C 22
5.12	EXTENSION OF TIME FOR PRACTICAL COMPLETION	C 22
6.6	PROVISIONAL SUMS	C 22
6.8.2	PRICE ADJUSTMENT FACTOR	C 22
8.5	REPORTING OF ACCIDENTS	C 23
7.4.3	TESTING AND COMMISSIONING	C 23
6.1	PAYMENT FOR THE LABOUR-INTENSIVE COMPONENT OF THE WORKS	C 23
6.1	LINKAGE OF PAYMENT FOR LABOUR INTENSIVE COMPONENT OF WORKS TO SUBMISSION OF PROJECT DATA	C 23
6.1	APPLICABLE LABOUR LAWS	C 23
6.1	METHOD SPECIFICATION	C 23
6.1	GUIDELINES FOR THE IMPLEMENTATION OF L.I.C. INFRASTRUCTURE PROJECTS UNDER THE EXPANDED PUBLIC WORKS PROGRAMME	C 23
6.1	CIVIL ENGINEERING INDUSTRY MINIMUM WAGE RATE	C 23

CLAUSE 3.2.3 – SPECIFIC APPROVAL OF THE EMPLOYER REQUIRED

Clause 3.2.3 Add the following sub-clauses:

3.2.3.1 "The Employer Agent shall not reduce the quality of the works without the written approval of the Employer".

3.2.3.2 "The Employers Agent shall not extend the due completion date without the written approval of the Employer".

CLAUSE 4.3 – LEGAL PROVISIONS

Clause 4.3.1 Add the following sub-clause:

4.3.1.1 The Occupational Health and Safety Act (1993) (OHS Act) shall apply. The Engineer's Representative shall be co-opted as a member of the Contractor's Safety Committee for the Works in accordance with Section 19 of the OHS Act. The Explosives Regulations Act 26 of 1956 and as amended shall apply.

Clause 4.3.2 Delete the words "If required"

CLAUSE 5.8 NON-WORKING HOURS AND SPECIAL NON-WORKING DAYS

The first paragraph is to be amended to read:

"None of the Works shall be executed except between 07:00 and 18:00 on Monday to Friday inclusive and 07:00 and 14:00 on Saturday of any week or on any non-working and special non-working days stated in the Contract Data unless."

Delete sub-clauses 5.8.1.2 and 5.8.1.3.

CLAUSE 5.12 EXTENSION OF TIME FOR PRACTICAL COMPLETION

Clause 5.12.2.2 Add the following:

"Where these conditions are attributable solely to rainfall and the resultant stoppage of work, the Contractor may only claim an extension of time for completion where the Work items stopped were critical to the date for practical completion of the whole of the Works as indicated by the programme provided in terms of Clause 5.6.1 and the aggregated claims exceed the allowance to be made as described in the Table below."

Month	No. rain days lost	Month	No. rain days lost
January	4.0	July	2.0
February	4.0	August	2.0
March	3.0	September	2.0
April	2.0	October	3.0
May	2.0	November	4.0
June	2.0	December	4.0

CLAUSE 6.6 PROVISIONAL SUMS

Sub-Clause 6.6.1.2.2 - Delete the entire sub-clause.

CLAUSE 6.8.2 PRICE ADJUSTMENT FACTOR

Add sub-clause 6.8.2.1:

"The Price Adjustment Factor shall only apply to those contracts whose tender prices exceed R3 000 000.00".

Add sub-clause 6.8.2.2:

"Should a contract which would otherwise have been fixed price not be awarded within 120 calendar days of the date for receipt of tenders, then escalation as described below will become payable. The amount will be quantified using the standard formula from the General Conditions of Contract for Construction Works (GCC 2015), with the calculation based on the following:-

(1) The coefficients to be used with the indices shall be:-

x = 0, 10 a = 0,25 b = 0,15 c = 0,53 d = 0,0.7

The base month for indices shall be the month prior to the month for receipt of tender. The current month for indices shall be the month in which the tender is due for submission.

CLAUSE 8.5 REPORTING ACCIDENTS

Clause 8.5.1 Delete, in the second paragraph, "If required by the Employers Agent"

Clause 7.4.3 Testing and Commissioning

Testing and commissioning of the works described in this contract shall be witnessed by the employer's Agent in the presence of a representative of the Employer.

Clause 6.1 Payment for the Labour-Intensive Component of the Works

Payment for labour-intensive works identified in the Scope of Work shall only be made in accordance with the provisions of the Contract if the works are constructed strictly in accordance with those provisions. Any non-payment for such works shall not relieve the Contractor in any way from his obligations, either in contract or in delict.

Clause 6.1 Linkage of Payment for Labour-Intensive Component of Works to Submission of Project Data

The Contractor's payment invoices shall be accompanied by labour information for the corresponding period in a format specified by the employer. If the contractor chooses to delay submitting payment invoices, labour returns shall still be submitted as per the frequency and timeframe stipulated by the Employer. The Contractor's invoices shall not be paid until all pending labour information has been submitted.

Clause 6.1 Applicable Labour Laws

The current Ministerial Determination (also downloadable at www.epwp.gov.za), Expanded Public Works Programmes, issued in terms of the Basic Conditions of Employment Act of 1997 by the Minister of Labour in Government Notice, shall apply to works described in the scope of work as being labour intensive and which are undertaken by unskilled or semi-skilled workers.

Clause 6.1 Method Specification

Certain operations will be executed by Labour Intensive Construction methods and are indicated as L.I. in the Schedule.

Clause 6.1 Guidelines for the Implementation of L.I.C. Infrastructure Projects under the Expanded Public Works Programme

The tenderers should take note of the relevant requirements, of Government Gazette Notice 41904 dated 14 September 2018, regarding the following:

- Basic conditions of employment.
- Sourcing of labour in accordance with SANS 1914-5
- Participation of targeted labour.
- Use of local service providers
- Reporting mechanisms and headings.

Clause 6.1 Civil Engineering Industry Minimum Wage Rate

The minimum wage for a general worker to perform a task or performing work on a working day basis, not exceeding 9 hours work per day, shall be remunerated at the current gazetted rate at the time of tender.

C1.3 FORMS OF GUARANTEE (ONLY FSB APPROVED GUARANTEE WILL BE ACCEPTED)

PRO-FORMA PERFORMANCE GUARANTEE

For use with the General Conditions of Contract for Construction Works, Third Edition, 2015 (GCC 2015).

WHEREAS

UGU

(hereinafter referred to as the “Employer”),

enters into a Contract (Tender No: UGU-07-1689-2025) with

.....
(hereinafter referred to as the “Contractor”)

**PHASE 2A - UPGRADE AND EXTENSION OF THE UMZINTO WASTEWATER
TREATMENT WORKS FROM 2.5 MI to 4.0 MI**

UGU-07-1689-2025

Construction and Commissioning of Civil - Mechanical and Electrical Works

WHEREAS in terms of the General Conditions of the Contract the Contractor is required to furnish an acceptable security for the due and proper fulfilment by him of all his duties and obligations in terms of the Contract.

NOW THEREFORE, we the undersigned

..... [full names of authorized agent(s)]

and acting in my/our capacity as and as such
duly authorized thereto, do hereby bind the said (hereinafter referred to as the “Guarantor”) as
guarantor and co-principal debtor in solidum for the sum of

R
(.....)

for the due and proper fulfilment by the Contractor of all or any of his duties and obligations in terms of the said Contract.

The Guarantor further undertakes, in the event of the Contractor failing duly and properly to fulfil any of his duties and obligations in terms of the said Contract or in the event of termination of the Contract by the Employer in terms of the General Conditions of Contract, to

C1.4 AGREEMENT IN TERMS OF SECTION 37(2) OF THE OCCUPATIONAL HEALTH AND SAFETY ACT No 85 OF 2014



**Contract No: UGU-07-1689-2025 - Umzinto Wastewater Treatment Works & Outfall Sewers
Upgrade and Rehabilitation Phase 2A - Upgrade and Extension of the Umzinto Wastewater
Treatment Works From 2.5 MI to 4.0 MI**

Construction and commissioning of Civil, Mechanical and Electrical Works

WRITTEN AGREEMENT ON OCCUPATIONAL HEALTH AND SAFETY

In accordance with the provisions of Section 37(2) of the Occupational Health
and Safety Act 85 of 1993 entered into and between

UGU DISTRICT MUNICIPALITY
(hereinafter referred to as "the Employer")

and

.....
(hereinafter referred to as "the Mandatary")

.....
COID Registration Number

Whereas the Employer has entered into a contract and / or Purchase order with the Mandatary, in terms of which the Mandatary is to perform certain work and services for and on behalf of the Employer, subject to terms and conditions as contained in such contract and / or Purchase Order.

The parties have agreed that in respect of performance of the work the Mandatary shall be responsible for compliance with the Occupational Health and Safety Act and its regulations. The Employer and Mandatary accordingly enter in to this Agreement in terms of Section 37(2) of the OHS Act, the terms and conditions of which are set out hereunder.

1. Definitions

Unless inconsistent with the context, the expressions set forth below shall bear the following meanings:

Expressions which denote:

- any gender shall include the other genders

- a natural person shall include a juristic person and vice versa
- the singular shall include the plural and vice versa

Agreement shall mean this document containing its terms and conditions as applicable to the parties thereto;

Employer shall mean the party as described on the face of this document;

Employees shall mean all Employees, servants, contractors, sub-contractors, agents, invitees and the like of the Mandatary;

Mandatary shall mean the party as described on the face of this document

OHS Act shall mean the Occupational Health and Safety Act 85 of 1993, as amended, together with all regulations thereto;

Premises shall mean all such Premises of the Employer, where the Mandatary and Employees perform work or render a service for and on behalf of the Employer

Parties shall mean the Employer and the Mandatary

PPE shall mean the personal protective equipment

2. WARRANTY OF COMPLIANCE

2.1 The Mandatary acknowledges that this Agreement constitutes an agreement in terms of Section 37(2) of the OHS Act, whereby all responsibility for health and safety matters relating to the work that the Mandatary and the Employees are to perform on the Premises shall be the obligation of the Mandatary

2.2 The Mandatary hereby undertakes to ensure that the health and safety of any other person on the premises is not endangered by the conduct and / or activities of the Employees whilst they are on the Premises

By entering into this agreement, the Mandatary warrants that he is familiar with working conditions and agrees to the arrangements and procedures, as prescribed by the Employer and as provided for in terms of Section 37(2) of the OHS Act, for the purpose of compliance with the OHS Act.

The Mandatary shall also ensure that he complies with all relevant Labour Legislations including the Basic conditions of employment Act, the Labour Relations Act and any specific wage determination specific to his business activity.

3. MANDATARY AN EMPLOYER

The Mandatary shall be deemed to be the employer on his right whilst on

Employer's Premises. In terms of Section 16(1) of the OHS Act the Mandatary shall accordingly ensure that the requirements of the OHS Act are complied with by himself and / or his Chief Executive Officer.

4. LEGAL APPOINTMENTS

4.1 The Mandatary undertakes to make all statutory appointments as per the requirements of the OHS Act, in particular, 16(2) assignee and / or Construction Regulation 6(1).

4.2 The Mandatary warrants that all appointed persons are trained to understand their roles in terms of the OHS Act. The Mandatary shall further ensure that employees receive basic safety training to understand the hazards and risks associated with their work.

4.3 The Mandatary shall ensure that all work performed for and / or on behalf of the employer is performed under general supervision of a competent person who has been appointed in writing. Such appointed person shall be vested with full authority to strictly enforce the law.

5. ACCESS TO THE OHS-ACT

The mandatary shall ensure that his appointed responsible person has an updated copy of the OHS Act. The copy should be produce to the Employer's representative at all times if so required.

6. SAFETY FILE

The Mandatary shall ensure that a health and safety file is opened and kept on the premises, which shall include all documentation required in terms of the provisions of the OHS Act, including but not limited to

- The COID certificate
- Public liability cover
- Safety Plans
- Risk assessments and Safe work procedures
- Names of responsible persons and their appointment letters
- List of sub-contractors if any

7. MEDICAL EXAMINATIONS

The Mandatary shall ensure that all the Employees undergo routine medical examinations where these are necessary in terms of the working environment and that they are medically fit for the purposes of the work they are to perform.

8. INCIDENT REPORTING AND INVESTIGATION

All incidents referred to in Section 24 of the OHS Act shall be reported by the Mandatary to the Department of Labour and to the Employer. The Employer shall further be provided with copies of any written documentation relating to any incident.

9. PERSONAL PROTECTIVE EQUIPMENT

The Mandatary shall ensure that his responsible persons and the Employees are provided, free of charge, with adequate personal protective equipment (PPE) for the work they are required to perform. The PPE to be supplied should be in accordance with General Safety Regulation 2(1) of the OHS Act. The Mandatary shall ensure that his employees wear the PPE supplied to them at all times.

10. INTOXICATION NOT ALLOWED

No intoxicating substance of any form is allowed on the Premises. Any person suspected to be under influence of intoxicating substance shall not be allowed on site. Any person with prescribed medication shall notify the relevant responsible person and also advise him of the potential side effects.

11. FIRST AID AND EMERGENCY EQUIPMENT

The Mandatary shall ensure that, where more than five employees are employed at the Premises, a first aid box is made readily available as per General Safety Regulation 3(2). If the Mandatary employs more than 10 employees, the Mandatary shall ensure that a certificated first aid provider is available. Provided that the Mandatary may enter into a written arrangement with the Employer for the provision of such first aid facilities.

11. 2 The Mandatary shall further ensure that there is adequate supply of fire protection and emergency equipment, and employees are made familiar with fire precautions. at the Premises, which include fire alarm signals and emergency exits and that such precautions are adhered to.

12. PLANT, MACHINERY AND EQUIPMENT

The Mandatary shall ensure that all the plant, machinery, equipment and/or vehicles he may wish to utilize on the Premises is/are at all times of sound order and fit for the purpose for which it is intended, and that it complies with the requirements of Section 10 of the OHS Act.

In accordance with the provision of Section 10(4) of the OHS Act, the

Mandatary hereby assumes the liability, for taking the necessary steps to ensure that any article or substance that is erected or installed at the Premises, or manufactured, sold or supplied to or for the Employer, and which the Mandatary uses at work complies with all the prescribed requirements and will be safe and without risk to health when properly used.

13. NO USAGE OF THE EMPLOYER'S EQUIPMENT

The Mandatary hereby acknowledges that the Employees shall not be permitted to use any materials, machinery or equipment of the Employer unless the prior written consent of the employer has been obtained, in which case, the Mandatary shall ensure that only those persons authorized to make use of the same, have access thereto.

14. INDEMNITY BY MANDATARY

Notwithstanding the provisions of this Agreement, or any other contractual relationship as between the Employer and the Mandatary:

The Employer shall not be responsible for any loss, damage, injury or death, howsoever caused, to the Mandatary or to the Employees, and the Mandatary hereby indemnifies the Employer and holds the Employer harmless against all and any claims, losses, demands, liability, costs and expenses of whatsoever nature, which the Employer may, at any time sustain or incur arising out of the circumstances referred to herein; provided that such loss, damage, injury or death is not caused by the wilful action or omission or gross negligence of the Employer

The Mandatary hereby assumes liability for any loss or damage which is caused by the Mandatary's negligence, or through the negligence of any of the Employees, and the Mandatary hereby indemnifies the Employer for such loss or damage, whether caused by the Mandatary's breach of any of the terms of this Agreement, or by delict.

The Mandatary in pursuance of clause 14 undertakes to ensure that he carries the appropriate insurance cover, including third party public liability cover, the details of which shall be furnished to the Employer on demand.

15. CLARIFICATION

In the event that the Mandatary requires clarification of any of the terms or provisions of this Agreement, it should contact the appropriate and designated representative of the Employer, whose clarification in terms hereof shall be in writing.

16. DURATION OF AGREEMENT

This Agreement shall remain in force for any work performed by the Mandatary and/or any of his Employees at the Employer's premises.

17. HEADINGS

The headings as contained in this Agreement are for reference purposes only and shall not be construed as having interpretative value in themselves, nor any indication as to the meaning of the contents of the paragraphs contained in this Agreement.

SIGNED AT _____ ON THE ____ DAY OF _____ YEAR _____

Name: _____
Name and Surname

Signature: _____
for and on behalf of the **Employer**
he being duly authorised

SIGNED AT _____ ON THE ____ DAY OF _____ YEAR _____

Name: _____
Name and Surname

Signature: _____
for and on behalf of the **Mandatary**
he being duly authorised

NB: Please ensure that each person signing this Agreement initials all pages

C1.5 NOTIFICATION OF CONSTRUCTION WORK

OCCUPATIONAL HEALTH AND SAFETY ACT, 1993 Regulation 3 of the Construction Regulations, 2014

1. (a) Name and postal address of principal contractor:

1. (b) Name and telephone number of the principal contractor's contact person:

2. Principal contractor's compensation registration number: _____

3. (a) Name and postal address of client:

3. (b) Name and telephone number of client's contact person or agent:

4. (a) Name and postal address of designer(s) for this project:

4. (b) Name and telephone number of designer(s) contact person:

5. Name and telephone number of principal contractor's construction supervisor on site appointed in terms of regulation 6.(1).

6. Name/s of principal contractor's sub-ordinate supervisors on site appointed in terms of regulation 6.(2):

7. Exact physical address of the construction site or site office:

8. Nature of construction work:

9. Expected commencement date: _____

10. Expected completion date: _____

Estimated maximum number of persons on the construction site: _____

Planned number of contractors on the construction site accountable to principal contractor:

13. Name(s) of contractors already chosen:

Principal Contractor

Date

Client

Date

This document is to be forwarded to the Department of Labour and the Ugu District Municipality prior to commencement of work on site.

All principal contractors that quality to notify must do so even if another principal contractor on the same site had done so prior to the commencement of work.

C1.6 ADJUDICATOR'S AGREEMENT

DISCLOSURE STATEMENT

Please note that words in italics within brackets are items which should be stated.

(Date)

Contract: **Contract No: UGU-07-1689-2025 - Umzinto Wastewater Treatment Works & Outfall Sewers Upgrade and Rehabilitation Phase 2A - Upgrade and Extension of the Umzinto Wastewater Treatment Works From 2.5 MI to 4.0 MI**

Construction and commissioning of Civil, Mechanical and Electrical Works

Contractor:

Employer: UGU DISTRICT MUNICIPALITY

Engineer: **S ZOKO CONSULTING**

Dear Sirs

I am willing and available to serve as (*ad-hoc / standing*) Adjudication Board Member in the above mentioned Contract.

In accordance with the General Conditions of Contract for Construction Works Adjudication Board Rules relating to disclosure statements by selected or nominated persons to the adjudication, I hereby state that:

I shall act with complete impartiality and know of nothing at this time, which could affect my impartiality.

I have had no previous involvement with this project.

I do not have any financial interest in this project.

I am not currently employed by the Contractor, Employer or Engineer.

I do not have any financial connections with the Contractor, Employer or Engineer.

I do not have or have not had a personal relationship with any authoritative member of the Contractor, Employer or the Engineer which could affect my impartiality.

I undertake to immediately disclose to the parties any changes in the above position which could affect my impartiality or be perceived to affect same.

Should there be any deviation from the foregoing statements, details shall be given.

I further declare that I am experienced in the work which is carried out under the Contract and in interpreting contract documentation.

Name in full:

Signature:

ADJUDICATION BOARD MEMBER AGREEMENT

This Agreement is entered into between:

Adjudication Board Member:

Name:

Physical address:

.....

.....

Postal address:

.....

.....

e-mail address: Fax number:

Telephone number: Mobile number:

Contractor:

Name:

Physical address:

.....

.....

Postal address:

.....

.....

e-mail address: Fax number:

Telephone number: Mobile number:

Employer:

Name: UGU DISTRICT MUNICIPALITY

Physical address: 28 Connor Street, Port Shepstone 4240

Postal address: P O Box 33 Port Shepstone 4240

Telephone number: 039 688 5700 Fax number: 039 682 2646

The Contractor and the Employer will hereinafter be collectively referred to as the Parties.

The Parties entered into a Contract for:

UGU DISTRICT MUNICIPALITY

Contract No: UGU-07-1689-2025 - Umzinto Wastewater Treatment Works & Outfall Sewers Upgrade and Rehabilitation Phase 2A - Upgrade and Extension of the Umzinto Wastewater Treatment Works From 2.5 MI to 4.0 MI

Construction and commissioning of Civil, Mechanical and Electrical Works

Contract No.: UGU-07-1689-2025

which provides that a dispute under or in connection with the General Conditions of Contract for Construction Works, Third Edition, 2015, must be referred to (*ad-hoc adjudication/standing adjudication*).

The undersigned natural person has been appointed to serve as Adjudication Board Member and together with the undersigned Parties agree as follows:

1. The Adjudication Board Member accepts to perform his duties in accordance with the terms of Contract, the General Conditions of Contract for Construction Works Adjudication Board Rules and this Agreement.
2. The Adjudicator undertakes to remain independent and impartial of the Contractor, Employer and Engineer for the duration of the Adjudication Board proceedings.
3. The Adjudication Board Member agrees to serve for the duration of the Adjudication Board proceedings.
4. The Parties may at any time, without cause and with immediate effect, jointly terminate this Agreement.
5. Unless the Parties agree, the Adjudication Board Member shall not act as arbitrator or representative of either Party in any subsequent proceedings between the Parties under the Contract. No Party may call the Adjudication Board Member as a witness in any such subsequent proceedings.
6. The standing Adjudication Board's duties shall end upon the Adjudication Board Member(s) receiving notice from the Parties of their joint decision to disband the Adjudication Board.
7. The Adjudication Board Member shall be paid in respect of time spent upon or in connection with the adjudication including time spent travelling:
 - (a) A monthly retainer of (amount)
for (number) of months, and/or
 - (b) A daily fee of (amount)
based on a (number) hour day, and or
 - (c) A hourly free of (amount), and/or
 - (d) A non-recurrent appointment fee of (amount)
which shall be accounted for in the final sums payable.

8. The Adjudication Board Member's expenses incurred in adjudication work shall be reimbursed at cost.

Upon submission of an invoice for fees and expenses to the Parties, the (Contractor/Employer*) shall pay the full amount within 28 days of receipt of the invoice and he shall be reimbursed by the other party by half the amount so that the fees and expenses are borne equally by the Parties. Late payment of such invoices shall attract interest at prime plus 3% points compounded monthly at the prime rate charged by the Adjudication Board Member's bank.

This Agreement is entered into by:

Contractor's signature:

Contractor's name:

Place:

Date:

Employer's signature

Employer's name: UGU DISTRICT MUNICIPALITY

Place:

Date:

Adjudication Board Member's signature:

Adjudication Board Member's name:

Place:

Date:

**Delete the inapplicable party*

C1.7 FORMS OF GUARANTEE (MOS)
(only FSB approved Guarantees will be accepted)

PRO-FORMA GUARANTEE (MATERIALS ON SITE)

GUARANTOR DETAILS AND DEFINITIONS

"Guarantor" means:

Physical address:

"Employer" means: **UGU DISTRICT MUNICIPALITY**

Physical address:

"Engineer" means: **S ZOKO CONSULTING**

Physical address:

"Contractor" means:

Physical address:

"Contract" means: The Agreement made between the Employer and Contractor for construction of the works into which the materials or goods which are the subject of this Guarantee are to be incorporated.

"Guaranteed Sum" means: The maximum value of the materials or goods identified by the Engineer and named herein, which are to be considered by the Employer for advanced payment to the Contractor, while in an unused or unfixed condition, and whether stored on the Contract site or off the Contract site.

Amount in words:

"Expiry Date" means: **Date of Issue of Certificate of Completion in terms of Clause 5.14.4 of GCC 2015**

GUARANTEE

1. The purpose of this guarantee is to recompense the Employer in the event of the Employer's not acquiring legal ownership of the materials or goods, as identified by the Engineer, for whatever reason or the Employer being legally obliged to make payment to any third party or protect his ownership and quiet possession of the materials or goods.
2. The Guarantor's liability shall be to the amount of the Guaranteed Sum.
3. The Guarantor's period of liability shall be from and including the date of issue of this Guarantee up to and including the Expiry Date herein or the date of issue by the Engineer on behalf of the Employer of the Certificate of Completion of the Works in the Contract, or the date of payment of the Guaranteed Sum, whichever occurs first.
4. The Guarantor acknowledges that any reference in this Guarantee to the Contract is made for the purpose of convenience and shall not be construed as any intention to create an accessory obligation or a surety ship, and its obligation under this Guarantee is restricted to the payment of money.

- 5. Subject to the Guarantor's maximum liability referred to in the Guaranteed Sum, the Guarantor hereby undertakes to pay the Employer the sum certified by the Engineer as recompense to the Employer arising out of failure by the Contractor to effect transfer of ownership of any of the stated materials or goods to the Employer, for any reason whatsoever.
- 6. Payment by the Guarantor in terms of (5) shall be made within seven (7) calendar days upon receipt of the first written demand to the Guarantor.
- 7. The Employer shall have the absolute right to arrange his affairs with the Contractor in any manner which the Employer may deem fit and the Guarantor shall not have the right to claim his release from this Guarantee on account of any conduct alleged to be prejudicial to the Guarantor.
- 8. This Guarantee is neither negotiable nor transferable and shall expire in terms of (3), whereafter no claims will be considered by the Guarantor.
- 9. This Guarantee, together with any of the required demand notices in terms of (6), shall be regarded as a liquid document for the purposes of obtaining a court order.
- 10. Where this Performance Guarantee is issued in the Republic of South Africa the Guarantor hereby consents in terms of the Magistrate's Courts Act No 32 of 1944, as amended, to the jurisdiction of the Magistrate's Court of any district having jurisdiction in terms of Section 28 of the said Act, notwithstanding that the amount of the claim may exceed the jurisdiction of Magistrate's Court.

Signed at

Date

Guarantor's signatory (1)

Capacity

Guarantor's signatory (2)

Capacity

Witness signatory (1)

Witness signatory (2)



VOLUME 1
CONTRACT
PART 2
PRICING DATA

CONTENTS

PARAGRAPH	PARAGRAPH TITLE	PAGE No.
C2.1	PRICING INSTRUCTIONS	PD 3
C2.2	BILL OF QUANTITIES	PD 5 – PD 89

C2.1 PRICING INSTRUCTIONS

1. The Tenderer is advised to check the number of pages and, should any be found to be missing or in duplicate or the figures or writing indistinct or the Bill of Quantities containing any obvious errors, the Tenderer must inform the Engineer at once and have it rectified. No liability whatsoever will be admitted in respect of errors due to the foregoing.

Should there be any doubt or obscurity as to the meaning of any particular item, the Tenderer must obtain an explanation of it, in writing, from the Engineer. No claims for extras arising from any such doubt or obscurity will be admitted after delivery of the tender.

2. The work is to be in accordance with the drawings, specifications, and instructions, under the supervision of the engineer, and to the entire satisfaction of the Engineer.
3. The Bills of Quantities should be read in conjunction with the Conditions of Contract, the Special Conditions of Contract, the Specifications (Project, Standardised and Particular Specifications) and Drawings for the full intent and meaning of each clause or item. The quantities are measured generally in accordance with SANS 1200.
4. The sum and unit prices to be inserted in the Bill of Quantities are to be the fully inclusive value of the work described under the several items, including all costs, expenses, overheads and profits which may be required in and for the construction of the work described, together with all general risks, liabilities, obligations and taxes (excluding Value Added Tax) set forth or implied in the documents on which the tender is based.
5. A sum or unit price is to be entered against each item in the Bill of Quantities, whether quantities are stated or not. Items against which no price is entered will be considered a risk to the client/employer and shall be grounds for rejection. Should there be any conflict between the unit of measurement of any item in the Bill and the unit in any applicable specification, the unit in the Bill shall take precedence.
Should there be any conflict between definitions or specifications covering any item, the order of precedence shall be as follows:
The project specification
Variations to a standardised or particular specification.
The standardised or particular specification.

7. Arithmetical errors:

Where there is a discrepancy between the amounts in figures and in words, the amount in words shall govern.

Where there is an error in the line-item total resulting from the product of the unit rate and the quantity, the line-item total shall govern, and the rate shall be corrected. Where there is an obviously gross misplacement of the decimal point in the unit rate, the line-item total as quoted shall govern, and the unit rate shall be corrected.

Where there is an error in the total of the prices either as a result of other corrections required by this checking process or in the Tenderers addition of prices, the total of the prices shall govern, and the Tenderer will be asked to revise selected item prices and their rates to achieve the tendered total of the prices.

8. All unit prices, extensions and totals must be filled in, in **BLACK INK**. Failure to do so will render the tender as non-responsive.
9. No claim whatsoever will be allowed in respect of errors in pricing due to brevity of description of items which are fully described when read in conjunction with the relevant instruction.

10. The Tenderer is advised that, where trade or patent names are used in description of items in the Bill of Quantities, except in the case of nominated suppliers or sub-Contractors, it does not necessarily follow that these specific materials will be used.

The trade or patent names are inserted in the description only as a guide to the Tenderer and to make clear the type of material required. All or any of these items may be replaced at the Engineer's discretion by other similar and approved materials without affecting the Billed Unit Prices.

Where such a change involves a difference in the basic price of the item, the Contractor will be requested to submit a revised unit price before the order is placed and this will be subject to the approval and acceptance of the Engineer.

Where, however, a trade or patent name is used in the description of an item and the Tenderer offers an alternative material, the onus will be on the Tenderer to produce proof that his material offered is equal in all respects to the material used in the description.

11. The Tenderer is hereby advised that, while every endeavour has been made to ensure the correctness of the quantities and descriptions of all labour and materials in the Bill of Quantities, any errors (whether in excess or short of the actual quantity, or insufficiently or incorrectly described) will be adjusted on completion of the Contract by the Engineer. For this purpose, the entire contents of the Bill of Quantities are to be considered as provisional and therefore subject to re-measurement and adjustment in part or as a whole. All such adjustment will be based on, or pro rata to, the Schedule unit prices submitted by the Contractor. The Bill of Quantities is not necessarily correct for ordering purposes.
12. It is deemed that provision for head office overheads, consumables, stores, profit, etc., as well as all labour, material and plant costs, is made in the priced items of the measured Bill following the Preliminary and General Bill and that any increases and decreases in the measured quantities will correspondingly adjust for these charges.

The column headed 'CLAUSE' in the Bill of Quantities, where used, indicates specifications and/or clauses in which further information in respect of billed items can be obtained. This is meant as an aid to Tenderers but does not imply that the specifications or clauses referred to are the only sources of information in respect of these items and further information and explanations may be found elsewhere in the Contract Documents and on the Drawings.

It is deemed that all costs incurred by the Contractor to ensure conformity with the Environmental Management Specifications, is made in the priced items of the measured Bill following the Preliminary and General Bill and that any increases and decreases in the measured quantities will correspondingly adjust for these charges.

15. Those parts of the contract to be constructed using labour-intensive methods have been marked in the bill of quantities with the letters LI in a separate column filled in against every item so designated. The works, or parts of the works so designated are to be constructed using labour-intensive methods only. The use of plant to provide such works, other than plant specifically provided for in the scope of work, is a variation to the contract. The items marked with the letters LI are not necessarily an exhaustive list of all the activities which must be done by hand, and this clause does not over-ride any of the requirements in the generic labour-intensive specification in the Scope of Works.
16. Payment for items which are designated to be constructed labour-intensively (either in this schedule or in the Scope of Works) will not be made unless they are constructed using labour-intensive methods. Any unauthorized use of plant to carry out work which was to be done labour-intensively will not be condoned and any works so constructed will not be certified for payment.
17. The Contractor will be required to prepare and submit monthly returns.

Item	Payment Reference	Description	Unit	CPG	Qty	Rate (R)	Amount (R)
	SANS 1200 A	BILL NO 1 PRELIMINARY AND GENERAL					
		FIXED-CHARGE ITEMS					
	PSA5.1	FIXED-CHARGE ITEMS					
1.1	8.3.1	a) Contractual Requirements <u>Establishment of Facilities on Site</u>	sum				
	8.3.2	.1 <u>Facilities for the Engineer/Employer</u>					
1.2	PSAB1	(a) Nameboard	no		2		-
1.3	PSAB2.1	(b) Furnished offices	sum				
1.4	PSAB2.2	(c) Testing (Laboratory equipment)	sum				
1.5	PSAB3	(d) Survey Equipment	sum				
1.6	PSAB2.1	(f) Carports	sum				
	8.3.2	.2 <u>Facilities for the Contractor</u>					
1.7		(a) Offices and storage sheds	sum				
1.8		(b) Workshops	sum				
1.9		(c) Laboratories	sum				
1.10		(d) Living accommodation	sum				
1.11		(e) Ablution and latrine facilities	sum				
1.12		(f) Tools and equipment	sum				
1.13		(g) Water supplies, power and communication	sum				
1.14		(h) Dealing with water (Sub-clause 5.5)	sum				
1.15		(i) Access (Sub-clause 5.8)	sum				
1.16		(j) Construction Equipment	sum				
1.17	8.3.3 PS 15	Other fixed-charge obligations In terms of Contractual obligations - requirements SMME Empowerment <u>Contractors markup for managing SMME's/CPG</u>	sum				
1.18		(a) Overheads, charges and profit on the above for 20 % of the Works done by the SMME's/CPG .1 Civil Works	sum				
Carried Forward							-

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

Item	Payment Reference	Description	Unit	CPG	Qty	Rate (R)	Amount (R)
Brought Forward							-
1.19		.2 Mechanical Works	sum				
1.20		.3 C&I - Electrical	sum				
1.21		.4 Bulk - Electrical	sum				
1.22	8.3.4	Removal of Contractor's and Engineers site establishment on completion	sum				
	8.3.5	<u>Occupational Health and Safety</u>					
1.23	PSA5.2	Compliance with Occupational Health and Safety Act (Act 85 of 1993) and its regulations and with the Employers Health and Safety Specification	sum				
	8.3.6	<u>Environmental Management</u>					
1.24	EMP	Compliance with Environmental Management plan	sum				
1.25	PSA5.4 PS19	Design and provision of as-built drawings and details	Sum				
1.26	PS19	Provision of Operation and Maintenance Manuals	Sum				
1.27	PS20	Commissioning, Trial Operation and Training of operating	Sum				
1.28	PSA6.4	Security for duration of construction	sum				
TIME-RELATED ITEMS							
<u>TIME-RELATED ITEMS</u>							
1.29	8.4.1	Contractual requirements	sum				
		<u>Operation and maintenance of facilities on the Site for the duration of construction</u>					
	8.4.2	.1 <u>Facilities for the Engineer</u>					
1.30	PSAB1	(a) Nameboard	no		1		-
1.31	PSAB2	(b) Furnished offices	sum				
1.32	PSAB2.2	(c) Testing (Laboratory equipment)	sum				
1.33	PSAB3	(d) Survey Equipment	sum				
1.34	PSAB6	(f) Carports	sum				
	8.4.2	.2 <u>Facilities for the Contractor</u>					
1.35		(a) Offices and storage sheds	sum				
1.36		(b) Workshops	sum				
1.37		(c) Laboratories	sum				
1.38		(d) Living accommodation	sum				
Carried Forward							-

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

Item	Payment Reference	Description	Unit	CPG	Qty	Rate (R)	Amount (R)
Brought Forward							-
1.39		(e) Ablution and latrine facilities	sum				
1.40		(f) Tools and equipment	sum				
1.41		(g) Water supplies, power and communication	sum				
1.42		(h) Dealing with water (Sub-clause 5.5)	sum				
1.43		(i) Access (Sub-clause 5.8)	sum				
1.44		(j) Construction Equipment	sum				
1.45	8.4.3	Supervision for duration of construction	sum				
1.46	8.4.4	Company and head office overhead costs for the duration of the contract	sum				
1.47	8.4.5	Other time-related obligations	sum				
	PS 15	In terms of Contractual obligations - requirements <u>SMME Empowerment</u> <u>Contractors markup for managing SMME's/CPG</u>					
		(b) Overheads, charges and profit on the above for 20 % of the Works done by the SMME's/CPG					
1.48		.1 Civil Works	sum				
1.49		.2 Mechanical Works	sum				
1.50		.3 C&I - Electrical	sum				
1.51		.4 Bulk - Electrical	sum				
	8.4.6	<u>Occupational Health and Safety</u>					
	PAP	Compliance with Occupational Health and Safety Act (Act 85 of 1993) and its regulations and with the					
1.52	PSA6.1	Employers Health and Safety Specification	sum				
	8.4.7	<u>Environmental Management</u>					
1.53	EMP SPEC	Compliance with Environmental Management plan	sum				
	PSA6.2						
1.45	PS19	Provision of as-built drawings and details	Sum				
1.46	PS19	Design and provision of as-built drawings and details	Sum				
1.47	PS20	Commissioning, Trial Operation and Training of Operators	Sum				
1.48	PSA6.4	Security for duration of construction	sum				
		<u>BILL NO 1</u> <u>PRELIMINARY AND GENERAL</u>					
Carried forward to Summary of Bills							Total
							-

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

Contract: 1843-30-00

Part C2: Pricing Data

Section C2.2: Bill of Quantities

Bill No. 2: Provisional Sums and Prime Cost Items

Item	Payment Reference	Description	Unit	CPG	Qty	Rate (R)	Amount (R)
	SANS 1200 A	BILL NO 2					
		PROVISIONAL SUMS AND PRIME COST ITEMS					
		PROVISIONAL SUMS					
		SUMS STATED PROVISIONALLY BY THE ENGINEER					
		For work to be executed by the Contractor and valued in terms of the "Valuation of Variations" clause in the Conditions of Contract					
		ALLOWANCES					
		Allowances					
	8.5	(a) .1 <u>Community requirements</u>					
2.1	PSA 7.3	.1 CLO/LDO remuneration	Prov sum				375,000.00
2.2		.2 Overheads, charges and profit on above	%				
	PSA 7.4	.3 Accredited training courses for selected local and other labourers	Prov sum				75,000.00
2.4		.4 Overheads, charges and profit on above	%				
2.5		.5 Wages and salaries of local and other labourers employed during training	Prov sum				75,000.00
2.6		.6 Overheads, charges and profit on above	%				
2.7		.7 Office Furniture for Client	Prov sum				20,000.00
2.8		.8 Overheads, charges and profit on above	%				
		ENGINEERS REQUIREMENTS					
	8.5	(a) .2 <u>Engineers requirements</u>					
2.9	PSA 7.5	.1 Engineers equipment and Facilities	Prov sum				20,000.00
2.10		.2 Overheads, charges and profit on above	%				
2.11	PSA 7.8	.3 Acceptance control testing	Prov sum				250,000.00
2.12		.4 Overheads, charges and profit on above	%				
2.13	PSA 7.6	.5 Site office consumables and personal protective equipment	Prov sum				25,000.00
2.14		.6 Overheads, charges and profit on above	%				
2.15	PSA 7.7	.7 Electronic office equipment	Prov sum				7,500.00
2.16		.8 Overheads, charges and profit on above	%				
Carried Forward							-

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

Contract: 1843-30-00

Part C2: Pricing Data

Section C2.2: Bill of Quantities

Bill No. 2: Provisional Sums and Prime Cost Items

Item	Payment Reference	Description	Unit	CPG	Qty	Rate (R)	Amount (R)
Brought Forward							-
		<u>WORK TO EXISTING SERVICES</u>					
	8.5	(a) .3 <u>Existing services</u>					
2.17	PSA 7.9	.1 Locating existing services	Prov sum				5,000.00
2.18		.2 Overheads, charges and profit on above	%				
2.19	PSA 7.10	.3 Relocating existing services	Prov sum				150,000.00
2.20		.4 Overheads, charges and profit on above	%				
2.21	PSA 7.11	.5 Specialized Services	Prov sum				200,000.00
2.22		.6 Overheads, charges and profit on above	%				
	PSA 7.12	.7 Allowance for Repair of Electrical Works					
2.23		a. Waste Water Works	Prov sum				350,000.00
2.24		b. Gandhinagar pump station	Prov sum				828,790.00
2.25		c. Sasol pump station	Prov sum				50,000.00
2.26		d. Umzinto pump station	Prov sum				50,000.00
		.8 Overheads, charges and profit on above					
2.27		a. Waste Water Works	%				
2.28		b. Gandhinagar pump station	%				
2.29		c. Sasol pump station	%				
2.30		d. Umzinto pump station	%				
	PSA 7.13	.9 Allowance for Repair of Mechanical Works					
2.31		a. Waste Water Works	Prov sum				1,250,000.00
2.32		b. Gandhinagar pump station	Prov sum				763,260.00
2.33		c. Sasol pump station	Prov sum				50,000.00
2.34		d. Umzinto pump station	Prov sum				50,000.00
		.10 Overheads, charges and profit on above					
2.35		a. Waste Water Works	%				
2.36		b. Gandhinagar pump station	%				
2.37		c. Sasol pump station	%				
2.38		d. Umzinto pump station	%				
Carried Forward							-

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

Contract: 1843-30-00

Part C2: Pricing Data

Section C2.2: Bill of Quantities

Bill No. 2: Provisional Sums and Prime Cost Items

Item	Payment Reference	Description	Unit	CPG	Qty	Rate (R)	Amount (R)
Brought Forward							-
2.39	8.5	<u>SUB-CONTRACTORS</u>					
		(b) <u>For work to be executed by the Employer Nominated Sub-contractor or a Selected Sub-contractor in accordance to clause 4.4.4 of the GCC 2015</u>	Prov sum				250,000.00
2.40			%				
<u>PRIME COST ITEMS</u>							
	8.6	<u>PRIME COST ITEMS</u>					
		<u>Materials for dayworks</u>					
2.41	PSA8.1	(a) Materials used in the execution of dayworks	Prov sum				100,000.00
2.42		(b) Overheads, charges and profit on above	%				
BILL NO 2 <u>PROVISIONAL SUMS AND PRIME COST ITEMS</u>							
Carried forward to Summary of Bills							Total

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

Contract: 1843-30-00

Part C2: Pricing Data

Section C2.2: Bill of Quantities

Bill No. 3: Dayworks and Temporary Works

Item	Payment Reference	Description	Unit	CPG	Qty	Rate (R)	Amount (R)
	SANS 1200 A	BILL NO 3 DAYWORKS AND TEMPORARY WORKS					
		DAYWORKS Note: Dayworks executed on instruction of the Engineer only. Supervision of dayworks is not payable under this section and is deemed to be included under Preliminary and General items in 1200A Daywork sheets shall be delivered to the Engineer at the end of each day for approval, failing this, the Engineer may reject the dayworks.					
		LABOUR					
	8.7.1	LABOUR					
3.1		(a) Skilled	hr	CPG	550		-
3.2		(b) Semi-skilled	hr		700		-
3.3		(c) Un-skilled	hr		1250		-
		CONSTRUCTION EQUIPMENT HIRE					
		CONSTRUCTION EQUIPMENT HIRE (WORK RATES ON SITE)					
		TRUCKS					
	8.7.2	.1 <u>Tipper trucks (specify capacity)</u>					
3.4		(a) Capacity 8m³ (small)	hr		40		-
3.5		(b) Capacity 10m³ (medium)	hr		40		-
3.6		(c) Capacity 15m³ (large)	hr		40		-
	8.7.2	.3 <u>Flatbed trucks (specify capacity)</u>					
3.7		(a) Capacity 4 ton (small)	hr		24		-
3.8		(b) Capacity 6 ton (medium)	hr		24		-
3.9		(c) Capacity 10 ton (large)	hr		24		-
		LDV'S					
	8.7.2	.4 <u>LDV (specify size)</u>					
3.10		(a) LDV 2 ton	km		500		-
		WATER TANKERS					
	8.7.2	.5 <u>Water tankers (specify capacity)</u>					
3.11		(a) Capacity 2 kilolitre (small, towable)	hr		8		-
3.12		(b) Capacity 11 kilolitre (medium)	hr		8		-
3.13		(c) Capacity 18 kilolitre (large)	hr		8		-
Carried Forward							-

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

Contract: 1843-30-00

Part C2: Pricing Data

Section C2.2: Bill of Quantities

Bill No. 3: Dayworks and Temporary Works

Item	Payment Reference	Description	Unit	CPG	Qty	Rate (R)	Amount (R)
Brought Forward							-
		<u>LOADERS</u>					
	8.7.2	.6 <u>Wheel loaders (specify capacity)</u>					
3.14		(a) Capacity 1.5m³ bucket capacities (small)	hr		8		-
3.15		(b) Capacity 3m³ bucket capacities (medium)	hr		8		-
3.16		(c) Capacity 5m³ bucket capacities (large)	hr		8		-
		<u>GRADERS</u>					
	8.7.2	.7 <u>Motor graders (kw)</u>					
3.17		(a) Model with min of 133 kw	hr		24		-
		<u>EXCAVATORS</u>					
	8.7.2	.9 <u>Crawler excavators (mass/kw)</u>					
3.18		(a) Model 19200kg/88kw Flywheel Power (small)	hr		40		-
3.19		(b) Model 25000kg/120kw Flywheel Power (medium)	hr		40		-
3.20		(c) Model 32000kg/200kw Net Flywheel Power (large)	hr		40		-
		<u>TLB'S</u>					
	8.7.2	.10 <u>Tractor loader backhoe (TLB) (mass/kw)</u>					
3.21		(a) Model 13300kg/98kw	hr		180		-
		<u>RIDE-ON ROLLERS</u>					
	8.7.2	.11 <u>Self propelled vibrating rollers (smooth drum)</u> <u>(specify mass)</u>					
3.22		(a) Mass 5000kg (medium)	hr		8		-
3.23		(b) Mass10000kg (large)	hr		8		-
	8.7.2	.12 <u>Self propelled vibrating rollers (padfoot)</u> <u>(specify mass)</u>					
3.24		(a) Mass 8500kg (medium)	hr		24		-
3.25		(b) Mass 12000kg (large)	hr		24		-
	8.7.2	.13 <u>Pneumatic tyred rollers (specify mass)</u>					
3.26		(a) Mass 9000kg (medium)	hr		24		-
3.27		(b) Mass 15000kg (large)	hr		24		-
		<u>WALK BEHIND ROLLERS</u>					
	8.7.2	.14 <u>Walk behind vibrating rollers (specify model)</u>					
3.28		(a) Model 757kg (BW 65) (small)	hr		8		-
3.29		(b) Model 1040kg (BW 75) (medium)	hr		8		-
Carried Forward							-

Contractor

Witness 1

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Employer

Witness 1

Witness 2

Contract: 1843-30-00

Part C2: Pricing Data

Section C2.2: Bill of Quantities

Bill No. 3: Dayworks and Temporary Works

Item	Payment Reference	Description	Unit	CPG	Qty	Rate (R)	Amount (R)
Brought Forward							-
		<u>COMPACTORS</u>					
	8.7.2	.15 <u>Plate compactors (specify model)</u>					
3.30		(a) Model 100kg	hr		24		-
	8.7.2	.16 <u>Wackers (specify model)</u>					
3.31		(a) Model 60kg	hr		24		-
		<u>CONCRETE MIXERS</u>					
	8.7.2	.17 <u>Concrete mixers (specify mixing volume)</u>					
3.32		(a) Volume 320 litre (small)	hr		24		-
3.33		(b) Volume 1200 litre (medium, towable)	hr		24		-
3.34		(c) Volume 7000 litre (large)	hr		24		-
		<u>COMPRESSORS</u>					
	8.7.2	.18 <u>Portable diesel compressors (specify capacity)</u>					
3.35		(a) Capacity 50 cfm (small)	hr		24		-
3.36		(b) Capacity 250 cfm (medium)	hr		24		-
3.37		(c) Capacity 490 cfm (large)	hr		24		-
		<u>WATERPUMPS</u>					
	8.7.2	.19 <u>Waterpump (specify capacity)</u>					
3.38		(a) Capacity 30 litre/sec (small)	hr		36		-
3.39		(b) Capacity 100 litre/sec (medium)	hr		36		-
3.40		(c) Capacity 300 litre/sec (large)	hr		36		-
		<u>WELDERS</u>					
	8.7.2	.20 <u>Welding unit (specify ampere)</u>					
3.41		(a) 200 Amp (small)	hr		24		-
3.42		(b) 315 Amp (medium)	hr		24		-
3.46		(c) 1000 Amp (large)	hr		24		-
		<u>GENERATORS</u>					
	8.7.2	.21 <u>Mobile generator set (specify KVA)</u>					
3.44		(a) 2 KVA (small)	hr		36		-
3.45		(b) 4 KVA (medium]	hr		36		-
3.46		(c) 8 KVA (large)	hr		36		-
Carried Forward							-

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

Contract: 1843-30-00

Part C2: Pricing Data

Section C2.2: Bill of Quantities

Bill No. 3: Dayworks and Temporary Works

Item	Payment Reference	Description	Unit	CPG	Qty	Rate (R)	Amount (R)
Brought Forward							-
TRANSPORT HEAVY PLANT TO SITE							
TRANSPORT (COST TO AND FROM SITE)							
Note: Distance shall be measured one way only (tender rates shall include for transport in both directions to and from site)							
3.47	8.7.3	.1 <u>Low bed</u>					
		(a) Low-bed (suitable for the largest piece of equipment above)	km		600		-
3.48	8.7.3	.2 <u>Tipper truck</u>					
		(a) Small (As per category above)	km		200		-
3.49		(b) Medium (As per category above)	km		200		-
3.50		(c) Large (As per category above)	km		200		-
3.51	8.7.3	.3 <u>Flatbed truck</u>					
		(a) Small (As per category above)	km		200		-
3.52		(b) Medium (As per category above)	km		200		-
3.53		(c) Large (As per category above)	km		200		-
3.54	8.7.3	.4 <u>Water tanker</u>					
		(a) Small (As per category above)	km		300		-
3.55		(b) Medium (As per category above)	km		300		-
3.56		(c) Large (As per category above)	km		300		-
TEMPORARY WORKS							
TEMPORARY WORKS							
3.57	8.8.1	Access road to works (construct and maintain)	sum				
3.58	8.8.2	Accommodation of traffic	sum				
3.59	8.8.3	<u>Protection of structures, etc. until construction in vicinity is complete</u>					
		.1 Sludge and supernatant pumpstation	sum		1		-
3.60		.2 Chlorine Room	sum		1		-
3.66		.3 Manholes & pipelines	sum		1		-
3.62		.4 SST's, and Humus Tanks	sum		1		-
3.63		.5 Pumpstation	sum		1		-
3.64		.6 Biological Filter	sum		1		-
3.65		.7 Aeration Tanks	sum		1		-
3.66		.8 PST's -Settling Tanks	sum		1		-
Carried Forward							-

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

Item	Payment Reference	Description	Unit	CPG	Qty	Rate (R)	Amount (R)
Brought Forward							-
		EXISTING SERVICES					
		<u>WORK TO EXISTING SERVICES</u>					
	8.8.4	<u>Existing services</u>					
3.67		(a) Supply or hire specialist equipment for the detection of services	sum		1		-
3.68		(b) The use of equipment referred to above	day		10		-
3.69		(c) Excavation by hand in soft material to expose services	m³		50		-
3.70	8.8.4	Temporary Protection as required in terms of project Specification (Clause 5.4)	sum		1		
		SPECIAL WATER CONTROL					
		<u>SPECIAL WATER CONTROL</u>					
	8.8.6	<u>Special water control in terms of the Project Specification</u>					
3.71		(a) Existing Works	sum				
		(b) <u>Control water inflow For items as described above</u>					
#REF!		.1 Provide equipment	sum	1			-
#REF!		.2 Operate and maintain	day	456			-
#REF!		.3 Remove equipment	sum	1	CPG		-
		BILL NO 3					
		<u>DAYWORKS AND TEMPORARY WORKS</u>					
Carried forward to Summary of Bills							-
Total							-

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

Item	Payment Reference	Description	Unit	CPG	Qty	Rate (R)	Amount (R)
	SANS 1200 C	BILL NO 4 SITE CLEARANCE					
		CLEAR SITE					
		CLEAR AND GRUB SITE					
	8.2.1	(a) <u>Clear and grub area for</u>					
4.1		.1 Biological Reactor	m ²	CPG	550		-
4.2		.2 Chlorine contact tank	m ²	CPG	150		-
4.3		.3 Fence line WWTW	m ²	CPG	2350		-
4.4		.4 Fence line Gandhinagar PS	m ²	CPG	160		-
4.5		.5 Fence line Sasol PS	m ²	CPG	160		-
4.6		.6 Fence line Sasol PS	m ²	CPG	160		-
		(b) <u>Grass cutting, Bush cutting and trimming of tree branches, and spoil material at site established by contractor</u>					
4.7		.1 WWTW - Site	m ²	CPG	5000		-
4.8		.2 Gandhinagar PS	m ²	CPG	1200		-
4.9		.3 Sasol PS	m ²	CPG	1200		-
4.10		.4 Sasol PS	m ²	CPG	1200		-
		REMOVE LARGE TREES AND STUMPS					
	8.2.2	<u>Remove and grub large trees and tree stumps of girth</u>					
4.11		(a) Exceeding 1m and up to and including 2m	no	CPG	3		-
4.12		(b) Exceeding 2m and up to and including 3m	no	CPG	2		-
	SANS 1200 DM	TOPSOIL AND LANDSCAPING					
		REMOVE TOPSOIL					
	8.3.2	(a) <u>Remove topsoil to a depth of 150mm and</u>					
	PSC	.1 Stockpile on site and maintain					
4.13		.1 Biological Reactor	m ³	CPG	55		-
4.14		.2 Chlorine Contact Tank	m ³	CPG	25		-
		.3 Around existing Drying Beds	m ³	CPG	30		-
Carried Forward							-

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

Item	Payment Reference	Description	Unit	CPG	Qty	Rate (R)	Amount (R)
	Brought Forward						-
		<u>FINISHING, TOPSOILING AND GRASSING</u>					
4.16	8.3.10	<u>Topsoiling with material from stockpiles on site</u> (a) Spread over site Note: position to be determined on site <u>Grassing or other vegetation cover</u> <u>Hydroseeding</u>	m³	CPG	150		-
4.17		(a) .1 <u>Provide approved seed mix</u> .1 Suitable for Umzinto area	kg	CPG	100		-
4.18		(b) <u>Provide and lay approved grass cuttings type</u> .1 Kikuyu	m²	CPG	750		-
	SANS 1200 C	REMOVE AND SPOIL EXISTING STRUCTURES					
		<u>DEMOLISH AND SPOIL MATERIAL OFF SITE</u>					
	8.2.8	<u>Demolish and spoil material for structures, buildings, etc. at a spoil site established by the Contractor</u> (a) <u>Sundry structures, etc.</u>					
4.19		.1 Bio-Filter .1 Concrete Walls	m³		67		-
4.20		.2 Foundation	m³		165		-
4.21		.3 Media	m³	CPG	1210		-
4.22		.4 Concrete Aprons .2 Chlorine contact tank & RAS pumpstation	m³	CPG	10		-
4.23		.1 Concrete Walls	m³		240		-
4.24		.2 Foundation	m³		30		-
4.25		.3 230 mm wide Brick Walls .3 Pipelines	m³	CPG	12		-
4.26		.1 200 mm dia uPVC	m	CPG	20		-
4.27		.2 250 mm dia uPVC	m	CPG	15		-
4.28		.3 450 & 600 mm dia RC	m	CPG	20		-
	Carried Forward						-

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

Item	Payment Reference	Description	Unit	CPG	Qty	Rate (R)	Amount (R)
Brought Forward							-
		CLEAN AND AMPTY EXISTING STRUCTURES					
		<u>EMPTY AND SAFE DISPOSAL OF CONTENTS</u>					
	8.2.9	(a) <u>Empty and clean of existing structures complete Waste Water and Solids of 2 to 10 % Solids Discharge onto drying beds and safe disposal of contents to location within 500 m as agreed by the Engineer</u>					
4.29		.1 Primary Dortmund Tanks 1 & 2	m ³	CPG	200		-
4.32		.2 Humas Tanks 1 & 2	m ³	CPG	250		-
4.31		.3 Aerobic Tank	m ³	CPG	2000		-
4.32		.4 Settling tanks 1 & 2	m ³	CPG	200		-
4.33		.5 Chlorine Contact Tank	m ³	CPG	100		-
4.34		.6 Primary Settling Tank 1 and 2	m ³	CPG	900		-
4.35		.7 Primary Settling Tank 1	m ³	CPG	120		-
4.36		.8 Digester Feed Sumps	m ³	CPG	20		-
4.37		.9 RAS Pump Station Sump	m ³	CPG	20		-
4.38		.10 Recycle Pump Station Sump	m ³	CPG	20		-
4.39		.11 Sludge drying beds	m ³	CPG	1100		-
4.40		.12 Gandhinagar PS	m ²	CPG	350		-
4.41		.13 Sasol PS	m ²	CPG	350		-
4.42		.44 Sasol PS	m ²	CPG	350		-
		(b) <u>Extra over item (a) above for Sludge and Solids removal @ 1650 kg/m³</u>					
4.43		.1 Primary Dortmund Tanks 1 & 2	m ³	CPG	30		-
4.44		.2 Humas Tanks 1 & 2	m ³	CPG	37.5		-
4.45		.3 Aerobic Tank	m ³	CPG	450		-
4.46		.4 Settling tanks 1 & 2	m ³	CPG	30		-
4.47		.5 Chlorine Contact Tank	m ³	CPG	15		-
4.48		.6 Digesters 1 & 2	m ³	CPG	720		-
4.49		.7 Primary Settling Tank 1 and 2	m ³	CPG	18		-
4.50		.8 Digester Feed Sumps	m ³	CPG	3		-
4.51		.9 RAS Pump Station Sump	m ³	CPG	3		-
Carried Forward							-

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

Bill No. 4: Site Clearance

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Witness 2

Item	Payment Reference	Description	Unit	CPG	Qty	Rate (R)	Amount (R)
5.1	SANS 1200 C	<u>SCHEDULE NO. 5</u> <u>FENCING</u>					
		TEMPORARY FENCING					
		<u>Providing temporary fences and gates</u>					
		Fencing supplied and fixed complete, including all posts, stays, standards, droppers, excavation, backfilling, Complete Fences provided with posts, including installation of concrete bases, etc.					
5.1.1		(a) Stock-proof fences	m		200		
5.1.2		(b) Pedestrian fences	m		150		
5.1.3		(c) <u>Temporary gates</u>					
		(i) Size 4.5 m	no		4		
5.2		NEW FENCING					
		<u>FENCING</u>					
		<u>Fencing supplied and fixed complete, including all posts, stays, standards, droppers, excavation, backfilling, anti-digging concrete bases, etc.</u>					
		<u>Dwg 3505.02.00.GZA.17.D001</u>					
5.2.1		(a) 2.4m high fencing with overhang - WWTW	m		300		
5.2.1		(b) 2.4m high fencing with overhang - Gandhinagar PS	m		40		
5.2.1		(c) 2.4m high fencing with overhang - Sasol PS	m		40		
5.2.1		(d) 2.4m high fencing with overhang - Umzinto Town PS	m		40		
		<u>Gates supplied and fixed complete, including all posts, stays, hinges, locking devices, excavation, backfilling, anti-digging concrete bases, etc.</u>					
		<u>Dwg 3505.02.00.GZA.17.D001</u>					
5.2.2		(a) Single gate size 1m	no		1		
5.2.3		(b) Double gate size 4.5m	no		3		
5.3		<u>SUNDRIES</u>					
5.3.1		Ringbolts for anchoring fencing to structures	Sum		1		
5.3.2		Drilling and blasting holes for posts and anchors	Sum		1		
		<u>SCHEDULE NO. 5</u> <u>FENCING</u>					
Carried forward to Summary of Bills						Total	

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

Item	Payment Reference	Description	Unit	CPG	Qty	Rate (R)	Amount (R)
	SANS 1200 D	BILL NO 5.1 EARTHWORKS					
		MASS EARTHWORKS					
		MASS EXCAVATION					
	8.3.2	(a) .1 <u>Excavate in all materials and stockpile, use as fill, or spoil at site established by the Contractor</u>					
5.1.1		.1 Biological Reactor	m³		2800		-
5.1.2		.2 Chlorine Contact Tank	m³		196		-
5.1.3		.3 Ras Pumpstation	m³		182		-
		ROCK EXCAVATION					
	8.3.2	(b) <u>Extra over reference 8.3.2 (a) for</u>					
		.1 Hard rock excavation					
5.1.4		.1 Biological Reactor	m³		140		-
5.1.5		.2 Chlorine Contact Tank	m³		2		-
5.1.6		.2 Ras Pumpstation	m³		1		-
		RESTRICTED EARTHWORKS					
		RESTRICTED EXCAVATION					
	8.3.3	(a) <u>Restricted excavation in all materials and place within freehaul distance for</u>					
5.1.7		.1 Bio reactor chambers	m³		6		-
5.1.8		.2 Chlorine Contact Tank	m³		3		-
5.1.9		.3 Shaping Around existing drying beds	m³	CPG	675		-
5.1.10		.4 Remove sand from existing drying beds	m³	CPG	300		-
	8.3.3	(b) <u>Extra over reference 8.3.3 (a) for</u>					
5.1.11		.1 Hard rock excavation	m³		1		-
		IMPORTING OF MATERIALS					
		The rates for imported materials shall also cater for the same volume of spoiling of unsuitable material. and include for all transport to and from site No overhall will be paid					
Carried Forward							-

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

Item	Payment Reference	Description	Unit	CPG	Qty	Rate (R)	Amount (R)
Brought Forward							-
		<u>COMMERCIAL MATERIAL PROVIDED BY THE CONTRACTOR</u>					
	8.3.4	(a) <u>Extra over reference 8.3.2 (a) for importation of materials</u>					
		.1 G5 type material for soil raft Placing and compacting to 95% mod. AASHTO density in maximum layers of 150 mm after compaction. The material must conform to the following requirements:					
		- Maximum PI : 10%					
		- Minimum GM : 1,2					
		- Minimum CBR at 93% mod. AASHTO density : 15 (PROVISIONAL ITEM)					
5.1.12		.1 Bio Reactor	m ³		295		-
5.1.13		.2 Chlorine Contact Tank	m ³		70		-
		.2 Soilcrete for backfill of excavation where ordered by Engineer or shown on the drawing with 5% cement (OPC) (PROVISIONAL ITEM)					
5.1.14		.1 Bio Reactor	m ³		7		-
5.1.15		.2 Chlorine Contact Tank	m ³		4		-
WORKING SPACE							
<u>WORKING SPACE</u>							
<u>Extra excavation and backfilling in all materials to provide working space around structures</u>							
5.1.16	8.3.5	(a) Excavate for working space (previously excavated face +- 600mm away from perimeter of structure) for the placing and removal of external formwork to perimeter walls. Average depth of excavation 3 m deep, including backfilling and compaction to 90% mod AASHTO density	m ²		318		-
LATERAL SUPPORT							
<u>LATERAL SUPPORT</u>							
	8.3.7	(a) <u>Additional lateral support</u>					
5.1.17		.1 For the Reactor	sum		1		-
5.1.18		.2 For the Chlorine Contact tank	sum		1		-
5.1.20		.3 For the, Buildings Maholes and Pumpstations	sum		1		-
		.4 For Gabiion retaining wall	sum		1		-
Carried Forward							-

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

Item	Payment Reference	Description	Unit	CPG	Qty	Rate (R)	Amount (R)
Brought Forward							-
WATER CONTROL							
8.3.8 TEMPORARY WORKS FOR WATER CONTROL DEALING WITH SERVICES							
(b) <u>Control water inflow for items as described above</u>							
5.1.21		.1 Provide equipment	sum		1		-
5.1.22		.2 Operate and maintain	day		456		-
5.1.23		.3 Remove equipment	sum		1		-
BACKFILLING RESTRICTED EXCAVATIONS							
RESTRICTED BACKFILLING							
<u>Extra over reference 8.3.2(a)..... and 8.3.3(a)..... for backfill or for fill material against structures</u>							
8.3.9 (a) Selected material compacted to 93% mod AASHTO density							
5.1.24		.1 Alongside walls in foundations	m³	CPG	64		-
MISCELLANEOUS							
IMPORTING AND PLACEMENT OF MATERIALS							
The rates for imported materials shall include for all transport to site and placement of material							
8.3.4 (a) River sand to be approved by Engineer placed in drying beds as specified, 300 mm thick							
			m³		300		-
SANS 1200 DB BILL NO 5.2 EARTHWORKS (PIPE TRENCHES)							
TRENCHING							
EXCAVATION AND BACKFILLING							
<u>Excavate in all materials, backfill and compact to 90% mod AASHTO density, and dispose of surplus and unsuitable materials for trenches</u>							
8.3.2 (a) .1 Up to 1.5 m wide							
5.2.1		.1 Up to 1m deep	m³	CPG	210		-
5.2.2		.2 Over 1m and up to 2m deep	m³	CPG	262		-
5.2.3		.3 Over 2m and up to 4m deep	m³	CPG	577		-
8.3.2 (a) .2 Water network for 25 mm to 90 mm dia pipes							
5.2.4		.1 Up to 1m deep	m³	CPG	50		-
Carried Forward							-

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

Item	Payment Reference	Description	Unit	CPG	Qty	Rate (R)	Amount (R)
Brought Forward							-
5.2.5	8.3.2	(b) <u>Extra over reference 8.3.2 (a) for</u> .2 Hard rock excavation	m³	CPG	10		-
5.2.6	8.3.2	(c) Excavate unsuitable material from trench bottom, dispose of material, and re-fill with suitable imported material compacted to 90% mod AASHTO density	m³	CPG	52		-
<u>STONE FROM COMMERCIAL SOURCES SUPPLIED BY THE CONTRACTOR</u>							
5.2.7	8.2.	.1 Permanent drainage of approved 19mm crushed stone, 110mm perforated Geopipe and KAYMAT geotextile fabric U14. Complete.	m³	CPG	175		-
<u>SHORING</u>							
<u>SHORING OF TRENCHES</u>							
5.2.8	8.3.4	(a) <u>Shore trench opposite structure or service</u> .1 For Pipelines all sizes	m		610		-
<u>WATER CONTROL</u>							
<u>TEMPORARY WORKS FOR WATER CONTROL</u>							
5.2.9	8.3.4	(b) <u>Control water inflow For items as described above</u> .1 Provide equipment	sum		1		-
5.2.10		.2 Operate and maintain	day		456		-
5.2.11		.3 Remove equipment	sum	CPG	1		-
<u>EXISTING SERVICES</u>							
<u>WORK TO EXISTING SERVICES</u>							
<u>Existing services that intersect or adjoin pipe trench excavations</u>							
5.2.12	8.3.5	(a) <u>Services that intersect a trench</u> .1 Electric cable	no		50		-
5.2.13		.2 Fibre optic cable	no		20		-
5.2.14		.4 Sewer main not exceeding 100 TO 300mm dia	no		10		-
5.2.15		.5 Stormwater pipe not exceeding 600mm dia	no		10		-
5.2.16	8.3.5	(b) <u>Services that adjoin a trench</u> .1 Electric cable	m		600		-
5.2.17		.3 Fibre optic cable	m		50		-
5.2.18		.5 Sewer main not exceeding 100 TO 300mm dia	m		300		-
Carried Forward							-

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

Item	Payment Reference	Description	Unit	CPG	Qty	Rate (R)	Amount (R)
Brought Forward							-
	SANS 1200 LB	BILL NO 5.3 BEDDING (PIPES)					
		BEDDING					
		BEDDING FROM TRENCH EXCAVATIONS					
	8.2.1	<u>Provision of bedding material from trench excavations, including all necessary screening of the material to the desired bedding design requirement</u>					
5.3.1		(a) Selected granular material	m ³	CPG	230		-
5.3.2		(b) Selected fill material	m ³	CPG	230		-
		BEDDING FROM COMMERCIAL SOURCES					
	8.2.2	<u>.3 Provision of bedding material by importation from commercial sources selected by the Contractor</u>					
5.3.3		(a) Selected granular material	m ³	CPG	57.5		-
5.3.4		(b) Selected fill material	m ³	CPG	57.5		-
5.3.5		(c) Class 20/19 concrete for pipe thrust blocks	m ³	CPG	5		-
	SANS 1200 DM	BILL NO 5.4 EARTHWORKS (ROADS)					
		GRAVEL SURFACING WITH COMMERCIAL MATERIAL					
		CONSTRUCT GRAVEL SURFACE LAYERS WITH COMMERCIAL MATERIAL SUPPLIED BY THE CONTRACTOR					
		<u>G5 - Gravel surface layer</u>					
	8.3.16	(a) <u>.1 Compacted to 95% mod AASHTO density</u>					
		150mm Thick - layers					
5.4.1		(a) Access - Road	m ³	CPG	120		-
5.4.2		(b) Access around Digesters and Drying beds	m ³	CPG	360		-
5.4.3		(c) Access around structures	m ³	CPG	560		-
	SANS 1200 DK	BILL NO 5.5 GABIONS AND PITCHING					
		PREPARATION OF SURFACES					
		SURFACE PREPARATION					
	8.2.1	<u>Surface preparation for bedding of gabions and mattresses</u>					
5.5.1		(a) (i) Cavities filled with approved excavated material or rock and compacted to 93% mod AASHTO density	m ²	CPG	250		-
Carried Forward							-

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

Item	Payment Reference	Description	Unit	CPG	Qty	Rate (R)	Amount (R)
Brought Forward							-
GABIONS							
GABIONS							
	8.2.2	.1 Gabions using galvanized wire of the following sizes					
5.5.2		(a) 2,0 x 1,5 x 1,0m Box of 80mm mesh size	m ³	CPG	150		-
5.5.3		(b) 2,0 x 1,0 x 1,0m Box of 80mm mesh size	m ³	CPG	100		-
5.5.4		(b) 0.5x 1,0 x 1,0m Box of 80mm mesh size	m ³	CPG	25		-
		.1 Matress using galvanized wire of the following sizes					
5.5.5		(a) 2,0 x 1,0 x 0.3m Box of 80mm mesh size	m ³	CPG	60		-
GEOTEXTILES							
GEOTEXTILES							
	8.2.4	Supply and lay geotextile fabric below gabions and mattresses					
5.5.6		(a) Bidim A2 (previously U24)	m ²	CPG	550		-
BACKFILL WIH COMMERCIAL MAERIAL							
RESTRICTED BACKFILLING							
The rates for imported materials shall include for all transport to site, backfilling and compaction of material							
5.5.7	8.3.4	(a) G3 material compacted to 93% Mod AASHTO	m ³	CPG	300		-
BILL NO 5 EARTHWORKS							
Carried forward to Summary of Bills							-
Total							-

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

Contract: 1843-30-00

Part C2: Pricing Data

Section C2.2: Bill of Quantities

Bill No. 6: Concrete (Structural) and Civil Work

Item	Payment Reference	Description	Unit	CPG	Qty	Rate (R)	Amount (R)
	SANS 1200 G	BILL NO 6.1 CONCRETE (STRUCTURAL)					
		BIOLOGICAL REACTOR					
		ROUGH FORMWORK					
		ROUGH FORMWORK					
	8.2.1	(a) <u>Plane vertical</u>					
6.1.1		.1 Sides of downstand ground beams	m ²		27		-
6.1.2		.2 Walls	m ²		325		-
6.1.3		.3 Square or rectangular columns	m ²		5		-
	8.2.5	<u>Rough formwork to narrow widths</u>					
6.1.4		(a) Edges, risers, etc. not exceeding 300mm wide	m		20		-
	8.1.1.2	<u>Rough formwork to chamfers, grooves, rebates, etc. exceeding 20x20mm in size</u>					
6.1.5		(a) Groove size 300mm wide x 150mm deep	m		15		-
6.1.6		(b) Groove size 250mm wide x 150mm deep	m		15		-
6.1.7		(c) Groove size 150mm wide x 150mm deep	m		10		-
		SMOOTH FORMWORK					
		SMOOTH FORMWORK					
	8.2.2	(a) <u>Plane horizontal</u>					
6.1.8		.1 Slabs	m ²		50		-
	8.2.2	(b) <u>Plane vertical</u>					
6.1.9		.1 Sides of slabs	m ²		30		-
6.1.10		.2 Walls	m ²		906		-
6.1.11		.3 Circular columns	m ²		65		-
6.1.12		.4 Baffle Walls	m ²		24		-
	8.2.2	(c) <u>Plane sloping</u>					
6.1.13		.1 Stairs	m ²		3		-
	8.2.5	<u>Smooth formwork to narrow widths</u>					
6.1.14		(a) Edges, risers, etc not exceeding 300mm wide	m		22		-
6.1.15		(c) Raking side of stairs maximum 400mm wide	m		4		-
Carried Forward							-

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

Contract: 1843-30-00

Part C2: Pricing Data

Section C2.2: Bill of Quantities

Bill No. 6: Concrete (Structural) and Civil Work

Item	Payment Reference	Description	Unit	CPG	Qty	Rate (R)	Amount (R)
Brought Forward							-
	8.1.1.2	Smooth formwork to chamfers, grooves, rebates, etc exceeding 20x20mm in size					
6.1.16	(a)	Chamfer size 100x100mm	m		7		-
6.1.17	(b)	Chamfer size 200x200mm	m		4		-
BOXING IN FOR HOLES AND VOIDS							
	8.2.6	(a) <u>Small, circular, up to 0,35m diameter with depth</u>					
6.1.18	.1	over 0m and up to 0,5m	no		9		-
	(b)	<u>Large, circular, over 0,35m and up to 0,7m diameter with depth</u>					
6.1.19	.1	over 0m and up to 0,5m	no		8		-
	(c)	<u>Large, other shapes, over 0,1m² up to 0,5m² in area with depth</u>					
6.1.20	8.2.6	.1 over 0,5m and up to 1,0m	no		5		-
REINFORCEMENT							
REINFORCEMENT							
<u>Steel bars</u>							
	8.3.1	(a) <u>Mild steel</u>					
6.1.21	.1	All sizes	ton		2		-
	8.3.1	(b) <u>High tensile steel</u>					
6.1.22	.1	All sizes	ton		58		-
	8.3.2	<u>High tensile welded mesh</u>					
6.1.23	(a)	Ref no. 395	m ²		6		-
CONCRETE							
PRESCRIBED MIX CONCRETE							
	8.4.1	(a) <u>Concrete mix 1:3:6</u>					
6.1.24	.1	50mm thick filling of electric cable trenches	m ²	CPG	8		-
STRENGTH CONCRETE							
	8.4.2	<u>Strength concrete 15Mpa/19mm</u>					
6.1.25	(a)	Blinding layer 50mm thick	m ³		21		-
	8.4.3	(a) <u>Strength concrete 20Mpa/19mm</u>					
6.1.26	.1	Benching including steel floating	m ³		8		-
Carried Forward							-

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

Contract: 1843-30-00

Part C2: Pricing Data

Section C2.2: Bill of Quantities

Bill No. 6: Concrete (Structural) and Civil Work

Item	Payment Reference	Description	Unit	CPG	Qty	Rate (R)	Amount (R)
Brought Forward							-
	8.4.3	(d) <u>Strength concrete 35Mpa/19mm</u>					
6.1.27		.1 Floor slabs	m ³		167		-
6.1.28		.2 Suspended slab	m ³		35		-
6.1.29		.3 Walls	m ³		185		-
6.1.30		.4 Columns	m ³		6		-
6.1.31		.5 Stairs	m ³		4		-
6.1.32		.6 Baffle Walls	m ³		4		-
		SURFACE FINISHING					
		<u>SURFACE FINISHES</u>					
		<u>Unformed surface finishes</u>					
	8.4.4	(a) <u>Wood floated finish</u>					
6.1.33		.1 Floor slabs	m ²	CPG	360		-
6.1.34		.2 Suspended slabs	m ²	CPG	130		-
6.1.35		.3 Top of walls, beams, etc	m ²	CPG	5		-
	8.4.4	(b) <u>Steel floated finish</u>					
6.1.36		.1 Benching	m ²	CPG	5		-
6.1.37		.2 Top of walls, beams, etc	m ²	CPG	30		-
		EXPANSION JOINTS					
		<u>EXPANSION JOINTS</u>					
	8.5	(a) <u>12mm Thick jointex placed vertically between concrete surfaces</u> <u>Dwg 1843.00.IA.14.D002</u>					
6.1.38		.1 Expansion between stair slab and structure	m ²		2		-
	8.5	(b) <u>Polyurethane joint sealer</u>					
6.1.39		.1 Remove 10 x 20mm tear off strip, prime with an approved primer and fill joint with polyurethane sealer	m		7		-
		PRECAST CONCRETE					
		<u>PRECAST CONCRETE</u>					
		<u>Precast concrete units supplied and fixed complete including all reinforcing, etc.</u> <u>Dwg 1843.30.00.WIA.14.X001</u>					
Carried Forward							-

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

Contract: 1843-30-00

Part C2: Pricing Data

Section C2.2: Bill of Quantities

Bill No. 6: Concrete (Structural) and Civil Work

Item	Payment Reference	Description	Unit	CPG	Qty	Rate (R)	Amount (R)
Brought Forward							-
6.1.40	8.6	(a) <u>As specified</u> .1 1200 Dia RC pipe class 25D	m	CPG	8		-
		SUNDRIES					
		GROUTING					
	8.7	<u>Standard bedding non shrink grout</u>					
6.1.41		(a) 200mm thick concrete wall	m ³		1		-
6.1.42		(b) .01 160mm diameter pipe	no		4		-
6.1.43		.02 250mm diameter pipe	no		2		-
6.1.44		.03 300mm diameter pipe	no		3		-
6.1.45		.04 350mm diameter pipe	no		2		-
6.1.46		.03 400mm diameter pipe	no		3		-
		CHLORINE CONTACT TANK					
		ROUGH FORMWORK					
		ROUGH FORMWORK					
	8.2.1	(a) <u>Plane vertical</u>					
6.1.47		.1 Sides of floor slabs	m ²		16.5		-
6.1.48		.2 Walls	m ²		60		-
	8.2.5	<u>Rough formwork to narrow widths</u>					
6.1.49		(a) Edges, risers, etc not exceeding 300mm wide	m		10		-
		SMOOTH FORMWORK					
	8.2.2	(b) <u>Plane vertical</u>					
6.1.50		.1 Walls	m ²		285		-
	8.2.5	<u>Smooth formwork to narrow widths</u>					
6.1.51		(a) Edges, risers, etc not exceeding 300mm wide	m		60		-
	8.1.1.2	<u>Smooth formwork to chamfers, grooves, rebates, etc exceeding 20x20mm in size</u>					
6.1.52		(a) Chamfer size 125x125mm	m		1.2		-
		BOXING IN FOR HOLES AND VOIDS					
	8.2.6	(a) <u>Small, circular, up to 0,35m diameter with depth</u>					
6.1.53		.1 over 0m and up to 0,5m	no		5		-
Carried Forward							-

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

Contract: 1843-30-00

Part C2: Pricing Data

Section C2.2: Bill of Quantities

Bill No. 6: Concrete (Structural) and Civil Work

Item	Payment Reference	Description	Unit	CPG	Qty	Rate (R)	Amount (R)
Brought Forward							-
6.1.54		(b) <u>Large, circular, over 0,35m and up to 0,7m diameter with depth</u> .1 over 0m and up to 0,5m	no		2		-
6.1.55	8.2.6	(c) <u>Large, other shapes, over 0,1m² up to 0,5m² in area with depth</u> .1 over 0,5m and up to 1,0m	no		2		-
REINFORCEMENT							
REINFORCEMENT							
<u>Steel bars</u>							
6.1.56	8.3.1	(a) <u>Mild steel</u> .1 All sizes	ton		0.5		-
6.1.57	8.3.1	(b) <u>High tensile steel</u> .1 All sizes	ton		19.00		-
CONCRETE							
PRESCRIBED MIX CONCRETE							
STRENGTH CONCRETE							
6.1.58	8.4.2	<u>Strength concrete 15Mpa/19mm</u> (a) Blinding layer 50mm thick	m³		8		-
6.1.59	8.4.3	(a) <u>Strength concrete 20Mpa/19mm</u> .1 Benching including steel floating	m³		1		-
6.1.60	8.4.3	(d) <u>Strength concrete 35Mpa/19mm</u> .1 Floor slabs	m³		68		-
6.1.61		.2 Walls	m³		65		-
SURFACE FINISHING							
SURFACE FINISHES							
<u>Unformed surface finishes</u>							
6.1.62	8.4.4	(a) <u>Wood floated finish</u> .1 Floor slabs	m²	CPG	120		-
6.1.63		.2 Top of walls, beams, etc	m²	CPG	22		-
6.1.64	8.4.4	(b) <u>Steel floated finish</u> .1 Benching	m²	CPG	10		-
Carried Forward							-

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

Item	Payment Reference	Description	Unit	CPG	Qty	Rate (R)	Amount (R)
Brought Forward							-
6.1.65		.2 Top of walls, beams, etc	m ²	CPG	20		-
		SUNDRIES					
		GROUTING					
	8.7	<u>Standard bedding non shrink grout</u>					
		(a) 250mm thick concrete wall					
6.1.66		.01 150mm diameter pipe	no		2		-
6.1.67		.02 315mm diameter pipe	no		3		-
6.1.68		.03 400mm diameter pipe	no		2		-
		RAS PUMP STATION					
		ROUGH FORMWORK					
		ROUGH FORMWORK					
	8.2.1	(a) <u>Plane vertical</u>					
6.1.69		.1 Sides of floor slabs	m ²		7.5		-
6.1.70		.2 Walls	m ²		42		-
		SMOOTH FORMWORK					
	8.2.2	(b) <u>Plane vertical</u>					
6.1.71		.1 Walls	m ²		52		-
	8.1.1.2	<u>Smooth formwork to chamfers, grooves, rebates, etc exceeding 20x20mm in size</u>					
6.1.72		(a) Chamfer size 125x125mm	m		40		-
		BOXING IN FOR HOLES AND VOIDS					
	8.2.6	(a) <u>Small, circular, up to 0,35m diameter with depth</u>					
6.1.73		.1 over 0m and up to 0,5m	no	CPG	1		-
		REINFORCEMENT					
		REINFORCEMENT					
		<u>Steel bars</u>					
	8.3.1	(a) <u>Mild steel</u>					
6.1.74		.1 All sizes	ton		0.1		-
	8.3.1	(b) <u>High tensile steel</u>					
6.1.75		.1 All sizes	ton		3		-
Carried Forward							-

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

Item	Payment Reference	Description	Unit	CPG	Qty	Rate (R)	Amount (R)
Brought Forward							-
CONCRETE							
<u>PRESCRIBED MIX CONCRETE</u>							
<u>STRENGTH CONCRETE</u>							
6.1.76	8.4.2	Strength concrete 15Mpa/19mm (a) Blinding layer 50mm thick	m ³		1		-
6.1.77	8.4.3	(a) Strength concrete 20Mpa/19mm .1 Benching including steel floating	m ³		3		-
6.1.78	8.4.3	(d) Strength concrete 35Mpa/19mm .1 Floor slabs	m ³		8		-
6.1.79		.2 Walls	m ³		12		-
SURFACE FINISHING							
<u>SURFACE FINISHES</u>							
<u>Unformed surface finishes</u>							
6.1.80	8.4.4	(a) Wood floated finish .1 Floor slabs	m ²	CPG	48		-
6.1.81	8.4.4	(b) Steel floated finish .1 Benching	m ²	CPG	8		-
6.1.82		.2 Top of walls, beams, etc	m ²		4		-
SUNDRIES							
<u>GROUTING</u>							
6.1.82	8.7	Standard bedding non shrink grout (a) 250mm thick concrete wall .01 250mm diameter pipe	no		1		-
6.1.84		.2 Walls	m ²		48		-
SMOOTH FORMWORK							
6.1.85	8.2.2	(b) Plane vertical .1 Walls	m ²		56		-
6.1.86	8.1.1.2	Smooth formwork to chamfers, grooves, rebates, etc exceeding 20x20mm in size (a) Chamfer size 125x125mm	m		64		-
Carried Forward							-

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

Contract: 1843-30-00

Part C2: Pricing Data

Section C2.2: Bill of Quantities

Bill No. 6: Concrete (Structural) and Civil Work

Item	Payment Reference	Description	Unit	CPG	Qty	Rate (R)	Amount (R)
Brought Forward							-
		<u>BOXING IN FOR HOLES AND VOIDS</u>					
6.1.87	8.2.6	(a) <u>Small, circular, up to 0,35m diameter with depth</u> .1 over 0m and up to 0,5m	no		5		-
6.1.88		(b) <u>Large, circular, over 0,35m and up to 0,7m diameter with depth</u> .1 over 0m and up to 0,5m	no		5		-
REINFORCEMENT							
<u>REINFORCEMENT</u>							
<u>Steel bars</u>							
6.1.89	8.3.1	(a) <u>Mild steel</u> .1 All sizes	ton		0.1		-
6.1.90	8.3.1	(b) <u>High tensile steel</u> .1 All sizes	ton		9		-
CONCRETE							
<u>PRESCRIBED MIX CONCRETE</u>							
<u>STRENGTH CONCRETE</u>							
6.1.91	8.4.2	<u>Strength concrete 15Mpa/19mm</u> (a) Blinding layer 50mm thick	m³		1		-
6.1.92	8.4.3	(a) <u>Strength concrete 20Mpa/19mm</u> .1 Benching including steel floating	m³		2		-
6.1.93	8.4.3	(d) <u>Strength concrete 35Mpa/19mm</u> .1 Floor slabs	m³		16		-
6.1.94		.2 Walls	m³		54		-
SURFACE FINISHING							
<u>SURFACE FINISHES</u>							
<u>Unformed surface finishes</u>							
6.1.95	8.4.4	(a) <u>Wood floated finish</u> .1 Floor slabs	m²	CPG	37.5		-
6.1.96		.2 Top of walls, beams, etc	m²	CPG	8		-
6.1.97	8.4.4	(b) <u>Steel floated finish</u> .1 Benching	m²	CPG	5		-
Carried Forward							-

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

Item	Payment Reference	Description	Unit	CPG	Qty	Rate (R)	Amount (R)
Brought Forward							-
6.1.98		.2 Top of walls, beams, etc	m ²		1		-
		SUNDRIES					
		GROUTING					
	8.7	Standard bedding non shrink grout					
		(a) 250mm thick concrete wall					
6.1.99		.01 150mm diameter pipe	no		10		-
6.1.102		.02 450mm diameter pipe	no		2		-
		MISCELLANEOUS					
		ROUGH FORMWORK					
		ROUGH FORMWORK					
	8.2.1	(a) Plane vertical					
6.1.101		.1 Sides of aprons	m ²		10		-
6.1.102		.2 Sides of Generator container base	m ²		6		-
		CONCRETE					
		PRESCRIBED MIX CONCRETE					
		STRENGTH CONCRETE					
	8.4.3	(a) Strength concrete 20Mpa/19mm					
6.1.103		.1 Aprons	m ³		30		-
		.2 Sides of Generator container base	m ³		6		-
	PSG	TEST AND DIS-INFECT STRUCTURE					
6.1.105	PSG 10.5	(a) Reactor	Sum				
6.1.106		(b) Chlorine Contact Tank	Sum				
		DRAINAGE					
	8.4.3	.1 Stormwater channel located above gabion wall - In-situ cast concrete V-drain, Class 20/19 complete with Ref. 395 mesh and joints					
6.1.107		a) 2.5 m wide, 150mm thick concrete open drain	m ³	CPG	13		-
Carried Forward							-

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

Contract: 1843-30-00

Part C2: Pricing Data

Section C2.2: Bill of Quantities

Bill No. 6: Concrete (Structural) and Civil Work

Item	Payment Reference	Description	Unit	CPG	Qty	Rate (R)	Amount (R)
Brought Forward							-
6.2.1	SANS 1200 MJ	BILL NO 6.2 SEGMENTED PAVING					
		EDGE RESTRAINTS					
		EDGE RESTRAINTS					
	8.2.1	.1 <u>Cast-in-situ strength concrete 30Mpa/19mm edge beam size 150mm wide x 150mm high, wood floated on top, angle rounded edges and 10mm thick jointex expansion joints at 3m centres</u>					
	6.2.1	.1 Straight sections	m		200		-
	6.2.2	.2 Circular sections	m		50		-
		CONCRETE PAVING					
		INTERLOCKING PRECAST CONCRETE PAVING					
	8.2.2	.1 <u>Grey interlocking precast concrete paving blocks type SA, including all cutting of units to fit between edge restraints, laid on and including 20mm riversand, compacted and plastersand broomed into joints on completion</u>					
		<u>Class 25 concrete paving blocks</u>					
6.2.3		.1 60mm thick	m ²	CPG	1200		-
6.2.4		.2 80mm thick	m ²	CPG	550		-
6.3.1	SANS 1200 MH	BILL NO 6.3 ASPHALT SURFACING					
		ASPHALT SURFACING					
		ASPHALT SURFACING					
	8.5.4	.1 .1 <u>Continuously graded TPA medium asphalt with 80/100 penetrating grade bitumen binder</u>					
		.1 30mm Thick	m ²		550		-
		BILL NO 6 CONCRETE (STRUCTURAL) AND CIVIL WORKS					
Carried forward to Summary of Bills							-
Total							-

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

Item	Payment Reference	Description	Unit	CPG	Qty	Rate (R)	Amount (R)
7.1	PU	BILL NO 7					
		BUILDING WORK					
		BRICKWORK					
	8.1.0	<u>Stock brickwork in 1:4 cement mortar</u>					
	.1	230mm Thick wall	m ²	CPG	50		-
		FACE BRICKWORK					
	PU 5.1.2	FACE BRICKWORK					
	8.4.0	<u>Extra over reference 8.1.0 and 8.2.0 for face brickwork (Allow R4200.00/1000 for purchasing and delivery of bricks to site excluding VAT)</u>					
	.1	Stretcher course bond	m ²	CPG	50		-
	.2	230mm Wide face brick on edge sill	m	CPG	50		-
7.2		SUNDRIES					
		BRICK REINFORCING					
	8.5.0	<u>Brick reinforcing</u>					
	.1	150mm Wide brickforce	m	CPG	150		-
		FASCIA AND BARGE BOARDS					
	PU 3.2.1	FASCIA AND BARGE BOARDS					
	8.15.0	<u>Fibre cement fascia board fixed complete</u>					
	.1	10 x 200mm Fascia	m	CPG	40		-
	8.15.1	<u>Fibre cement barge board fixed complete</u>					
	.1	10 x 200mm Barge board	m	CPG	40		-
7.4		FIXED CEILINGS					
		FIXED CEILINGS					
		<u>Supply and erect fixed ceilings</u>					
	8.16.0	.1 <u>Plasterboard ceilings</u>					
	.1	6mm Plasterboard fixed ceiling including	m ²	CPG	100		-
	.2	70mm Gypsum coved cornice at junction of ceiling and wall	m	CPG	50		-
Carried Forward							-

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

Item	Payment Reference	Description	Unit	CPG	Qty	Rate (R)	Amount (R)
Brought Forward							-
DOORS							
<u>SOLID CORE DOORS</u>							
8.18.0 Solid core doors with meranti veneer suitable for varnishing							
7.9		.1 Door size 813 x 2032mm	no	CPG	10		-
<u>ALUMINIUM DOORS</u>							
8.20.0 Hinged Aluminium doors Type G2, Finishing to be confirmed on site							
7.10		.1 Single Door size 813 x 2032mm	no	CPG	20		-
7.11		.2 Double door size 1511 x 2032mm	no	CPG	5		-
<u>STEEL SECURITY DOORS - At Pump Stations</u>							
Heavy Duty (6 mm-thick Steel Plates) 8.20.0 Hinged Galvanized Doors Type G2, Finishing to be confirmed on site							
7.12		.1 Single Door size 813 x 2032mm	no	CPG	3		-
7.13		.2 Double door size 1511 x 2032mm	no	CPG	2		-
<u>SHOWER DOORS</u>							
<u>ALUMINIUM SHOWER PARTITIONS</u>							
Shower doors and partitions with approved safety glass glazing fixed complete							
7.14		.1 Glazed aluminium shower partition size 300x1800mm high	no	CPG	6		-
<u>RAINWATER DISPOSAL</u>							
<u>GUTTERS</u>							
Gutters supplied and fixed complete, including all mitres, stopped ends, outlets, etc.							
1,6mm Galvanized mild steel							
7.15		.1 Size 100 x 100mm	m	CPG	50		-
<u>RAINWATER DOWNPIPES</u>							
	PU 5.2	Rainwater pipes supplied and fixed complete, including offsets, shoes, etc.					
Carried Forward							-

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

Item	Payment Reference	Description	Unit	CPG	Qty	Rate (R)	Amount (R)
Brought Forward							-
7.16	8.31.0	<u>1,6mm Galvanized mild steel</u> .1 Size 100 x 100mm	m	CPG	20		-
		GLAZING					
	PU 3.4.9	GLAZING					
7.17	8.38.0	<u>Glazing to steel with putty</u> .1 4mm Clear sheet glass	m ²	CPG	10		-
		IRONMONGERY					
		IRONMONGERY					
7.18	8.24.0	<u>Locksets</u> .1 Union CZ 682-24-975C tree lever lockset including chrome furniture	no	CPG	35		-
		PAINTING					
	PU 3.3.1 PU 5.3	PAINTING					
7.19	8.39.1	<u>Undercoat and two coats exterior quality gloss enamel paint to</u> .1 Steel door frames	m ²	CPG	10		-
7.20		.2 Steel doors	m ²	CPG	40		-
7.21		.3 Steel windows (both sides measured)	m ²	CPG	10		-
7.22		.4 Timber doors	m ²	CPG	20		-
7.23	8.39.4	<u>Undercoat and two coats eggshell enamel paint to</u> .1 Plastered walls - Interior WWTW Plastered walls - Interior PS	m ²	CPG	400		-
7.24		.2 Gandhinagar PS	m ²	CPG	400		-
7.25		.3 Sasol PS	m ²	CPG	400		-
7.26		.4 Sasol PS	m ²	CPG	400		-
7.27		.5 Plastered walls - Exterior WWTW Plastered walls - Exterior PS	m ²	CPG	300		-
7.28		.6 Gandhinagar PS	m ²	CPG	400		-
Carried Forward							-

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

Item	Payment Reference	Description	Unit	CPG	Qty	Rate (R)	Amount (R)
Brought Forward							-
7.29		.7 Sasol PS	m ²	CPG	400		-
7.30		.8 Sasol PS	m ²	CPG	400		-
		Ceilings					
7.31		WWTW	m ²	CPG	400		-
7.32		Gandhinagar PS	m ²	CPG	400		-
7.33		Sasol PS	m ²	CPG	400		-
7.34		Sasol PS	m ²	CPG	400		-
	8.39.5	<u>Two coats exterior quality varnish to</u>					
7.35		.1 Timber doors	m ²	CPG	40		-
		FLOORING					
		Porcelain non-slip floor tiles fixed to floors in accordance with manufacturers specifications					
7.36		.1 10 mm thick tiles to floors (heavy duty)	m ²	CPG	96		-
		PLUMBING					
		<u>Note:</u> Plumbing measured in elements (plumbing points) and shall be priced accordingly. Prices must include for supply and installation of all fittings, taps, supply and discharge piping from the fitting to the perimeter of the building face complete. Supply and discharge piping from the perimeter of the building up to the connection point on the site, will be measured separately, and must be priced accordingly. The external supply and discharge piping must include all items such as, excavation, bedding, backfilling, pipe fittings, manholes, etc complete Plumbing points in building					
7.37		.1 Wash Sink	no	CPG	2		-
7.38		.3 Toilet	no	CPG	2		-
		BILL NO 7 BUILDING WORK					
Carried forward to Summary of Bills							-
Total							-

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

Item	Payment Reference	Description	Unit	CPG	Qty	Rate (R)	Amount (R)
	SANS 1200 LD	BILL NO 8.1 uPVC PIPES					
		PIPES, FITTINGS AND VALVES					
		uPVC SEWER PIPES					
	8.2.1	(a) <u>Supply, lay, joint, bed (flexible pipe bedding) and test uPVC class 34 spigot and socket sewer pipes with moulded rubber rings to SABS 791</u>					
8.1.1		.1 110 mm dia uPVC, Class 9	m		135		-
8.1.2		.3 200 mm dia uPVC, Class 9	m		70		-
8.1.3		.4 250 mm dia uPVC, Class 9	m		25		-
8.1.4		.5 315 mm dia uPVC, Class 12	m		50		-
8.1.5		.6 355 mm dia uPVC, Class 12	m		25		-
	8.2.1	(b) <u>Supply, lay, joint, bed (flexible pipe bedding) and test HDPE class 6 Type 4 water reticulation Rate to include all bends, cut lengths, couplings, tees, reducers, etc.</u>					
8.1.6		.1 50 mm dia	m	CPG	25		-
8.1.7		.2 40 mm dia	m	CPG	25		-
8.1.8		.3 25 mm dia	m	CPG	25		-
		SPECIALS TO SEWER PIPES					
	8.2.2	(a) <u>Extra over reference 8.2.1 (a) for specials</u>					
8.1.9		.1 110 mm dia uPVC, Class 9 , 45° bend	no		7		-
8.1.10		.2 110 mm dia uPVC, Class 9 , 90° bend	no		12		-
8.1.11		.3 200 mm dia uPVC, Class 9 , 45° bend	no		3		-
8.1.12		.4 200 mm dia uPVC, Class 9 , 90° bend	no		8		-
8.1.13		.5 250 mm dia uPVC, Class 9 , 45° bend	no		6		-
8.1.14		.6 315 mm dia uPVC, Class 12 , 90° bend	no		5		-
8.1.15		.7 355 mm dia uPVC, Class 12 , 45° bend	no		3		-
8.1.16		.7 355 mm dia uPVC, Class 12 , 90° bend	no		3		-
	8.2.2	(b) <u>Extra over reference 8.2.1 (b) for Stand pipe with gardenhose connection clamped to concrete or brickwall or fixed on MS iron dropped, complete as shown on dwg 1843.00.AA.13.D001</u>					
		.1 Standpipe	no	CPG	7		-
Carried Forward							-

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

Item	Payment Reference	Description	Unit	CPG	Qty	Rate (R)	Amount (R)
Brought Forward							-
		<u>SPIGOT AND SOCKET SACRIFICIAL LINED SEWER PIPES WITH RUBBER RINGS</u>					
	8.2.1	<u>Supply, lay, bed (class C bedding) and test concrete sacrificial lined sewer pipe culverts including all cutting to ends</u>					
	8.2.1	(a) <u>Spigot and socket class 75D with rubber rings</u>					
		.1 400mm Diameter	m		10		-
		MISCELLANEOUS					
		a) Break opening through 200mm thick concrete wall, place pipe into position and repair with non-shrink grout water tight					
8.1.19		.01 for 110mm dia pipe	no	CPG	2		-
8.1.20		.02 for 200mm dia pipe	no	CPG	1		-
8.1.21		.03 for 250mm dia pipe	no	CPG	2		-
8.1.22		.04 for 315mm dia pipe	no	CPG	2		-
	PLK, PLKA, PLN PLQ	BILL NO 8.2					
		<u>STEEL PIPE FITTINGS AND VALVES</u>					
		PIPES, FITTINGS AND VALVES					
		<u>SUPPLY AND DELIVER TO SITE</u>					
	Pipe Item Schedule	(a) <u>The rate for all items to include for the supply, delivery, factory applied corrosion protection and off-loading on site</u>					
		.1 Bio Reactor ref dwg. 1843.30.WIA.13.M001					
8.2.1		IA 1.1	no		2		-
8.2.2		IA 1.2	no		2		-
8.2.3		IA 1.3	no		2		-
8.2.4		IA 1.4	no		3		-
8.2.5		IA 1.5	no		2		-
8.2.6		IA 1.6	no		3		-
8.2.7		IA 1.7	no		1		-
8.2.8		IA 1.8	no		8		-
8.2.9		IA 1.9	no		1		-
8.2.10		IA 1.10	no		1		-
8.2.11		IA 2.1	no		4		-
Carried Forward							-

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

Item	Payment Reference	Description	Unit	CPG	Qty	Rate (R)	Amount (R)
Brought Forward							-
8.2.12		IA 2.2	no		1		-
8.2.13		IA 2.3	no		4		-
8.2.14		IA 2.4	no		1		-
8.2.15		IA 2.5	no		1		-
8.2.16		IA 2.6	no		1		-
8.2.17		IA 6.1	no		2		-
8.2.18		IA 6.2	no		2		-
8.2.19		IA 6.3	no		2		-
8.2.20		IA 6.4	no		1		-
8.2.21		IA 7.1	no		1		-
8.2.22		IA 12.1	no		1		-
8.2.23		IA 12.2	no		3		-
8.2.24		IA 12.3	no		2		-
8.2.25		IA 12.4	no		1		-
		.4 <u>Chlorine Contact Tank</u> ref dwg. 1843.30.WNA.13.M001					
8.2.26		NA 1.1	no		1		-
8.2.27		NA 1.2	no		2		-
8.2.28		NA 1.3	no		2		-
8.2.29		NA 2.1	no		2		-
8.2.30		NA 2.2	no		1		-
8.2.31		NA 6.1	no		1		-
8.2.32		NA 6.2	no		4		-
8.2.33		NA 9.1	no		1		-
8.2.34		NA 12.1	no		1		-
8.2.35		NA 12.2	no		1		-
		.5 <u>RAS Pump station</u> ref dwg. 1843.30.WPB.13.M001					
8.2.36		PB 1.1	no		2		-
8.2.37		PB 1.2	no		2		-
8.2.38		PB 1.3	no		2		-
Carried Forward							-

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

Item	Payment Reference	Description	Unit	CPG	Qty	Rate (R)	Amount (R)
Brought Forward							-
8.2.39		PB 2.1	no		2		-
8.2.40		PB 2.2	no		2		-
8.2.41		PB 2.3	no		2		-
8.2.42		PB 2.4	no		1		-
8.2.43		PB 3.1	no		1		-
8.2.44		PB 3.2	no		1		-
8.2.45		PB 4.1	no		2		-
8.2.46		PB 6.1	no		1		-
8.2.47		PB 7.1	no		1		-
8.2.48		PB 9.1	no		2		-
8.2.49		PB 10.1	no		2		-
		.6 <u>Dortmond & SST</u> ref dwg. 1843.30.WDA.13.M001					
8.2.50		DA 1.1	no		1		-
8.2.51		DA 2.1	no		1		-
8.2.52		DA 9.1	no		1		-
8.2.53		DB 1.1	no		3		-
8.2.54		DB 1.2	no		2		-
8.2.55		DB 1.3	no		1		-
8.2.56		DB 1.4	no		4		-
8.2.57		DB 1.5	no		2		-
8.2.58		DB 1.6	no		7		-
8.2.59		DB 1.7	no		2		-
8.2.60		DB 1.8	no		2		-
8.2.61		DB 2.1	no		1		-
8.2.62		DB 2.2	no		1		-
8.2.63		DB 2.3	no		2		-
8.2.64		DB 6.1	no		6		-
8.2.65		DB 6.2	no		11		-
8.2.66		DB 6.3	no		7		-
8.2.67		DB 6.4	no		2		-
Carried Forward							-

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

Item	Payment Reference	Description	Unit	CPG	Qty	Rate (R)	Amount (R)	
		Brought Forward					-	
8.2.68	Pipe Item Schedule	DB 9.1	no		2		-	
		<u>INSTALLATION</u>						
		(b) <u>The rate for all items to include for the handling, installation, testing, site corrosion protection, painting and building into walls</u>						
		.1 <u>Bio Reactor</u> ref dwg. 1843.30.WIA.13.M001						
8.2.69		IA 1.1	no		1		-	
8.2.70		IA 1.2	no		2		-	
8.2.71		IA 1.3	no		2		-	
8.2.72		IA 1.4	no		3		-	
8.2.73		IA 1.5	no		2		-	
8.2.74		IA 1.6	no		3		-	
8.2.75		IA 1.7	no		1		-	
8.2.76		IA 1.8	no		8		-	
8.2.77		IA 1.9	no		1		-	
8.2.78		IA 1.10	no		1		-	
8.2.79		IA 2.1	no		4		-	
8.2.80		IA 2.2	no		1		-	
8.2.81		IA 2.3	no		4		-	
8.2.82		IA 2.4	no		1		-	
8.2.83		IA 2.5	no		1		-	
8.2.84		IA 2.6	no		1		-	
8.2.85		IA 6.1	no		2		-	
8.2.86		IA 6.2	no		4		-	
8.2.87		IA 6.3	no		2		-	
8.2.88		IA 6.4	no		1		-	
8.2.89		IA 7.1	no		1		-	
8.2.90		IA 12.1	no		1		-	
8.2.91		IA 12.2	no		3		-	
8.2.92		IA 12.3	no		2		-	
8.2.93		IA 12.4	no		1		-	
			Carried Forward					-

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

Item	Payment Reference	Description	Unit	CPG	Qty	Rate (R)	Amount (R)
Brought Forward							-
		.4 Chlorine Contact Tank ref dwg. 1843.30.WNA.13.M001					
8.2.94		NA 1.1	no		1		-
8.2.95		NA 1.2	no		2		-
8.2.96		NA 1.3	no		2		-
8.2.97		NA 2.1	no		2		-
8.2.98		NA 2.2	no		1		-
8.2.99		NA 6.1	no		1		-
8.2.100		NA 6.2	no		4		-
8.2.101		NA 9.1	no		1		-
8.2.102		NA 12.1	no		1		-
8.2.103		NA 12.2	no		1		-
		.5 RAS Pump station ref dwg. 1843.30.WPB.13.M001					
8.2.104		PB 1.1	no		2		-
8.2.105		PB 1.2	no		2		-
8.2.106		PB 1.3	no		2		-
8.2.107		PB 2.1	no		2		-
8.2.108		PB 2.2	no		2		-
8.2.109		PB 2.3	no		2		-
8.2.110		PB 2.4	no		1		-
8.2.111		PB 3.1	no		1		-
8.2.112		PB 3.2	no		1		-
8.2.113		PB 4.1	no		2		-
8.2.114		PB 6.1	no		1		-
8.2.115		PB 7.1	no		1		-
8.2.116		PB 9.1	no		2		-
8.2.117		PB 10.1	no		2		-
		.6 Dortmund & SST ref dwg. 1843.30.WDA.13.M001					
8.2.118		DA 1.1	no		1		-
8.2.119		DA 2.1	no		1		-
Carried Forward							-

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

Item	Payment Reference	Description	Unit	CPG	Qty	Rate (R)	Amount (R)
Brought Forward							-
8.2.120		DA 9.1	no		1		-
8.2.121		DB 1.1	no		3		-
8.2.122		DB 1.2	no		2		-
8.2.123		DB 1.3	no		1		-
8.2.124		DB 1.4	no		4		-
8.2.125		DB 1.5	no		2		-
8.2.126		DB 1.6	no		7		-
8.2.127		DB 1.7	no		2		
8.2.128		DB 1.8	no		2		-
8.2.129		DB 2.1	no		1		-
8.2.130		DB 2.2	no		1		-
8.2.131		DB 2.3	no		2		-
8.2.132		DB 6.1	no		6		-
8.2.133		DB 6.2	no		11		-
8.2.134		DB 6.3	no		7		-
8.2.135		DB 6.4	no		2		-
8.2.136		DB 9.1	no		2		-
		BILL NO 8 PIPEWORK					
Carried forward to Summary of Bills							-
Total							-

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

Item	Payment Reference	Description	Unit	CPG	Qty	Rate (R)	Amount (R)
	PT	BILL NO 9.1					
	PSPT	PUMPING EQUIPMENT					
9.1.1	PSPT 1	DESIGN	Sum		1		-
		DESIGN, DRAWINGS AND GENERAL					
		.1 Provision of designs, drawings and technical information as specified					
		PUMPS					
		SUPPLY AND DELIVER TO SITE					
		(a) <u>The rate for all items to include for the Supply and deliver pumps complete with motors, baseplates etc. and associated pipework, fittings and valves not specified in Schedule 7</u>					
9.1.2		.1 Recycle Pumps (Existing A)	No		3		-
9.1.3		.2 RAS Recycle Pumps (New B)	No		2		-
9.1.4		.3 Sludge Pumps (Existing C)	No		1		-
9.1.5		.4 Scum Pumps (Existing D)	No		1		-
9.1.6		.5 A-Recycle Pumps (New E)	No		3		-
9.1.7		.6 WAS Pumps (Existing F)	No		1		-
9.1.8		.7 RAS Pumps (Existing G)	No		3		-
9.1.9		.8 Chlorine Booster Pumps (New H)	No		2		-
		INSTALLATION					
		(b) <u>The rate for all items to include for the handling and installation of equipment as specified</u>					
9.1.10		.1 A-Recycle Pumps (Existing A)	No		3		-
9.1.11		.2 RAS Recycle Pumps (New B)	No		2		-
9.1.12		.3 Sludge Pumps (Existing C)	No		1		-
9.1.13		.4 Scum Pumps (Existing D)	No		1		-
9.1.14		.5 Recycle Pumps (New E)	No		3		-
9.1.15		.6 WAS Pumps (Existing F)	No		1		-
9.1.16		.7 RAS Pumps (Existing G)	No		3		-
9.1.17		.8 Chlorine Booster Pumps (New H)	No		2		-
Carried Forward							-

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

Item	Payment Reference	Description	Unit	CPG	Qty	Rate (R)	Amount (R)
Brought Forward							-
<u>COMMISSIONING</u>							
(c) <u>The rate for all items to include for the commissioning of equipment as specified</u>							
9.1.18		.1 Recycle Pumps (Existing A)	No		3		-
9.1.19		.2 RAS Recycle Pumps (New B)	No		2		-
9.1.20		.3 Sludge Pumps (Existing C)	No		1		-
9.1.21		.4 Scum Pumps (Existing D)	No		1		-
9.1.22		.5 A-Recycle Pumps (New E)	No		3		-
9.1.23		.6 WAS Pumps (Existing F)	No		1		-
9.1.24		.7 RAS Pumps (Existing G)	No		2		-
9.1.25		.8 Chlorine Booster Pumps (New H)	No		2		-
<u>ANCILLARY EQUIPMENT</u>							
<u>SUPPLY AND DELIVER TO SITE</u>							
(a) <u>Ancillary equipment associated with pump installation as specified</u>							
.1 Pressure gauges as specified							
.2 Pedestals and number plates							
.3 Pump vents and drain fittings							
9.1.26		.1 Recycle Pumps (Existing A)	Sum		1		-
9.1.27		.2 RAS Recycle Pumps (New B)	Sum		1		-
9.1.28		.3 Sludge Pumps (Existing C)	Sum		1		-
9.1.29		.4 Scum Pumps (Existing D)	Sum		1		-
9.1.30		.5 A-Recycle Pumps (New E)	Sum		1		-
9.1.31		.6 WAS Pumps (Existing F)	Sum		1		-
9.1.32		.7 RAS Pumps (New G)	Sum		1		-
9.1.33		.8 Chlorine Booster Pumps (New H)	Sum		1		-
<u>INSTALLATION</u>							
(b) <u>The rate for all items to include for the handling and installation of equipment as specified</u>							
.1 Pressure gauges as specified							
.2 Pedestals and number plates							
.3 Pump vents and drain fittings							
Carried Forward							-

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

Item	Payment Reference	Description	Unit	CPG	Qty	Rate (R)	Amount (R)
Brought Forward							-
9.2.16		.1 Recycle Pumps (Existing A)	Sum		1		-
9.2.15		.2 RAS Recycle Pumps (New B)	Sum		1		-
9.2.14		.3 Sludge Pumps (Existing C)	Sum		1		-
9.2.13		.4 Scum Pumps (Existing D)	Sum		1		-
9.2.12		.5 A-Recycle Pumps (New E)	Sum		1		-
9.2.11		.6 WAS Pumps (Existing F)	Sum		1		-
9.2.10		.7 RAS Pumps (New G)	Sum		1		-
9.2.9		.8 Chlorine Booster Pumps (New H)	Sum		1		-
<u>COMMISSIONING</u>							
(c) <u>The rate for all items to include for the commissioning of equipment as specified</u>							
		.1 Pressure gauges as specified					
		.2 Pedestals and number plates					
		.3 Pump vents and drain fittings					
9.2.8		.1 Recycle Pumps (Existing A)	Sum		1		-
9.2.7		.2 RAS Recycle Pumps (New B)	Sum		1		-
9.2.6		.3 Sludge Pumps (Existing C)	Sum		1		-
9.2.5		.4 Scum Pumps (Existing D)	Sum		1		-
9.2.4		.5 ARecycle Pumps (New E)	Sum		1		-
9.2.3		.6 WAS Pumps (Existing F)	Sum		1		-
9.2.2		.7 RAS Pumps (New G)	Sum		1		-
9.2.1		.8 Chlorine Booster Pumps (New H)	Sum		1		-
	PTMa	<u>BILL NO 9.2</u>					
	PSPTMa	<u>MIXING EQUIPMENT</u>					
<u>DESIGN, DRAWINGS AND GENERAL</u>							
9.2.1		.1 Provision of designs, drawings and technical information as specified	Sum		1		-
<u>VERTICAL SHAFT STIRRERS</u>							
<u>SUPPLY AND DELIVER TO SITE</u>							
(a) <u>The rate for all items to include for the Supply and deliver equipment complete with motors, baseplates etc. as specified</u>							
9.2.2		.1 Vertical shaft stirrers	No		3		-
Carried Forward							-

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

Bill No. 9: Mechanical Equipment							
Item	Payment Reference	Description	Unit	CPG	Qty	Rate (R)	Amount (R)
Brought Forward							-
9.2.3		<u>INSTALLATION</u> (b) <u>The rate for all items to include for the handling and installation of equipment as specified</u> .1 Vertical shaft stirrers	No		3		-
		<u>COMMISSIONING</u> (c) <u>The rate for all items to include for the commissioning of equipment as specified</u> .1 Vertical shaft stirrers	No		3		-
9.2.4	PTJ PSPTJ	BILL NO 9.3 <u>AERATION EQUIPMENT</u>					
9.3.1		<u>DESIGN, DRAWINGS AND GENERAL</u> .1 Provision of designs, drawings and technical information as specified	Sum		1		-
		<u>VERTICAL SHAFT AERATORS</u>					
9.3.2		<u>SUPPLY AND DELIVER TO SITE</u> (a) <u>The rate for all items to include for the Supply and deliver equipment complete with motors, baseplates etc. as specified</u> .1 Vertical shaft aerators	No		3		-
		<u>INSTALLATION</u> (b) <u>The rate for all items to include for the handling and installation of equipment as specified</u> .1 Vertical shaft aerators	No		3		-
9.3.3		<u>COMMISSIONING</u> (c) <u>The rate for all items to include for the commissioning of equipment as specified</u> .1 Vertical shaft aerators	No		3		-
		<u>COMMISSIONING</u> (c) <u>The rate for all items to include for the commissioning of equipment as specified</u> .1 Vertical shaft aerators	No		3		-
9.3.4	PTS PSPTS	BILL NO 9.4 <u>ROTATORY BIOFILTER</u>					
9.4.1		<u>DESIGN, DRAWINGS AND GENERAL</u> .1 Provision of designs, drawings and technical information as specified	Sum		1		-
Carried Forward							

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

Item	Payment Reference	Description	Unit	CPG	Qty	Rate (R)	Amount (R)
Brought Forward							-
		BIOLOGICAL FILTER EQUIPMENT					
		<u>SUPPLY AND DELIVER TO SITE</u>					
		(a) <u>The rate for all items to include for the Supply and deliver equipment complete with motors, baseplates etc. as specified (Hot Dipped Glavanized)</u>					
9.4.2		.1 Hot Dipped galvanized rotators sewage Seamless distribution arms	Sum		1		-
9.4.3		.2 Pipe Mast with weather proof mast cap	Sum		1		-
9.4.4		.3 Distribution crown	Sum		1		-
9.4.5		.4 Rope stays and cables, and tie rods	Sum		1		-
9.4.6		.5 Flanges , Bolts and Nuts	Sum		1		-
		<u>INSTALLATION</u>					
		(b) <u>The rate for all items to include for the handling and installation of equipment as specified</u>					
9.4.7		.1 Hot Dipped galvanized rotators sewage Seamless distribution arms	Sum		1		-
9.4.8		.2 Pipe Mast with weather proof mast cap	Sum		1		-
9.4.9		.3 Distribution crown	Sum		1		-
9.4.10		.4 Rope stays and cables, and tie rods	Sum		1		-
9.4.11		.5 Flanges , Bolts and Nuts	Sum		1		-
		<u>COMMISSIONING</u>					
		(c) <u>The rate for all items to include for the commissioning of equipment as specified</u>					
9.4.12		.1 Hot Dipped galvanized rotators sewage Seamless distribution arms	Sum		1		-
9.4.13		.2 Pipe Mast with weather proof mast cap	Sum		1		-
9.4.14		.3 Distribution crown	Sum		1		-
9.4.15		.4 Rope stays and cables, and tie rods	Sum		1		-
9.4.16		.5 Flanges , Bolts and Nuts	Sum		1		-
Carried Forward							-

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

Item	Payment Reference	Description	Unit	CPG	Qty	Rate (R)	Amount (R)
Brought Forward							-
	PTD	BILL NO 9.5					
	PSPTD	DIGESTER EQUIPMENT					
	PTD 10	DIGESTER EQUIPMENT					
		DESIGN, DRAWINGS AND GENERAL					
9.5.1		.1 Provision of CFD, Analyses, designs, drawings and technical information as specified	Sum		1		-
		SUPPLY AND DELIVER TO SITE					
		(a) <u>The rate for all items to include for the Supply and deliver equipment complete with motors, baseplates etc. as specified</u>					
9.5.2		.1 Suction Pipework	No		2		-
9.5.3		.2 Delivery Pipework	No		2		-
9.5.4		.3 Pump, Mixer and Motors	No		2		-
9.5.5		.4 Nozzles, Valves and Equipment	No		2		-
9.5.6		.5 Mixer and Gas Pipework	No		2		-
9.5.7		.6 Sludge removal and Scum Pipework	No		2		-
9.5.8		.7 Spares and Tools	No		2		-
9.5.9		.8 Flame Arrester including Gass Controll Valves	No		2		-
		.9 Existing Valve - Replacement					
9.5.10		a) 100 mm Dia PN 10 - RSV	No		6		-
9.5.11		b) 150 mm Dia PN 10 - RSV	No		6		-
		INSTALLATION					
		(b) <u>The rate for all items to include for the handling and installation of equipment as specified</u>					
9.5.12		.1 Suction Pipework	No		2		-
9.5.13		.2 Delivery Pipework	No		2		-
9.5.14		.3 Pump, Mixer and Motors	No		2		-
9.5.15		.4 Nozzles, Valves and Equipment	No		2		-
9.5.16		.5 Mixer and Gas Pipework	No		2		-
9.5.17		.6 Sludge removal and Scum Pipework	No		2		-
9.5.18		.7 Spares and Tools	No		2		-
9.5.19		.8 Flame Arrester including Gass Controll Valves	No		2		-
Carried Forward							-

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

Item	Payment Reference	Description	Unit	CPG	Qty	Rate (R)	Amount (R)
Brought Forward							-
9.5.20		.9 Existing Valve - Replacement a) 100 mm Dia PN 10 - RSV	No		6		-
9.5.21		b) 150 mm Dia PN 10 - RSV	No		6		-
<u>COMMISSIONING</u>							
(c) <u>The rate for all items to include for the commissioning of equipment as specified</u>							
9.5.22		.1 Suction Pipework	No		2		-
9.5.23		.2 Delivery Pipework	No		2		-
9.5.24		.3 Pump, Mixer and Motors	No		2		-
9.5.25		.4 Nozzles, Valves and Equipment	No		2		-
9.5.26		.5 Mixer and Gas Pipework	No		2		-
9.5.27		.6 Sludge removal and Scum Pipework	No		2		-
9.5.28		.7 Spares and Tools	No		2		-
9.5.29		.8 Flame Arrester including Gass Controll Valves	No		2		-
9.5.30		.9 Existing Valve - Replacement a) 100 mm Dia PN 10 - RSV	No		6		-
9.5.31		b) 150 mm Dia PN 10 - RSV	No		6		-
	PTR PSPTR	<u>BILL NO 9.6</u> <u>SEDIMENTATION TANK EQUIPMENT</u>					
<u>DESIGN, DRAWINGS AND GENERAL</u>							
		.1 Provision of designs, drawings and technical information as specified	Sum		1		-
<u>SECONDARY SETTLING TANK NO.3</u>							
<u>SUPPLY AND DELIVER TO SITE</u>							
(a) <u>The rate for all items to include for the Supply and deliver equipment complete with motors, baseplates etc. as specified</u>							
9.6.2		.1 GRP defelctor drum	Sum		1		-
9.6.3		.2 Access bridge and walkway complete with scrapper, motor, brush gear, handrailing, and sludge associated cabling between kingpost and drive unit/emergency stop	Sum		1		-
Carried Forward							-

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

Item	Payment Reference	Description	Unit	CPG	Qty	Rate (R)	Amount (R)
		Brought Forward					-
9.6.7		<u>INSTALLATION</u>					
		(b) <u>The rate for all items to include for the handling and installation of equipment as specified</u>					
		.1 GRP defelctor drum	Sum		1		-
		.2 Access bridge and walkway complete with scrapper, motor, brush gear, handrailing, and sludge associated cabling between kingpost and drive unit/emergency stop	Sum		1		-
		<u>COMMISSIONING</u>					
		(c) <u>The rate for all items to include for the commissioning of equipment as specified</u>					
		.1 GRP defelctor drum	Sum		1		-
		.2 Access bridge and walkway complete with scrapper, motor, brush gear, handrailing, and sludge associated cabling between kingpost and drive unit/emergency stop	Sum		1		-
		<u>BILL NO 9</u>					
		<u>MECHANICAL EQUIPMENT</u>					
		Carried forward to Summary of Bills					-
		Total					-

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

Item	Payment Reference	Description	Unit	CPG	Qty	Rate (R)	Amount (R)
	SANS 1200 H	BILL NO 10 STRUCTURAL STEELWORK					
		STEELWORK MEASURED IN DETAIL					
		SHOP DRAWINGS					
		SHOP DRAWINGS AND DETAILING					
10.1	8.3.1.1	.1 Preparation of shop detail drawings and submit for approval	Sum		1		-
		SUPPLY, FABRICATE AND ERECT STEELWORK - ALL INCLUSIVE					
		HANDRAILS					
10.2	8.3.7	(a) <u>Side mounted standard ball type as peicified (1000 mm high)</u> .1 Bio-reactor	m	CPG	10		-
	8.3.7	(b) <u>Top mounted standard ball type as peicified (1000 mm high)</u>					
10.3		.1 Bio-reactor	m	CPG	110		-
10.4		.2 RAS pump station	m	CPG	11		-
10.5		.3 Chlorine contact tank	m	CPG	60		-
		LADDERS					
10.6	8.3.8	(a) <u>Ladders installed complete Dwg 1843.30.WAA.14.D002</u> .1 RAS pump station (Ladder 4m long)	no	CPG	1		-
10.7		.2 Chlorine contact tank (Ladder 2m long)	no	CPG	1		-
		FLOORING					
10.8	8.3.9	(a) <u>RS40 Open grid floors Dwg 1843.30.WAA.14.D002</u> .1 <u>Bio-reactor</u> .1 Flooring size 1930x1080mm	no	CPG	1		-
10.9		.2 Flooring size 1080x930mm	no	CPG	1		-
10.10		.3 Flooring size 2080x1080mm	no	CPG	1		-
		.4 Flooring size 1080x880mm	no	CPG	3		-
		.5 Flooring size 3880x980mm	no	CPG	1		-
10.13		.6 Flooring size 4730x930mm	no	CPG	1		-
Carried Forward							-

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

Item	Payment Reference	Description	Unit	CPG	Qty	Rate (R)	Amount (R)
Brought Forward							-
10.14		.2 <u>Chlorine contact tank</u>					
		.1 Flooring size 1580x1280mm	no	CPG	1		-
10.15		.3 <u>Existing structures</u>					
		.1 Fiberglass grating (size to be confirmed on site)	m ²	CPG	50		-
	8.3.9	(b) <u>40x40x5mm angle iron with spliced lugs cast into concrete complete</u> <u>Dwg 1843.30.WAA.14.D002</u>					
10.16		.1 Cast in angle iron	m	CPG	50		-
MISCELLANEOUS							
	8.3.1-6	(a) <u>Bio-reactor</u>					
10.17		.1 Portal Crane Frame with bracing I-beam, trolley and chain block for 500kg max. load bolted to concrete slab including paintwork. Complete Dwg 1843.30.WIA.14.D001,X001	no		1		-
10.18		.2 Stainless steel (316L) pipe support bolted to concrete wall complete. Dwg 1843.30.WIA.14.X001	no		9		-
10.19		.3 A-Recycle stainless steel (316L) weir plate with neoprene packing bolted to concrete wall, complete. Dwg 1843.30.WIA.14.X001	no		1		-
10.20		.4 Stainless steel (316L) baffle plate bolted to concrete wall, complete Dwg 1843.30.WIA.14.X001	no		1		-
	8.3.1-6	(c) <u>RAS Pump Station</u>					
10.21		.1 Portal Crane Frame with bracing I-beam, trolley and chain block for 500kg max. load bolted to concrete slab including paintwork. Complete Dwg 1843.30.WPB.15.D001	no		2		-
	8.3.1-6	(d) <u>Chlorine Contact Tank</u>					
10.22		.1 Stainless steel (316L) weir plate with neoprene packing bolted to concrete wall, complete as Dwg 1843.30.WNA.14.D001	no		1		-
	SANS 1200H	<u>CORROSION PROTECTION</u>					
	8.3.13	<u>Extra over reference 8.3.1 to 8.3.9 for corrosion protection</u>					
		<u>AT WORKSHOP</u>					
	8.3.13	.1 .1 <u>Hot dipped galvanising</u>					
Carried Forward							-

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

Item	Payment Reference	Description	Unit	CPG	Qty	Rate (R)	Amount (R)
Brought Forward							-
10.23		.1 Structural steel	ton	CPG	5		-
		<u>ON SITE AFTER ERECTION</u>					
	8.3.13	.2 .1 <u>Repair damaged primer coat and apply one coat universal undercoat to 25um DFT and one coat gloss enamel finish to 35 micron DFT</u>					
10.24		.1 General surfaces of structural steel	m²	CPG	20		-
		.2 General surfaces of structural steel					
10.25		<u>a) Hand Rails ball type</u> <u>as peicified (1000 mm high)</u>	m	CPG	500		-
10.26		b) Structural steel (100 - 250 mm wide)	m	CPG	250		-
		<u>BILL NO 10</u> <u>STRUCTURAL STEELWORK</u>					
Carried forward to Summary of Bills							-
Total							-

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

Item	Payment Reference	Description	Unit	CPG	Qty	Rate (R)	Amount (R)
	PTU PSPTU	BILL NO 11 CHEMICAL DOSING					
		DESIGN					
		DEIGN, DRAWINGS AND GENERAL					
11.1		.1 Provision of designs, drawings and technical information as specified	Sum		1		-
		SUPPLY					
	PTU 6	SUPPLY AND DELIVERY TO SITE OF CHLORINATION EQUIPMENT					
		<u>DOSING EQUIPMENT</u>					
11.2	PTU 6.1	Chlorinator complete with ejectors, multiple flow meter assemblies, rotameters, in-line strainers, control water supply piping to clear water supply connection, valves, clear solenoid valves, inline strainers, pressure gauges, heaters, by-pass connection, vacuum regulators, and automatic change-over devices (automatic rate control devices if specified):	Sum		1		-
		<u>LOAD CELLS</u>					
11.3	PTU 6.2	Load cells for weighing 68 kg chlorine containers complete with trunnions and LCD displays.	No		2		-
11.4		68 Kg chlorine containers	No		4		-
		<u>PIPEWORK</u>					
11.5	PTU 6.3.1	Cadmium plated copper flexible connectors and seamless steel header piping to BS 1485 from the containers to the regulators including brass plug valves and suitably sized catch pots	Sum		1		-
11.6	PTU 6.3.2	The complete uPVC piping with the necessary isolating valves, bends, flanges, etc. from the ejectors to the diffuser	Sum		1		-
11.7	PTU 6.3.3	The complete uPVC piping with the necessary isolating valves, bends, flanges, pressure gauge etc. from the site water installation to the ejectors	Sum		1		-
		<u>CHLORINE DIFFUSER</u>					
11.8	PTU 6.4.1	Chlorine diffuser complete with the necessary fixing brackets, bends, flanges, etc. to complete the installation	Sum		1		-
		<u>LOW LEVEL FANS</u>					
11.9	PTU 6.5.1	Low level extractor fans with vent pipes for controlled release	No		2		-
11.10	PTU 3	Wall mounted cupboard with glass front complete with resuscitator and two gas masks	Sum		1		-
11.11	PTU 3	Chlorine detector	Sum		1		-
Carried Forward							-

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

Item	Payment Reference	Description	Unit	CPG	Qty	Rate (R)	Amount (R)
Brought Forward							-
11.12	PTU 3	Emergency repair kit for the containers	Sum		1		-
11.13	PTU 5	Emergency shut-off system	Sum		1		-
		INSTALLATION					
	PTU 6	INSTALLATION, TESTING AND COMMISSIONING OF CHLORINATION EQUIPMENT					
	PTU 6.1	Chlorinator complete with ejectors, multiple flow meter assemblies, rotameters, in-line strainers, control water supply piping to clear water supply connection, valves, clear solenoid valves, inline strainers, pressure gauges, heaters, by-pass connection, vacuum regulators, and automatic change-over devices (automatic rate control devices if specified):	Sum		1		-
11.14		<u>LOAD CELLS</u>					
	PTU 6.2	Load cells for weighing 68 kg chlorine containers complete with trunnions and LCD displays.	No		2		-
11.15							
11.16		68 Kg chlorine containers	No		4		-
		<u>PIPEWORK</u>					
	PTU 6.3.1	Cadmium plated copper flexible connectors and seamless steel header piping to BS 1485 from the containers to the regulators including brass plug valves and suitably sized catch pots	Sum		1		-
11.17							
	PTU 6.3.2	The complete uPVC piping with the necessary isolating valves, bends, flanges, etc. from the ejectors to the diffuser	Sum		1		-
11.18							
	PTU 6.3.3	The complete uPVC piping with the necessary isolating valves, bends, flanges, pressure gauge etc. from the site water installation to the ejectors	Sum		1		-
11.19							
		<u>CHLORINE DIFFUSER</u>					
	PTU 6.4.1	Chlorine diffuser complete with the necessary fixing brackets, bends, flanges, etc. to complete the installation	Sum		1		-
11.20							
		<u>LOW LEVEL FANS</u>					
11.21	PTU 6.5.1	Low level extractor fans with vent pipes for controlled release	No		1		-
	PTU 3	Wall mounted cupboard with glass front complete with resuscitator and two gas masks	Sum		1		-
11.22							
11.23	PTU 3	Chlorine detector	Sum		1		-
11.24	PTU 3	Emergency repair kit for the containers	Sum		1		-
11.25	PTU 5	Emergency shut-off system	Sum		1		-
Carried Forward							-

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

Item	Payment Reference	Description	Unit	CPG	Qty	Rate (R)	Amount (R)
Brought Forward							-
		MISCELLANEOUS					
		(a) <u>Design and build temporary diversion system and of final chlorine dosing system for final effluent treatment and construction of temporary discharge to river</u>					
11.26		.1 Tie-in to existing outlet and inlet lines	Sum	CPG	1		-
11.27		.2 Construct temporary bypass	Sum	CPG	1		-
11.28		.3 Install temporry dosing point	Sum	CPG	1		-
11.29		.4 Operate and mainatin ,for the duration of the contract.	Sum	CPG	1		-
		BILL NO 11 CHEMICAL DOSING					
Carried forward to Summary of Bills							-
Total							-

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

Item	Payment Reference	Description	Unit	CPG	Qty	Rate (R)	Amount (R)
E1.1	ERMU	BILL NO. E1					
		RING MAIN UNITS					
	ERMU 3.1	DESIGN, DRAWINGS AND GENERAL					
	ERMU 3.1 (a)	Provide design drawings and design information for ring main units (refer to project specification PSERMU)	Sum		-		
	ERMU 3.1 (b)	Provide operating all maintenance manuals and "as-built" drawings as specified (refer to project specification PSERMU)	Sum		-		
	ERMU 3.1 (c)	Protection short circuit analysis and coordination study and protection setting calculations for protection relays (refer to project specification PSERMU)	Sum		-		
	ERMU 3.2	SUPPLY AND DELIVERY TO SITE					
	ERMU 3.2 (a)	Supply and delivery to site of ring main units complete as specified (refer to project specification PSERMU)	Sum		-		
	ERMU 3.2 (b)	Supply and delivery to site of all additional assosries (refer to project specification PSERMU)	Sum		-		
	ERMU 3.3	INSTALLATION					
	ERMU 3.3 (a)	Site installation of ring main units complete as specified (refer to project specification PSERMU)	Sum		-		
	ERMU 3.3 (b)	Site installation of all additional assosries as specified (refer to project specification PSERMU)	Sum		-		
	ERMU 3.3 (d)	Programming of protection settings (refer to project specification PSERMU)	Sum		-		
	ERMU 3.4	COMMISSIONING					
	ERMU 3.4 (a)	Commissioning of all complete ring main units on site inclusive of charger and battery unit (refer to project specification PSERMU)	Sum		-		
		BILL NO. E1					
		RING MAIN UNITS					
Carried forward to Summary of Bills						Total	

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

Item	Payment Reference	Description	Unit	CPG	Qty	Rate (R)	Amount (R)
E2.1	EMSS	BILL NO. E2					
		MINIATURE SUBSTATIONS					
	EMSS 15.1	DESIGN, DRAWINGS AND GENERAL					
	EMSS 15.1 (a)	Provide design drawings and design information for miniature substation (refer to particular specifications EMVS)	Sum		-		
	EMSS 15.1 (b)	Provide operating all maintenance manuals and "as-built" drawings as specified (refer to particular specification EMVS)	Sum		-		
	EMSS 15.1 (c)	Protection short circuit analysis and coordination study and protection setting calculations for protection relays (refer to particular specification EMVS)	Sum		-		
	EMSS 15.2	SUPPLY AND DELIVERY TO SITE					
	EMSS 15.2 (a)	Supply and delivery to site of miniature substations complete with concrete plinth (refer to project specification PSEMSS)	Sum		-		
	EMSS 15.3	INSTALLATION					
	EMSS 15.3 (a)	Site installation of miniature substation complete with concrete plinth and floor screed (refer to particular specification EMSS)	Sum		-		
	EMSS 15.3 (b)	Installation of protection settings (refer to particular specification EMVS)	Sum		-		
E2.4	EMSS 15.4	COMMISSIONING					
	EMSS 15.4 (a)	Commissioning of miniature substation (refer to particular specification EMSS)	Sum		-		
E2.4.2	EMSS 15.4 (b)	Commissioning of protection settings (refer to particular specification EMVS)	Sum		-		
		BILL NO. E2					
		MINIATURE SUBSTATIONS					
Carried forward to Summary of Bills							Total

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

Contract: 1843-30-00

Part C2: Pricing Data

Section C2.2: Bill of Quantities

Bill No. E3: Motor Control Centres and Distribution Boards

Item	Payment Reference	Description	Unit	CPG	Qty	Rate (R)	Amount (R)
	EMCC	BILL NO. E3					
		MOTOR CONTROL CENTERS AND DISTRIBUTION BOARDS					
E3.1	EMCC 21.1	DESIGN, DRAWINGS AND GENERAL					
E3.1.1	EMCC 21.1 (a)	Provide motor control center design drawings and wiring diagrams (refer to particular specifications EMCC)	Sum		1		-
E3.1.2	EMCC 21.1 (b)	Provide operating all maintenance manuals and "as-built" drawings as specified (refer to particular specification EMCC)	Sum		1		-
E3.2	EMCC 21.2	SUPPLY AND DELIVERY TO SITE					
E3.2.1	EMCC 21.2 (a)	Supply and delivery to site complete MCC refer to project specification PSEMCC-6.A)	Each		1		-
E3.2.2	EMCC 21.2 (a)	Supply and delivery to site complete MCC (refer to project specification PSEMCC-6.B)	Each		1		-
E3.2.3	EMCC 21.2 (a)	Supply and delivery to site complete MCC (refer to project specification PSEMCC-6.C)	Each		1		-
E3.2.4	EMCC 21.2 (a)	Supply and delivery to site complete MCC (refer to project specification PSEMCC-6.D)	Each		1		-
E3.3	EMCC 21.3	INSTALLATION					
E3.3.1	EMCC 21.3 (a)	Supply and delivery to site complete MCC refer to project specification PSEMCC-6.A)	Each		1		-
E3.3.2	EMCC 21.3 (a)	Supply and delivery to site complete MCC (refer to project specification PSEMCC-6.B)	Each		1		-
E3.3.3	EMCC 21.3 (a)	Supply and delivery to site complete MCC (refer to project specification PSEMCC-6.C)	Each		1		-
E3.3.4	EMCC 21.3 (a)	Supply and delivery to site complete MCC (refer to project specification PSEMCC-6.D)	Each		1		-
E3.4	EMCC 21.4	COMMISSIONING					
E3.4.1	EMCC 21.4 (a)	Supply and delivery to site complete MCC refer to project specification PSEMCC-6.A)	Each		1		-
E3.4.2	EMCC 21.4 (a)	Supply and delivery to site complete MCC (refer to project specification PSEMCC-6.B)	Each		1		-
E3.4.3	EMCC 21.4 (a)	Supply and delivery to site complete MCC (refer to project specification PSEMCC-6.C)	Each		1		-
E3.4.4	EMCC 21.4 (a)	Supply and delivery to site complete MCC (refer to project specification PSEMCC-6.D)	Each		1		-
		BILL NO. E3					
		MOTOR CONTROL CENTRE & DISTRIBUTION BOARDS					
		Carried forward to Summary of Bills				Total	-

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

Item	Payment Reference	Description	Unit	CPG	Qty	Rate (R)	Amount (R)
E4.1							
	EPLC	BILL NO. E4					
		PROGRAMMABLE & LOGIC CONTROLLERS					
		DESIGN, DRAWINGS AND GENERAL					
	EPLC 26.1						
	EPLC 26.1 (a)	The Contractor will provide the following design calculations, Drawings and wiring diagrams for approval by the Engineer:					
		a) Fibre loss design calculations in excel format which will include but limited to From, To, Distance losses and Tag numbers and total losses through the fibre network [fibre losses]					
		b) Electrical Load lists in excel format of all PLC equipment					
		c) Engineer design drawings of network layout which contains all IP addresses, equipment and drawings					
		d) Report which will include antennae radio paths, drawings which have line of sight of all locations in AutoCad Format, Connection speeds with the radio or wireless communication, details of all Radio & Wireless Radio losses					
		e) Input and Output schedules in excel format which contains all tag numbers, names, commands, and description of all I/O					
		f) Loop diagrams in AutoCAD format					
		g) Cable schedules in excel format which will include but limited to From, To, Distance and Tag numbers					
		h) AutoCAD drawing of all equipment positions, equipment layouts, cable layouts, rack layouts, router / modems, switches connections and layouts.					
		i) P&ID drawings of the entire system which is implemented and equipment in AutoCAD format which shall strictly accordance to ANSI/ISA-5.1 [American national Standard]					
		j) Functional design specification which will include but not limited to all mimic diagrams, control procedures compared to control philosophy and a detail description how the PLC will control the entire system [broken down into each component].					
E4.1.1		(Refer to particular specifications)	Sum		1		
E4.1.2	EPLC 26.1 (b)	Provide operating all maintenance manuals and "as-built" drawings as specified (refer to particular specification EPLC)	Sum		1		
Carried Forward							-

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

Item	Payment Reference	Description	Unit	CPG	Qty	Rate (R)	Amount (R)
Brought Forward							-
E4.2	EPLC 26.2	SUPPLY AND DELIVERY TO SITE					
E4.2.1	EPLC 26.2 (a)	Supply and delivery to site complete PLC and peripheral equipment installed in or other specified enclosures, all as specified [refer to project specification PSEPLC-6.A]	Each		1		-
E4.2.2	EPLC 26.2 (b)	Supply and delivery to site complete UPS as specified [refer to project specification PSEPLC-6.A]	Each		1		-
E4.2.3	EPLC 26.2 (c)	Supply and delivery to site complete HMI as specified [refer to project specification PSEPLC-6.A]	Each		1		-
E4.2.4	EPLC 26.2 (a)	Supply and delivery to site complete PLC and peripheral equipment installed in or other specified enclosures, all as specified [refer to project specification PSEPLC-6.B]	Each		1		-
E4.2.5	EPLC 26.2 (b)	Supply and delivery to site complete UPS as [refer to project specification PSEPLC-6.B]	Each		1		-
E4.2.6	EPLC 26.2 (c)	Supply and delivery to site complete HMI as [refer to project specification PSEPLC-6.B]	Each		1		-
E4.2.7	EPLC 26.2 (a)	Supply and delivery to site complete PLC and peripheral equipment installed in or other specified enclosures, all as specified [refer to project specification PSEPLC-6.C]	Each		1		-
E4.2.8	EPLC 26.2 (b)	Supply and delivery to site complete UPS as [refer to project specification PSEPLC-6.C]	Each		1		-
E4.2.9	EPLC 26.2 (c)	Supply and delivery to site complete HMI as [refer to project specification PSEPLC-6.C]	Each		1		-
E4.2.10	EPLC 26.2 (a)	Supply and delivery to site complete PLC and peripheral equipment installed in or other specified enclosures, all as specified [refer to project specification PSEPLC-6.D]	Each		1		-
E4.2.11	EPLC 26.2 (b)	Supply and delivery to site complete UPS as [refer to project specification PSEPLC-6.D]	Each		1		-
E4.2.12	EPLC 26.2 (c)	Supply and delivery to site complete HMI as specified [refer to project specification PSEPLC-6.D]	Each		1		-
E4.2.13	EPLC 26.2 (d)	Supply and delivery to site complete cable connections and programming of SCADA, PLC's & HMI's and peripheral equipment for an complete system	Each		1		-
E4.3	EPLC 26.3	INSTALLATION					
E4.3.1	EPLC 26.3 (a)	Installation to site complete PLC and peripheral equipment installed in or other specified enclosures, all as specified [refer to project specification PSEPLC-6.A]	Each		1		-
E4.3.2	EPLC 26.3 (b)	Installation to site complete UPS as specified [refer to project specification PSEPLC-6.A]	Each		1		-
Carried Forward							-

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

Item	Payment Reference	Description	Unit	CPG	Qty	Rate (R)	Amount (R)
Brought Forward							-
E4.3.3	EPLC 26.3 (c)	Installation to site complete HMI as specified [refer to project specification PSEPLC-6.A]	Each		1		-
E4.3.4	EPLC 26.3 (a)	Installation to site complete PLC and peripheral equipment installed in or other specified enclosures, all as specified [refer to project specification PSEPLC-6.B]	Each		1		-
E4.3.5	EPLC 26.3 (b)	Installation to site complete UPS as [refer to project specification PSEPLC-6.B]	Each		1		-
E4.3.6	EPLC 26.3 (c)	Installation to site complete HMI as [refer to project specification PSEPLC-6.B]	Each		1		-
E4.3.7	EPLC 26.3 (a)	Installation to site complete PLC and peripheral equipment installed in or other specified enclosures, all as specified [refer to project specification PSEPLC-6.C]	Each		1		-
E4.3.8	EPLC 26.3 (b)	Installation to site complete UPS as [refer to project specification PSEPLC-6.C]	Each		1		-
E4.3.9	EPLC 26.3 (c)	Installation to site complete HMI as [refer to project specification PSEPLC-6.C]	Each		1		-
E4.3.10	EPLC 26.3 (a)	Installation to site complete PLC and peripheral equipment installed in or other specified enclosures, all as specified [refer to project specification PSEPLC-6.D]	Each		1		-
E4.3.12	EPLC 26.3 ©	Installation to site complete HMI as specified [refer to project specification PSEPLC-6.D]	Each		1		-
E4.3.12	EPLC 26.3 (d)	Installation to site complete cable connections and programming of SCADA, PLC's & HMI's and peripheral equipment for an complete system	Each		1		-
E4.4	EPLC 26.4	COMMISSIONING					
E4.4.1	EPLC 26.4 (a)	Commissioning of complete PLC and peripheral equipment installed in or other specified enclosures, all as specified [refer to project specification PSEPLC-6.A]	Each		1		-
E4.4.2	EPLC 26.4 (b)	Commissioning of complete UPS as specified [refer to project specification PSEPLC-6.A]	Each		1		-
E4.4.3	EPLC 26.4 (c)	Commissioning of complete HMI as specified [refer to project specification PSEPLC-6.A]	Each		1		-
E4.4.4	EPLC 26.4 (a)	Commissioning of complete PLC and peripheral equipment installed in or other specified enclosures, all as specified [refer to project specification PSEPLC-6.B]	Each		1		-
E4.4.5	EPLC 26.4 (b)	Commissioning of complete UPS as [refer to project specification PSEPLC-6.B]	Each		1		-
E4.4.6	EPLC 26.4 (c)	Commissioning of complete HMI as [refer to project specification PSEPLC-6.B]	Each		1		-
Carried Forward							-

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

Item	Payment Reference	Description	Unit	CPG	Qty	Rate (R)	Amount (R)
Brought Forward							-
E4.4.7	EPLC 26.4 (a)	Commissioning of complete PLC and peripheral equipment installed in or other specified enclosures, all as specified [refer to project specification PSEPLC-6.C]	Each		1		-
E4.4.8	EPLC 26.4 (b)	Commissioning of complete UPS as [refer to project specification PSEPLC-6.C]	Each		1		-
E4.4.9	EPLC 26.4 (c)	Commissioning of complete HMI as [refer to project specification PSEPLC-6.C]	Each		1		-
E4.4.10	EPLC 26.4 (a)	Commissioning of complete PLC and peripheral equipment installed in or other specified enclosures, all as specified [refer to project specification PSEPLC-6.D]	Each		1		-
E4.4.11	EPLC 26.4 (c)	Commissioning of complete HMI as specified [refer to project specification PSEPLC-6.D]	Each		1		-
BILL NO. E4 PROGRAMMABLE & LOGIC CONTROLLERS							
Carried forward to Summary of Bills							-
Total							-

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

Item	Payment Reference	Description	Unit	CPG	Qty	Rate (R)	Amount (R)
E5.1	ECIS	BILL NO. E5					
		CONTROL AND INSTRUMENTATION SYSTEM					
E5.1	ECIS 13.1	DESIGN, DRAWINGS AND GENERAL					
	ECIS 13.1 (a)	Provide general layout drawings and wiring diagrams of the enclosure and instrumentation for approval [Refer to particular specification]	Sum		1		
E5.1.1	ECIS 13.1 (a)	Provide general layout drawings and wiring diagrams of the enclosure and instrumentation for approval [Refer to particular specification]	Sum		1		
E5.1.2	ECIS 13.1 (b)	Provide operating and maintenance manuals, data sheets of all equipment and "as built" drawings	Sum		1		
E5.2	ECIS 13.2	SUPPLY AND DELIVERY TO SITE					
E5.2.1	ECIS 13.2 (a)	Supply and delivery to site a complete pressure transducer (refer to project specification PSECIS-2.A)	Each		22		-
E5.2.2	ECIS 13.2 (c)	Supply and delivery to site of electrical installation equipment at and in flow meter manholes (refer to project specification PSECIS-3.A)	Each		6		-
E5.2.3	ECIS 13.2 (c)	Supply and delivery to site of electrical installation equipment at and in flow meter manholes (refer to project specification PSECIS-3.B)	Each		5		-
E5.2.4	ECIS 13.2 (c)	Supply and delivery to site of electrical installation equipment at and in flow meter manholes (refer to project specification PSECIS-3.C)	Each		5		-
E5.2.5	ECIS 13.2 (b)	Supply and delivery to site a complete level transducer and controller complete with mounting bracket (refer to project specification PS ECIS-4.A)	Each		5		-
E5.2.6	ECIS 13.2 (b)	Supply and delivery to site a complete level transducer and controller complete with mounting bracket (refer to project specification PS ECIS-4.B)	Each		14		-
E5.2.7	ECIS 13.2 (b)	Supply and delivery to site a complete level transducer and controller complete with mounting bracket (refer to project specification PS ECIS-4.C)	Each		5		-
E5.2.8	ECIS 13.2 (a)	Supply and delivery to site a complete Free Chlorine Analyzer (refer to project specification PS ECIS-6)	Each		1		-
E5.2.10	ECIS 13.2 (b)	Supply and delivery to site a complete pH transducer and controller complete with mounting bracket (refer to project specification PS ECIS-7.A)	Each		2		-
E5.2.10	ECIS 13.2 (b)	Supply and delivery to site a complete turbidity transducer and controller complete with mounting bracket (refer to project specification PS ECIS-8.A)	Each		1		-
E5.2.11	ECIS 13.2 (b)	Supply and delivery to site a complete Dissolved Oxygen and controller complete with mounting bracket (refer to project specification PS ECIS-12)	Each		4		-
E5.2.12	ECIS 13.2 (b)	Supply and delivery to site a complete proximity sensor complete with mounting bracket and kiosk (refer to project specification PSECIS-15)	Each		4		-
Carried Forward							-

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

Item	Payment Reference	Description	Unit	CPG	Qty	Rate (R)	Amount (R)
Brought Forward							-
E5.3	ECIS 13.3	INSTALLATION					
E5.3.1	ECIS 13.3 (a)	Installation on site of a complete pressure transducer (refer to project specification PSECIS-2.A)	Each		22		-
E5.3.2	ECIS 13.3 (c)	Installation on site of a complete electrical installation equipment at and in flow meter manholes (refer to project specification PSECIS-3.A)	Each		6		-
E5.3.3	ECIS 13.3 (c)	Installation on site of a complete electrical installation equipment at and in flow meter manholes (refer to project specification PSECIS-3.B)	Each		5		-
E5.3.4	ECIS 13.3 (c)	Installation on site of a complete electrical installation equipment at and in flow meter manholes (refer to project specification PSECIS-3.C)	Each		5		-
E5.3.5	ECIS 13.3 (b)	Installation on site of a complete level transducer and controller complete with mounting bracket (refer to project specification PS ECIS-4.A)	Each		5		-
E5.3.6	ECIS 13.3 (b)	Installation on site of a complete level transducer and controller complete with mounting bracket (refer to project specification PS ECIS-4.B)	Each		14		-
E5.3.7	ECIS 13.3 (b)	Installation on site of a complete level transducer and controller complete with mounting bracket (refer to project specification PS ECIS-4.C)	Each		5		-
E5.3.8	ECIS 13.3 (a)	Installation on site of a complete Free Chlorine Analyzer (refer to project specification PS ECIS-6)	Each		1		-
E5.3.9	ECIS 13.3 (b)	Installation on site of a complete pH transducer and controller complete with mounting bracket (refer to project specification PS ECIS-7.A)	Each		2		-
E5.3.10	ECIS 13.3 (b)	Installation on site of a complete turbidity transducer and controller complete with mounting bracket (refer to project specification PS ECIS-8.A)	Each		1		-
E5.3.11	ECIS 13.3 (b)	Installation on site of a complete Dissolved Oxygen and controller complete with mounting bracket (refer to project specification PS ECIS-12)	Each		4		-
E5.3.12	ECIS 13.3 (b)	Installation on site a complete proximity sensor complete with mounting bracket and kiosk (refer to project specification PSECIS-15)	Each		4		-
E5.4	ECIS 13.4	COMMISSIONING					
E5.4.1	ECIS 13.4 (a)	Commissioning of a complete pressure transducer (refer to project specification PSECIS-2.A)	Each		22		-
E5.4.2	ECIS 13.4 (c)	Commissioning of a complete electrical installation equipment at and in flow meter manholes (refer to project specification PSECIS-3.A)	Each		6		-
E5.4.3	ECIS 13.4 (c)	Commissioning of a complete electrical installation equipment at and in flow meter manholes (refer to project specification PSECIS-3.B)	Each		5		-
Carried Forward							-

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

Item	Payment Reference	Description	Unit	CPG	Qty	Rate (R)	Amount (R)
Brought Forward							-
E5.4.4	ECIS 13.4 (c)	Commissioning of a complete electrical installation equipment at and in flow meter manholes (refer to project specification PSECIS-3.C)	Each		5		-
E5.4.5	ECIS 13.4 (b)	Commissioning of a complete level transducer and controller complete with mounting bracket (refer to project specification PS ECIS-4.A)	Each		5		-
E5.4.6	ECIS 13.4 (b)	Commissioning of a complete level transducer and controller complete with mounting bracket (refer to project specification PS ECIS-4.B)	Each		14		-
E5.4.7	ECIS 13.4 (b)	Commissioning of a complete level transducer and controller complete with mounting bracket (refer to project specification PS ECIS-4.C)	Each		5		-
E5.4.8	ECIS 13.4 (a)	Commissioning of a complete Free Chlorine Analyzer (refer to project specification PS ECIS-6)	Each		1		-
E5.4.9	ECIS 13.4 (b)	Commissioning of a complete pH transducer and controller complete with mounting bracket (refer to project specification PS ECIS-7.A)	Each		2		-
E5.4.10	ECIS 13.4 (b)	Commissioning of a complete turbidity transducer and controller complete with mounting bracket (refer to project specification PS ECIS-8.A)	Each		1		-
E5.4.12	ECIS 13.4 (b)	Commissioning of a complete Dissolved Oxygen and controller complete with mounting bracket (refer to project specification PS ECIS-12)	Each		4		-
E5.4.12	ECIS 13.3 (b)	Commissioning of a complete proximity sensor complete with mounting bracket and kiosk (refer to project specification PSECIS-15)	Each		4		-
		BILL NO. E5 CONTROL INSTRUMENTATION SYSTEM					
Carried forward to Summary of Bills							-
Total							-

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

Item	Payment Reference	Description	Unit	CPG	Qty	Rate (R)	Amount (R)
E6.1	EG&M	BILL NO. E6					
		GENERAL AND MISCELLANEOUS					
E6.1	EG&M 13.1	DESIGN, DRAWINGS AND GENERAL					
E6.1.1	EG&M 13.1 (a)	Provide general layouts drawings, notice drawings and wiring diagrams for approval.	Sum		1		-
E6.1.2	EG&M 13.1 (b)	Provide operating and maintenance manuals, data sheets of all equipment and "as built" drawings	Sum		1		-
E6.2	EG&M 13.2	SUPPLY AND DELIVERY TO SITE					
E6.2.1	EG&M 13.2 (a)	Supply and delivery to site of emergency stop stations [Refer to particular specification specification EG&M 10]	Each	CPG	34		-
E6.2.2	EG&M 13.2 (b)	Supply and delivery to site of emergency stop stations with built in motor cable termination box [refer to particular specification EG&M 10]	Each	CPG	6		-
E6.2.3	EG&M 13.2 (c)	Supply and delivery to site of complete fire extinguishers with outdoor bracket, enclosure and fire signage (refer to project specifications PS EG&M-9)	Each	CPG	10		-
E6.2.4	EG&M 13.2 (d)	Supply and delivery to site of complete all notices and all danger plates as may be required (refer to project specifications PS EG&M-8)	Sum	CPG	1		-
E6.3	EG&M 13.3	INSTALLATION					
E6.3.1	EG&M 13.3 (a)	Installation on site of emergency stop stations [refer to particular specification EG&M 10]	Each	CPG	34		-
E6.3.2	EG&M 13.3 (b)	Installation on site of emergency stop stations with built in motor cable termination box [refer to particular specification EG&M 10]	Each	CPG	6		-
E6.3.3	EG&M 13.3 (c)	Installation on site of fire extinguishers with outdoor bracket, enclosure and fire signage (refer to project specifications PS EG&M-9)	Each	CPG	10		-
E6.3.4	EG&M 13.3 (d)	Installation on site of all notices and all danger plates as may be required (refer to project specifications PS EG&M-8)	Sum	CPG	1		-
E6.4	EG&M 13.4	COMMISSIONING					
E6.4.1	EG&M 13.4 (a)	Commissioning of a complete of emergency stop stations [refer to particular specification EG&M 10]	Each	CPG	34		-
E6.4.3	EG&M 13.4 (b)	Commissioning of a complete of emergency stop stations with built in motor cable termination box [refer to particular specification EG&M 10]	Each	CPG	6		-
E6.4.3	EG&M 13.4 (c)	Commissioning of a complete of fire extinguishers with outdoor bracket, enclosure and fire signage (refer to project specifications PS EG&M-9)	Each	CPG	10		-
Carried Forward							

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

Item	Payment Reference	Description	Unit	CPG	Qty	Rate (R)	Amount (R)
Brought Forward							-
E6.4.4	EG&M 13.4 (d)	Commissioning of a complete of all notices and all danger plates as may be required (refer to project specifications PS EG&M-8)	Sum	CPG	1		-
		<u>BILL NO. E6</u> <u>GENERAL AND MISCELLANEOUS</u>					
Carried forward to Summary of Bills							-
Total							-

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

Item	Payment Reference	Description	Unit	CPG	Qty	Rate (R)	Amount (R)
	ESPL	BILL NO. E7 SMALL POWER AND LIGHTING INSTALLATIONS					
E7.1	ESPL 12.1	DESIGN, DRAWINGS AND GENERAL					
E7.1.1	ECIS 12.1 (a)	Provide wiring diagrams for approval [Refer to Motor Control centre and Distribution particular specification]	Sum		-		-
E7.1.2	ECIS 12.1 (b)	Provide operating and maintenance manuals, data sheets of all equipment and "as built" drawings	Sum		-		-
E7.2	ESPL 12.2	SUPPLY AND DELIVERY TO SITE					
E7.2.1	ESPL 12.2 (a)	Supply and delivery to site of a complete electrical installation (refer to project specification PSESPL-A)	Sum	CPG	-		-
E7.2.2	ESPL 12.2 (a)	Supply and delivery to site of a complete electrical installation (refer to project specification PSESPL-B)	Sum	CPG	-		-
E7.2.3	ESPL 12.2 (a)	Supply and delivery to site of a complete electrical installation (refer to project specification PSESPL-C)	Sum	CPG	-		-
E7.2.4	ESPL 12.2 (a)	Supply and delivery to site of a complete electrical installation (refer to project specification PSESPL-D)	Sum	CPG	-		-
E7.3	ESPL 12.3	INSTALLATION					
E7.3.1	ESPL 12.3 (a)	Site Installation of a complete electrical installation (refer to project specification PSESPL-A)	Sum	CPG	-		-
E7.3.2	ESPL 12.3 (a)	Site Installation of a complete electrical installation (refer to project specification PSESPL-B)	Sum	CPG	-		-
E7.3.3	ESPL 12.3 (a)	Site Installation of a complete electrical installation (refer to project specification PSESPL-C)	Sum	CPG	-		-
E7.3.4	ESPL 12.3 (a)	Site Installation of a complete electrical installation (refer to project specification PSESPL-D)	Sum	CPG	-		-
E7.4	ESPL 12.4	COMMISSIONING					
E7.4.1	ESPL 12.4 (a)	Commissioning to site of a complete electrical installation (refer to project specification PSESPL-A)	Sum	CPG	-		-
E7.4.2	ESPL 12.4 (a)	Commissioning to site of a complete electrical installation (refer to project specification PSESPL-B)	Sum	CPG	-		-
E7.4.3	ESPL 12.4 (a)	Commissioning to site of a complete electrical installation (refer to project specification PSESPL-C)	Sum	CPG	-		-
E7.4.4	ESPL 12.4 (a)	Commissioning to site of a complete electrical installation (refer to project specification PSESPL-D)	Sum	CPG	-		-
		BILL NO. E7 SMALL POWER AND LIGHTING INSTALLATIONS					
Carried forward to Summary of Bills						Total	-

Contractor

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Contract: 1843-30-00

Part C2: Pricing Data

Section C2.2: Bill of Quantities

Bill No. E8: Multicore Cables & Earth Wires

Item	Payment Reference	Description	Unit	CPG	Qty	Rate (R)	Amount (R)
E8.1	EMCA	BILL NO. E8					
		MULTICORE CABLES & EARTH WIRES					
	EMCA 18.1	DESIGN, DRAWINGS AND GENERAL					
E8.1.1	EMCA 18.1 (a)	The Contractor will provide the following design calculations, drawings, method statements, cable routes, cable schedules in excel format which will include but limited to From, To, Distance and Tag numbers all to the approval of the Engineer [Refer to particular specification EMCA 3.3.2, 8.7 & 17]	Sum		1		-
E8.1.2	EMCA 18.1 (b)	Provide operating and maintenance manuals, all data sheets (a) cables, b) joint kits, c) ladders, d) glands, conduit, fasteners and all that are used and etc] and furthermore the Contractor to supply as built" drawings	Sum		1		-
E8.2	EMCA 18.2	SUPPLY AND DELIVERY TO SITE					
E8.2.1	EMCA 18.2 (a)	Supply and delivery to site of multicore cables and earthwires and cable name tags for the following cables as per the particular:					
E8.2.1		95mm ² 3C 6.35kV/11kV XLPE PVC SWA PVC Cable	m		150		-
E8.2.2		150mm ² 4C PVC SWA PVC Cu Cable	m		770		-
E8.2.3		50mm ² 4C PVC SWA PVC Cu Cable	m		255		-
E8.2.4		35mm ² 4C PVC SWA PVC Cu Cable	m		110		-
E8.2.5		25mm ² 4C PVC SWA PVC Cu Cable	m		130		-
E8.2.6		16mm ² 4C PVC SWA PVC Cu Cable	m		580		-
E8.2.7		10mm ² 4C PVC SWA PVC Cu Cable	m		15		-
E8.2.8		6mm ² 4C PVC SWA PVC Cu Cable	m		1310		-
E8.2.9		4mm ² 4C PVC SWA PVC Cu Cable	m		255		-
E8.2.10		2.5mm ² 7C PVC SWA PVC Cu Cable	m		495		-
E8.2.11		2.5mm ² 4C PVC SWA PVC Cu Cable	m		1996		-
E8.2.12		2.5mm ² 3C PVC SWA PVC Cu Cable	m		170		-
E8.2.13		1.5mm ² 3C PVC SWA PVC Cu Cable	m		1996		-
E8.2.14		1.5mm ² 4C PVC SWA PVC Cu Cable	m		20		-
E8.2.15		95mm ² Bare Copper Conductor	m		150		-
E8.2.16		70mm ² Bare Copper Conductor	m		1150		-
E8.2.17		35mm ² Bare Copper Conductor	m		10		-
Carried Forward							-

Contractor

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Contract: 1843-30-00

Part C2: Pricing Data

Section C2.2: Bill of Quantities

Bill No. E8: Multicore Cables & Earth Wires

Item	Payment Reference	Description	Unit	CPG	Qty	Rate (R)	Amount (R)
	Brought Forward						-
E8.2.18	EMCA 18.2 (b)	25mm² Bare Copper Conductor	m		110		-
E8.2.19		16mm² Bare Copper Conductor	m		130		-
E8.2.20		10mm² Bare Copper Conductor	m		580		-
E8.2.21		6mm² Bare Copper Conductor	m		15		-
E8.2.22		4C PVC CST PVC Heavy Duty Fibre Optic Cable Singlemode	m		690		-
E8.2.23		1mm² x 1pr twisted PVC SWA PVC (individually and overall screened)	m		614		-
E8.2.24		1mm² x 2pr twisted PVC SWA PVC (individually and overall screened)	m		20		-
E8.2.25		1mm² x 4pr twisted PVC SWA PVC (individually and overall screened)	m		2385		-
E8.2.26		1mm² x 6pr twisted PVC SWA PVC (individually and overall screened)	m		20		-
E8.2.27		1mm² x 8pr twisted PVC SWA PVC (individually and overall screened)	m		20		-
E8.2.28		4pr twisted PVC, Non-Woven Tape + alu Foil (Industrial CAT6)	m		100		-
		Supply and delivery to site of all multicore cables and earthwires termination materials [equal or similar to Enviro Glands, neoprene shrouds, lugs, insulating, materials, cable ties and corrosion proof bolts, washers, spring washers, nuts, etc] to terminate the following cables as per the particular specification					
E8.2.29		95mm² 3C 6.35kV/11kV XLPE PVC SWA PVC Cable into Miniature Substation	Each		1		-
E8.2.30		95mm² 3C 6.35kV/11kV XLPE PVC SWA PVC Cable into 11kV Overhead Line [Weather proof]	Each		1		-
E8.2.31		150mm² 4C PVC SWA PVC Cu Cable	Each		22		-
E8.2.32		50mm² 4C PVC SWA PVC Cu Cable	Each		6		-
E8.2.33		35mm² 4C PVC SWA PVC Cu Cable	Each		2		-
E8.2.34		25mm² 4C PVC SWA PVC Cu Cable	Each		2		-
E8.2.35		16mm² 4C PVC SWA PVC Cu Cable	Each		20		-
E8.2.36		10mm² 4C PVC SWA PVC Cu Cable	Each		2		-
E8.2.37		6mm² 4C PVC SWA PVC Cu Cable	Each		42		-
E8.2.38		4mm² 4C PVC SWA PVC Cu Cable	Each		6		-
E8.2.39		2.5mm² 7C PVC SWA PVC Cu Cable	Each		10		-
		Carried Forward					

Contractor

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Contract: 1843-30-00

Part C2: Pricing Data

Section C2.2: Bill of Quantities

Bill No. E8: Multicore Cables & Earth Wires

Item	Payment Reference	Description	Unit	CPG	Qty	Rate (R)	Amount (R)
Brought Forward							-
E8.2.40		2.5mm² 4C PVC SWA PVC Cu Cable	Each		80		-
E8.2.41		2.5mm² 3C PVC SWA PVC Cu Cable	Each		20		-
E8.2.42		1.5mm² 3C PVC SWA PVC Cu Cable	Each		74		-
E8.2.43		1.5mm² 4C PVC SWA PVC Cu Cable	Each		6		-
E8.2.44		95mm² Bare Copper Conductor	Each		2		-
E8.2.45		70mm² Bare Copper Conductor	Each		26		-
E8.2.46		35mm² Bare Copper Conductor	Each		4		-
E8.2.47		25mm² Bare Copper Conductor	Each		2		-
E8.2.48		16mm² Bare Copper Conductor	Each		2		-
E8.2.49		10mm² Bare Copper Conductor	Each		20		-
E8.2.50		6mm² Bare Copper Conductor	Each		2		-
E8.2.51		4C PVC CST PVC Heavy Duty Fibre Optic Cable Singlemode	Each		10		-
E8.2.52		1mm² x 1pr twisted PVC SWA PVC (individually and overall screened)	Each		162		-
E8.2.53		1mm² x 2pr twisted PVC SWA PVC (individually and overall screened)	Each		4		-
E8.2.54		1mm² x 4pr twisted PVC SWA PVC (individually and overall screened)	Each		88		-
E8.2.55		1mm² x 6pr twisted PVC SWA PVC (individually and overall screened)	Each		4		-
E8.2.56		1mm² x 8pr twisted PVC SWA PVC (individually and overall screened)	Each		4		-
E8.2.57		4pr twisted PVC, Non-Woven Tape + alu Foil (Industrial CAT6)	Each		10		-
E8.2.58	EMCA 18.2 (c)	Supply and delivery to site of cable route markers	Each		20		-
E8.2.59	EMCA 18.2 (d)	Supply and delivery to site of concrete cable slabs	Each		80		-
	EMCA 18.2 (e)	Supply, delivery to site of 316 Stainless Steel heavy-duty cable ladder, trunking, welded wire mesh and accessories including all necessary supports, clamps strapping, brackets, reducer splice, hangers, threaded rods, trunking, bolts, nuts and anchor bolts etc as per the particular specification					
E8.2.60		150mm Wide cable ladder	m		60		-
E8.2.61		200mm Wide cable ladder	m		20		-
Carried Forward							-

Contractor

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Contract: 1843-30-00

Part C2: Pricing Data

Section C2.2: Bill of Quantities

Bill No. E8: Multicore Cables & Earth Wires

Item	Payment Reference	Description	Unit	CPG	Qty	Rate (R)	Amount (R)
Brought Forward							-
E8.2.62		300mm Wide cable ladder	m		50		-
E8.2.63		400mm Wide cable ladder	m		8		-
E8.2.64		500mm Wide cable ladder	m		5		-
E8.2.65		150mm Wide cable ladder flat covers	m		6		-
E8.2.66		200mm Wide cable ladder flat covers	m		2		-
E8.2.67		300mm Wide cable ladder flat covers	m		5		-
E8.2.68		400mm Wide cable ladder flat covers	m		1		-
E8.2.69		500mm Wide cable ladder flat covers	m		1		-
E8.2.70	EMCA 18.2 (g)	Supply, delivery to site of all hot dipped galvanised heavy-duty cable ladder supports, bolts, holders and etc that is required as per the particular specification	Sum		1		-
E8.2.71	EMCA 18.2 (h)	Supply and delivery to site of pump set sensor termination cubicles	Each		2		-
	EMCA 18.2 (i)	Supply and delivery to site of HPDE heavy-duty cable sleeves, joints, sealing rings, couplings, end plugs, spacer modules, bell mounth, manderel, duct brush flexibend, stainless steel draw wire long bend as per the particular specification					
E8.2.72		110mm ² HDPE Sleeves equal or similar to kabelflex	m		110		-
E8.2.73		160mm ² HDPE Sleeves equal or similar to kabelflex	m		50		-
	EMCA 18.2 (j)	Equal or similar CCG with solid cover IP68 including non sparking connectors, insulating sleeves, identification tag, mounting screws, locknuts, lockout device with lock, lid securing chain and all accessories					
E8.2.74		Box 0	Each	CPG	20		-
E8.2.75		Compression Kits (Small)	Each	CPG	80		-
E8.2.76		Compression Kits (large)	Each	CPG	80		-
E8.2.77		Blanking Plugs	Each	CPG	40		-
E8.2.78		Box 1	Each	CPG	30		-
E8.2.79		Reducing Glands [25-20]	Each	CPG	60		-
E8.2.80		Compression Kits (Small)	Each	CPG	60		-
E8.2.81		Compression Kits (large)	Each	CPG	60		-
E8.2.82		Blanking Plugs	Each	CPG	60		-
E8.2.83		Box 2	Each	CPG	6		-
E8.2.84		Reducing Glands [32-20]	Each	CPG	12		-
E8.2.85		Reducing Glands [32-25]	Each	CPG	12		-
E8.2.86		Compression Kits	Each	CPG	12		-
E8.2.87		Blanking Plugs	Each	CPG	12		-
E8.2.88		Box 3	Each	CPG	1		-
E8.2.89		Reducing Glands [40-20]	Each	CPG	2		-
E8.2.90		Reducing Glands [40-25]	Each	CPG	2		-
Carried Forward							-

Contractor

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Contract: 1843-30-00

Part C2: Pricing Data

Section C2.2: Bill of Quantities

Bill No. E8: Multicore Cables & Earth Wires

Item	Payment Reference	Description	Unit	CPG	Qty	Rate (R)	Amount (R)
Brought Forward							-
E8.2.91	EMCA 18.2 (k)	Reducing Glands [40-32]	Each	CPG	2		-
E8.2.92		Compression Kits	Each	CPG	2		-
E8.2.93		Blanking Plugs	Each	CPG	2		-
E8.2.94		Box 4	Each	CPG	2		-
E8.2.95		Reducing Glands [50-20]	Each	CPG	4		-
E8.2.96		Reducing Glands [50-25]	Each	CPG	4		-
E8.2.97		Reducing Glands [50-32]	Each	CPG	4		-
E8.2.98		Reducing Glands [50-40]	Each	CPG	8		-
E8.2.99		Compression Kits	Each	CPG	4		-
E8.2.100		Blanking Plugs	Each	CPG	4		-
E8.2.101	EMCA 18.2 (l)	Hot dipped galvanised conduit with saddles, fasteners, surface mounted against brick or concrete every 500mm and all accessories					
E8.2.101		20mm Conduit	m	CPG	55		-
E8.2.102		20mm conduit saddles	Each	CPG	110		-
E8.2.103		Solid Coupling Female Threaded Adaptor	Each	CPG	110		-
E8.2.104	EMCA 18.2 (l)	Round Conduit box plus cover	Each	CPG	50		-
E8.2.105		Supply and delivery to site of all soil for the bedding of cables during excavations including cleaning of cable routes complete as per particular specification	m³		10		-
E8.3	EMCA 18.3	INSTALLATION					
	EMCA 18.3 (a)	Installation of all multicore cables and earthwires and cable name tags for the following cables as per the particular:					
E8.3.1		95mm² 3C 6.35kV/11kV XLPE PVC SWA PVC Cable	m		150		-
E8.3.2		150mm² 4C PVC SWA PVC Cu Cable	m		770		-
E8.3.3		50mm² 4C PVC SWA PVC Cu Cable	m		255		-
E8.3.4		35mm² 4C PVC SWA PVC Cu Cable	m		110		-
E8.3.5		25mm² 4C PVC SWA PVC Cu Cable	m		130		-
E8.3.6		16mm² 4C PVC SWA PVC Cu Cable	m		580		-
E8.3.7		10mm² 4C PVC SWA PVC Cu Cable	m		15		-
E8.3.8		6mm² 4C PVC SWA PVC Cu Cable	m		1310		-
E8.3.9		4mm² 4C PVC SWA PVC Cu Cable	m		255		-
E8.3.10		2.5mm² 7C PVC SWA PVC Cu Cable	m		495		-
E8.3.11		2.5mm² 4C PVC SWA PVC Cu Cable	m		1996		-
E8.3.12		2.5mm² 3C PVC SWA PVC Cu Cable	m		170		-
Carried Forward							-

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Contract: 1843-30-00

Part C2: Pricing Data

Section C2.2: Bill of Quantities

Bill No. E8: Multicore Cables & Earth Wires

Item	Payment Reference	Description	Unit	CPG	Qty	Rate (R)	Amount (R)
	Brought Forward						-
E8.3.13	EMCA 18.3 (b)	1.5mm² 3C PVC SWA PVC Cu Cable	m		1996		-
E8.3.14		1.5mm² 4C PVC SWA PVC Cu Cable	m		20		-
E8.3.15		95mm² Bare Copper Conductor	m		150		-
E8.3.16		70mm² Bare Copper Conductor	m		1150		-
E8.3.17		35mm² Bare Copper Conductor	m		10		-
E8.3.18		25mm² Bare Copper Conductor	m		110		-
E8.3.19		16mm² Bare Copper Conductor	m		130		-
E8.3.20		10mm² Bare Copper Conductor	m		580		-
E8.3.21		6mm² Bare Copper Conductor	m		15		-
E8.3.22		4C PVC CST PVC Heavy Duty Fibre Optic Cable Singlemode	m		690		-
E8.3.23		1mm² x 1pr twisted PVC SWA PVC (individually and overall screened)	m		614		-
E8.3.24		1mm² x 2pr twisted PVC SWA PVC (individually and overall screened)	m		20		-
E8.3.25		1mm² x 4pr twisted PVC SWA PVC (individually and overall screened)	m		2385		-
E8.3.26		1mm² x 6pr twisted PVC SWA PVC (individually and overall screened)	m		20		-
E8.3.27		1mm² x 8pr twisted PVC SWA PVC (individually and overall screened)	m		20		-
E8.3.28		4pr twisted PVC, Non-Woven Tape + alu Foil (Industrial CAT6)	m		100		-
		Installation of all multicore cables and earthwires termination materials [equal or similar to Enviro Glands, neoprene shrouds, lugs, insulating, materials, cable ties and corrosion proof bolts, washers, spring washers, nuts, etc] to terminate the following cables as per the particular specification					
E8.3.29		95mm² 3C 6.35kV/11kV XLPE PVC SWA PVC Cable into Miniature Substation	Each		1		-
E8.3.30		95mm² 3C 6.35kV/11kV XLPE PVC SWA PVC Cable into 11kV Overhead Line [Weather proof]	Each		1		-
E8.3.31		150mm² 4C PVC SWA PVC Cu Cable	Each		22		-
E8.3.32		50mm² 4C PVC SWA PVC Cu Cable	Each		6		-
E8.3.33		35mm² 4C PVC SWA PVC Cu Cable	Each		2		-
E8.3.34		25mm² 4C PVC SWA PVC Cu Cable	Each		2		-
		Carried Forward					

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Contract: 1843-30-00

Part C2: Pricing Data

Section C2.2: Bill of Quantities

Bill No. E8: Multicore Cables & Earth Wires

Item	Payment Reference	Description	Unit	CPG	Qty	Rate (R)	Amount (R)
Brought Forward							-
E8.3.35		16mm ² 4C PVC SWA PVC Cu Cable	Each		20		-
E8.3.36		10mm ² 4C PVC SWA PVC Cu Cable	Each		2		-
E8.3.37		6mm ² 4C PVC SWA PVC Cu Cable	Each		42		-
E8.3.38		4mm ² 4C PVC SWA PVC Cu Cable	Each		6		-
E8.3.39		2.5mm ² 7C PVC SWA PVC Cu Cable	Each		10		-
E8.3.40		2.5mm ² 4C PVC SWA PVC Cu Cable	Each		80		-
E8.3.41		2.5mm ² 3C PVC SWA PVC Cu Cable	Each		20		-
E8.3.42		1.5mm ² 3C PVC SWA PVC Cu Cable	Each		74		-
E8.3.43		1.5mm ² 4C PVC SWA PVC Cu Cable	Each		6		-
E8.3.44		95mm ² Bare Copper Conductor	Each		2		-
E8.3.45		70mm ² Bare Copper Conductor	Each		26		-
E8.3.46		35mm ² Bare Copper Conductor	Each		4		-
E8.3.47		25mm ² Bare Copper Conductor	Each		2		-
E8.3.48		16mm ² Bare Copper Conductor	Each		2		-
E8.3.49		10mm ² Bare Copper Conductor	Each		20		-
E8.3.50		6mm ² Bare Copper Conductor	Each		2		-
E8.3.51		4C PVC CST PVC Heavy Duty Fibre Optic Cable Singlmode	Each		10		-
E8.3.52		1mm ² x 1pr twisted PVC SWA PVC (individually and overall screened)	Each		162		-
E8.3.53		1mm ² x 2pr twisted PVC SWA PVC (individually and overall screened)	Each		4		-
E8.3.54		1mm ² x 4pr twisted PVC SWA PVC (individually and overall screened)	Each		88		-
E8.3.55		1mm ² x 6pr twisted PVC SWA PVC (individually and overall screened)	Each		4		-
E8.3.56		1mm ² x 8pr twisted PVC SWA PVC (individually and overall screened)	Each		4		-
E8.3.57		4pr twisted PVC, Non-Woven Tape + alu Foil (Industrial CAT6)	Each		10		-
E8.3.58	EMCA 18.3 (c)	Installation of all cable route markers	Each		20		-
E8.3.59	EMCA 18.3 (d)	Installation of all concrete cable slabs	Each		80		-
Carried Forward							-

Contractor

Witness 1

Witness 2

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Witness 1

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Contract: 1843-30-00

Part C2: Pricing Data

Section C2.2: Bill of Quantities

Bill No. E8: Multicore Cables & Earth Wires

Item	Payment Reference	Description	Unit	CPG	Qty	Rate (R)	Amount (R)
Brought Forward							-
	EMCA 18.3 (e)	Installation of all hot dipped galvanised heavy-duty cable ladder, trunking, welded wire mesh and accessories including all necessary supports, clamps strapping, brackets, reducer splice, hangers, threaded rods, trunking, bolts, nuts and anchor bolts etc as per the particular specification					
E8.3.60		150mm Wide cable ladder	m		60		-
E8.3.61		200mm Wide cable ladder	m		20		-
E8.3.62		300mm Wide cable ladder	m		50		-
E8.3.63		400mm Wide cable ladder	m		8		-
E8.3.64		500mm Wide cable ladder	m		5		-
E8.3.65		150mm Wide cable ladder flat covers	m		6		-
E8.3.66		200mm Wide cable ladder flat covers	m		2		-
E8.3.67		300mm Wide cable ladder flat covers	m		5		-
E8.3.68		400mm Wide cable ladder flat covers	m		1		-
E8.3.69		500mm Wide cable ladder flat covers	m		1		-
	EMCA 18.3 (g)	Installation of all hot dipped galvanised heavy-duty cable ladder supports, bolts, holders and etc that is required as per the particular specification					
E8.3.70			Sum		1		
	EMCA 18.3 (h)	Installation of all pump set sensor termination cubicles					
E8.3.71			Each		2		-
	EMCA 18.3 (i)	Installation of all HPDE heavy-duty cable sleeves, joints, sealing rings, couplings, end plugs, spacer modules, bell mounth, manderel, duct brush flexibend, stainless steel draw wire long bend as per the particular specification					
E8.3.72		110mm ² HDPE Sleeves equal or similar to kabelflex	m		110		-
E8.3.73		160mm ² HDPE Sleeves equal or similar to kabelflex	m		50		-
	EMCA 18.3 (j)	Installation of all Equal or similar CCG with solid cover IP68 including non sparking connectors, insulating sleeves, identification tag, mounting screws, locknuts, lockout device with lock, lid securing chain and all accessories					
E8.3.74		Box 0	Each	CPG	20		-
E8.3.75		Compression Kits (Small)	Each	CPG	80		-
E8.3.76		Compression Kits (large)	Each	CPG	80		-
E8.3.77		Blanking Plugs	Each	CPG	40		-
E8.3.78		Box 1	Each	CPG	30		-
E8.3.79		Reducing Glands [25-20]	Each	CPG	60		-
E8.3.80		Compression Kits (Small)	Each	CPG	60		-
Carried Forward							-

Contractor

Witness 1

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Part C2: Pricing Data

Section C2.2: Bill of Quantities

Bill No. E8: Multicore Cables & Earth Wires

Item	Payment Reference	Description	Unit	CPG	Qty	Rate (R)	Amount (R)
Brought Forward							-
E8.3.81		Compression Kits (large)	Each	CPG	60		-
E8.3.82		Blanking Plugs	Each	CPG	60		-
E8.3.83		Box 2	Each	CPG	6		-
E8.3.84		Reducing Glands [32-20]	Each	CPG	12		-
E8.3.85		Reducing Glands [32-25]	Each	CPG	12		-
E8.3.86		Compression Kits	Each	CPG	12		-
E8.3.87		Blanking Plugs	Each	CPG	12		-
E8.3.88		Box 3	Each	CPG	1		-
E8.3.89		Reducing Glands [40-20]	Each	CPG	2		-
E8.3.90		Reducing Glands [40-25]	Each	CPG	2		-
E8.3.91		Reducing Glands [40-32]	Each	CPG	2		-
E8.3.92		Compression Kits	Each	CPG	2		-
E8.3.93		Blanking Plugs	Each	CPG	2		-
E8.3.94		Box 4	Each	CPG	2		-
E8.3.95		Reducing Glands [50-20]	Each	CPG	4		-
E8.3.96		Reducing Glands [50-25]	Each	CPG	4		-
E8.3.97		Reducing Glands [50-32]	Each	CPG	4		-
E8.3.98		Reducing Glands [50-40]	Each	CPG	8		-
E8.3.99		Compression Kits	Each	CPG	4		-
E8.3.100		Blanking Plugs	Each	CPG	4		-
	EMCA 18.3 (k)	Installation of all hot dipped galvanised with saddles, fasteners,surface mounted against brick or concrete every 500mm and all accessories					
E8.3.101		20mm Conduit	m	CPG	55		
E8.3.102		20mm conduit saddles	Each	CPG	110		-
E8.3.103		Solid Coupling Female Threaded Adaptor	Each	CPG	110		-
E8.3.104		Round Conduit box plus cover	Each	CPG	50		-
	EMCA 18.3 (l)	Installation of all soil for the bedding of cables during excavations including cleaning of cable routes complete as per particular specification					
E8.3.105			m³	CPG	10		-
	EMCA 18.3 (m)	Excavating, back filling, consolidation, importation of soil and dumping of all rock and stone removed during excavations including cleaning of cable routes all according to particular specifications (including hand excavations where necessary along existing cable routes)					
E8.3.106		a) Pickable soil	m³	CPG	350		-
E8.3.107		b) Soft rock	m³	CPG	5		-
E8.3.108		c) Hard rock	m³	CPG	5		-
		Dumping and removing of all rock and stone removed during excavations including cleaning of cable routes complete as per particular specification. Dumping will at a registered dumping site within the border of Municipal Area. Contractor to allow dumping within a vicinity of 30km the site Contractor to allow all labour, truck hire and dumping site payments					
E8.3.109			m³	CPG	10		
Carried Forward							

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

Contract: 1843-30-00

Part C2: Pricing Data

Section C2.2: Bill of Quantities

Bill No. E8: Multicore Cables & Earth Wires

Item	Payment Reference	Description	Unit	CPG	Qty	Rate (R)	Amount (R)
Brought Forward							-
E8.3.110		Sifting soil through a 4mm mesh size for the bedding of cables and the backfilling of trenches complete as per particular specification.	m³	CPG	350		-
E8.3.111		Nett amount for core drilling 100mm diameter holes through 250mm concrete	Each		10		-
E8.4	EMCA 18.4	COMMISSIONING					
E8.4.1	EMCA 18.4 (a)	Testing and commissioning of all cables as above mentioned	Sum		1		-
E8.4.2	EMCA 18.4 (b)	Updating, verifying and submission of Electronic Cable schedules with Tag numbers and final agreed lengths	Sum		1		-
E8.4.3	EMCA 18.4 (c)	Surveyor to mark-up as-built cable route plans and all mark-up must be on made on the AutoCAD format	Sum		1		-
BILL NO. E8 MULTICORE CABLES & EARTH WIRES							
Carried forward to Summary of Bills							-
Total							-

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

Item	Payment Reference	Description	Unit	CPG	Qty	Rate (R)	Amount (R)
E9.1	ESLS	BILL NO. E9 SITE LIGHTING					
	GEN	DESIGN, DRAWINGS AND GENERAL					
	PSGEN B	Provide all design drawings and wiring diagrams	Sum		1		-
	PSGEN B	Provide operating all maintenance manuals and "as-built" drawings	Sum		1		-
	ESLS 5.1	SUPPLY AND DELIVERY TO SITE					
	ESLS 5.1 (a)	Supply and delivery to site of complete mast (refer to project specification PSESLS-2)	No.		6		-
	ESLS 5.2	INSTALLATION					
	ESLS 5.2 (a)	Installation of complete mast (refer to project specification PSESLS-2)	No.		6		-
	ESLS 5.3	COMMISSIONING					
	ESLS 5.3 (a)	Commissioning of complete mast (refer to project specification PSESLS-2)	No.		6		-
		BILL NO. E9 SITE LIGHTING					
Carried forward to Summary of Bills							-

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

Item	Payment Reference	Description	Unit	CPG	Qty	Rate (R)	Amount (R)
E10.1	ESGS	BILL NO.E10					
		STANDBY GENERATOR SYSTEM					
E10.1	ESGS 17	DESIGN, DRAWINGS AND GENERAL					
E10.1.1	PSGEN B	Provide general layout drawings and wiring diagrams for approval [Refer to particular specification]	Sum		-		
E10.1.2	PSGEN B	Provide operating and maintenance manuals, data sheets of all equipment and "as built" drawings	Sum		-		
E10.2	ESGS 17.1	SUPPLY AND DELIVERY TO SITE					
E10.2.1	ESGS 17.1 (a)	Supply and delivery to site of complete Standby generator set as specified with suitable alternator (refer to project specification PSESGS)	Sum		-		
E10.2.2	ESGS 17.1 (b)	Supply and delivery to site of complete automatic mains failure Start-up system as specified (refer to project specification PSESGS)	Sum		-		
E10.2.3	ESGS 17.1 (c)	Supply and delivery to site of complete automatic change over system as specified (refer to project specification PSESGS)	Sum		-		
E10.2.4	ESGS 17.1 (d)	Supply and delivery to site of complete container enclosure as specified (refer to project specification PSESGS)	Sum		-		
E10.2.5	ESGS 17.1 (e)	Supply and delivery to site of complete fuel tank complete with mounting frame (refer to project specification PSESGS)	Sum		-		
E10.3	ESGS 17.2	INSTALLATION					
E10.3.1	ESGS 17.2 (a)	Installation of complete Standby generator set as specified suitable alternator (refer to project specification PSESGS)	Sum		-		
E10.3.2	ESGS 17.2 (b)	Installation of complete automatic mains failure Start-up system as specified (refer to project specification PSESGS)	Sum		-		
E10.3.3	ESGS 17.2 (c)	Installation of complete automatic change over system as specified (refer to project specification PSESGS)	Sum		-		
E10.3.4	ESGS 17.2 (d)	Installation of complete container enclosure as specified (refer to project specification PSESGS)	Sum		-		
E10.3.5	ESGS 17.2 (e)	Installation of complete fuel tank complete with mounting frame (refer to project specification PSESGS)	Sum		-		
Carried Forward							-

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

Item	Payment Reference	Description	Unit	CPG	Qty	Rate (R)	Amount (R)
Brought Forward							-
E10.4	ESGS 17.3	COMMISSIONING					
E10.4.1	ESGS 17.3 (a)	Commissioning of complete Standby generator set as specified with suitable alternator (refer to project specification PSESGS)	Sum		-		
E10.4.2	ESGS 17.3 (b)	Commissioning of complete automatic mains failure Start-up system as specified (refer to project specification PSESGS)	Sum		-		
E10.4.3	ESGS 17.3 (c)	Commissioning of complete automatic change over system as specified (refer to project specification PSESGS)	Sum		-		
E10.4.4	ESGS 17.3 (d)	Commissioning of complete container enclosure as specified (refer to project specification PSESGS)	Sum		-		
E10.4.5	ESGS 17.3 (e)	Commissioning of complete fuel tank complete with mounting frame (refer to project specification PSESGS)	Sum		-		
		BILL NO. E10 STANDBY GENERATOR SYSTEM					
Carried forward to Summary of Bills							Total

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

Ugu District Municipality
UPGRADING OF UMZINTO WWTW: PHASE 2
CONTRACT NUMBER 1843-30-00
UPGRADING OF UMZINTO WWTW

Summary of Bills

Bill No.	Description	Amount (R)
1	Preliminary and General	
2	Provisional Sums and Prime Cost Items	
3	Dayworks and Temporary Works	
4	Site Clearance	
5	Earthworks	
6	Concrete (Structural)	
7	Building Work	
8	Mechanical Pipework	
9	Mechanical Equipment	
10	Structural Steelwork	
11	Chemical Dosing	
E1	Ring Main Units	
E2	Miniature Substations	
E3	Motor Control Centres and Distribution Boards	
E4	Programmable & Logic Controllers	
E5	Control and Instrumentation system	
E6	General and Miscellaneous	
E7	Small Power And Lighting Installations	
E8	Multicore Cables & Earth Wires	
E9	Site Lighting	
E10	Standby Generator System	
Sub-Total		R -
Provisional sum: Allowance for Contract Price Adjustment («6%»% of Sub-Total)		R -
Sub-Total all Portions		R -
Provisional sum: Allowance for Contingencies («10%»% of Sub-Total)		R -
Total Construction Cost		R -
Value Added Tax at 15%		R -
Total Amount of Tender Carried Forward to Form of Offer and Acceptance		R -

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

Bankers Details :

Contractor's Name: _____

Name reflected on bank statement: _____

Bank: _____

Branch: _____

Account Number: _____

Cheque Account ☐ or Savings Account ☐

Signature :

By Tenderer : _____

Company Name : _____

Date : _____

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2



VOLUME 2

Contract UGU-07-1689-2025 - Umzinto Wastewater Treatment Works & Outfall Sewers Upgrade and Rehabilitation

Phase 2A - Upgrade and Extension of the Umzinto Wastewater Treatment Works From 2.5 MI to 4.0 MI

PART C3

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PART C3: SCOPE OF WORK

PORTION 1: C 3.1 - STANDARD SPECIFICATION

The applicable "Standard Specifications" shall be the document "Standard Specifications for Civil Engineering Construction, SABS 1200-1986", issued by the South African Bureau of Standards.

Note:

The Standard Specifications are not bound into the tender and contract documents but are available at the Tenderer's/Contractor's expense from the South African Bureau of Standards in Pretoria, Private Bag X191, PRETORIA, 0001.

Portion 3 and Portion 4 include variations and additions to the standardized specifications listed above. The variations are prefixed PS and take precedence over the SANS Standardized Specification.

Where the particular specifications conflict with either the variations and additions to standardised specifications or the SANS Standardised Specifications, the particular specifications shall take precedence.

Applicable SANS Standards

This document also refers to the following SANS specifications, and the Contractor is advised to obtain them from Standards South Africa (a division of SANS) in Pretoria.

SANS 10396 (2003) Implementing Preferential Construction Procurement Policies using Targeted Procurement Procedures

SANS 1921-1 (2004) Construction and Management Requirements for Works Contracts Part 1: General Engineering and Construction Works

SANS 1921-6 (2004) Construction and Management Requirements for Works Contracts Part 6: HIV/AIDS Awareness

SANS 1914: Targeted Construction Procurement

SANS 1921: Construction and Management Requirements for Works Contracts.

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

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

The Standard Specifications do not cover all the different types of work included in the Contract. The general requirements for portions of the Works not covered by the Standard Specifications are described in the Particular Specifications under section C3.4

RELEVANT ACTS, REGULATIONS AND STANDARDS

The whole of the installation shall comply, and the work shall be executed in accordance with the latest edition of the following:

- a) The Occupational Health and Safety Act, 1993 (Act no 85 of 1993) and the regulations promulgated in terms of the Act or the Factories Machinery and Building Works Act of 1941, whichever is applicable and their respective Regulations.
- b) The regulations and bylaws of the local supply authorities.
- c) The applicable regulations of the relevant telecommunications authority.
- d) The local Fire Department Regulations; and
- e) The latest revisions of the relevant SANS, DIN, BS, IEC and ISO supporting specifications referred to in the Particular Specifications.

RESPONSIBLE PERSONS AND REPRESENTATION

The Contractor shall, before establishing on-site, appoint and submit to the Engineer in writing a project organisational chart, listing the name(s) of the responsible person(s) in terms of the Occupational Health and Safety Act, 1993 (Act no 85 of 1993) and the regulations promulgated in terms of the Act within 14 days from being appointed.

The Contractor shall submit to the Employer and Engineer within 14 days of the Commencement Date a list of addresses and telephone numbers of his Representative and key personnel who may be contacted both during and outside normal working hours in connection with the Works.

The Contractor shall also refer to Sub-Clauses 4.3 and 4.4 of the Conditions of Contract.

STANDARDS

- a) All electrical equipment shall be of approved manufacture, and its construction, design, and testing shall be in accordance with the requirements of the most recent South African National Standards, British Standards or IEC publications, including all amendments issued thereto up to the date of tender. The design and installation of the equipment shall also comply with the relevant clauses of the Occupational Health and Safety Act, 1993 (Act No 85 of 1993) and the regulations promulgated in terms of this Act, as well as the Code of Practice for the Wiring of Premises, SANS 0142.
- b) For all material and equipment that are required to conform to any national or international specification or standard, the Contractor shall submit a certificate to the Engineer, issued by an accredited testing laboratory clearly stating that the material and equipment comply with the specific specification or standard.
- c) Notwithstanding reference in this specification to the South African or British Standards and the IEC or ISO recommendations, the supplier may submit for approval by the Engineer, material and designs conforming to other technically equivalent national standards and shall submit documentary proof in English of actual compliance therewith.

PART C3: SCOPE OF WORK

PORTION 2: C3.2 - PROJECT SPECIFICATIONS

PS 1 GENERAL DESCRIPTION – EMPLOYERS' OBJECTIVES

The existing Umzinto WWTW has a design capacity of approximately 1.5 – 2.0 MI/d and requires an extension in treatment capacity to accommodate future township developments in the plant's catchment area. In addition, the current plant also requires process upgrading because the existing process is unable to achieve the target effluent standards that will be applicable to the upgraded facility. The project entails extending and upgrading the existing treatment plant to a 4.0 MI/d (ADDW) treatment capacity.

To execute the necessary capacity and process upgrading, the Employer is hereby soliciting bids from suitably qualified and experienced civil, mechanical, and electrical engineering contractors for the construction of the civil works and the supply and installation of associated mechanical and electrical equipment. The employer intends to appoint a single contracting entity for the execution of the works. Civil engineering contractors will be such an entity in association with suitably qualified and experienced mechanical and electrical contractors appointed as subcontractors. The formation of joint ventures will also be acceptable, provided they adhere to the eligibility requirements.

The Engineer has designed the Permanent Works on behalf of the Employer as shown on the Drawings. Although the Engineer has selected Plant and Equipment that are deemed suitably sized and selected for the intended purposes of the Employer *for tendering purposes*, the Contractor shall be responsible for the detailed design of all propriety plant and mechanical and electrical equipment and associated systems to ensure these are appropriately selected and installed to meet the intended application and particular installation conditions on Site. Although the tender document shall be priced in terms of the scope of works described therein for tender evaluation purposes, alternatives may be proposed and included in the Contractor's bid submission.

PS2 DESCRIPTION OF SITE AND ACCESS

PS2.1 Location of the Works

The Umzinto Wastewater Treatment Works is located at **30°18'12"S & 30°41'03"E**, it situated directly west of the town. It can be accessed via the N2, R612, Court Road (refer to locality plan).

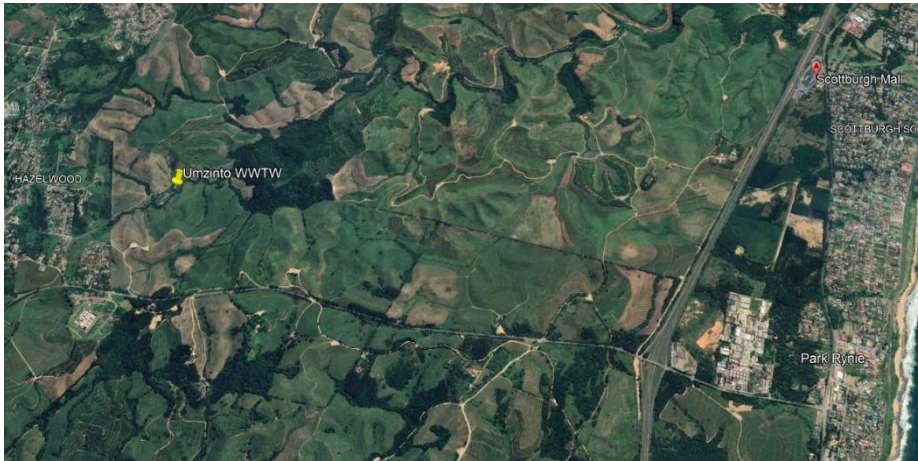


Figure 1: Umzinto WWTW

PS2.2 Overview of the Works

The existing Umzinto Wastewater Treatment Works consists of two treatment modules: a biofilter trickling module and an activated sludge treatment module. The influent pass through the inlet works, which consist of a coarse screen, de-gritting channels, and a division chamber. The flow is split proportionately between the biofilter plant and the activated sludge module to approximately 40% and 60%, respectively.

The bio filter trickling module consists out of two primary settling tanks, two bio filter trickling filters, two humus tanks and a bio filter recycling pump station. The bio filter effluent is then recycled back to the activated sludge module where it combines with a portion of the raw influent from the inlet works.

The activated sludge module consists of a primary settling tank, an aerated bioreactor, two secondary clarifiers, a RAS pump station and a chlorine contact tank. The sludge generated throughout the plant gets stabilised in two anaerobic digesters before it gets discharged to the sludge drying beds.

PS3 AMBIENT CONDITIONS AT THE SITE

The following climatic and general conditions are prevalent on the Sites and the specified capacities of all equipment provided under this Tender shall be applicable under these conditions.

Maximum ambient temperature:	30°C
Minimum ambient temperature:	13°C
24-hour maximum temperature:	28°C
Humidity:	High
Altitude (meters above mean sea level):	97

Atmosphere: Dusty

General: Lengthy periods of sunshine cause high temperatures in indoor enclosures. High breakdown of outdoor synthetic materials due to extended exposure to ultraviolet rays

Lightning: High lightning rate

PS4 NATURE OF GROUND AND SUBSOIL CONDITIONS

A copy of the geotechnical study and report for the Site has been appended under section C4 – *Site Information; Part C4.2*.

Subsoil investigations have been undertaken in the vicinity of the structures on site. Test results are included in this section of the tender documents. The Employer is not responsible for any deductions made by the tenderer/contractor from observation and interpretation of the test results.

Warning:

As recorded in the Geotech report, significant shoring and de-watering operations are required for the excavations. Tenderers are to satisfy themselves as to the nature of excavations to be encountered. In doing this, Tenderers may carry out further investigations at their own cost. Should these investigations require visiting the site and disturbing it, the Tenderers should seek approval from the Engineer to carry out such investigations.

All information regarding sub-surface conditions and materials on the Site is provided in good faith, for the Contractor's convenience, to indicate the conditions likely to be encountered.

Geotechnical Information

The following section presents the findings of the Geotechnical Investigation undertaken for the site. The full report shall be issued to the appointed Contractor at the issuance of a Notice to Proceed.

Based on the findings from the Inspection Pit, the subsoils consist of the following typical soil profiles:

0,0 – 1,3 m: Slightly moist, yellowish brown, firm, gravely CLAY with abundant fragments of weathered shale up to 50cm. River sand also mixed in profile. Fill.

1,3 – 2,5 m: Slightly moist, dark grey to black, firm to stiff, micro-shattered, silty CLAY. Alluvium.

2,5 – 2,9 m: Slightly moist, olive grey mottled orange, stiff, micro-shattered, silty CLAY. Alluvium.

2,9 – 3,1m: Grey, highly weathered, blocky, medium jointed, medium fractured, Shale. Occasional sub- rounded fragments of dolerite mixed with shale fragments. Possibility of dolerite boulder bed occurring. Ecca formation.

Fieldwork was undertaken for the site to assess the excavatability of the pipelines and the quality of the excavated material for its suitability as backfill and bedding material. The findings indicate that the material is unsuitable for both purposes. A class A bedding is proposed.

The foundations for the proposed aeration basin/Bioreactor were to be constructed below ground level and placed on the shale bedrock. Major shoring and de-watering operations are required for the excavations at all the new structures to be constructed on site. Alternatively, temporary lateral support measures such as soil nailing or trench sheeting/sheet piles may be required instead of shoring.

The Existing Trickling Filter must be removed, and soil must be removed up to the founding level of the new aeration basin/Bioreactor.

The founding conditions were assessed for a proposed aeration basin/Bioreactor. Subsequently, the position of these tanks has changed since the completion of the Geotech Report, but the same conditions and improvements are expected to be required as prescribed below.

If the shale bedrock is at a different level, soil improvement measures beneath the reinforced concrete base might be required to rationalise settlements caused by this differential movement.

Ground improvement should be carried out as detailed below:

- Subsoil materials should be removed and replaced with inert granular soil such as a G5 and compacted in 150mm layers to 95 % Mod A.A.S.H.T.O maximum dry density.
- An allowable bearing pressure of up to 150 kN/m² is feasible for foundation design based on the above-ground improvement measures. While every effort has been made during the fieldwork phase of this investigation to identify the various soil and rock horizons, their problems and their distribution, it is impossible to guarantee that isolated zones of varying material have not been missed. An existing structure must be removed before final founding can be confirmed.
- Nevertheless, it is a requirement that the engineers inspect all excavations to assure themselves that conditions are not at variance with those described in the reports. Disparities in subsoil conditions should be referred to an expert. Excavations below the new structure's founding level should only be done with formal approval from the Engineer.

Due to the existing site conditions and the nature of the ground and subsoil, no claims for additional payment or an extension of time will be considered. Any further trial pits, boreholes or sub-surface investigations of the area to ascertain the character and nature of the ground and subsoil will be at the Tenderer's own expense

This information is made available to tenderers in good faith. It is subjected to the usual limitations and constraints associated with details of this nature. It shall not be used as a basis for any claim of whatsoever nature against the Employer or the Engineers.

PS 5 DETAILS OF THE CONTRACT

PS 5.1 SCOPE OF WORK

The existing Wastewater Treatment Works will be expanded to accommodate the ultimate plant capacity of 4.0 Ml/day.

Three pump stations forming part of this phase of the Umzinto outfall sewer are in poor condition, and urgent remedial work is required. The 3 No's pump stations are not located on site. The proposed works included in this project comprise the construction and commissioning of the following:

CIVIL WORKS

- **Associated and temporary works, including cleaning and emptying:**

Demolish Biofilter 1, the existing Chlorine Contact Tank, and minor pipelines.

Clean and empty various structures, including Primary Dortmund Tanks 1 & 2, Humus Tanks 1 & 2, Aerobic Tank, Settling Tanks 1 to 2, Chlorine Contact Tank, Digesters 1 & 2, Primary Settling Tank 1, Digester Feed Sumps, RAS Pump Station Sump and Recycle Pump Station Sump

- **New Infrastructure:**

Construction of a new Aerobic Zone for the existing Biological Reactor

Construction of a new Chlorine Contact Channel.

- **Upgrades and Modifications to existing Infrastructure:**

Modification to the inlet and outlet of the existing Primary Dortmund Tanks

Reconfiguration of the Recycle Pump Station

Modification of the existing Primary Settling Tank to function as a Gravity Thickener

- **General Facilities upgrade and refurbishment**

Upgrade and modify the Primary Dortmund Tank No.1 to discharge to the Biological Reactor.

- **Modify the following interconnecting pipework:**

Pipeline from the existing MH3 downstream of the Inlet Works to the new Inlet to the Biological Reactor

Pipeline discharging settled effluent from the outlet of Primary Dortmund Tank No.1 into the new Inlet Box of the Biological Reactor

Pressure pipeline delivering treated effluent from Module 1's Biofilter Recycle Pump Station to the new Inlet Box of the Biological Reactor

Pressure pipeline delivering sludge from the RAS Pump Station to the new Inlet Box of the Biological Reactor

Overflow pipeline from the Biofilter Return Pump Station to the inlet of the new Chlorine Contact Channel

Pipeline discharging settled effluent from existing outlet of the Secondary Settling Tank No.1 to the inlet of the new Chlorine Contact Channel

Pipeline from the outlet of the new WAS Draw-off outlet of the Aerobic Tank to the existing suction pipe of the WAS Pump Station

Pipelines from the Outlet Box of the new Aerobic Tank (BNR) to the existing inlets of Secondary Settling Tanks No.1 and No.2 as well as Humus Tank No.1 (which will be converted to Secondary Settling Tank No.3 under this Contract)

Pipeline diverting the pumped sludge from the exiting WAS Pump Station to Primary Settling Tanks No.1 (which will be modified to a Gravity Sludge Thickener under this Contract)

- **Replace media in the Sludge Drying Beds**

- **Repair the gravel access road**

- **Gabion Protection of Structures next to River and Stream**

MECHANICAL WORKS (REFURBISHMENT & MODIFICATION SCOPE)

The modification and/or refurbishment, re-installation and commissioning of mechanical equipment complete as specified:

- **Settling Tank Equipment:**

- Primary Dortmund Tank No.1 & 2
- Humus Tank No.1
- Humus Tank No.2

- **Biological Trickling Filter Equipment:**

- Biological Trickling Filter No.1 – decommission and removal of equipment
- Biological Trickling Filter No.2

- **Pumping Equipment:**
 - Recycle Pump Station - 2 off submersible pumps (E)
 - WAS Pump Station – 2 off centrifugal pumps (F)
- **Chlorine Dosing Equipment**

MECHANICAL WORKS (NEW SCOPE)

The design, supply, installation and commissioning of mechanical equipment complete as specified:

- **Settling Tank Equipment:**
 - Primary Settling Tank No.1 to be converted to Gravity Sludge Thickener
- **Biological Trickling Filter Equipment:**
 - Biological Trickling Filter No.2
- **Mixing Equipment:**
 - Biological Reactor Mixer – 2off vertical shaft mixers complete
- **Aeration Equipment:**
 - Biological Reactor Aerators – 2off vertical shaft aerator complete
- **Pumping Equipment:**
 - A-recycle Pumps at Biological Reactor– 3 off (A)
 - RAS Pumps – 4 off (B)
 - Sludge Pumps – 2 off self-priming, centrifugal pumps (C)
 - Scum Pumps – 2 off self-priming, centrifugal pumps (D)
 - Motive Water Pumps at Chlorine Contact – 2 off submersible pumps (H)
- **Anaerobic Digester Equipment:**
 - External pump mixing system complete – 2 off
- **Flow Control Equipment:**
 - Titling Weir Gate - 1off (2,8m long)
 - Wall-mounted sluice gates at Biological Reactor – 2 off (250mm diameter opening) and 1 off (355mm diameter opening)
 - Channel gates at Biological Reactor – 1 off (950mm wide)
 - Wall-mounted sluice gates at Chlorine Contact Channel – 2 off (315mm diameter opening)
 - Floor-mounted sluice gate at Chlorine Contact Channel – 1 off (500x500mm opening)

ELECTRICAL WORKS (NEW SCOPE)

- Install new MCCs for the Biological Reactor and Digesters 1 & 2.
- Implement a completely new SCADA telemetry system.
- Replace control and instrumentation components.

- Refurbish existing MCC panels, cables, controls, and instrumentation.

PROPOSED PUMPSTATION REMEDIAL WORKS AND UPGRADE

- Civile, Mechanical and Electrical Works for
 - GANDHINAGAR PUMP STATION
 - SASOL PUMP STATION
 - UMZINTO PUMP STATION

The Employer reserves the right to reduce the scope of work in line with available funding.

The Works will be executed at an operational wastewater treatment facility, and the Contractor shall implement the necessary measures to ensure the continuous operation of the existing plant. The contractor must be aware of the potential presence of hazardous materials (e.g., chemicals, pathogens) and handle them with extreme caution whilst working with raw sewage. The contractor must also follow all safety protocols and guidelines. All workers must wear appropriate PPE and adhere to all excavation safety regulations to prevent accidents and injuries.

PS 6 CONSTRUCTION PROGRAM AND PENALTIES

It is estimated that the total construction period of the infrastructure (civil and mechanical/electrical works) will be approximately 15 months from the Commencement Date, including the builder's holiday.

Alternative offers for a shorter construction period may be submitted and considered during the tender evaluation stage.

The contractor shall complete the work within the maximum time, achieving the practical completion indicated in the Appendix to the tender calculated from the commencement date. In this regard, the contractor shall note that the minimum trial and operation of four weeks will be required after successfully commissioning the works as part of the Tests on Completion.

The contractor is to allow the client a two-month float from the Commencement of the project for the application of the work permit.

Each Tenderer shall submit with his Tender a suitable and realistic preliminary construction programme (referred to as the Tender Programme) for consideration by the Engineer. This programme shall commence on the Commencement Date, shall be prepared in accordance with the maximum Time for Completion comprising the Works and shall provide interim completion dates for each milestone or element of the works, including the period for executing the Test for Completion, especially watertightness testing of water-retaining structures.

The tenderer shall allow all connections shown on the drawings between the new and existing works included in the contract and the existing water supply infrastructure in his programme. In this regard, the tenderer shall ensure that tie-ins and connections are programmed to have limited impact on the operation of existing water treatment infrastructure.

After the award of a Contract, the Contractor shall submit a detailed construction programme to the Engineer in accordance with the requirements of Sub-Clause 5.6 [Programme] of the Conditions of Contract. Except as provided above, the approval by the Engineer of the Contractor's construction programme, or of any amendment or adjustment thereto, shall not in any way alter the Contract, act as estoppel or limit the right of the Employer to demand due performance under the Contract. The approval of a construction programme by the Engineer indicates only that the Engineer will be satisfied if the work is carried out according to such programme and that the Contractor undertakes to carry out the work in accordance with the programme. However, the approval of a construction programme by

the Engineer shall not limit his right to give notice to the Contractor to submit a revised programme if the existing programme fails to comply with the Contract.

The contract completion date is indicated in the contract Data Section 1.2. The penalty for late completion is as indicated in the Contact Data. The full penalty shall be applied should the contractor fail to meet the completion date.

PS 7 SETTING OUT

The Contractor shall establish his own controls and set out the works as indicated on the drawings in sufficient detail to accurately locate all portions of the work and construct the works within the specified tolerances.

No separate payment will be made for survey, establishing and setting out and the costs of such work will be deemed to be included in the tendered rates for the appropriate works.

PS 8 SITE FACILITIES AND SERVICES AVAILABLE

PS 8.1 Source of Water Supply

The Contractor shall arrange the water supply and his workforce for construction purposes. The Contractor shall bear the cost of all water and its supply to the required site(s).

PS 8.2 Source of Power Supply

The Contractor shall be responsible for making his arrangements with the relevant authority and paying all the requisite connection and consumption charges for whatever temporary power supplies he may require for use on the sites. His tender will be held to include all such costs and charges.

PS 8.3 Location of site camp and depot

The Contractor shall provide all his office accommodation and all associated facilities on the campsite required for the adequate supervision, control, and execution of the work. The area occupied shall be neatly fenced off to denote its limit. The Contractor shall be responsible for the proper upkeep and control of the area for the duration of the contract and all structures and buildings shall be kept in good repair. The Contractor must not cut down or damage any trees or make any excavations without the Engineer's written permission. The Contractor will be required to restore the site to its original condition on completion of the works.

PS 8.4 Access to Site

The Contractor may use the existing access road to and within the Site but shall be responsible for restoring these roads as part of the rehabilitation requirements to a similar or better condition that prevailed at the Commencement Date and at his expense. If the Contractor requires additional access to and within the Site, these shall be submitted to the Engineer for approval and constructed at his own expense. The Contractor shall institute proper access control to prevent any unauthorised entry to the Work as well as to the Employer's facilities.

PS 8.5 Water supply

Potable water is available on Site, and the Contractor shall be responsible under the Contract for the supply and distribution at his Cost of all water that he may require for purposes of human consumption, construction, testing and commissioning of the Works. Accordingly, the Contractor shall pay all consumption charges and at his cost, provide and install all connections, consumption meters, pipework, storage tanks, transport and other items associated with the water supply for construction

activities. All connections to pipelines of the Employer shall be in accordance to standards approved by the Employer and the Engineer.

PS 8. Power supply

Electricity is available near the Site, but the supply assurance cannot be guaranteed. The Contractor shall be responsible for the supply and distribution at his cost of all electricity that he may require for constructing the Works. The Contractor may apply with the local authority to install an electrical connection. Accordingly, the Contractor shall pay all consumption charges and, at his own cost, provide all connections, distribution, consumption meters and the like for the construction of the Works. The electricity distribution shall be by the applicable bylaws and regulations of the local authority.

PS 8.7 Sanitation

The Contractor shall provide the necessary ablution facilities for his camp and depot. Pit latrines shall not be allowed. The Contractor shall either connect to the existing outfall sewer or install a conservancy tank, which will be removed once construction has ended.

PS 9 SITE FACILITIES REQUIRED

PS 9.1 Contractor s Site Camp

The Contractor shall provide all his office accommodation and all associated facilities on the campsite required for the adequate supervision, control, and execution of the work.

The area occupied shall be neatly fenced off to denote its limit. The Contractor shall be responsible for the proper upkeep and control of the area for the duration of the contract and all structures and buildings shall be kept in good repair. The Contractor must not cut down or damage any trees or make any excavations without the Engineer's written permission. The Contractor will be required to restore the site to its original condition on completion of the works.

PS 9.2 Laboratory Facilities

No testing laboratory is required on-site by the Engineer.

PS 9.3 Sanitary Facilities

The Contractor shall provide screened latrines as necessary for his employees at all his work sites, including for local labour, the siting of which shall be to the satisfaction of the Engineer. They shall be constructed and maintained by the Contractor to the satisfaction of the Engineer and in accordance with the requirements of Government, Provincial and/or Local Authority. All applicable fees due under any health by law or any or all of the above authorities shall be paid by the Contractor.

Chemical toilets, or flush units where possible, shall be used, and they shall be kept thoroughly clean and sanitary. Chemical toilets shall be serviced at least twice a month. All these facilities shall be provided before the commencement of construction, and the Contractor shall strictly enforce their use. The contractor shall provide a toilet facility for the engineer's sole use.

PS 9.4 Refuse Containers and Disposal

The Contractor shall provide adequate containers for collecting refuse. All containers shall have lids. Arrangements for refuse disposal shall be made with the relevant authority.

PS 9.5 Parking Facilities

These will not be required.

PS 9.6 Housing Facilities.

These will not be required or allowed.

PS 10 PROTECTION OF EXISTING SERVICES

PS 10.1 Care, Damage and Protection

The Contractor shall so carry out all his operations so as not to infringe on, interfere with, trespass on, or damage adjoining lands, buildings, properties, road structures, pipelines, places and things, in the vicinity of the Works and so as not to interfere in any way at any time with the smooth and continuous operation of the existing facilities.

PS 10.2 Location of Services

The Contractor shall take all the necessary steps to ascertain the location of existing services before commencing any section of the works and shall exercise the greatest care when working in the vicinity of such services. No more than three weeks and not less than one week before commencing his operations in any particular area, the Contractor shall obtain the latest available drawings showing the location of services already installed from the relevant authority. The contractor shall prove/ locate as far as possible know services. The contractor must provide a method statement for approval before commencing the following.

- **Associated and temporary works, including cleaning and emptying:**
 - Demolish Biofilter 2, the existing Chlorine Contact Tank, and minor pipelines.
 - Clean and empty various structures, including Primary Dortmund Tanks 1 & 2, Humus Tanks
1 & 2, Aerobic Tank, Settling Tanks 1 to 2, Chlorine Contact Tank, Digesters 1 & 2, Primary
Settling Tank 1, Sargassums, Digester Feed Sumps, and replacement of media at the Sludge
Drying Beds.
- **New Facilities:**
 - Construction of a new biological reactor. Shoring and temporary protection of existing services
 - Construction of a new chlorine contact channel. Shoring and temporary protection of existing services

The position and details of all existing services and structures known to the Engineer are shown on the Drawings or as-builts of previous construction activities that shall be issued to the Contractor upon awarding the Contract. Although the Engineer has endeavoured to indicate the position of the services and structures as accurately as possible, it will remain the Contractor's responsibility to prove the exact position of all services impacted by construction activities before commencing with such activity.

Any/all known services and structures damaged during the construction period due to construction activities shall be repaired by the Contractor as soon as possible at the Contractor's expense. In emergencies, the Employer or its mandated agent may undertake critical repairs at the cost of the Contractor should this be deemed necessary.

It must be highlighted that most construction activities will be undertaken in and around an existing water treatment facility. This Contract requires explicitly that the construction of the new infrastructure

have no or minimal impact on the plant's operation. The contractor may need to schedule certain activities during low-demand conditions.

If the Contractor deems it necessary to alter the existing services or structures, the engineer must approve such alteration before execution.

PS11 ACCOMMODATION FOR WORKERS

Workers who are not recruited locally must be provided with housing by any prevailing applicable legislation. Accommodation on-site will not be permitted.

PS12 SECURITY OF THE SITE

The Contractor shall be responsible for providing all necessary security arrangements for the site establishment and the construction site for the entire duration of the contract, and no claims for additional security costs incurred by the Contractor will be considered.

PS13 DEALING WITH WATER

The Geotechnical Report identified groundwater in the inspection pits. The Contractor shall be responsible for dealing with all water during construction from whatever source, and the cost of all dewatering, unless otherwise itemised in the Bill of Quantities, shall be deemed to be included in the tender price.

PS14 ADVERSE WEATHER CONDITIONS

Critical Path Method - Regarding GCC 2015, Clause 5.12.2.2, an extension of time will be considered for abnormal rainfall. The number of days per month on which work is expected not to be possible due to normal rainfall and for which the Contractor shall make provision in his/her tendered rates, prices and programme are listed in Table PS-23.1 below. Only the number of days lost as a result of adverse weather conditions exceeds the number of days listed in Table PS-14.1 will qualify for consideration of extension of time.

Month	The expected number of working days was lost due to normal rainfall.
January	*4
February	3
March	4
April	2
May	2
June	1
July	1
August	2
September	2
October	3
November	3

Month	The expected number of working days was lost due to normal rainfall.
December	*3
Total	30 days

Table PS-14.1: Expected number of working days lost per month due to normal rainfall

Note: Rainfall records above relate to rainfall station No 211 437 — Scottburgh.

(* The number of working days lost for December and January allows for the builders' holidays from December to the end of January.)

During the execution of the Works, the Engineer's Representative will certify a day lost due to abnormal rainfall and adverse weather conditions only:

- If no work was possible on the relevant working day on any item on the critical path according to the latest approved construction programme or
- if less than 30% of the workforce and plant on site could work during that specific working day.

Extension of time as a result of abnormal rainfall and adverse weather conditions shall be calculated monthly, being equal to the number of working days certified by the Engineer's Representative as lost due to rains and adverse weather conditions, less the number of days allowed for as in Table PS-14.1, which could result in a negative figure for specific months. The total extension of time due to abnormal climatic conditions for which the Contractor may apply shall be the cumulative algebraic sum of the monthly extensions. Should the sum thus obtained be negative, the extension of time shall be taken as nil.

The Contractor shall provide a rain gauge installation and ensure that it is tamper-proof.

Costs thereof shall be deemed to be included in tendered rates.

PS15 LOCAL LABOUR AND SUB-CONTRACTORS TEMPORARY WORKFORCE

The Contractor shall employ labour from the local communities through the Labour Desk(s). Accordingly, the workforce employed on Site shall consist of local residents, except for approved key staff in the permanent employ of the Contractor, to the maximum extent compatible with the requirements of Clause C3.3.2.

With the assistance of the Infrastructure Portfolio Committee of the UGU DM and local ward committees, a Project Steering Committee (PSC) will be established. The PSC will appoint a Community Liaison Officer (CLO) that the Contractor will employ for the duration of the Contract.

The CLO will assist the Contractor with local labour issues, including employment conditions, remuneration, performance monitoring, etc.

The PSC shall assist in identifying available local labour and, where available, semi-skilled labour as well as local subcontractors. The PSC shall also assist and advise regarding conditions of employment, minimum wages, disputes, and disciplinary procedures. The function of the PSC shall, however, in no way diminish the Contractor's responsibilities in terms of the Conditions of Contract.

A contract of employment or subcontract shall be signed between the Contractor and each of his employees and sub-contractors. Likewise, contracts of employment must be entered into between each such sub-contractor and each of the specific sub-contractor's employees. Although the

Contractor shall adhere to the minimum wage rates described below, he is at liberty to negotiate additional incentive payments based on performance.

Contracts of employment or sub-contracts should provide for the following basic conditions:

- The minimum wage payable will be determined in terms of the latest applicable (at the time of tendering) legislation. It shall, as a minimum, adhere to section 56(1) of the Basic Conditions of Employment Act (Act 75 of 1997), Sectorial Determination 2: Civil Engineering Sector as published by the Department of Labour.
 - The Contractor shall adhere to the provisions for payment method and intervals, overtime and pay for work on Sundays and public holidays (if required) in the Basic Conditions of Employment Act (Act 75 of 1997).
 - The Contractor shall register all labourers employed on the Contract with the Workmen's Compensation Commissioner and the Unemployment Insurance Fund, as applicable. The Contractor shall obtain the Unemployment Insurance Fund and Workmen's Compensation registration cards.
 - Workers shall be entitled to one (1) day sick leave with full pay per month worked. This will accumulate if the leave is not used.
 - Annual leave shall be calculated as published in terms of (the latest edition of) section 56(1) of the Basic Conditions of Employment Act (Act 75 of 1997), Sectorial Determination 2: Civil Engineering Sector as published by the Department of Labour.
- a) Upon termination of the Contract, each locally employed labourer shall be entitled to receive his/her Unemployment Insurance Fund and the Workmen's Compensation registration cards as well as a Certificate of Employment from the Contractor clearly stating the following:
- I. The type of work done.
 - II. The duration of employment.
 - III. The number of days absent from work.
 - IV. The Contractor's general impression of the quality of work done.
- b) The Occupational Health and Safety Act must be adhered to regarding the safety of all employees employed by the Contractor. The contractor shall issue and maintain suitable safety equipment and clothing for the duration of construction. Contractor's company policy regarding:
- I. Inclement weather
 - II. Sickness and absence
 - III. Disciplinary matters
 - IV. Grievances

Should any of the above conditions be less favourable than any bargaining council agreement or Act applicable to the Contractor, the more favourable condition shall apply. It is the intention that this Contract should make the maximum possible use of the local labour force.

The Contractor must note that 20% of the work shall be subcontracted to local emerging Contractors.

The main Contractor will be responsible for the quality, coordination and programming of all works undertaken by the CPG sub-contractors.

Where possible, the Contractor is also to source materials from small emerging local suppliers, provided that their quality of work and materials comply with the project specifications and are competitively priced.

The ISD Facilitator, in conjunction with the local Councillor, will assist with the identification of local contractors and local suppliers. The use of local sub-contractors and suppliers and the use of emerging and previously disadvantaged individuals and companies, in general, will be strongly favoured during tender adjudication.

Reference is also to be made to the Particular Specification PB: EPWP Labour Intensive Specification.

To ensure a smooth and efficient construction process, the contractor's senior management shall oversee the coordination of local labour and subcontractor negotiations. Weekly meetings between the contractor and subcontractors will be held to monitor progress, address any potential issues, and ensure that the construction targets are met without delays.

PS16 SITE MEETINGS

The Engineer shall arrange monthly site meetings between the engineers' Representatives, the Employer's representatives, and the Contractors, together with any other interested or affected party whom the Engineer may require to be in attendance.

The Site Agent shall be present at all meetings and fully empowered to make decisions regarding the Contract at all levels. The Site Agent shall prepare and submit reports on progress, programme, and cash flows at each site meeting.

PS17 DAILY SITE DIARY

The Main Contractor is required to keep a site diary on site to record daily site conditions, work performed on the site, and all significant events.

PS 18 GENERAL TECHNICAL REQUIREMENTS

PS 18.1 DESIGN

The Engineer has designed the Permanent Works on behalf of the Employer as shown on the Drawings. Although the Engineer has selected Plant and Equipment that are deemed suitably sized and selected for the intended purposes of the Employer *for tendering purposes*, the Contractor shall be responsible for the detailed design of all propriety plant and mechanical and electrical equipment and associated systems to ensure these are appropriately selected and installed to meet the intended application and particular installation conditions on Site.

The Contractor shall submit a detailed General Arrangement (GA) and detailed drawings of all mechanical systems and pipework, including Process and Instrumentation Diagrams (P&ID), for the Engineer's approval before manufacturing and procuring equipment.

"The contractor shall ensure that all as-built levels for the project are finalised and submitted for review and approval before the commencement of manufacturing. Regarding site and interconnecting pipework, the Engineer has provided the proposed pipework layout on the Drawings for tendering purposes. However, the Contractor shall be responsible for all final measurements on site and the correct manufacturing and installation of all pipe items and specials to suit the installation.

Any/all modifications on site shall be handled according to the relevant specifications for repairs to damaged corrosion protection. The Contractor shall also maintain suitable records of all such items so that the Engineer can complete the as-built drawings after the work.

In cases where there is a discrepancy between the civil and structural (rebar) drawings, the Contractor shall request clarification from the Engineer before proceeding with the affected work.

In cases where there is a discrepancy between the mechanical and civil drawings, the Contractor shall request clarification from the Engineer before proceeding with the affected work.

In addition, the Contractor shall submit for the Engineer's approval applicable design calculations associated with the Contractor's selection of all equipment to be supplied under this Contract, including but not limited to

- Biological Reactor and digester equipment, instrumentation, pumps, mixers, gearboxes, motors, chemical dosing equipment, blowers, compressors, Generator, Scada, MCC et cetera (mechanical and electrical equipment), and the Contractor shall take due consideration of the civil constraints, location of installation with envisaged worst-case ambient conditions, hydraulics, ergonomics and applicable health and safety requirements.

The civil portion of the works has been designed by the engineer, and details are indicated on the tender Drawings and Specifications. The civil works included under this Contract shall be constructed by the main civil contractor strictly according to the Drawings and Specifications.

With regards to this Contract, the Employer's Requirements, including the proposed size and position of the new equipment, cable routes etc. are indicated on the tender Drawings issued under Volume 3, while the technical details are described in subsequent clauses and in the Specifications (refer to Volume 1A).

Although the Engineer, on behalf of the Employer, has endeavoured to design and specify the mechanical and electrical works as accurately as possible for tender purposes, the sub-contractors shall be responsible for the final design of the mechanical and electrical equipment to be included in the Permanent Works, ensuring that all equipment offered is fit for its intended purpose.

When designing the mechanical and electrical works, the sub-contractors shall take cognisance of the following:

- a) The Works shall be designed to facilitate easy accessibility, equipment replacement, maintenance, handling, inspection, cleaning and repairs, and to ensure satisfactory operation in which safety of plant, personnel and public and continuity of service is primary considerations.
- b) All plant, equipment and apparatus shall operate satisfactorily under the ambient climatic conditions prevailing at the site specified under Section C3.1.
- c) All apparatus shall be designed to prevent the risk of accidental short circuits due to the activities of animals, birds, ants and vermin.
- d) Fire risk shall be minimised as far as possible.
- e) All moving, rubbing or wearing surfaces shall be machined or ground where they bear upon each other.
- f) All equipment shall be designed for operation on normal electrical supply systems with voltage fluctuations of $\pm 10\%$.
- g) The Works shall be designed for a life span of at least **10 years** for mechanical and electrical equipment.

PS19 DRAWINGS, DOCUMENTATION AND SAMPLES

PS19.1 Engineer's Drawings and Documentation

In order for the Engineer to prepare the as-built drawings and completion report for the Employer, the Contractor shall submit to the Engineer all as-built documents and operation and maintenance manuals in accordance with Sub-Clause 4.1(d) of the Conditions of Contract prior to commencement of the Tests on Completion.

In constructing the Works, the Contractor may use only figured dimensions; the drawings may not be scaled unless the Contractor is so instructed by the Engineer in writing. The Engineer will, upon written request, provide any dimension(s) that may have been omitted from the drawings.

Only A1-size drawings in hard-copy bearing the signature of the Engineer shall be used for construction purposes.

Where there are discrepancies between, for instance, civil and reinforcing drawings, clarification shall be requested from and issued by the Engineer in writing prior to commencing or continuing with the work in question.

The Contractor shall generally receive 2 x A1 and 1 x A3 size construction drawings. Additional copies may be made by the Contractor at his expense.

PS19.2 Contractor's Drawings and Documentation

The following requirement are applicable for portions of the works designed by the Contractor such as final pipe items and fittings, mechanical and electrical configurations and systems.

General

All drawings and documentation submitted by the Contractor shall be in English and shall comply with the requirements prescribed below.

All symbols used in electrical drawings shall be in accordance with IEC Publication 60617 unless otherwise specified in the Project Specifications and the SI system of units shall be used throughout.

All designs shall be complete, accurate and geographically correct. The designs and drawings shall be sufficiently detailed to enable construction and installation to proceed without further need for additional drawings or documentation.

All drawings and documentation submitted shall be suitably identified and labelled by means of title blocks, page numbers and revision status.

All designs and drawings shall be submitted for the Engineer's approval prior to commencement of manufacturing or construction on site. Approval by the Engineer of any design or drawing shall not relieve the Contractor of his responsibility for the accuracy or correctness of designs and drawings, or for the safety, adequacy and suitability of any part of the works manufactured or constructed in accordance with the design or drawing. Designs approved by the Engineer shall not be altered without his written agreement.

Preparation and Submission of Drawings

All drawings shall be accurately scaled in terms of generally accepted scaling factors and submitted on international A4, A3 or A1 size sheets.

Electronic submissions of drawings shall in all instances comprise *.DXF (Drawing Exchange Format) or *.DWG (AutoCad) formats accompanied by the *.PDF (Adobe Reader) format.

The Contractor may request a set of the Engineer's drawings in digital or paper format for modification and updating if necessary. These drawings shall be re-titled in accordance with the Contractor's system and shall thereafter be submitted as a Contractor's drawing.

The Contractor shall submit all drawings with reasonable promptness and in an orderly sequence as to cause no delay in the execution of any work directly or indirectly linked to the finalisation of the details contained in the drawings. The Engineer shall be given reasonable opportunity of at least 14 days to evaluate, comment on or approve the drawings. In the event that the Engineer does not respond within the said period, the Contractor shall notify the Engineer in writing of his acceptance that the drawings have been approved, and that manufacturing and/or construction will commence in accordance with the drawings.

The Contractor shall make any corrections or provide additional information if requested by the Engineer and shall re-submit the corrected or updated drawings until approved. When re-submitting drawings, the Contractor shall specifically direct the Engineer's attention (in writing) on revisions other than corrections required by the Engineer on previous submissions.

'As Built' Drawings

'As Built' drawings shall be furnished on completion, and the relevant completion certificate shall not be issued until such as built drawings have been received and approved by the Engineer.

Final and approved as built drawings shall be submitted to the Engineer in five-fold hard copy in A3 size accurately scaled. In addition, the Contractor shall also prepare one complete set of all drawings in digital format as specified above for submission to the Engineer.

PS19.3 Operation and Maintenance Manuals

Draft Operation and Maintenance (O&M) manuals must be submitted at least two weeks before commencing the Tests on Completion. Two (2) copies of the draft manuals shall be submitted in hard copy in the format described below for the Engineer's approval at least two weeks before commencing the Tests on Completion.

Once the Operating and Maintenance manuals have been approved by the Engineer, four (4) complete sets of the manuals shall be provided by the Contractor to the Engineer. The submission of these final manuals shall not be later than 4 weeks after the works have been taken over by the Employer.

The manuals shall be printed on durable paper and be neatly and securely bound in A4 size hard-backed plastic/waterproof ring binders with clear pockets on the spine and front cover for insertion of title slips giving contract number, scheme description and equipment supplied.

As built drawings in A3 size, index and other title pages shall be contained in separate pockets.

Layout and content

The manual shall contain the following:

1. Title page
2. Contents list
3. List of drawings and appendices
4. Maintenance and Lubrication Schedule (summary)
 - The maintenance schedule shall be in table format and shall include a summary of all the maintenance actions required of all the different systems and functional units covered by the manual to give an overall summary of maintenance actions required for the complete works.

The schedule shall indicate daily, weekly, fortnightly, monthly and annual maintenance actions. A lubrication schedule shall also be included under this section.

A schedule indicating daily, weekly, fortnightly, monthly and yearly maintenance actions shall also be provided.

1. Detailed Plant description

- The main body of the manual shall be divided into sensible sections, each covering a system or functional units. Each section shall contain the following sub-sections:
 - Plant Description (brief but detailed);
 - Maintenance and Lubrication Schedule (in table format);
 - Process and Instrumentation Diagrams (P&ID's);
 - Operating instructions (including start-up and stopping procedures as well as manual and/or automatic operation)
 - Fault Finding
 - Equipment Data Sheets containing as a minimum:
 - a) Equipment Tag Number (for asset register purposes)
 - b) Equipment Description
 - c) Supplier Details
 - d) Model and Make
 - e) Cost of supply (at date of tendering)
 - Equipment Technical Manuals

For each piece of equipment and/or machine supplied, the following shall be provided under this sub-section:

- i. Supplier's Operation and Maintenance instructions
- ii. Parts list and data sheets
- iii. Calibration charts
- iv. Test certificates for hydraulic pressure tests, flame proof grading, materials, non-destructive tests, coating and lining details
- v. Applicable drawings and details

2. As-built drawings

Folded A3-size as-built drawings correctly scaled.

3. Computer programmes and software

Digital copies of programmes and software are required by computerized systems installed on the project for maintaining, updating, or altering the system by the Employer or Operator.

4. Wiring diagrams of electrical installations (separate volume)

PS19.3 Training

The specialist electrical and mechanical sub-contractor shall be responsible for the Plant Operator's initial training during the works' testing and commissioning. Training shall focus on the correct operation and maintenance of the Plant and shall address the following issues, amongst others:

- Start-up, shut-down and safety procedures;

- Troubleshooting and corrective actions;
- Understanding all processes, equipment and control methodology;
- Operation and maintenance of SCADA system (if applicable);
- Operating the works in manual mode in cases when SCADA is not available (if applicable);
- Execution of tests, relevant calculations and calibration of equipment;
- Maintenance of instrumentation;
- Collection, interpretation and reporting of process data.

Once the training has been completed, the Contractor shall examine all operators to ensure that the subjects and training material covered has been adequately mastered. The Contractor shall subsequently compile a training report for the Engineer's approval stating the following:

- Training subjects and material covered.
- Name and ID number of all operators trained.
- Outcomes for examination of Operators.
- Final sign-off from Contractor that all training in terms of Specifications has been completed.

The subcontractors' training staff shall be conversant in English and knowledgeable and experienced in the manufacture, erection, testing, fault finding, and maintenance of the equipment installed under the Contract.

PS20 TESTING AND COMMISSIONING

PS20.1 FACTORY ACCEPTANCE TESTS

Manufacturer-type or factory acceptance tests (FATs) shall be performed on all equipment as described in the Project or Particular Specifications.

For equipment manufactured outside the borders of South Africa, the requirement for witnessing factory acceptance tests by a representative(s) of the Engineer and the Employer shall be clearly specified in the Project Specification, and a separate payment item shall be provided in the schedule of quantities for attendance at such tests.

The Engineer or a duly appointed third-party inspectorate reserves the right to be present at all or any tests conducted on equipment to be supplied under the Contract.

For any factory acceptance test, at least one (calendar) weeks' notice shall be given to the engineer in writing for such test. No equipment shall be dispatched to the site before the engineer approves the factory test results.

PS20.2 TESTS ON COMPLETION

Notwithstanding any requirements of Clause 5.14.1 (Practical Completion) [*Tests on Completion – Contractor's Obligations*] of the General Conditions of Contract, the following tests on completion shall be executed by the Contractor

Dry testing as part of construction

Once the construction of the Works or a Sub-section has reached the stage of completion where it can be tested, the Contractor shall give to the Employer notice of the date at which the Contractor will be ready to carry out the Dry Commissioning of the Works or any Sub-section thereof. Dry Commissioning shall commence as soon as the Works or a Sub-section is mechanically and electrically

ready to test, it shall undergo pre-commissioning tests and inspections to check the following general aspects:-

Components of the Works or Sub-section are complete and comply with the Drawings, Specifications and data as indicated in the manufacturer's documentation;

The assembly has been carried out in compliance with the above documents and professional practice; Visual checking of general installation and appearance.

In addition dry commissioning shall include the following specific aspects:

- Thorough check of all ergonomic (lighting and noise), maintainability and safety-related aspects;
- Thorough check of flow lines of products, materials, fluid, and compressed air;
- Thorough check of electrical, hydraulic, pneumatic and electromechanical circuits;
- Thorough check of all functional and control loop tests (equipment level)
- Dry-run of every machine and checking of its operation and, if necessary, running in;
- Calibration checks and supporting documentation on all metering and monitoring equipment;
- Dry-run or no-load run of every section;
- Fixing of equipment, pipes, brackets, anchors, etc.;
- Written proof of all direction testing and alignment tests on pumps, motors and rotating equipment;
- Statutory testing requirements (Lifting, hoisting, pressure vessels etc.);
- Checking and testing of all actuators, valve and control valve settings;
- Water testing of chemical dosing equipment, pipes, joints;
- Water tightness and pressure tests on all water retaining structures, pressure vessels, pipelines and pipe fittings;
- Visual checking of general appearance and equipment labelling;
- Checking of all terminations;
- Verify correctness of field equipment statuses in relation to PLC and SCADA displays (if applicable);
- Testing of low voltage cables;
- Testing of high voltage cables;
- Checking of all safety settings;
- Directional testing of rotating elements;
- General safety of installations;
- Signals and SCADA/MMI configuration;
- Completion and issuing of all test reports and test certificates;
- Completion of cathodic and lightning protection;
- Compilation of an asset register suitable for integration with the Financial and Computerised Maintenance Management system of the Client;

- Completion and issuing of all equipment and O&M manuals including functional specifications and control philosophy;
- Supply of all critical spares and special tools on site;
- Check that first charge of chemicals has been delivered (if applicable).

Wet commissioning and testing as part of construction

Once the dry testing of all equipment in terms of the above has been completed, each process and system will be wet commissioned, which shall include the same operations as for dry commissioning tests but with the equipment loaded. The Employer will provide suitable raw water and power as set out by the Contract. The Contractor shall provide the first charge of chemicals (if applicable) for testing purposes. Wet commissioning shall entail the following:

- Performance testing of all equipment at specified duties and efficiencies for at least 24 hours continuously.
- Checking levels, flows, pressures and temperatures at minimum and maximum operating conditions for all operational scenarios.
- Temperatures of all bearings.
- Vibration of rotating elements.
- Calibration of dosing equipment.
- Water tightness tests of installations at full production.
- Functional and control loop testing (process level).
- Site performance tests on individual equipment as per the testing plan.
- Performance and control tests on the entire system

After the successful completion of the Wet Commissioning of all equipment and processes and the Works as a whole, the Trial Operation Period, as defined below, shall commence.

Trial Operation Period

After completing the wet commissioning phase and submitting the draft Operation & Maintenance manuals in the prescribed format, a 4-week Trial Operation Period shall commence, during which the new treatment processes shall be operated under the auspices of the Contractor. The Contractor shall provide full-time attendance for the duration of the Trial Operation Period during regular working hours (07h00 to 18h00) and shall have an individual(s) on standby during non-working hours for any/all emergencies.

The purpose of the Trial Operation Period is to (a) prove the functionality of all mechanical and electrical equipment installed under the Contract and (b) make final adjustments and optimise relevant operational settings.

The Trial Operation Period shall be declared successful if/when the plant operates as intended without any mechanical and electrical failure for a continuous period of 4(No) consecutive weeks. At this time, the Completion / Taking-Over Certificate shall be issued, signifying the start of the 12-month defects liability and maintenance period.

The Contractor shall allow in his tender for the supply of the chemicals and consumables for testing, commissioning and observance of the Trial and Operation Period: Chlorine shall be supplied by the Operator for testing and commissioning purposes.

The purpose of the Trial Operation Period is to prove the functionality of Works constructed under the Contract and to make final adjustments and optimizations of relevant operational settings.

Guarantees of Performance

The Contractor shall guarantee the output and efficiency of all machines, which guarantees shall be binding under the Contract. The fulfilment of these guarantees shall be demonstrated at the Contractor's factory premises or a suitable off-site test facility approved by the Engineer. All measuring instruments used in the tests shall have previously been certified by an independent testing authority not more than one month before the test and to the Engineer's satisfaction.

Where guaranteed performance is specified, certified test curves shall be drawn from the test data obtained from the purchased pumps and shall include; head (m), quantity pumped (m³/h or l/s), efficiency (%), power consumption (kW), speed in rpm and speed/torque (rpm/kNm). The probable performance with maximum and minimum impellers shall also be indicated, as well as tested NPSH available.

Each pump shall be checked for acceptable vibration and noise limits during testing. The Contractor shall ensure that the pumps deliver the "Required minimum and maximum discharge", by fitting new impellers or taking whatever action is necessary should there be any shortfall in the quantity of water measured when the pumps are delivering at the total head associated with the "duty point" in fulfilment of the Guaranteed Performance criteria.

Payment by the Contractor in *lieu* of under-performance of the pump sets relative to the Guaranteed Performance will not be acceptable.

Test Plan and Reports

Method statements and test reports shall be submitted before and after the successful completion of each testing phase. The following documents shall be submitted in writing to the Employer:

The overall testing method statement must be submitted before dry commissioning.

- Progressive testing reports are detailed in the testing plan.
Tests on completion:
Dry commissioning report;
Wet commissioning report;
- Method statement for the execution of the Trial Operation Period;
Failure investigation reports (where necessary) during the Defects Notification Period.

PS21 CONSTRUCTION AND MANAGEMENT REQUIREMENTS

PS 21.1 Applicable SANS 1921 Standards

The following SANS 1921 Construction and Management requirements for works standards and associated specification data are applicable

SANS 1921-1 General engineering and construction works

SANS 1921-2 Accommodation of Traffic on Public Roads

SANS 1921-6 HIV/AIDS Awareness

The associated specification data applicable to these SANS 1921 standards is as follows:

Standard	Clause	Specification Data
SANS 1921-1		Essential Data
	4.1.7	The project specifications detail the requirements for drawings, information, and calculations for which the Contractor is to be responsible.
	4.2.1	The responsibility strategy assigned to the Contractor for the Works is A.
	4.3	The planning, programme and method statements are to comply with the following: a) The programme shall be prepared in bar (Gantt) chart form, preferably using a project management software tool such as <i>Microsoft Project</i> and shall be issued to the Engineer in both hard copy and electronic format. The programme shall be structured to cover all items of work conceivable including all work to be done by sub-contractors and shall clearly indicate the critical path b) The programme must clearly show the intermediate milestone dates to be achieved taking the indicative construction sequences into account. c) Method statements shall be prepared in accordance with the requirements of the project specifications.
	4.17.4	The requirements for detection apparatus are: Nil Where services are found the Engineer must be notified immediately so that a decision can be made regarding re-alignment, relocation or protection of said services. The Contractor shall on no account effect such adjustments without the prior consent of the Engineer.
	4.17.5	If unknown services are found undamaged, they shall then be deemed to be known services with the provisions pertaining to known services becoming applicable.
	4.17.6	Where a service has been located and exposed, the Contractor shall take every care in ensuring that the excavation containing the service is barricaded and protected against collapse and that the service is adequately protected against damage. Should the existing service become damaged by the Contractor or any third party due to negligence on part of the Contractor, then the cost of its repair along with any consequential costs shall be borne by the Contractor.
	4.17.7	Existing known services or services that have been proved by the Contractor, which the Contractor damages, shall be repaired by the service provider and all costs of the repair shall be borne by the Contractor.
	4.18	The additional health and safety requirements of the Employer are as specified in the health and safety specifications included in the tender document.
		Variations

Standard	Clause	Specification Data
SANS 1921-1	4.1.10	Where reference is made to "SANS 2001", substitute with "SANS 1200"
SANS 1921-1		Additional Clauses
	4.6 (e)	The Contractor is to ensure that PSAB runoff or any groundwater seepage is controlled by means of temporary earthworks, cofferdams, pumping equipment, well-pointing, de-watering equipment etc. to keep the works free of water
	4.6 (f)	Dealing with all water during construction from whatever source will include for bypass arrangements for dealing with all possible flows whether or not the existing flow path is being interfered with during installation of the Works.
	4.7.4	No blasting will be permitted within 10 m of any structure, pipeline or service unless the Contractor can satisfy the Engineer that his proposed blasting methods and controls are such that no damage will be caused to the adjoining structure, pipeline or service. The Contractor will be required to provide equipment for and take vibro-recordings at no additional cost to the Employer. It shall therefore be a requirement of this project that the Contractor shall arrange for his blasting procedure to be prepared by an approved specialist in explosive techniques, to take into account the proximity of the existing powerline and other works, structures etc. The recommendations by this specialist shall be adhered to at all times. All costs associated with compliance with the above requirements shall be included in the tendered rates.
	4.8.1	The Contractor shall be responsible for protection from damage to any structures or services that might be affected by the excavations or works. The Contractor shall, before submitting his tender, carefully study the tender drawings and inspect on site the structures to be constructed in close proximity to existing structures and services and make due allowance in his rates for protection of structures and services by use of special construction methods such as close shoring, sheet piling, etc.
	4.8.2	Notwithstanding whatsoever special construction methods, equipment or materials are used by the Contractor to protect the structure or service from damage, all work will be measured for payment on the assumption that normal excavation had been carried out and the Contractor shall therefore make allowance for the additional costs in his tendered rates.
	4.9.5	It will be necessary for the Contractor to liaise closely with the Employer and the Engineer's Representative regarding any disruption of the water supply as a result of his construction activities.
	4.9.6	The provision of security for the Contractor's site establishment, plant and personnel at all times is sole responsibility of the Contractor and no claims for payment for additional security measures taken during the contract will be entertained.
	4.17.8	The Contractor shall so carry out all his operations as not to encroach on, or interfere with, trespass on, or damage adjoining land, buildings, properties, road structures, pipelines, places and things, in the vicinity of the Works and outside of the site boundary.

PS 21.2 Quality Assurance (QA) (Read with SANS 1921 – 1: 2004 clause 4.4)

The Contractor will be solely responsible for the production of work that complies with the Specifications to the satisfaction of the Engineer. To this end it will be the full responsibility of the Contractor to institute an appropriate Quality Assurance (QA) system on site. The Engineer and Employer will audit the Contractor's quality assurance (QA) system on a regular basis to verify that adequate independent checks and tests are being carried out and to ensure that the Contractor's own control is sufficient to identify any possible quality problems which could cause a delay or failure.

The Contractor may only procure goods and/or services from vendors that have received the prior approval of the Employer. In this regard the Employer has a list of approved suppliers and, in the event of the Contractor wishing to procure an item(s) from a vendor that is not on that list, the prospective vendor will be required to make application in writing to the Employer.

Attention is drawn to the need to allow at least one month for the Employer to carry out a vendor assessment and that there is no guarantee that the Employer will approve any particular vendor.

PS 21.3 Testing (Read with SANS 1921 – 1: 2004 Clause 4.11)

PS 21.3.1 Process control

The Contractor shall arrange for all tests required for process control to be done by an independent laboratory acceptable to and approved by the Engineer.

The Contractor must employ the services of an independent commercial laboratory. The Contractor must submit the results of tests carried out on materials and workmanship when submitting work for acceptance by the Engineer. The costs for these tests shall be deemed to be included in the relevant rates and no additional payment will be made for testing as required.

PS 21.3.2 Acceptance control

The process control test results submitted by the Contractor for approval of materials and workmanship may be used by the Engineer for acceptance control. However, before accepting any work, the Engineer may have further control tests carried out by a laboratory of his/her choice. The cost of such additional tests will be covered by a provisional sum provided in the schedule of quantities. Still, tests that failed to confirm compliance with the specifications will be for the Contractor's account.

PS 21.4 Survey beacons (Read with SANS 1921 - 1: 2004 Clause 4.15)

The Contractor shall take special precautions to protect all permanent survey beacons or pegs such as benchmarks, stand boundary pegs and trigonometrical beacons, regardless of whether such beacons or pegs were placed before or during the execution of the Contract. If any such beacons or pegs have been disturbed by the Contractor or his/her employees, the Contractor shall have them replaced by a registered land surveyor at his/her own cost.

PS 21.3 Management of the environment (Read with SANS 1921 – 1:2004 Clause 4.19 and the Environment Particular Specification)

The Contractor shall pay special attention to the following:

a) Clearing of vegetation

The Contractor will not destroy, remove, or clear trees, timber, or shrubs to a greater extent than that approved. The Contractor will not carry out any activity outside the areas defined for clearing unless otherwise approved by the Environmental Control Officer.

b) Soil Erosion

The quality of topsoil in stockpiles will be maintained by measures including contamination from other materials, minimizing stockpiling periods and prevention of soil erosion by surface runoff or wind. Monitoring for erosion and soil erosion risk will be undertaken regularly to ensure that any erosion that occurs is mitigated as soon as possible.

c) Risk of fall, injury and death

The trenches will be kept open for the minimum period necessary to undertake the works. Temporary fencing or barriers will be placed along the trenches in areas that are likely to be used as corridors, i.e. linkages between bushes where possible along the corridor.

d) Pollution Prevention

With particular regard to Sanitation, Solid Waste Facilities, Fuels, Hazardous Substances and other Liquid Pollutants as elaborated in the Particular Specification for Environmental Management.

e) Rehabilitation

The Contractor is to ensure that the site and its surrounds is rehabilitated to the condition in which it was prior to commencement of construction activities.

PS 22 OCCUPATIONAL HEALTH AND SAFETY (Read with SANS 1921 - 1: 2004 Clause 4.14 and the Particular Safety Specification)

PS 22.1 General Statement

It is a requirement of this contract that the Contractor shall provide a safe and healthy working environment and to direct all his/her activities in such a manner that his/her employees and any other persons, who may be directly affected by his/her activities, are not exposed to hazards to their health and safety. To this end the Contractor shall assume full responsibility to conform to all the provisions of the Occupational Health and Safety Act No 85 and Amendment Act No 181 of 1993, and the OHSA 1993 Construction Regulations 2014 issued on 07 March 2014 by the Department of Labour.

For the purpose of this contract the Contractor is required to confirm his/her status as Mandatory and employer in his/her own right for the execution of the contract by entering into an agreement with the Employer in terms of the Occupational Health and Safety Act by executing the Agreement Form included in Section C1: Forms of Security.

PS 22.2 Health and Safety Specifications and Plans to be submitted at tender stage

a) Employer's Health and Safety Specification

The Employer's Particular Health and Safety Specification will be included in the tender documents as part of the Project Specifications.

b) Tenderer's Health and Safety Plan

The successful Tenderer shall, on receipt of notification that he/she has been awarded the contract, submit without delay his/her own documented Health and Safety Plan for the execution of the work under the contract. His/her Health and Safety Plan must at least cover the following:

- i. a proper risk assessment of the works, risk items, work methods and procedures in terms of Regulations 7 to 28;
 - ii. pro-active identification of potential hazards and unsafe working conditions.
provision of a safe working environment and equipment.
 - iii. statements of methods to ensure the health and safety of subcontractors, employees and visitors to the site, including safety training in hazards and risk areas (*Regulation 5*);
- monitoring health and safety on the site of works regularly, and keeping of records and registers as provided for in the Construction Regulations;
 - details of the Construction Supervisor, the Construction Safety Officers and other competent persons he/she intends to appoint for the construction works in terms of Regulation 6 and other applicable regulations; and
 - details of methods to ensure that his/her Health and Safety Plan is carried out effectively in accordance with the Construction Regulations 2014.

The Contractor's Health and Safety Plan will be subject to approval by the Employer, or amendment, if necessary, before commencement of construction work. The Contractor will not be allowed to commence work, or his/her work will be suspended if he/she had already commenced work before he/she has obtained the Employer's written approval of his/her Health and Safety Plan.

Time lost due to delayed commencement or suspension of the work due to the Contractor's failure to obtain approval for his/her safety plan shall not be used as a reason to claim for extension of time or standing time and related costs.

PS 22.1 Cost of Compliance with the OHSA Construction Regulations

The rates and prices tendered by the Contractor shall be deemed to include all costs for conforming to the requirements of the Act, the Construction Regulations and the Employer's Health and Safety Specification as applicable to this contract. Should the Contractor fail to comply with the provisions of the Construction Regulations, he/she will be liable for penalties as provided in the Construction Regulations and the Employer's Health and Safety Specification. Items that may qualify for remuneration will be specified in the Safety Specifications or in the Project specifications.

PS 23 APPLICABLE STANDARDISED SPECIFICATIONS

- SANS 1200 A General
- SANS 1200 AB Engineers Office
- SANS 1200 C Site Clearance
- SANS 1200 D Earthworks
- SANS 1200 DB Earthworks (Pipe Trenches)
- SANS 1200 DK Gabions and Pitching

- SANS 1200 DM Earthworks (Roads, Subgrade)
- SANS 1200 G Concrete (Structural)
- SANS 1200 L Medium Pressure Pipelines
- SANS 1200 LB Bedding (Pipes)
- SANS 1200 LD Sewers
- SANS 1200 ME Subbase
- SANS 1200 MF Base
- SANS 1200 MH Asphalt Base and Surfacing
- SANS 1200 MK Kerbing and Channelling

PS 24 APPLICABLE PARTICULAR SPECIFICATIONS

Civil Works, Mechanical and Electrical Works

PB	EPWP Labor Intensive Specification
PLK	Manufacture and supply of valves
PLN	Manufacture, supply and testing of steel pipes
PLQ	Corrosion protection of steel pipes and fittings
PT	Pumps
PLT	Flow meters
PTD	Digester equipment
PTJ	Vertical shaft aerator
PTM	Vertical shaft stirrers
PTU	Chlorine dosing equipment
PLP	Particular Specifications for Process Instrumentation
EMVS	Medium Voltage Switchgear
ERMU	Electronic Rising Main Unit
EPPT	Power Transformers
EMSS	Miniature Substations
EMCC	Motor Control Centres and Distribution Boards
EPLC	Electrical/Electronic: Programmable Logic Controllers
ESCA	Scada - Supervisory Control and Data Acquisition
ECIS	Control and Instrumentation Systems
EG&M	General and Miscellaneous
EPTM	Telemetry System
EELP	Earthing and Lightning Protection
ESPL	Small Power and Lighting Installations on Buildings and Structures
EMCA	Multicore Cables and Earth Wires
ESLS	Site Lighting System
ESGS	Standby Generator System

PORTION 3: C 3.3. – VARIATIONS & ADDITIONS TO THE STRANDARD AND PARTICULAR SPECIRFICATIONS

C 3.3.1 SPECIFICATIONS FOR CIVIL WORKS

C3.3.1.1 Variations and additions to the standard and particular specifications (Project Specifications)

The SANS 1200 suite of Standardized Specifications does not cover all the different types of work included in the Contract. The general requirements for portions of the civil works not covered by the Standard Specifications are described in the Particular Specifications under section C3.4.

The Clauses under section C3.2 (referred to as Project Specifications) are numbered “PS” and refer to the affected clauses (number in *italics*) in the Standard or Particular Specifications. New clauses not covered by clauses in the Standard or Particular Specifications, if included here, are also designated “PS” followed by a number.

The documents listed under section C3.3 (Construction) shall be treated as mutually explanatory. However, should any requirement of section C3.3 conflict with any requirement of the Standard Specification or any requirement of the Particular Specifications, then the Project Specifications C3.2 - shall prevail.

PSA GENERAL

PSA1 QUALITY (Sub-Clause 3.1)

All material used in the Works shall, where such mark has been awarded for a specific type of material, bear the SABS/SANS mark. Alternatively, the Contractor shall furnish the Engineer with certificates of compliance of materials, which bear the official mark of the appropriate standard.

PSA1.1 ORDERING OF MATERIALS (Sub-Clause 3.3)

The quantities set out in the Schedule of Quantities have been determined from calculations based on data available at the time and should, therefore, be only approximate quantities. The liability shall rest entirely and solely with the Contractor to determine, before order, the required types and quantities of the various materials required for the completion of the works in accordance with the specifications and the drawings issued.

PSA2 CONTRACTOR’S OFFICES, STORES AND SERVICES (Sub-Clause 4.2)

PSA2.1 Contractor’s Camp

The contractor's main camp is envisaged to be at the Umzinto WWTW site, and all progress and technical meetings will be held there.

As the site camp will be at the existing operational wastewater treatment facilities, the Contractor shall take cognisance of the health hazards associated herewith and take the necessary pre-cautions and measures to ensure minimal contact with contaminated areas. Proper medicals shall be performed on all labour prior at the start of construction to ensure that the Contractor’s workforce is healthy and able to operate in the expected working environment.

The Contractor’s camp(s) shall be always kept clean during construction and conform to the requirements and regulations of the Employer, authorities and the applicable Environmental Management Plan.

The Contractor must fence off his construction camp area with 1.8m high diamond mesh fence. The inside of each camp area shall be screened off from the public by 1.8m high green shade cloth neatly tied to the inside of the fence. All temporary fencing must be removed on completion of the Contract.

The camp may be used for the working hours activities of the Contractor's and the Employer's personnel and for all related facilities required by the Contractor and the Employer such as workshops, stores, testing laboratories, etc. The Contractor's personnel, including *bona fide* night watchmen, may only sleep within the camp should the Contractor:

- take all the necessary steps required to comply fully with public legislation and regulations and all specification clauses governing the environment, health, transport, safety and public disturbance impacts of such on-site accommodation.
- acquire the Employer's and relevant authority's written permission and comply with their requirements.

Should, at any stage of the Contract, the Employer and/or the Engineer be of the opinion that the housing of personnel within the camp site of the Contractor is causing disturbance or inconvenience to the public, then the authority granted by this clause for the Contractor to house personnel on site may be withdrawn, either partially or entirely.

The Contractor shall at all times conform to all requirements contained in law or bylaws, as well as any other requirements set by the controlling local authority.

The Contractor shall water all access roads to the construction camp, as well as working areas used by vehicles inside the camps, twice daily including weekends as required or as may be directed by the Engineer, to prevent dust being churned up by vehicles or wind.

At the completion of the construction work, the Contractor must break down and remove all concrete slabs, etc. in the construction camps and at the batching plant (if applicable), remove all rubble from the camp site and hand back the sites in a clean and tidy condition.

No Taking-over Certificate shall be issued for the Works unless the site clearing is done to the satisfaction of the Engineer.

PSA2.2 Source of Water Supply

Except as provided for in of the General Clauses (section C3) or the Particular Conditions of Contract, the Contractor is responsible under the Contract for the supply and distribution at his cost of all water that he may require for purposes of constructing, testing and commissioning the Works.

Accordingly, the Contractor shall pay all consumption charges, and at his cost provide all connections, consumption meters, pipework, storage tanks, transport and other items associated with the supply of water for the execution of the Works. All connections to pipelines at the existing treatment facilities shall be at points and to standards approved by the Engineer and that the Operator of the works.

PSA2.3 Source of Power Supply

Under the Contract, the Contractor is responsible for the supply and distribution at his cost of all electricity that he may require for constructing the Works. Accordingly, the Contractor shall pay all consumption charges and at his cost to provide all connections, transformers, consumption meters, cables, distribution boards and other items associated with the electricity supply for the construction of the Works.

The Contractor shall, subject to the approval of the Engineer, make any necessary arrangements with the relevant authority for the requisite connection(s). The distribution of electricity shall be in accordance with the applicable bylaws and regulations of the supply authority.

PSA2.4 Rail Facilities

There are no rail facilities close to the Umzinto WWTW.

PSA2.5 Sanitary facilities

Ablution facilities shall be kept hygienic at all times. In addition, the Contractor shall at all times during construction of the Works provide adequate sanitary facilities on site so that all employees are at all times within easy reach of sanitary facilities.

PSA2.6 Housing

The Contractor will not be permitted to house any personnel within his camp site unless the Employer approves a written request to this end by the Contractor.

PSA3 PROTECTION OF OVERHEAD AND UNDERGROUND SERVICES (Sub-Clause 5.4)

PSA3.1 Existing services and structures

The position and details of all existing services and structures known to the Engineer are shown on the Drawings as Site Data. In accordance with Sub-Clauses 2.1 to 2.4 of the General Conditions of Contract, the Drawings show the best information available to the Employer at time of tender. The Employer takes no responsibility as to the accuracy or completeness of this information and has provided this information merely as an aid to the tenderers in preparing their bids for construction of the Works.

The Contractor shall protect all known existing services as well as all work being carried out and structures being erected on the Site by other contractors or public authorities. The Contractor must familiarize himself with the various standard regulations of the relevant public authorities and act accordingly. Any damage caused to these services or structures, or any obstructions or hindrance caused to other contractors or public authorities by the Contractor and all claims arising from such damage, obstruction or hindrance shall be the sole responsibility of the Contractor.

All repair work shall be carried out at the Contractor's expense to the entire satisfaction of the Engineer or the appropriate public authority. The same obligations shall be imposed on other contractors employed by the Employer in respect of the Works being executed under this Contract.

The Contractor shall conduct the necessary search for unknown services as required by the Standard Specifications. After searching, all services shall be deemed as known. The Contractors' cost of searching for existing services and accommodating all existing services and relocating all services shall be priced into the appropriate items forming part of the Contract.

PSA4 TESTING (Clause 7)

PSA4.1 All test results obtained by the Contractor in the course of his process control of the Works shall be submitted to the Engineer or his Representative prior to requesting inspection of the relevant portions of the Works. Any request for inspection shall be submitted on the prescribed forms that will be issued once the Contract has been awarded.

PSA4.2 The Contractor shall make suitable arrangements for process control prior to commencement with the Works. Should he intend using site personnel for this purpose he shall ensure that suitably trained and competent personnel take charge of the necessary test work, and that the necessary

equipment is at their disposal prior to commencement of the Works. Failure to comply with these requirements shall be cause for the Engineer to order suspension of the Works without additional remuneration, or for him to recommend termination to the Employer in terms of the Conditions of Contract.

PSA5 OTHER GENERAL FIXED-CHARGE ITEMS

Add the following new sub-clause 8.3.5 – Other general fixed-charge items.

PSA5.1 Fixed-charge and value-related items (SUBCLAUSE 8.2.1)

Replace the contents of this sub-clause with the following:

Eighty percent (80%) of the sum tendered will be paid once the facilities have been provided and approved. The remaining twenty percent (20%) will be paid once the Works have been completed, the facilities removed, and the campsite cleared and cleaned.

The Contractor must note that 20% of the work will be subcontracted to local emerging Contractors.

The main Contractor will be responsible for the quality, coordination and programming of all works undertaken by the CPG sub-contractors.

To ensure a smooth and efficient construction process, the contractor's senior management shall oversee the coordination of local labour and subcontractor negotiations. Weekly meetings between the contractor and subcontractors will be held to monitor progress, address any potential issues, and ensure that the construction targets are met without delays.

PSA5.2 Compliance with Health and Safety Requirements (Sub Clause 8.3.5.1) Unit: Sum

The tendered sum shall cover all fixed charge expenses to ensure compliance with the Occupational Health and Safety Act (Act 85 of 1993) and its Regulations and with the Employer's Health and Safety Specification. The tendered sum shall include, but not be limited to the following:

- Preparation of Health and Safety Plan;
- Establishment of Health and Safety File;
- Health and Safety Training;
- Issue of personal protective clothing and equipment;
- Fences, barricades and signage;
- Establishment of Safety Administration;
- Conducting medical assessments on all labour;
- Other obligations not mentioned above, but deemed applicable.

PSA5.4 Environmental Management Plan (Sub Clause 8.3.5.2) Unit: Sum

The Contractor shall comply with the record of the Decision and Environmental Management Plan (EMP) bound into the document under section C3.5.2. The tender fixed charge item shall cover all costs, overheads, profits and charges incurred for the establishment of a suitable environmental control system on site and compliance with the requirements of the EMP.

PSA6 OTHER GENERAL TIME-RELATED CHARGE ITEMS

Add the following new sub-clause 8.3.6 – Other general time-related charge items

PSA6.1 Time Relates items (SUBCLAUSE 8.2.2)

(Time-related item) will be made monthly in equal amounts, calculated by dividing the sum tendered for the item by the tendered Contract Period in months, always provided that the total of the monthly amounts paid for the item is not more than in proportion to the progress of the work as a whole.

The Contractor must note that 20% of the work will be subcontracted to local emerging Contractors.

The main Contractor will be responsible for the quality, coordination and programming of all works undertaken by the CPG sub-contractors.

To ensure a smooth and efficient construction process, the contractor's senior management shall oversee the coordination of local labour and subcontractor negotiations. Weekly meetings between the contractor and subcontractors will be held to monitor progress, address any potential issues, and ensure that the construction targets are met without delays.

PSA6.2 Compliance with Health and Safety Requirements (Sub Clause 8.3.6.1)Unit: Sum

The tendered sum shall cover all time-related charge expenses to ensure compliance with the Occupational Health and Safety Act (Act 85 of 1993) and its Regulations and with the Employer's Health and Safety Specification. The tendered sum shall include, but not be limited to the following:

- The employment cost of all health and safety personnel including consultants, health and safety officers, inspectors, supervisors and issuers required in terms of the Contractor's Health and Safety Plan;
- Updating the Health and Safety Plan when required;
- Carrying out of periodic internal audits and follow-up audits;
- Compiling ongoing risk assessments and risk assessment reports as required by the Works;
- Convening of regular safety meetings with the Safety Representatives;
- Accompanying and supporting the Employer and his authorised Safety Agent during ad-hoc audits;
- Compilation of monthly safety reports and statistics for the Employer or his authorised Safety Agent;
- Ongoing health and safety-related training;
- Maintenance of personal protective clothing and equipment;
- Maintenance of fences, barricades and signage;
- Maintenance of safety administration;
- Other health and safety obligations not listed above

PSA6.3 Environmental Management Plan (Sub Clause 8.3.6.2) Unit: Sum

The Contractor shall comply with the record of Decision and Environmental Management Plan (EMP) bound into the document under section C3.5.2. The tender time-related charge item shall cover all costs, overheads, profits and charges incurred for the establishment of a suitable environmental control system on site and compliance with the requirements of the EMP.

PSA6.4 Security (Sub Clause 8.3.6.3) Unit: Sum

Although the Works at the Umzinto WWTW will generally be executed within the perimeter fencing of the plant, the Contractor shall maintain a security presence on Site for the full duration of the construction activities to protect the Contractor's equipment and materials. The Contractor shall

also be responsible to control access to the Site/plant for construction activities and shall implement a suitable access control system to prevent unauthorised entry to the Site.

PSA7 SUMS STATED PROVISIONALLY (Clause 8.5)

PSA7.1 Contingencies

A Provisional Sum shall be included in the Summary of Schedules for contingencies. No percentage mark-up will be applicable to any payments made using contingency money other than the mark up included in prices for variations determined in terms of the Conditions of Contract. The value of the Provisional Sum shall be based on the percentage of the sub-total value as specified in the Summary of Schedules.

PSA7.2 Contract Price Adjustment

A provisional sum shall be included for contract price adjustment in the summary of schedules to make provisions for contract price adjustment in terms of the conditions of the contract. The value of the Provisional Sum shall be based on the percentage of the subtotal value as specified in the Summary of Schedules. No percentage mark-up will be applicable to any payments made in this regard.

PSA7.3 Salary for Labour Desk Officer and Community Liaison Officer

A Provisional Sum has been included in Schedule 2 for a salary to be paid to the Labour Desk Officer and Community Liaison Officer.

In addition to the abovementioned amount, provision is made in Schedule 2 for a mark-up on the amount to be paid as stated in the Appendix to Tender. The mark-up shall be regarded as full compensation for overheads, charges and profits as provided for in Clause 13.5 of the Conditions of Contract.

PSA7.4 Artisans and Skills Training

A Provisional Sum has been included in Schedule 2 for payments to be made to specialists for the training of unskilled or semi-skilled persons in industry-accredited management and generic skills. An allowance has also been made for wages and salaries of such labourers under a separate payment item.

Payment to the Contractor will be based on invoices certified by the Engineer and issued by training specialists to the Contractor for work undertaken in terms of this item.

In addition to the above amount, provision is made in Schedule 2 for a mark-up on any payments made by the Contractor in this regard as stated in the Appendix to Tender. The markup shall be regarded as full compensation for overheads, charges and profits as provided for in Clause 13.5 of the Conditions of Contract.

PSA7.5 Telephone Calls and Rental

A Provisional Sum has been included in Schedule 2 for telephone calls (cellular only) of the Engineer's Representative for the duration of the Contract. The Engineer's Representative will provide his own cellular telephone for the Contract. Payment for cellular calls will be based on call and rental costs.

In addition to the above amount, Schedule 2 provides for a markup on any payments made by the Contractor. The markup shall be regarded as full compensation for overheads, charges, and profits as provided for in Clause 13.5 of the Conditions of Contract.

PSA7.6 Office consumables for Engineer's site facility

A provisional sum has been included in schedule 2 for the provision of all office consumables for the Engineer's office establishment to cover all expenses related to stationary, paper, printer cartridges etc.

In addition to the above amount, provision is made in Schedule 2 for a mark-up on any payments made by the Contractor. The mark-up shall be regarded as full compensation for overheads, charges and profits as provided for in Clause 13.5 of the Conditions of Contract.

PSA7.7 Electronic Equipment for the Engineer's office

A provisional sum has been included in schedule 2 for the provision of all electronic equipment required by the Engineer and his representatives/assistants for the execution of their task during the construction stage, which includes computers, printers, cameras etc.

All equipment procured for the Engineer and his representatives shall be new and remain the property of the Contractor i.e. ownership shall revert back to the Contractor upon completion of the Works.

In addition to the above amount, provision is made in Schedule 2 for a mark-up on any payments made by the Contractor. The mark-up shall be regarded as full compensation for overheads, charges and profits as provided for in Clause 13.5 of the Conditions of Contract.

PSA7.8 Acceptance Control Testing

A Provisional Sum has been included in Schedule 2 for acceptance control testing ordered by the Engineer to be undertaken by a commercial laboratory. Payment will be based on the actual invoicing by the laboratory to the Contractor.

In addition to the abovementioned amount, provision is made in Schedule 2 for a mark-up on any payments made by the Contractor in this regard as stated in the Appendix to Tender. The mark-up shall be regarded as full compensation for overheads, charges and profits as provided for in Clause 13.5 of the Conditions of Contract.

PSA7.9 Locating existing services

A Provisional Sum has been included in Schedule 2 for the location of existing services in terms of the Specification as ordered by the Engineer.

In addition to the abovementioned amount, provision is made in Schedule 2 for a mark-up on the amount to be paid as stated in the Appendix to Tender. The mark-up shall be regarded as full compensation for overheads, charges and profits as provided for in Clause 13.5 of the Conditions of Contract.

PSA7.10 Relocation of Existing Services

A Provisional Sum has been included in Schedule 2 for the relocation of existing services by specialists if and when required and ordered by the Engineer.

In addition to the abovementioned amount, provision is made in Schedule 2 for a mark-up on the amount to be paid as stated in the Appendix to Tender. The mark-up shall be regarded as full compensation for overheads, charges and profits as provided for in Clause 13.5 of the Conditions of Contract.

PSA7.11 Specialized Services

A Provisional Sum has been included in Schedule 2 for the appointment and payment for specialised services if and when required. These may include all work required by the following specialists, which will be appointed as nominated sub-contractors:

- Environmental compliance monitoring by the ECO;
- Acceptance control testing of pipework, coatings and linings;
- Health and Safety compliance monitoring;
- Geotechnical Specialist.

In addition to the above-mentioned amount, Schedule 2 provides for a mark-up on the amount to be paid as stated in the Appendix to Tender. The mark-up shall be regarded as full compensation for overheads, charges, and profits as provided for in Clause 13.5 of the Conditions of Contract.

PSA7.12 Allowance for Repair of Electrical Works and Motors

Schedule 2 includes a provisional sum for the testing of Electrical and Motor works, including repair, at the employer's sole discretion.

In addition to the abovementioned amount, Schedule 2 provides for a markup of the amount to be paid as stated in the Appendix to Tender. The markup shall be regarded as full compensation for overheads, charges, and profits as provided for in Clause 6.6 of the Conditions of Contract.

PSA7.13 Allowance for Repair of Mechanical Works and Pumps

Schedule 2 includes a provisional sum for the testing of Mechanical Works, pumps, and Motors works, including repair, at the employer's sole discretion.

In addition to the abovementioned amount, Schedule 2 provides for a markup of the amount to be paid as stated in the Appendix to Tender. The markup shall be regarded as full compensation for overheads, charges, and profits as provided for in Clause 6.6 of the Conditions of Contract.

PSA8 PRIME COST ITEMS (Clause 8.6)

PSA8.1 Materials for Dayworks

A Provisional Sum has been included in Schedule 2 for materials to be used during the execution of works. In addition to the abovementioned amount, a provision is made in Schedule 2 for a mark-up of the materials used during the execution of the dayworks by the Contractor, as stated in the Appendix to Tender. Payment made shall be regarded as full compensation for overheads, charges, and profit from the materials used when executing dayworks.

PSAB ENGINEER'S OFFICE

PSAB1 NAME BOARDS (Clause 3.1)

The Contractor shall supply and erect one (2) name boards in accordance with the details shown on the Drawings and in positions instructed by the Engineer.

PSAB2 OFFICE BUILDING (Clause 3.2)

PSAB2.1 Resident Engineer's Offices and Equipment

The Contractor shall provide one (1No) furnished office for the Resident Engineer at the Umzinto site establishment and shall properly maintain these facilities for the duration of the Contract. The facilities shall be provided according to the Standard Specifications and as amended below. It

shall be deemed that the Contractor has allowed in his rate tendered under this item for all requirements described below as well as under points (a) to (e).

The office shall have the floor area of at least 15 m² and a ceiling height of at least 2,5m. The offices shall be weatherproof with wooden boarded floors that are at least 150mm above the ground, and shall be provided with ceilings, a door with a secure lock, and with opening windows of glazed area at least 40% of the floor area. Offices shall be well ventilated and shall be insulated as to provide comfortable working conditions.

The internal finishing of each office shall include the following:

- a desk with a top of size at least 1,5m x 0.9m and at least two lockable drawers;
- a lockable upright steel cabinet with three shelves;
- a steel filing cabinet with four drawers;
- One HP Officejet 8620 Printer , scanner and copier to the max value of R 7500
- racks for hanging construction drawings;
- a wash hand basin with towel rack and soap dish;
- an acceptable model air conditioner, capable of maintaining the room temperature between 18°C and 22°C,
- suitable electrical lighting (fluorescent type);
- one high stool;
- two 15 amp plug points with earth leakage;
- one drawing table, 3m long x 1m high x 0.9m wide, with a smooth top and draftsman stool;
- two chairs;
- an acceptable blind on each window

The Contractor shall provide all electrical equipment as required by the office staff as well as all consumables required for facilities and equipment i.e. paper, toner, stationery etc. Provisional sums have been included in schedule 2 for the electrical equipment and consumables.

The Contractor shall also be responsible to provide and maintain an adequate internet connection for the Engineer's offices.

All offices, facilities and equipment shall be new and be furnished, serviced, cleaned and maintained by the Contractor. The Contractor shall provide a full-time assistant for cleaning the offices and car wash. The Contractor shall provide a full-time guard service and ablution facilities for the office complex.

The Contractor shall be responsible for all running costs and costs for other services, including telecommunication, electricity, water, etc. to operate and maintain the offices efficiently. The Contractor shall be responsible for all cellular cost by the Engineer's staff. A provisional sum is included in the Contract for this item under schedule 2.

The Contractor will be responsible for the maintenance and insurance of the equipment, which shall become the property of the Contractor upon the issue of the Taking-Over Certificate.

a) Office equipment

The Contractor shall provide the necessary computing, printing and copying equipment for the exclusive use of the Engineer and his staff and shall provide all maintenance and consumables for this equipment for the duration of the Contract. Ablution units

The Contractor shall provide two separate toilets for ladies and gents for the exclusive use of the Employer, Engineer and his staff. The Contractor shall provide cleaning materials and toilet paper and maintain the ablutions for the duration of the Contract.

b) Cellular Phone and Data

The Contractor will be required to pay for the cellular phone charges for the Senior Engineer and Representative for the duration of the contract with the provision that the total cellular call charges do not exceed R1,500.00 per month per person.

c) Computer Equipment

The Contractor shall purchase 2 laptops for the maximum value of R15,000.00 (Excl. VAT) per laptop, for the Senior Engineer and Representative which shall be returned to the Client (uGu District Municipality) upon completion.

Insurance

The Contractor shall keep the equipment continuously insured against any loss, damage or breakage, and he shall indemnify the Engineer and the Employer against any claims in this regard. Should any or all the above not be provided by the Contractor, the Engineer shall at his sole discretion, determine the cost of such items and deduct said cost from the contractor payment certificate

PSAB2.2 Laboratory Equipment

The Engineer only requires the laboratory facilities and equipment that are listed below. At the request of the Engineer, the Contractor shall arrange separately with an independent commercial laboratory and/or designated specialists to carry out additional acceptance control tests, over and above the normal quality control testing required for the construction of the Works. A provisional sum is included in the contract for the additional control tests ordered by the Engineer. The Contractor shall remain responsible to carry out the process control testing required by the Standardized, Particular and Project Specifications.

The Contractor shall supply and maintain the following acceptance control equipment for use by the Engineer during the Contract:

- 1 Troxler nuclear system Model 3440, complete with accessories and stored in a suitable transit case as supplied by the manufacturer. A detailed description of the unit and principals of operation shall be included in the manual for the nuclear instrument.
Calibration test certificates shall be provided for each instrument.
- Six concrete cube moulds, 150mm nominal size.

PSAB3 SURVEY EQUIPMENT (Sub-Clause 5.5)

The survey equipment listed below shall be made available and be maintained in good condition for the exclusive use of the Engineer or his Representative for the duration of the Contract.

a) Automatic surveyor's level complete with tripod and leather carry case such as Zeiss N1-2 or equivalent	1 No.
b) 20-second tachometer with optical plumbob complete with tripod and leather carry case such as Sokkisha TM20C or equivalent.	1 No.
c) Nylon-coated steel surveyor's tape 100m long and 10mm wide	1 No.
d) 5m long steel tape	1 No.
e) 5m long three-piece telescopic survey staves (metric double-face)	
f) complete with angle bracket level	1 No.
g) Survey books: Level	2 No.
h) One metre long spirit level	1 No.

The rate tendered for this item under the fixed-charge section shall also include for the installation of two benchmarks at the Site as shown on the Drawings as well as the appointment and verification of these benchmarks by an independent land surveyor.

PSC SITE CLEARANCE

PSC1 DISPOSAL OF MATERIAL (Sub-Clauses 3.1 and 8.2.1)

Materials arising from clearing and grubbing shall be disposed of at a suitable spoil site. The Contractor shall be responsible to make his own arrangements for a suitable spoil site and all transport costs shall be included in the rates tendered for site clearance. Trees and stumps necessarily removed shall not be burnt unless authorized by the Engineer but shall be cut and stacked at areas designated by the Engineer.

PSC3 MEASUREMENT AND PAYMENT (Sub-Clause 8.2.1)

Replace the first line with the following:

"The area designated by the Engineer to be cleared and grubbed will be measured in square meter to the nearest square meter or,"

PSD EARTHWORKS

PSD1 INTERPRETATION (Sub-Clause 2.1)

Replace sub-clause 2.1 with the following:

"Any of the other SABS 1200 specifications may form part of the Contract documents."

PSD2 DEFINITIONS (Sub-Clause 2.3)

Replace the word and the definition for "borrow" with the following:

"Borrow material: Material, other than material obtained from excavations required for the works, obtained from commercial sources or existing borrow pits. 'Borrow' shall have a corresponding meaning."

Replace the definition for "Specified density" with the following:

"Specified density: The specified dry density expressed as a percentage of modified AASHTO dry density."

Replace the definition for "Stockpile" with the following:

"Stockpile (verb): The process of selecting and, when necessary, loading, transporting and off-loading material in a designated area for later use for a specific purpose"

Add the following definitions:

"Commercial source: A source of material provided by the Contractor, not the Employer.

Fill: An embankment or terrace constructed of material obtained from excavations or borrow pits. In roads it includes the earthworks up to the underside of the selected subgrade level.

Fill (material): Material used for the construction of an embankment or terrace

Roadbed: The natural in situ material on which the fill or, in the absence of fill, the pavement layers are constructed"

PSD3 CLASSIFICATION FOR EXCAVATION PURPOSES (Clause 3.1.2)

Delete clause 3.1.2 (a) and clause 3.1.2 (b) and replace with the following:

3.1.2 (a) Soft excavation:

"All material that is not classified as hard rock excavation in terms of clause 3.1.2 (c), boulder excavation class A in terms of clause 3.1.2 (d) or boulder excavation class B in terms of clause 3.1.2 (e) shall be classified as soft excavation"

In clause 3.1.2 (c) (1), replace the words "equivalent to that specified in (b) (1) above" with the words "of mass approximately 35 t, fitted with a single-tine ripper suitable for heavy ripping and of fly wheel power approximately 220 kW."

In the last sentence of clause 3.1.2 (d), replace the words "intermediate excavation" with the words "soft excavation."

In the last sentence of clause 3.1.2 (e) (2), replace the words "or intermediate excavations, according to the nature of the material" with the word "excavation."

PSD4 SELECTION

Add the following new sub-Clause 3.3.3

"Approval of a borrow area for a certain purpose does not necessarily mean that all the material in that area is suitable for the specified purpose. What it does mean is that the borrow area contains some suitable material. The onus shall rest on the Contractor to ensure that only material that is indeed suitable is removed and used for the specified purpose.

When the Contractor has to select excavated material for a specific purpose, the above provisions relating to borrow areas shall apply mutatis mutandis to excavations.

The Contractor shall not waste or contaminate material that has been selected for a specific purpose."

PSD5 PLANT (Sub-Clause 4.4)

Replace the contents of sub-Clause 4.4 with the following:

"The Contractor shall, for the purposes of detecting and locating underground services in accordance with the provisions of sub-clause 5.4 of SABS 1200 A and sub-clause 5.1.2 of SABS 1200 D, at his own cost, provide and use detecting equipment which is suitable for the detection of underground cables and pipes."

PSD6 CONSTRUCTION - PRECAUTIONS

PSD6.1 Safeguarding of Excavations (Sub-Clause 5.1.1.2)

Any cost the Contractor may undergo in ensuring the safety of excavations or any additional excavation and backfilling he may have to undertake due to the unstable sides of excavations and trenches shall be held to his account and the various rates for excavation and trenching included in the Schedule of Quantities shall include full compensation, therefore.

PSD6.2 Explosives (Sub-Clause 5.1.1.3)

Replace the contents of this sub-Clause with the following:

"The Contractor will generally be permitted to use explosives for breaking up hard material during excavations, for demolishing existing structures, and for other purposes where explosives are normally required, subject to the following conditions:

- a) The Engineer may prohibit the use of explosives in cases where, in his opinion, the risk of injury to persons or damage to property or to adjoining structures is too high. Such action by the Engineer does not entitle the Contractor to additional payment for having to resort to less economical methods of construction.
- b) The Engineer's prior written approval shall be obtained for each and every blasting operation. This approval may be withheld if the Contractor does not use explosives responsibly and carefully.
- c) The Contractor shall comply fully with the applicable legislation and regulations.
- d) Before blasting is undertaken, the Contractor shall satisfy the Engineer that he has established whether or not the insurers concerned require pre- and post-blasting inspections of buildings and structures within a certain radius of the proposed blasting.

Should such inspections be required, the Contractor shall, together with the Engineer and the insurer, examine and measure the buildings, houses or structures in the vicinity of the proposed blasting site and establish and record, together with the owner, lessee or occupier, the extent of any existing cracking or damage before blasting operations commence.

- a) When there is a possibility of damage to power and telephone lines or any other services or property, the Contractor shall adapt his method of blasting and the size of the charges and shall use adequate protective measures (e.g. cover-blasting) to reduce the risk of damage.
- b) All accidents, injury to persons and animals and damage to property shall be reported to the Engineer in detail and in writing as soon as is practicable.
- c) The Engineer shall be given 24 hours' notice by the Contractor before each blasting operation is carried out.
- d) When blasting to specified profiles, the Contractor shall so arrange the holes and charges that the resulting exposed surfaces are as sound as the nature of the material permits. The Contractor shall make good at his own expense, any additional excavation necessitated by the shattering of rock in excess of any overbreak allowances specified in the Project Specifications or given on any Drawing.

Notwithstanding the Contractor's compliance with the above provisions, the Contractor shall remain liable for any injury to persons and animals and loss of or damage to property occurring as a result of blasting operations."

PSD6.3 Existing Services

PSD6.3.1 Detection, location and exposure (Sub-Clause 5.1.2.2)

Replace the contents of sub-Clause 5.1.2.2 with the following:

"The exposure by the Contractor of underground services, as required in terms of sub-clause 5.4 of SABS 1200 A (as amended) shall be carried out by careful hand excavation at such positions and to such dimensions as are agreed to by the Engineer.

Unless otherwise instructed or agreed by the Engineer, no service shall be left exposed after its exact position has been determined and all excavations carried out for the purposes of exposing underground services shall be promptly backfilled and compacted to the following densities:

- a) In roadways: 93% Mod AASHTO density; and
- b) In all other areas: 90% Mod AASHTO density.

Where hand excavations to expose underground services have to be carried out in roadways, the Contractor shall reinstate the road layer works in accordance with the provisions of sub-clause 5.9 of SABS 1200 DB.

Payment in respect of exposing the services by means of hand excavation as described above, will be made in accordance with sub-clause PSD 8.3.8.1.

Payment in respect of reinstating layer works in roadways will be made in accordance with sub-clause 8.3.6.1 of SABS 1200 DB (as amended)."

PSD6.3.2 Protection during construction (Sub-Clause 5.1.2.3)

Replace the contents of sub-Clause 5.1.2.3 with the following:

"Protection during construction."

Further to the requirements of sub-clause 5.4 of SABS 1200 A (as amended), major excavating equipment and other plant shall not be operated dangerously close to known services. Where necessary, excavation in close proximity to known services shall be carefully carried out with suitable hand tools, excluding picks wherever their use could damage the services. No additional payment will apply to such more difficult work.

Should any service not being a known service be discovered or encountered during the course of the Contract, the Contractor shall, in addition to complying with the requirements of sub-clause 5.4 of SABS 1200 A (as amended), immediately notify the Engineer thereof and implement such measures as will prevent damage of such service or, if it was damaged in the course of discovery, will prevent and minimise the occurrence of any further damage occurring."

PSD6.3.3 Negligence (Sub-Clause 5.1.2.5)

Delete Sub-Clause 5.1.2.5

PSD6.4 Stormwater and Groundwater (Sub-Clause 5.1.3)

Add the following:

"The Contractor shall, where applicable and at the earliest practicable opportunity, install the permanent drainage specified or shown on the Drawings and shall at his own cost provide the temporary drainage required to protect the works."

PSD6.5 Reinstatement and Maintenance of Roads

Add the following:

"Where crossings have been made, the roads shall be reinstated in accordance with the details specified in sub-clause 5.9 of SABS 1200 DB."

PSD7 CONSTRUCTION – METHODS AND PROCEDURES

PSD7.1 Site Preparation

PSD7.1.1 Conservation of topsoil ((Sub-Clause 5.2.1.2)

Add the following:

Topsoil shall be removed from all areas where structures are to be constructed and shall be stockpiled, maintained and reinstated in areas as indicated by the Engineer.

PSD7.2 Excavation

PSD7.2.1 Excavation for general earthworks and for structures (Sub-Clause 5.2.2.1)

Add the following to paragraph (b):

"When the nature of the material precludes the above procedure, additional excavations shall be carried out to provide working space for the erection of formwork. The tendered rate for item 8.3.5 will be deemed to include the cost of a working width of 600mm, but the Contractor may excavate a greater working width at no additional cost to the Employer."

Replace the first sentence of paragraph (e) with the following:

"Where excavations have been carried below the authorised levels, the Contractor shall backfill such excavations to the correct level with approved gravel compacted to 97% of modified AASHTO density or to the density of the surrounding material, whichever is the higher density.

Where excavations for structures have been carried out in hard material, the Engineer may direct that over-excavation be backfilled with weak concrete if there is a danger of settlement or differential settlement of the foundations.

Where the sides of excavations against which concrete is to be cast have been over-excavated or have collapsed partially, the Contractor shall re-trim the excavations if necessary and, unless other remedial measures are agreed to by the Engineer, shall cast the concrete for the structure, including the additional concrete that may be required as a result of the over-excavation or partial collapse. The cost of the additional concrete or remedial measures shall be for the Contractor's account."

PSD7.2.2 Borrow Pits (Sub-Clause 5.2.2.2)

Add the following:

Bedding and backfill materials shall be obtained from approved borrow pits or commercial sources. Where borrow materials are required, such materials shall be obtained from borrow sources to be identified by the Contractor, who shall be entirely responsible for ensuring that such materials comply in all respects with the material specifications. Unless otherwise specified the opening of new borrow pits shall not be allowed.

The Contractor shall in all respect comply with the various requirements of SABS 1200D and in relation to the opening up, closing down and utilization of borrow pits.

All costs associated with the importation of suitable material from borrow or other sources must be borne by the Contractor, including excavation, crushing, screening, transport and royalties, and the tendered rates for material from borrow must include therefore, as no other payment will be made in this regard.

The Contractor shall co-ordinate his borrowing operations with other contractors that might be using the same borrow pit(s).

The closing down of a borrow put will include all earthworks required to leave the area in a neat condition without irregularities in the surface and with even slopes to the satisfaction of the Engineer and other concerned parties.

PSD7.2.3 Disposal (Sub-Clause 5.2.2.3)

Replace the second sentence with the following:

"The Contractor shall provide all necessary spoil sites for the spoiling of all surplus and unsuitable materials and shall make the necessary arrangements with the owner of the site where the material is disposed of, and pay all charges and levies as may be applicable for the use of such spoil sites. No excess material shall be spoiled at the Site of the Works.

Every spoil site provided by the Contractor shall be approved by the local authority in whose area it is located, and the spoiling shall comply with the applicable statutory and municipal regulations as well as the requirements of the owner of the spoil site.

If so instructed by the Engineer, surplus or unsuitable materials arising from the works shall be spoiled and neatly spread and levelled so as not to interfere with future works nor to disrupt the natural overland flow of storm runoff, at spoil areas arranged by the Contractor and approved by the land owner and Engineer. Where a pipeline is laid within a rail or road reserve the route of the pipeline shall be finished neatly to be flush with the natural ground level or finished sidewalk level as may be applicable.

Payment to the Contractor in respect of locating and making arrangements for suitable spoil sites and spoiling material at such sites will be made in accordance with the provisions of sub-clause PSD 8.3.15."

PSD7.2.4 Selection and stockpiling

Add the following new sub-Clause 5.2.2.4

"PSD 5.2.2.4 Selection and stockpiling

Approval or designation of the material in a particular borrow pit or excavation for particular purpose does not imply that all the material in the borrow pit or excavation is suitable for the particular purpose to which the said approval or designation relates, nor that all material in the borrow pit or source should be used for the particular purpose. The Contractor shall select suitable material from that borrow pit or source, discard unsuitable material and reserve material for other purposes as necessary.

The Contractor shall organize and carry out his operations in such a manner as will prevent the contamination of suitable embankment and backfill material with unsuitable materials. Any excavated material which becomes, in the Engineer's opinion, unsuitable for use in embankments or backfill as a result of contamination, shall be disposed of in a manner acceptable to the Engineer and shall be replaced by the Contractor with materials acceptable to the Engineer, all at the Contractor's cost.

When required, or when ordered by the Engineer, material shall be stockpiled for later use. The additional costs for stockpiling material shall be paid to the Contractor in accordance with the provisions of sub-clause PSD 8.3.14."

PSD7.3 Placing and Compaction

Add the following new sub-Clause 5.2.3.3

"PSD 5.2.3.3 Backfilling with soilcrete

Soilcrete backfilling shall be a G5 material as specified in SABS 1200M, stabilised with 5% cement and compacted to 93% modified AASHTO maximum density.

PSD7.4 Transport and earthworks

PSD7.4.1 Freehaul (Sub-Clause 5.2.5.1)

Replace this sub-Clause with the following:

"All haul within the boundaries of the Site will be regarded as freehaul."

PSD8 TESTING

PSD 8.1 Taking and testing of samples

Replace the contents of this sub-clause with the following:

"The Contractor shall arrange with an approved independent laboratory engaged by the Contractor to carry out sufficient tests on a regular basis as agreed between him and the Engineer to determine whether the degree of compaction, and, where applicable, the quality of materials used, comply with the Specifications and shall submit the results of these tests to the Engineer in a form approved by him.

The compaction requirements for fills shall be deemed complied with when at least 75% of the dry-density tests on any lot show values equal to or above the specified density and when no single value is more than five (5) percentage points below the specified value."

PSD9 MEASUREMENT AND PAYMENT

PSD9.1 SCHEDULED ITEMS

PSD9.1.1 Restricted excavation (Sub-Clause 8.3.3)

Replace the words "in 1 m increments" at the end of the first sentence of sub-item (a) with "in the increments indicated in the schedule of quantities".

Replace "in 5.2.2.1 – 5.2.2.3 (inclusive)" at the end of sub-clause (a) with "in sub-clauses 5.2.2.1 to 5.2.2.5 (inclusive)".

PSD9.1.2 PSD8.3.14 Extra over items PSD 8.3.2.(a)(1) and PSD 8.3.3 for temporary stockpiling Unit: m³

Add the following new sub-Clause:

The unit of measurement shall be the cubic meter of material from necessary excavations, temporarily stockpiled by the Contractor on the instructions of the Engineer, before being used in embankments or backfill. Measurements shall be taken in place in compacted embankment or backfill as the case may be.

The tendered rate shall include for the costs, additional to those provided for in PSD 8.3.2(a)(1) and PSD 8.3.3, of off-loading, forming and maintaining the stockpile for as long as is required, reloading and transporting within the applicable free-haul distance from the stockpile.

Payments to the Contractor under this item will only be made in respect of that material stockpiled on the instructions of the Engineer (which instruction shall state specifically that payments for such stockpiling will be paid for under this item) and no payments will be made to the Contractor under this item in respect of materials stockpiled by the Contractor on his own volition, nor for materials necessarily stockpiled by the Contractor in consequence of the sequence of operations adopted by him in the course of executing the works, whether such stockpiling was avoidable or otherwise."

PSD9.1.3 PSD8.3.15 Extra over items PSD 8.3.2(b) and PSD 8.3.3 for disposing of spoil material on a site provided by the Contractor Unit: m³

The unit of measurement shall be the cubic meter measured in accordance with sub-clause 8.2 of SABS 1200 D of surplus and/or unsuitable material disposed of, on the instruction of the Engineer, at a spoil site or spoil sites provided by the Contractor.

The tendered rate shall include full compensation for the additional cost of providing a spoil site or other means of disposing of surplus spoil material, for transporting the material regardless of the distance involved, for acceptance charges for such material and for all other incidental costs to dispose of the spoil material."

PSD9.1.5 PSD8.3.16 Extra over item PSD 8.3.3 above for:

- 1) Soilcrete backfill where directed by the Engineer Unit: m³
The unit of measurement shall be the cubic meter of soilcrete placed on the Engineer's instructions in accordance with sub-clause PSDB 3.5(d), measured in place according to the authorized dimensions.

The tendered rate shall include full compensation for supplying the cement, selecting, mixing, and placing the silcrete, and the cost of shuttering if required."

PSDB EARTHWORKS (PIPE TRENCHES)

PSDB1 CONSTRUCTION

PSDB1.1 Precautions

PSDB1.1.1 Existing Services (Sub-Clauses 5.1.4)

Where any existing service occurs within the specified trench excavation, and the presence of such service is known before being uncovered, then the protection of the service will be scheduled and measured as provided for in Clause 8.3.5 of 1200DB. Only known services (as defined in Clause 5.4 of 1200A) shall be measured for payment.

Where an unknown existing service is damaged during construction, and the Engineer orders that the Contractor should undertake the repair of such service, then such repair will either be measured and paid as dayworks or alternatively as a contractual variation in terms of Clause 13 of the General Conditions of Contract.

No construction activity which may affect the integrity of telephone or electrical poles or stays may be carried out without the prior written approval of the Engineer, which approval shall only be given subject to the acceptance of a *modus operandi* that will ensure the integrity of such structures during construction.

PSDB1.1.2 Special Water Hazards (Sub-Clause 5.1.2.2)

Where groundwater is present during construction to such an extent that, in the opinion of the Engineer, it would hamper the placing and consolidation of the granular or concrete bedding, as the case may be, or would cause buoyancy of the pipes, the Engineer may order the provision of a drain in the bottom of the trench to assist with dewatering during the construction and until the trench has been backfilled to such an extent that buoyancy of the pipeline will be prevented.

The drain shall be constructed over the full width of the trench as follows:

- Place filter cloth (Kaytech A4 or similar) to cover the trench bottom and part of the
- vertical trench sides.
- Place and compact 300mm thick 13mm crushed stone bedding.
- Cover the stone bedding with the installed filter cloth to a minimum overlap of 300mm.

At points designated by the Engineer, sumps shall be formed from which ground water can be pumped to maintain the water table below the pipe bedding level. The Contractor shall, if instructed, establish on site, operate and remove on completion, a dewatering pump of 10 l/s minimum capacity as per the requirements of Item 8.3.4(b) of 1200 DB. Lengths of trench opened at any one stage shall be limited by the dewatering capacity of the pump.

PSDB1.2 TRENCH WIDTHS (Sub-Clauses 4.1 and 5.2)

Trenches in general shall not exceed the widths laid down in Sub-Clause 8.2.3 or shown on the. If trenches exceed the specified width the Contractor shall be liable for the cost of any thicker pipes or more expensive bedding which may be required as a result of the additional trench width.

PSDB1.3 EXCAVATION (Sub-Clause 5.4)

The Contractor will be required to follow a procedure, whereby laying, jointing, testing and backfilling for each section of the pipeline will follow soon after trenching, and he will not be permitted to open up lengths of trench far in advance of pipe laying and backfilling operations. If in the opinion of the Engineer, trenching has proceeded too far ahead of pipe laying and backfilling, the Engineer shall have the right to stop trenching until the pipe laying and backfilling has caught up and the Contractor shall not be entitled to any extra payment due to this instruction.

PSDB1.4 TRENCH BOTTOMS (Sub-Clause 5.5)

Replace the first paragraph of this sub-clause "Material that compacted as directed" with the following :-

Where a firm foundation cannot be obtained at the grade indicated due to soft or unsuitable material, the Engineer may instruct the Contractor to remove such unsuitable material and to backfill the excess depth with approved selected material or concrete, as directed by the Engineer in each particular case, at the cost of the Employer. Backfill other than concrete, shall be placed in layers of 100mm uncompacted thickness, each layer thoroughly compacted to the entire satisfaction of the Engineer, to provide adequate support for the pipe bedding to be placed on top of it.

Should the Contractor remove more ground than is required to secure the proper grade of the pipeline, the Contractor must, at his own cost, backfill the excess excavation with approved selected material or concrete, as directed by the Engineer in each particular case.

PSDB1.5 DISPOSAL OF EXCAVATED MATERIAL (Sub-Clauses 5.6.3 and 5.6.4)

All surplus or unsuitable materials arising from excavation shall be spoiled and spread within or adjacent to the Site of the Works or, when ordered by the Engineer, be spoilt at a spoil site established by Contractor.

PSDB1.6 FREEHAUL AND OVERHAUL (Sub-Clause 5.6.8)

All hauls shall be considered free hauls, and no payment will be made for hauls.

PSDK GABIONS AND PITCHING

PSDK1 MATERIALS

PSDK 1.1 Stone (Sub-Clause 3.2.1)

Replace the contents of table 2 with the following:

"Table 2 size and mass of individual stones for pitching"

1	2	3	4
Size/mass of pitching	Thickness of pitching mm, min	Least dimension mm, min	Mass kg, min
Extra heavy	600	300	180
Heavy	400	190	50
Medium	300	150	27
Light	200	110	11

PSDK2 CONSTRUCTION

PSDK2.1 Grouted pitching

Replace the words "(table 4)" in the second line of the first paragraph with "(table 2)".

PSDM EARTHWORKS (Roads, subgrade)

PSDM1 MATERIALS

PSDM1.1 Classification for Placing Purposes

PSDM1.1.1 Selected layer (Sub-Clause 3.2.3)

Replace the contents of this sub-clause with the following:

"The following requirements shall apply in respect of the selected layer:

a) Maximum particle size: 60% of compacted layer thickness

b) Unstabilized selected layer

i) Upper selected layer

Minimum CBR at 93% of modified AASHTO density: 15

Maximum PI: 12 (the Engineer has the right to alter this requirement to 3 x the grading modulus + 10)

ii) Lower selected layer

Minimum CBR at 90% of modified AASHTO density: 7

Maximum PI: 12 (the Engineer has the right to alter this requirement to 3 x the grading modulus + 10)

c) Stabilized selected layer

Minimum grading modulus of natural material: 0.75

UCS of stabilized material 300 kPa - 500 kPa at 93% of modified AASHTO density

Maximum PI for stabilized material: 10"

PSDM2 CONSTRUCTION – METHODS AND PROCEDURES

PSDM2.1 Cut and Borrow

PSDM2.1.1 Use of material (Sub-Clause 5.2.2.3)

Add the following paragraph:

" e) Commercial sources

The provisions of sub-clause PSD 5.2.2.5 of SABS 1200 D as amended shall apply."

PSDM2.1.1 Catchwater mounds and channels and mitre banks and channels (Sub-Clause 5.2.2.6)

Add the following sentence:

"Catchwater mounds and mitre banks shall be compacted to a minimum density of 90% of modified AASHTO density."

PSDM2.2 Treatment of the roadbed

PSDM2.2.1 Removal of suitable ground (Sub-Clause 5.2.3.2)

Replace the second sentence of paragraph (a) with the following:

"The excavated spaces shall then be backfilled with approved imported material compacted to the required density."

Add the following sentence to paragraph (b):

"Unsuitable excavated material will be paid for as cut to spoil."

PSDM2.2.2 Treatment of roadbed (Sub-Clause 5.2.3.3)

Add the following paragraph:

" c) Three-pass roller compaction

Any portion of the roadbed that is shown on the Drawings or is specified or is directed by the Engineer to be given three-pass roller compaction because of its inadequate natural density, shall be prepared by shaping where necessary and compacting with a roller, complying with the requirements specified below.

Compaction shall comprise three complete coverages by the wheels of the specified roller over every portion of the area that is being compacted. While it is not the intention that the Contractor should apply water to the roadbed for this type of compaction, and while no rigid moisture control will be exercised during compaction, the Contractor shall nevertheless satisfy the Engineer that everything is being done to take full advantage of favourable soil moisture conditions during the rainy season, and that such compaction is as far as possible carried out when the roadbed is neither excessively dry nor excessively wet.

The Engineer has the authority to decide when conditions are favourable for compaction and where such compaction is to be carried out at any particular time, and he has the right to instruct the Contractor to water the roadbed at the Contractor's expense when, in the opinion of the Engineer, the Contractor failed, neglected or refused to comply with these requirements.

The rollers to be used for roller-pass compaction shall conform to the following requirements:

Grid roller: The grid roller shall have a mass of not less than 13,5 t when ballasted, shall be loaded to this mass if required, and shall be moved at a speed of not less than 12 km/h.

Vibratory roller: The vibratory roller shall be capable of exerting a combined static and dynamic force of not less than 120 kN/m width for every metre of loose-layer thickness at an operating frequency not exceeding 25 Hz and shall move at a speed not exceeding 4 km/h."

PSDM2.3 Selected layer (Sub-Clause 5.2.5)

Replace the contents of this sub-clause with the following:

"Except with regard to density, the requirements of sub-clause 5.2.4 shall apply. The degree of compaction shall be:

Upper selected*

Selected* : 93% of modified AASHTO density

PSDM2.4 Gravel surfacing (Sub-Clause 5.2.6)

Replace the third sentence of this sub-clause with the following:

"The relevant requirements in sub-clause 5.2.4.2 shall apply, except that the material shall be compacted to 93% of modified AASHTO density."

PSDM2.5 Transport (Sub-Clause 5.2.8)

Replace the contents of this sub-clause with the following:

"The provisions of sub-clause PSD 5.2.5 of SABS 1200 D, as amended, shall apply."

PSDM3 TESTING

PSDM3.1 Routine Inspection and Testing (Sub-Clause 7.3)

Replace table 2 and the contents of sub-clause 7.3.2 with the following:

"PSDM 7.3.2 The dry density requirements for a particular lot of selected layer or wearing course shall be deemed to be satisfied if the average density and the results of individual tests meet the requirements specified in table 2 below. Refer to sub-clause PSD 7.2 for the requirements for fill.

1	2	3	4	5
Layer	Specified density (% of modified AASHTO density)	Number of tests per lot	Average density, %	Minimum density for any single test, %
Upper selected*	93	3 and 4	93,1	89,4
or selected		5	93,4	89,2
layer* and gravel		6	93,6	89,0
wearing course*				

PSDM4 MEASUREMENT AND PAYMENT

PSDM4.1 Computation of quantities

Replace sub-clauses 8.2.1 to 8.2.3 (inclusive) with the following:

"PSDM 8.2.1 The provisions of subclause 8.2.1 of SABS 1200 D shall apply.

PSDM 8.2.2 The provisions of subclause 8.2.2 of SABS 1200 D shall apply.

PSDM 8.2.3 The provisions of subclause 8.2.2 of SABS 1200 D shall apply."

PSDM4.1.1. Verifying quantities (Sub-Clause 8.2.5)

Replace the first sentence with the following:

"Before any earthworks are commenced but after completion of any site preparation, the Engineer will, upon a written request from the Contractor, provide cross-sections for the purpose of measurement of earthworks quantities."

PSDM4.2 Scheduled items

PSDM4.2.1 Treatment of roadbed (Sub-Clause 8.3.3)

(a) Roadbed preparation and compaction of material to

Add the following:

"The unit of measurement shall be the cubic meter of material recompacted as specified and the volume shall be determined from levelled cross-sections on which are superimposed the levels to which the roadbed is to be constructed. When material is imported to make up the required volume, such material will be paid for as cut or borrow to fill as relevant."

PSDM4.2.2 Cut to fill, borrow to fill (Sub-Clause 8.3.4)

Replace the last sentence of this item with the following:

"The unit of measurement shall be the cubic meter of fill and the volume will be calculated in accordance with the authorized dimensions of the embankment and levelled cross-sections.

The tendered rates shall include full compensation for excavating the material as if in soft material, for selecting, loading, transporting for the free-haul distance, off-loading, watering, mixing and compacting the material as specified. Borrow to fill in this item relates to material from designated borrow areas (provided by the Employer).

Where it is required that material be obtained from commercial sources, payment for procuring the material will be made under item PSDM 8.3.17."

PSDM4.2.3 Selected layer compacted to 93% of modified AASHTO maximum Density (Sub-Clause 8.3.5)

Replace the heading and the contents of this item with the following:

"PSDM 8.3.5 Selected layer using material from commercial sources:

- a) Compacted to 90% of modified AASHTO density Unit: m³
- b) Compacted to 93% of modified AASHTO density Unit: m³

The unit of measurement shall be the cubic meter and the quantity will be calculated from the authorized dimensions of the compacted layer.

The tendered rates shall include full compensation for excavating the material as if in soft material for loading, transporting for the free-haul distance, off-loading, spreading, watering, mixing, breaking down and compacting the layer."

PSDM4.2.4 Cut to spoil or stockpile from (Sub-Clause 8.3.7)

Replace the heading with the following:

"PSDM 8.3.7 Cut to spoil from"

PSDM4.2.5 Overhaul

Replace this item with the following:

"PSDM 8.3.12 Overhaul

Delete this item as no overhaul will be paid on material for the purposes of this Contract and all the costs for transporting material shall be included in the applicable tendered rates and amounts."

PSDM4.2.6 Final finishing and cleaning up of the site of the works

Add the following item:

"PSDM 8.3.18 Final finishing and cleaning up of the site of the works

Unit: sum

The tendered sum shall include full compensation for the clearing, disposal of material, finishing, tidying and all other work required to finish and clean up the Site of the works and affected areas by removing excess earth, stones, boulders, debris and other waste material, by clearing stormwater inlets and outlets and pipe barrels, by clearing the surfacing of all dirt, mud and foreign material, and by neatly finishing off all junctions, intersections and kerbing.

All material resulting from the finishing operations shall be disposed of to a spoil site furnished by the Contractor.

The tendered rate shall make provision for the reinstatement of existing driveways to their original condition where these have been affected by the works, as these items will not be measured and paid for separately."

PSDM4.2.7 PSDM 8.3.19 Extra over items 8.3.4, 8.3.5 and 8.3.16 for obtaining material from commercial sources

Unit: m³

Add the following new item:

The tendered rate shall include full compensation for the additional cost of finding a suitable source of material, for procuring the material and paying all royalties or other charges to the owner of the source, for transporting the material to the point of use regardless of the distance hauled and for excavating in intermediate, hard or boulder material as required.

Items PSDM 8.3.6, PSDM 8.3.12 and PSDM 8.3.14 do not apply to material obtained from commercial sources.

PSG CONCRETE (STRUCTURAL)

PSG1 SCOPE (Sub-Clause 1)

This specification covers the requirements for water-retaining structural concrete for civil engineering work.

PSG2 INTERPRETATIONS

PSG2.1 Definition (Sub-Clause 2.3)

For purpose of this variation to the Standard Specification, all reinforced concrete structures at the Umzinto WWTW will be regarded as water-retaining structures unless stated otherwise in the Project Specification. The Standard Specification shall be applicable to all other concrete structures not mentioned above.

PSG2.2 Explanation of Terms

PSG2.2.1 Exposure Conditions

For the purpose of this Specification, Water retaining structures shall be deemed to be classified under clause 2.4.1.3 (severe conditions) as specified in SABS 1200 G unless specified otherwise in the project specification.

PSG3 CEMENT

PSG3.1 Applicable standards (Sub-Clause 3.2.1)

All cementitious material used in concrete shall comply with the following standards, as relevant:

Common cements

SANS 50197-1: Cement part 1: Cement composition, specifications and conformity criteria

Cement extenders

SABS 1491: Part I Ground granulated blast furnace slag

SABS 1491: Part II Fly ash

SABS 1491: Part III *Condensed silica fume*

PSG3.2 Type (Sub-Clause 3.2.2)

Only CEM I of strength 32.5N and with a C₃A content of less than 9% shall be used in water-retaining structures.

PSG4 AGGREGATES (Sub-Clause 3.4)

The following additional requirements shall be applicable to water retaining structures:

PSG4.1 Fine Aggregate

Samples of the proposed fine aggregate shall be submitted to the Engineer for his approval before use.

The Contractor shall submit a sieve grading analysis to the Engineer for approval and if unacceptable, the Contractor shall offer another sample and grading for approval or may blend aggregate from different sources and submit the blend for approval.

The water demand of the fine aggregate shall not exceed 195 l/m³.

Fine aggregate shall be stored on a concrete surface and washed sand shall be allowed to drain for at least 24 (twenty-four) hours before use. The Engineer may require the Contractor to test the sand daily (or more frequently if necessary) for moisture content, impurities and grading before use.

PSG4.2 Coarse Aggregate

The voids ratio of the coarse aggregate shall not exceed 47 % (forty-seven per cent). Single sized aggregates shall be stored on a concrete surface in separate stock piles, according to size. The proportions of the various single sized aggregates required for the various portions of the work shall be submitted by the Contractor for the Engineer's approval.

PSG4.3 Origin

Aggregates for concrete in contact with sewage or sewage gases shall be of dolomitic origin. All concrete for sewers and sewage treatment facilities, except concrete for the following, shall therefore be made with aggregates of dolomitic origin:

- Blinding;
- Mass concrete for foundation fill;
- Concrete for encasing and bedding pipes

PSG5 FORMWORK (Sub-Clause 4.5)

PSG5.1 Design

The use of wooden formwork shall generally not be allowed for the construction of any visible surfaces above normal water level on any structure. This requirement applies to all walls, columns, walkways and steps.

Formwork for circular structures (sedimentation tanks, clarifiers, anaerobic digesters etc) shall be custom-designed and manufactured to suit the specific radius of the structure.

PSG5.2 Finish

Unless otherwise specified, the surface finish of all structural concrete on water-retaining structures shall be Smooth as defined in clause 5.2.1 (b).

PSG6 CONSTRUCTION (Clause 5)

PSG6.1 Reinforcement (Sub-Clause 5.1)

The following additional requirements shall be applicable to water-retaining structures:

PSG6.1.1 Fixing (Sub-clause 5.1.2)

The use of plastic spacer blocks will not be allowed. Concrete spacer blocks, of same mix design as the strength concrete, shall be used.

"The Engineer will inspect the reinforcing after it has been fixed in place, the formwork has been cleaned, cover blocks have been positioned, and before concreting commences.

Welding of reinforcing steel will not be permitted."

PSG6.1.2 Cover (Sub-clause 5.1.3)

In water retaining structures the exposure condition of a reinforcing bar closest to the face in direct contact with water or soil backfilling, shall be classified as severe.

It should be noted that in some water retaining structures only one face of the structural elements will be in contact with water.

Unless detailed to the contrary, the minimum cover on the waterside shall be 50mm on and the cover on the non-water side as specified for mild exposure conditions.

The soffit of a slab suspended above the water (e.g. a reservoir roof) will be treated as being in contact with the water for the purpose of determining the cover.

PSG6.2 Concrete

PSG6.2.1 Strength concrete (Sub-Clause 5.5.1.7)

It is a requirement that the Contractor employ the services of an approved specialist to recommend design mixes compatible with the Specification. The preferred specialist shall confirm in writing:

No concrete shall be placed until the Contractor's concrete mix design has been approved by the Engineer. The Contractor shall submit to the Engineer a statement of the mix proportion proposed, together with a report from an approved testing laboratory, showing the 28-day concrete strength obtained when using the materials proposed for the work.

The strength determinations shall be based on not less than three concrete test specimens.

When the Contractor can furnish reliable test records of concrete of a quality at least equal to that specified, having been made with materials from the same sources and of the same qualities as he proposes to use, the Engineer may waive all or part of the strength tests required in the above paragraph.

The preparation of the 150 mm test cube specimens and the sampling techniques shall be in accordance with the relevant SABS specification.

Concrete for water retaining structures shall be class (min) 35MPa/19mm concrete and shall have a cement/water ratio not less than 2.38 and a cement content of not less than 380 kg/m³.

The cementitious material should consist of 70% OPC and 30% Fly Ash.

Admixtures may be used to increase the workability of the concrete but only with the express approval of the Engineer and when the details of the active ingredients of the admixture and their effects are supplied to the Engineer for approval before use. No additives likely to impair low permeability of the concrete will be approved. Calcium chloride or admixtures containing chlorides may not be used in concrete for water retaining structures. Other admixtures and constituents may only be used with the approval of, or as specified by the Engineer.

Water used for batching concrete shall be clean and free from harmful concentrations of acids, alkalis, salts, sugar or other organic or chemical substances. If the water used for bathing purposes is not obtained from the public drinking water supply system, the Engineer may require the Contractor to have the suitability of the water proved by means of tests by an approved laboratory. The costs of these tests or any subsequent tests ordered by the Engineer shall be borne by the Contractor.

PSG6.2.2 Placing (Sub-Clause 5.5.5)

Panels between construction joints shall be cast in long strips and saw cut as per details.

PSG6.2.3 Construction Joints (Sub-Clause 5.5.7)

The following additional requirements shall be applicable to water-retaining structures:

The Engineer may allow the Contractor to cut an additional straight construction joint if it is possible without prejudicing the water tightness of the structure. The additional construction joint shall be sealed with the same seal that is specified for planned construction joints at the expense of the Contractor.

Construction joints in reinforced concrete walls, embankments, etc. shall consist only of horizontal joints. If a vertical construction joint is unavoidable, it may only be constructed with the approval of the Engineer.

Construction joints shall only be placed at intervals shown on the drawings or as directed by the Engineer. The exact position of construction joints shall be marked on the formwork in order to obtain truly horizontal joints.

Preparation of Surface

Prior to placing any further concrete, the joint must be clean, damp and free of laitance. During the period when the concrete is still green, all loose material shall be removed, without disturbing the aggregates, by light brushing. Where this is not possible, or if the concrete has already set, the surface film shall be removed by mechanical means appropriate to the degree of hardness of concrete so as to expose the aggregate over the entire surface and leave a sound, irregular surface.

Before Placing Concrete

Where the concrete of the previous lift is more than 3 days old, it shall be kept wet to create a damp substrate before the slush and fresh concrete is placed.

On all construction joints the following steps shall be taken after the surface has been prepared and at the most, 30 minutes before placing the concrete:

- i. Remove all surface water with an air hose; install the swellable bar strictly following the
- ii. manufacturer's specification;
- iii. Brush a layer of slush consisting of cement and gauging liquid, made up of equal volumes
- iv. clean water and Duralex (or similar and approved) mixed with cement in the same proportion as used in the concrete;
- v. Place concrete within 30 minutes.

PSG6.2.4 Curing and Protection (Sub-Clause 5.5.8)

SABS 1200 G Clause 5.5.8 will be deleted for the purpose of this Specification and replaced with the following:

"All concrete other than blinding concrete shall be maintained continuously saturated for at least ten days or as directed on the drawings immediately after placement or after stripping formwork in the case of walls, by methods which shall receive the prior written approval of the Engineer if different from the following:

For floors

Ponded water with a minimum depth of 30 mm.

For Walls

Continuously saturated heavy jute sacking or other approved absorbent material maintained in contact with the concrete surface by fastenings spaced at not more than 2 m centres.

Columns

Covering the previously saturated surfaces with approved plastic sheets maintained in contact with the concrete surface and with all edges and joints sealed by methods approved by the Engineer.

Where the ambient temperature is below 4°C the curing period of 10 days or as directed on the drawings, will be extended by 72 hours.

Newly cast concrete sections shall not be used for supporting loaded wheel-barrows, monorails, material or scaffolding, etc., until permission is obtained from the Engineer."

PSG6.2.5 Adverse Weather Conditions (Sub-Clause 5.5.9)

Concreting in cold weather

During cold weather no material having a temperature below 5 °C shall be used for making concrete.

No concrete shall be placed when the ground or air temperature is below 2°C or if the ground or air temperature is likely to fall below 2° C within 6 (six) hours of placing the concrete.

The temperature of placed concrete shall not be allowed to fall below 5 °C until the concrete has attained a strength of at least 5 Mpa, and the Contractor shall be responsible for all the necessary protective measures to ensure this. All concrete that has been damaged by frost or by the formation of ice in the concrete shall be removed and replaced by the Contractor at his own expense.

Concreting in hot weather

During hot weather, the temperature of the concrete, as placed, shall not exceed 30°C. The Contractor shall ensure that the placing of the fresh concrete does not exceed the ambient temperature by more than 5°C. Where necessary this shall be accomplished by shading aggregate stockpiles, shading or insulating water pipes and water storage tanks.

PSG6.2.6 Concrete Surfaces (Sub-clause 5.5.10)

a) Wood-Floated Finish

Where wood floating is specified or scheduled, the surface shall first be given a finish as specified in Sub-Clause 5.5.10.1 of SABS 1200 G after the concrete has hardened sufficiently, it shall be floated to a uniform surface free of trowel marks. The screeded surface shall be wood-floated, either by hand or machine, only sufficiently to produce a uniform surface free from screed marks.

b) Steel-Floated Finish

Where steel is specified or scheduled, the surface shall be treated as specified in PSG6.1 except that, when the moisture film has disappeared and the concrete has hardened sufficiently to prevent laitance from being worked to the surface, the screeded surface shall be steel trowelled under firm pressure to produce a dense, smooth uniform surface free from trowel marks.

c) Power-Floated Finish

Where power floating is specified or scheduled, the surface shall be treated as specified in PSG6.1 except that the screeded surface shall be power-floated to produce a high quality dense, smooth, uniform surface free from trowel marks.

PSG6.2.7 Watertight Concrete (Sub-Clause 5.5.11)

a) Construction Joints (Sub-Clause 5.5.7)

Joints in the concrete, at which special measures are taken to achieve subsequent continuity, are termed construction joints. Construction joints will be permitted only where shown on the drawings or approved by the Engineer and shall be formed true to line on all formed or exposed surfaces. Horizontal joints shall be formed by casting against a timber or metal former. Recesses shall be formed as detailed on the drawings. Swellable bars and grout tubes, where detailed on the drawings, shall be cast into the joints. No unplanned construction joints will be allowed. If a breakdown occurs and there is no back-up plant to

continue the pour, the contractor shall strip the shuttering as soon as possible and break out all concrete up to the previous planned construction joint.

Except in the case where movement joints are required, the entire joint contact area of the concrete already placed, excluding the swellable bar and grout tube area, shall be thoroughly roughened by chipping with sharp chipping picks before placing concrete against the surface. This surface will not be accepted unless the coarse aggregate projects 5 mm beyond the surrounding matrix. In this connection approved light pneumatic or electric tools are preferred provided that no structural damage is done to the concrete being chipped: otherwise, hand tools are to be used. Chipping shall not be commenced until at least 48 (forty-eight) hours after the concrete was placed.

Alternative methods of preparing the surfaces of construction joints to those given above will be considered. The Contractor shall submit proposed alternative methods of achieving the roughened surface required to the Engineer for approval.

Should the Engineer at any time withhold or withdraw permission for alternative methods to be used then the Contractor shall prepare the surfaces of construction joints in accordance with the above specification.

Immediately before the adjoining concrete is placed, the chipped surface shall be prepared as per Clause PSG 6.2.3 [Preparation of surface].

In exceptional cases and only at the discretion of the Engineer, the percentage of coarse aggregate of the mix may be slightly reduced in a layer not exceeding 200 mm in depth immediately above the chipped surface of a horizontal construction joint. Suitable temporary openings shall be left in the shuttering to allow for the removal of sawdust, shavings, nails, debris, etc.

The application of compounds to the surfaces of stop ends at vertical joints to retard the setting of a film of concrete in contact with the stop end will be permitted subject to the Engineer's approval of the compound to be utilized and the Contractor's methods for the application of the same.

Movement Joints

Movement joints shall be formed where shown on the Drawings.

Movement joints shall be formed true to line and shall be thoroughly cleaned of all accretions of concrete or other foreign matter by scraping or other approved means. The surfaces in contact with joint sealing material shall be prepared strictly in accordance with the manufacturer's Specification.

WATERPROOFING OF CONCRETE JOINTS

Three different systems of waterproofing (or construction of systems) exist, and the appropriate system (or combination) will be applied as specified on the drawings: The three systems are:

- i. Waterproofing with hypalon bandage system
- ii. Waterproofing with swellable bars and grout tubes
- iii. Waterproofing with surface sealants

Hypalon system

Hypalon bandage joint sealing system shall be the Sikadur-Combiflex Hypalon bandage system as supplied by Sika (Pty) Ltd.

The joint shall consist of 2 mm thick Combiflex Hypalon sheeting, 200mm and 250mm wide, as shown on the drawings. The Hypalon sheeting shall have a tensile strength of 6N/mm² and an elongation at failure of not less than 400%.

The Hypalon sheeting shall be bonded to the concrete with Sikadur 31 two component, solvent free, moisture tolerant, high viscosity, epoxy paste adhesive.

Swellable Bars

Swellable bars shall have a volume increase of at least 170% and shall be adhered to the substrate with a suitable adhesive. Swellable bars shall be minimum 20mm x 10mm and approved types are Sika Swell Profile with Sika Swell S-2 adhesive and Masterflex 610 or 611 adhesive.

Swellable bars shall be installed strictly in accordance with the manufacturer's specification and recommendations.

Grout tubes

Where indicated on the drawings, the Contractor shall, over and above the swellable bars, provide and install permeable grout tubes to prevent leakage through construction joints. The components and installation procedures shall be in accordance with the manufacturer's specifications and recommendations. The injection of sealing material shall be done by the manufacturer's approved applicator.

Grout tube systems that are approved for use are Masterflex 900 (BASF), Sikafuko VT1, DeNeef InjectoTube and Tam Injection Tube RI.

Waterproofing with surface sealants

a) General

A groove of dimensions specified shall be formed, where indicated, and sealed by an approved sealant. The sealant shall be non-toxic and shall be either a hand applied bitumen putty sealant or a polysulphide sealant. The type of sealant to be specified on the drawings and the product to be used shall be approved by the Engineer.

b) Polysulphide Sealant

All joints shall be clean, dry and free of laitance. Prime joint face if required – following the suppliers specification. Apply the sealant and finish off flush with the concrete surface.

PSG7 TOLERANCES (Clause 6)

PSG7.1 General (Sub-Clause 6.2.1)

Unless otherwise stated on the Drawings, the degree of accuracy applicable to all concrete structures shall be Degree of Accuracy II (refer to table under clause 6.2.3).

PSG8 MISCELLANEOUS

PSG8.1 Porous concrete/No-fines concrete

Porous or no-fines concrete shall be laid under foundations and floor slabs and behind walls, etc, where shown on the drawings and where directed by the Engineer. Porous concrete shall be placed behind shuttering to form a vertical layer against the external face of foundations etc where shown on drawings and where directed by the Engineer. The thickness of the horizontal, sloping and vertical layers shall not be less than that shown on the drawings.

The exposed faces, both horizontal and vertical, of the porous concrete shall be finished with a cement mortar seal where reinforced concrete is to be cast against it. The porous concrete shall be sealed with a 5mm thick layer of mortar composed of one-part normal portland cement to two

parts of fine aggregate by mass, trowelled on before the porous concrete has hardened to provide a smooth, uniform plane surface without filling any of the internal voids of the porous concrete. The surface of the seal shall have a steel or power float finish.

The schedule rates for porous concrete shall include the cost of the mortar seal and steel float finish.

Porous concrete shall comprise water, cement, coarse aggregate and not more than 5% (five percent) by mass of fine sand. The voids ratio of porous concrete shall not be less than 27.5% (twenty-seven and one half) percent. Testing of porous concrete shall be carried out in accordance with test method 3 of BS 1881 Part 3 – 1970.

a) Classes of no-fines concrete

No-fines concrete shall be classified by the prefix NF and the size of aggregate to be used. Class NF 19 means a no-fines concrete with a 19 mm nominal size aggregate.

The volume of aggregate per 50 kg of cement for each class of concrete shall be as follows:

<u>Class</u>	<u>Aggregate per 50 kg cement</u>
NF 38	0,33 m ²
NF 19	0,30 m ²
NF 13	0,27 m ²

b) Batching and Mixing

Cement shall be measured by mass or in full pockets of 50 kg each and aggregate shall be measured by volume in approved measuring boxes or barrows.

The aggregate shall be moist or wetted before the cement is added. Where drum mixers are used, about 20% of the water shall be poured into the drum before the aggregate and cement are loaded. The mixing time in the drum shall be about 45 to 50 seconds.

The quantity of water added shall be just sufficient to form a smooth grout which will adhere to and completely coat each and every particle of aggregate, and which is just wet enough to ensure that, at points of contact of aggregate, the grout will run together to form a small fillet to bond the aggregate together. The mix shall contain no more than 20 liters of water for every 50 kg of cement.

Mixing shall be done in an approved batch-type mechanical mixer, but small quantities may be hand-mixed.

c) Placing

No-fines concrete shall be placed in accordance with the procedure approved by the Engineer. It shall be placed in its final position within 15 minutes of having been mixed.

The concrete shall be worked sufficiently to ensure that it will completely fill the space to be concreted and that adjacent aggregate particles are in contact with one another. Excessive tamping or ramming shall be avoided and under no circumstances shall the concrete be vibrated.

d) Protection

All no-fines concrete shall be protected from the elements and loss of moisture. Protection against loss of moisture shall be accomplished by one or more of the following methods:

- Retaining formwork in place

- Covering exposed surfaces with sacking or other approved material kept continuously wet

- Covering exposed surfaces with plastic sheeting

No-fines concrete placed during cold weather shall be adequately protected against frost for at least 3 days.

e) Measurement and Payment

Cast-in-situ no-fines concrete (state class).....Unit: m³

The provisions of sub-clause 8.1.3 of SABS 1200 G shall apply *mutatis mutandis*.

PSG8.2 Bond breaker

Unless otherwise indicated on the drawings or by site instruction, all no fines (porous) concrete under floor slabs and wall footings etc. shall be covered with a bond breaker consisting of 100 micron tear resistant damp proof membrane to SABS 952 (1969) C having 150mm laps and pierced at 1m intervals to allow the passage of water.

PSG8.3 Pipe work

All pipe specials shall be cast in by the Contractor. Special care shall be taken to maintain them in the exact position shown on the drawings and also to render the joints watertight.

The permanent fixing of any pipe item to the steel reinforcing shall be unacceptable.

For pipework to be cast in at a later stage, square box-outs shall be provided. For pipes with puddle flanges to be cast in, the size of the box-out shall be suitable for the outside diameter of the pipe plus a full size (class 10) flange according to SANS 1123 plus 100mm. For pipes without puddle flanges, the size of the box-out shall be suitable for the outside diameter of the pipe plus 100mm.

Pipework cast into concrete structures shall be done so with a suitable standard non-shrink grout (BASF Masterflow 525, Sika SikaGrout 212 or similar).

PSG8.4 Holding Down Bolts

All holding down bolts and nuts, other than those used in structures retaining liquid shall be galvanised in accordance with SABS 763.

All holding down bolts and nuts in structures retaining liquid shall be Stainless Steel, Grade 316.

All holding down bolts and anchorages shall be set in accordance with the drawings by means of accurate constructed steel templates and securely fixed in position to prevent displacement during the concreting.

Exposed threads of holdings down bolts shall be adequately protected with grease and sacking and this protection shall be maintained in all portions of the works until they are taken over.

For the installation of mechanical equipment (aerators, mixers, pump bases etc), nickel anti-seize shall be used on the holding down bolts.

PSG8.5 Ferrule Cap Holes

Recesses formed in reinforced concrete walls during the fixing of formwork shall be repaired on the waterside face with an approved epoxy or non-shrink grout (BASF Masterflow 525 or Sika SikaGrout 212 or similar). On the dry face, the recesses left in the concrete shall be repaired with a 1:3 cement-sand mortar. All grouting material shall be thoroughly caulked in.

No tie system leaving holes passing through the walls will be permitted. Ferrules shall be of the permanent cast in, sacrificial type.

PSG8.6 Sterilization of Reservoirs

Before a reservoir is sterilised, the roof shall have been tested for water tightness as set out in Clause 8.7 below, and the pipelines serving the reservoir shall have been sterilised. The reservoir shall then be thoroughly cleaned out and washed down with clean water.

The roof, beams, columns and walls shall thereafter be thoroughly sprayed down, using pressurised equipment, and the floors shall be scrubbed with water containing 0,015 g per litre of chloride of lime.

On completion of the sterilisation, the sterilising solution shall be run to waste before the reservoir is filled for testing its water tightness.

Should additional work be required to be done inside the reservoir after the water tightness test has been completed, the reservoir shall be re-sterilised at the Contractor's expense.

PSG8.7 Testing for Watertightness

Water for the initial filling of a water-retaining structure will be supplied free of charge by the Employer, however, the Contractor shall make the necessary arrangement to convey the water from a suitable source into the structure and shall provide any/all pumps, pipework etc to make this possible at his expense.

Each water-retaining structure shall be filled with water at a uniform rate not exceeding 2.0m in 24 hours until the top water level has been reached. The water level will then be carefully noted and recorded by the Engineer in relation to a fixed benchmark, and the structure shall be allowed to remain filled for a period of two weeks to permit complete absorption of water by the concrete.

Any loss of water which may have occurred shall then be made up by again filling the structure to the top water level and by allowing the water to remain undisturbed for a period of not less than four days. The structure shall be considered to be watertight if the drop in level in 96 hours (less the drop caused by evaporation) does not exceed 10mm.

The evaporation shall be measured by the mean drop in level caused by the evaporation of the water in three flat containers floating in the water, being recorded.

The Contractor is free to attend the taking of all measurements by the Engineer.

In the event of an appreciable leakage being evident or visible at any stage of the filling or testing, or in the event of the final degree of water tightness being unsatisfactory, the Contractor shall, when so ordered by the Engineer, discontinue such filling or testing and shall, at his own expense, take approved steps to rectify the leakage, until a test proves that a sufficient degree of water tightness has been obtained.

The water tightness of the reservoir roof shall be tested before that of the reservoir itself by water being continuously sprinkled over the roof in an approved manner so that a film of water is maintained on the surface of the slab. The roof shall be considered watertight if no damp patches are visible on the underside after 48 hours of sprinkling.

Before the expiry of the defect's notification period, the Engineer shall have the right to retest the structure for water tightness. Results of such further tests will be made available for the information of the Contractor. In the event of these tests indicating an unsatisfactory degree of water-tightness, the Engineer will, before issuing the final certificate, again require the Contractor to rectify the leakage, at his own expense, in such a manner as will cause the least interruption of the water supply to consumers and as will ensure the soundness of the work, to the satisfaction of the Engineer.

Should the failure of the reservoir to pass the first or any subsequent test for water tightness necessitate the drainage of the structure, the Employer reserves the right to utilise the water by discharging it into its water-reticulation network, in which case the Contractor:

- shall not have to pay for the subsequent refilling of the reservoir;
- shall, if applicable, reimburse the Employer for any additional costs incurred to make water fit for consumption; and
- shall not be entitled to claim for extra time whilst waiting for the water to be discharged into the network.

The costs of re-testing a water-retaining structure for water tightness shall be borne by the Contractor.

PSG9 TESTS (Clause 7)

PSG9.1 Facilities (Sub-Clause 7.1.1)

Add the following:

"The Contractor shall provide sufficient storage capacity for the concrete cubes and shall arrange to have them tested by an approved laboratory.

The cost of all testing, including the cost of sampling, storage and transport of samples shall be included in the rates tendered for concrete work."

PSG9.2 Acceptance criteria for strength concrete (Sub-Clause 7.3)

Add the following:

"Test results obtained from the supplier of ready-mixed concrete will not be accepted for evaluation in terms of sub-clause 7.3, but samples for testing shall be taken of such concrete at the point of placing."

PSG10 MEASUREMENT AND PAYMENT (Clause 8)

PSG10.1 Measurement and Rates (Sub-Clause 8.1)

PSG10.1.1 Formwork (Sub-Clause 8.1.1)

Delete "or splays over 20 mm x 20 mm" from the first line of paragraph 8.1.1.2.

Add the following to paragraph 8.1.1.2:

"Splays up to and including 25 mm x 25 mm will not be measured separately and will be deemed to be included in the formwork costs."

Add the following paragraphs:

"8.1.1.7 For construction joints at kickers, all additional costs for formwork to edges up to 300 mm high will be deemed to be included in the rates tendered for vertical formwork to sides of walls and will not be measured separately in narrow widths.

8.1.1.8 No formwork will be measured to edges of blinding layers under structures, and the cost thereof (if needed) will be deemed to be included in the rates tendered for concrete in blinding layers.

8.1.1.9 Back-shuttering or formwork to top revealed surfaces of sloping or conical formwork will only be measured to surfaces of over 40° and up to 85° to the horizontal.

8.1.1.10 Formwork to horizontal surfaces in pump stations, valve chambers, manholes or sumps can either be removed through the manhole cover opening or the Contractor may use permanent formwork at his own cost as no claims in this regard will be considered."

PSG10.2 Scheduled Concrete Items

PSG10.2.1 Strength concrete, Grade (Sub-Clause 8.4.3)

Add the following after the last sentence:

"In the case of structural floor screeds, the unit of measurement shall be the square meter and the average thickness and proportions will be stated."

Replace "Unit: m³" With "Unit: m³, m²"

PSG10.2.2 Unformed surface finishes (Sub-Clause 8.4.4)

a) Steel-floated finishes

Add the following sub-item:

"i) Extra over sub-item (b) for special finishing tolerances to top of outside
ringwalls as specified..... Unit: m²

The quoted rate shall include full compensation for the additional cost of finishing the ringwalls to closer tolerances as *specified* on the Drawings and in clause PSG 7.1."

PSG10.3 Joints (Sub-Clause 8.5)

Replace "Unit: m" with "Unit: m or m²".

ADD THE FOLLOWING ITEMS:

PSG10.4 **PSG8.9 Miscellaneous work other than metalwork..... Unit: as scheduled**

Separate items will be scheduled for each type of miscellaneous work.

The tendered rates shall include full compensation for providing all labour, materials and equipment required to carry out the work, for all preparatory work, for constructing the work scheduled in a workmanlike manner and for finishing off and cleaning up when the work has been completed.

PSG10.5 PSG8.10 Testing for watertightness:

- a) (Structure stated) Unit: sum

The unit of measurement shall be the number of each structure successfully passing the specified watertightness tests to the satisfaction of the Engineer.

The sums tendered shall include full compensation for the provision of all labour, plant and materials necessary for carrying out the test for watertightness as specified.

PSG10.6 PSG8.11 Screeds

- a) Floor screeds (1:3) with falls including V-joints to form panels and a smooth steel-trowelled fish/power float finish to top:

Description of application and thickness.....Unit: m²

- i) Etc for other applications and thickness

The unit of measurement shall be the square meter of screed constructed.

The tendered rate shall include full compensation for constructing the screeds as specified including supplying of all materials, preparing the concrete surface to receive the screeds and for all else that may be necessary to complete the work

PSG10.7 PSG8.12 Casting in pipes with or without puddle flanges

- a) Up to 300 mm nominal bore:

- i) Through (description and thickness of structural elements) Unit: number

- b) Over 300 mm up to 600 mm nominal bore:

- i) Through (description and thickness of structural elements)..... Unit: number

- c) Etc. for other nominal bores in increments of 300 mm

The unit of measurement shall be the number of each size of pipe installed.

The tendered rates shall include full compensation for installing the pipe where new pipes are used (with or without a puddle flange) in the exact position as shown on the Drawings, for splitting or cutting the formwork where required, supply and installation of suitable non-shrink grout and for ensuring watertightness where required and for all additional costs required to install the pipes specified or shown on the Drawings.

Pipe items to be cast in shall be measured elsewhere.

PSG10.8 PSG8.13 Corrosion protection by

- a) Vinyl anti-fouling paint and undercoats to form an algae-resistant coating on:

- i) (Description of structural element stated) Unit: m²

- b) Solvent-free abrasion-resistant coating and primer to a minimum thickness of 3 mm on:

ii) (Description of structural element stated) Unit: m²

The unit of measurement shall be the square meter of surface protected against corrosion.

The tendered rates shall include full compensation for surface preparation for supplying and applying the materials as specified, for all labour, equipment and appurtenant materials necessary to carry out the work and for all waste and cleaning up after the work has been completed."

PSHA STRUCTURAL STEELWORK (SMALL WORKS)

PSHA1 CONSTRUCTION (Clause 5)

PSHA1.1 Contractor to provide details (Sub-Clause 5.1.2)

Replace the first sentence of this clause with:

"The Engineer's drawings issued for construction purposes are preliminary with regards to structural steel items and the Contractor shall prepare shop drawings of all structural steel items for the Engineers approval."

Add the following sentence to the end of this clause:

"No payment shall be considered for any structural steel item without shop details being provided and approved by the Engineer in writing."

PSHA2.1 Fabrication and Assembly (Sub-Clause 5.2)

PSHA2.1.1 Protective Treatment

This clause shall be replaced with the requirements of Particular Specification PTV (Corrosion Protection).

PSHA3 MEASUREMENT AND PAYMENT (Clause 8)

PSHA3.1 Scheduled Items (Sub-Clause 8.3)

PSHA3.1.1"PSHA 8.3.2 Handrails:

Replace sub-item c(3) with the following:

"(c)(3) Extra over rails for bends, end closures and accessories:

i) (Description of item stated) Unit: number

PSHA3.1.2 PSHA 8.3.3 Ladders, complete and installed (Drawing number or type and length stated)

Replace this item with the following:

"PSHA 8.3.3 Ladders, complete and installed (Drawing number or type and length stated)

Separate items will be scheduled for grid ladders of different materials, dimensions and height.
.....Unit: number

The tendered rates shall include full compensation for the cost of supplying the specified or scheduled ladders complete, including welding where applicable."

PSHA3.1.3 PSHA 8.3.4 Flooring, Complete and installed with frames (Drawing number stated)

Replace this item with the following:

"PSHA 8.3.4 Flooring, Complete and installed with frames:

- a) Open grid floors.....Unit: m²
- b) Floor plate floors..... Unit: m² or t
- c) Frames and kerbs for flooring.....Unit: m

Separate items will be scheduled for grid floors, floor-plate floors, frames and kerbs of different materials, dimensions, weight and different methods of fixing.

The tendered rates shall include full compensation for the cost of supplying the specified or scheduled types of flooring, frames or kerbing complete, including welding where applicable."

PSME SUBBASE

PSME1 MATERIALS

PSME1.1 Physical Properties

PSME1.1.1 Subbase material (Sub-Clause 3.2.1)

Replace the contents of paragraph (a) with the following:

"(a) The maximum particle dimension of the gravel shall not exceed 63 mm."

Replace the contents of paragraph (d) with the following:

"(d) The CBR at specified density shall be 45 for unstabilized material as well as for stabilized material prior to stabilization."

Delete paragraph (e).

PSME1.1.2 Gravel shoulder and gravel wearing course material (Sub-Clause 3.2.2)

Replace the contents of this sub-clause with the following:

"The material used for gravel shoulders and gravel wearing course shall comply with the following:

- a) The PI shall not be less than 6 and not more than $(3 \times GM) + 10$.
- b) The maximum particle dimension of the gravel shall not exceed 40 mm.

c) The CBR shall be greater than 15 at 93% of modified AASHTO density."

PSME2 CONSTRUCTION

PSME2.1 Excavations

PSME2.1.1 Borrow pits (Sub-Clause 5.2.2)

Insert the words "designated by the Engineer and" between the words "pits" AND "established" in the first line.

PSME3 MEASUREMENT AND PAYMENT

PSME3.1 Basic Principles

Insert a semicolon in the first line of paragraph (b) after the words "will be paid for once only" and delete the rest of the paragraph.

Amend paragraph (d) as follows:

"(d) that, in the case of material from a commercial source or from borrow pits selected by the Contractor, no additional payment will be made for the class of excavation, method of processing (except stabilizing), or overhaul."

PSME3.2 Scheduled Items

PSME3.2.1 Construct the subbase course/shoulders/gravel wearing course with material from designated excavations (Sub-Clause 8.3.2)

Replace the contents of sub-item (a) with the following:

"The rate for (a) shall include full compensation for excavating and selecting subbase material, for loading and transporting the material within the free-haul distance, and for either placing the material on the road or stockpiling the material for later use. When material is stockpiled, the rate shall include compensation for shaping and grading the stockpile so that it is free-draining."

PSME3.2.2 Construct the subbase course/shoulders/gravel wearing course with material from commercial sources or designated borrow areas (Sub-Clause 8.3.3)

Replace the heading of this item with the following:

"PSME 8.3.3 Construct the subbase course/shoulders/gravel wearing course with material from commercial sources"

Add the following paragraph:

"This item shall also apply to the construction of subbase course/shoulders/gravel wearing course with material from borrow pits selected by the Contractor."

PSMF BASE

PSMF1 MATERIALS

PSMF1.1 Physical and Chemical properties

PSMF1.1.1 Natural gravel (stabilized or unstabilized) (Sub-Clause 3.3.1)

Replace the contents of paragraph (a) with the following:

"(a) The maximum particle dimension of the gravel shall not exceed 63 mm."

PSMF2 CONSTRUCTION

PSMF2.1 Processing

Replace this sub-clause with the following:

"PSMF 5.3 Chemical Modification

The base material shall be prepared, broken down and spread. Cement complying with the requirements of SABS 824 shall then be spread over the prepared base material at a rate of 3,0%. The materials shall then be mixed dry using road graders, ploughs and other suitable equipment until the lime is mixed thoroughly and uniformly with the base material. The mixed material shall then be watered, mixed and lightly compacted.

After 24 hours have elapsed the material shall be ripped, worked in the normal manner and compacted to 98% of modified AASHTO density."

PSMF2.2 Transport

Replace the contents of this sub-clause with the following:

"All movement of material will be considered as free-haul. No haulage cost will be paid."

PSMF3 MEASUREMENT AND PAYMENT

PSMF3.1 Scheduled Items

PSMF3.1.1 Construct base with material from commercial sources (Sub-Clause 8.3.3)

Replace the title of item 8.3.3 with the following:

"PSMF 8.3.3 Construct base course with material from commercial sources and compact to 86% of apparent density"

PSMF3.1.2 Process base material by the following processes, as relevant, and use in base (applicable to 8.3.1 or 8.3.2 or both):

Add the following sub-item:

"(e) Process base material by chemical modification
(applicable to item 8.3.1) Unit: m³

The tendered rate shall include full compensation for the chemical modification as specified, including all labour, transport, etc. The modifying agent will be paid for under item PSMF 8.3.8."

PSMJ SEGMENTED PAVING

PSMJ1 MEASUREMENT AND PAYMENT

PSMJ1.1 Scheduled Items

PSMJ1.1.1 Construction of paving complete (Sub-Clause 8.2.2)

Add the following:

"The tendered rate shall also include full compensation for cutting units to fit edge restraints and for the removal of waste material from the Site."

PSMK KERBING AND CHANNELLING

PSMK1 MATERIALS

PSMK1.1 Concrete

Add the following:

"The Contractor shall timeously submit the concrete mix design for cast-in-situ kerbing to the Engineer for approval and no kerbing shall be placed before the mix design has been approved."

PSMK2 CONSTRUCTION

PSMK2.1 Transition sections and inlet and outlet structures (Sub-Clause 5.11)

Delete the words "and with the requirements of the project specification" in the second paragraph.

PSMK3 TESTING

PSMK3.1 Cast-in-situ and extruded kerbing and channeling (Sub-Clause 7.2)

PSMK3.1.1. General tests (Sub-Clause 7.2.1)

Delete this sub-clause.

PSMK3.1.2 Alternative tests (Sub-Clause 7.2.2)

Replace the heading and contents of this sub-clause with the following:

"PSMK 7.2.2 Tests

The Contractor shall carry out a minimum of three cube crushing tests per 1 000 m of kerbing placed. The cost of such tests shall be deemed included in the rates tendered for kerbing.

One cube crushing test shall consist of a set of six cubes made with concrete taken from the mixer, the kerbing machine or from any part of the work as ordered.

If, after 28 days in an approved laboratory, after three cubes of any set of six cubes have been tested, the average crushing strength is found to be more than 3 MPa below the specified strength, the kerbing represented by the cubes will be rejected.

The Contractor may apply for resubmission of the rejected section on the basis of cores drilled from this section and tested for the estimated actual crushing strength in accordance with SABS method

865 (excluding Appendix A). The cost of drilling and testing the cores is for the Contractor's account, regardless of the outcome of the tests on the cores. The number of cores required will be determined by the Engineer and the criterion for rejection or acceptance of the section represented by the cores shall be as specified above for cubes."

PSMK3.1 Responsibility for the cost of testing

Delete this sub-clause.

PSMK4 MEASUREMENT AND PAYMENT

PSMK4.1 Scheduled Items

PSMK4.1.1 Concrete kerbing (Sub-Clause 8.2.1)

Replace "5.8.2" in the third line of paragraph (e) with "5.8.3".

PSMK4.1.2 Variation of tests on extruded kerbing (Sub-Clause 8.2.3)

Delete this sub-clause.

PSL MEDIUM PRESSURE PIPELINES

PSL1 MATERIALS - WATER SUPPLY MAINS (Clause 3)

PSL 1.1 Steel pipes

Steel pipes shall comply with the following particular specifications in Section C3.4.4.

PLN: Manufacture, supply and testing of steel pipes.

PLQ: Corrosion protection of steel pipes and fittings.

PSL 1.2 Glass Reinforced Plastic Pipe (GRP)

Any/all GRP pipe supplied under this Contract shall have a stiffness of at least SN 5000 and a PN 6 pressure rating.

Manufacturing of the GRP shall be strictly in accordance with SABS 1748-1.

Quality control by a suitable external quality inspectorate approved by the Engineer shall be implemented during manufacturing, handling, transport and installation of the GRP pipework and the cost for this external inspectorate shall be included in the rates tendered.

PSL 1.3 uPVC pipe

Notwithstanding the information included on the Drawings, the minimum pressure class for any uPVC pipework installed under this Contract shall be class 9.

PSL 1.4 HDPE pipe

Notwithstanding the information included on the Drawings, the minimum pressure class for any HDPE pipework installed under this Contract shall be class 10.

PLQ 13 MEASUREMENT AND PAYMENT (steel pipe items)

Corrosion protection and painting of steel and stainless-steel pipe items shall not be measured separately. The price for corrosion protection and painting shall be deemed to be included in the price for the pipe, fitting or special.

PSL3 PIPELINE MARKERS

Pipeline markers shall be installed at the following positions:

- Horizontal bends
- Servitude boundaries of provincial roads and railway lines
- Between horizontal bends and valve chambers where distances in between exceed 300m.

PSL4 HANDLING AND RIGGING (Clause 4.1)

PSL4.1 Transportation

Fittings, specials and valves shall be protected during transportation and handling against damage caused by impact, dropping, etc.

PSL4.2 Off-loading and storage

Pipes, fittings and specials shall at no time be laid, stacked or rolled directly onto the ground but shall be supported on suitable padded cradles or other approved material near each end of the pipe, fitting or special. Particular care shall be taken where pipes with fitted couplings are handled or stacked to prevent any pressure on the couplings.

PSL4.3 Inspection on delivery

The Contractor shall thoroughly inspect all pipes, fittings and specials delivered to the site.

Materials rejected by the Engineer shall be removed from the site within 30 days and shall be replaced by other approved materials by the Contractor at his own expense.

PSL5 DISINFECTION OF POTABLE WATER PIPELINE (Clause 5.10)

The disinfection shall be done in accordance with SABS 1200L with the exemption that the concentration of calcium hypochlorite can be reduced to 60mg/l.

The pipeline shall be tested hydraulically in sections including all the valves, fittings and specials.

All site welds that are not subject to the hydraulic testing, shall be 100% radiographically examined.

PSL6 FLEXIBLE CONNECTIONS AT STRUCTURES

In order to avoid damage to rigid pipes entering structures or other chambers caused by differential movement, all pipes built, cast or grouted into structures or other chambers shall be provided with flexible connections to the type details shown on Drawing LD-2 of SABS 1200 LD.

PSL7 STANDARD HYDRAULIC PIPE TEST (Sub-Clause 7.3)

The field test pressure shall be at least 1.50 times the maximum operating pressure, as confirmed by the Engineer.

PSLB BEDDING (PIPES)

PSLB1 MATERIALS

PSLB 1.1 Selected granular material (Sub-Clause 3.1)

Selected granular material shall have a plasticity index (PI) of less than 10 and 100% of the material shall pass a 9.5mm opening sieve. It shall have a minimum modulus of soil reaction ('E') value of 7 MPa at 85% Mod AASHTO maximum dry density and shall be one of the following soil types in accordance with the Unified Soil Classification System:

SM, SP, GP, GW, SW, GM

PSLB 1.2 Selected fill material (Sub-Clause 3.2)

Selected fill material shall be material that has a PI less than 10 and does not contain vegetation or stones exceeding 30mm.

PSLB1.3 Bedding (Sub-Clauses 3.3 & 5.1.2)

- a) Rigid Pipes
 - i. All clay and concrete pipes shall be laid on a Class C bedding as shown on drawing LB-1 of SABS 1200LB, as amended on general detail drawing 1890.12.AA.12.D001.
- b) Flexible Pipes
 - i. Steel, uPVC, mPVC, GRP, Ductile iron and polyethylene pipes will be regarded as being flexible and shall be bedded as per drawing LB-2 of SABS LB, as amended on general detail drawing 1890.12.AA.12.D001.

PSLB2 OVERHAUL (Sub-Clause 3.4.1 and 8.2.1)

All the haulage of bedding material shall be considered as freehaul and no payment will be made for haul.

PSLB3 SELECTION

PSLB3.1 Suitable material not available from trench excavations (Sub-Clause 3.4.2)

Material for the bedding shall be obtained from a commercial source or approved borrow pit designated by the Contractor.

PSLB4 PLACING AND COMPACTING OF RIGID PIPES

PSLB4.1 Class A bedding (Sub-Clause 5.2.1)

Concrete to be used in class A bedding to pipes shall be grade 20/19.

PSLB5 CONCRETE CASING TO PIPES (Sub-Clause 5.4)

Concrete to be used in the casing of pipes shall be grade 20/19.

PSLB6 TOLERANCES (Sub-Clause 6.1)

Degree of accuracy II shall prevail.

PSLB7 STONE BEDDING (Sub-Clause 8.2.6)

Add the following new sub-clause:

PSLB 8.2.6 Stone bedding will be measured per cubic meter under the appropriate item in SABS 1200LB. Type A bedding (crushed stone wrapped in a geotextile blanket) shall be measured per linear metre along the centreline of the trench. The provision, operation and removal of (a) the de-watering pump, where authorised by the Engineer, will be measured as day works under the appropriate item in Schedule 3.

C3.3.1.3 Particular Specifications for Civil Works

PB	EPWP Labor Intensive Specification
PPG	Contractor's Establishment & General Charges
PU	Building Work
PLK	Manufacture and Supply of Valves
PLKA	Sluice and Channel Gates, Adjustable Weirs, Handstops, Stoplogs
PLN	Manufacture, Supply and Testing of Steel Pipes
PLQ	Corrosion Protection of Steel Pipes and Fittings
PTV	Corrosion Protection

For specifications, refer to Volume 2.

C3.3.2 SPECIFICATIONS FOR MECHANICAL WORKS

C3.3.2.1 Variations and Additions To The Particular Specifications

Clauses under this section C3.3.2.1 referring to the Particular Specifications for mechanical works are numbered by adding *PS* to the numbering of the Particular Specification. For example, any variation to the Particular Specification pertaining to pumping equipment (PT) will be numbered PSPT followed by the relevant clause number.

Reference is also made to certain fixed and time-related charges included under Particular Specification PPG.

The full extent of the mechanical works is shown in the drawings included under Volume 3, the general clauses provided under section C3.3.1, and the specifications included under C3.3.2.1 (project specifications for mechanical works) and C3.3.2.2 (particular specifications for mechanical works). In addition, the project specifications for electrical and electronic works have been included under C3.3.3.1 with the electrical particular specifications included under C3.3.3.2.

These sections of the contract documents shall be treated as mutually explanatory. However, should there be any ambiguity in the requirements stated therein, the priority of documents shall be (a) General Clauses (section C3.3.1); (b) Variations and Additions to Standard and Particular Specifications or Project Specifications; (c) Particular Specifications, (d) Drawings and (e) Standard Specifications (if applicable).

List of Project Specifications:

<i>PSPT</i>	<i>PUMPING EQUIPMENT</i>
<i>PSPTQ</i>	<i>PRIMARY SEWAGE TREATMENT EQUIPMENT</i>
<i>PSPTS</i>	<i>BIOLOGICAL FILTERS</i>
<i>PSPTMa</i>	<i>VERTICAL SHAFT MIXERS</i>
<i>PSPTJ</i>	<i>VERTICAL SHAFT AERATORS</i>
<i>PSPTD</i>	<i>DIGESTER EQUIPMENT</i>
<i>PSPTU</i>	<i>CHLORINE DOSING EQUIPMENT</i>

PSPT PUMPS

PSPT 1 SCOPE

The supply and installation of the following new pumping equipment have been included under the scope of this Contract:

- 1 A-Recycle Pumps (A - New) - 3off - Biological Reactor
- 2 RAS Recycle Pumps (B - New) – 3 off – RAS Pump Station No.3
- 3 WAS Pumps (C - Existing) – 2 off – WAS Pump Room
- 4 Sludge Pumps (D - Existing) – 2 off – Sludge & Supernatant Pump Station
- 5 Scum Pumps (E - Existing) – 2 off - Sludge & Supernatant Pump Station
- 6 Recycle Pumps (F – New) – 2 off – Recycle Pump Station
- 7 RAS Pumps (G – New) – 2 off – Recycle Pump Station
- 8 Chlorine Booster Pumps (H – New) – 2 off – Chlorine Contact Tank

The specific requirements of each of the pumps are described below.

Tenderers shall take cognizance of the information required in terms of supporting documents to be submitted with the tender.

PSPT 1.1 Equipment required

PSPT 1.1.1 Recycle pumps (A)

Refer to drawing 1843.30.WIA.14.U001, D001, X001.

Three axial flow propeller-type submersible pumps complete with 316 Stainless steel housing shall be installed in the new Aerobic Zone of the Biological Reactor. The pumps shall be used to recycle nitrate-rich effluent from the aeration zone to the anoxic zone where the nitrate will be removed via denitrification.

It is a specific requirement to limit the oxygen entrainment in the A-recycle system and therefore it is envisaged to use horizontal axial flow type submersible pumps (Grundfos SRG or similar approved).

The pumps shall be supplied complete with relevant pipework and valves, self-cleaning strainer, and pressure switch.

The pumps shall be similar and shall be selected that a single pump Under normal conditions, one or all the pumps will be operational depending on the process requirements. Each pump shall be capable to deliver:

Speed	Flow (l/s)	Total Operating Head (m)
Max	208	0.67
Intermediate 1	139	0.58
Low	104	0.53

The pumps shall be fitted with Variable Frequency Drives and the flow rate must be able to be adjustable by varying the pump speed at the MCC.

The pump shall be equipped with a pedestal mounted emergency stop button.

The pump shall be manually started and stopped from the relevant MCC panel in Manual mode and provision shall be made for continuous operation for extended periods. The pumps shall also

be connected to the standby power supply system and if a pump or pumps were running prior to a power failure, such pump(s) shall automatically start once the standby generator comes online.

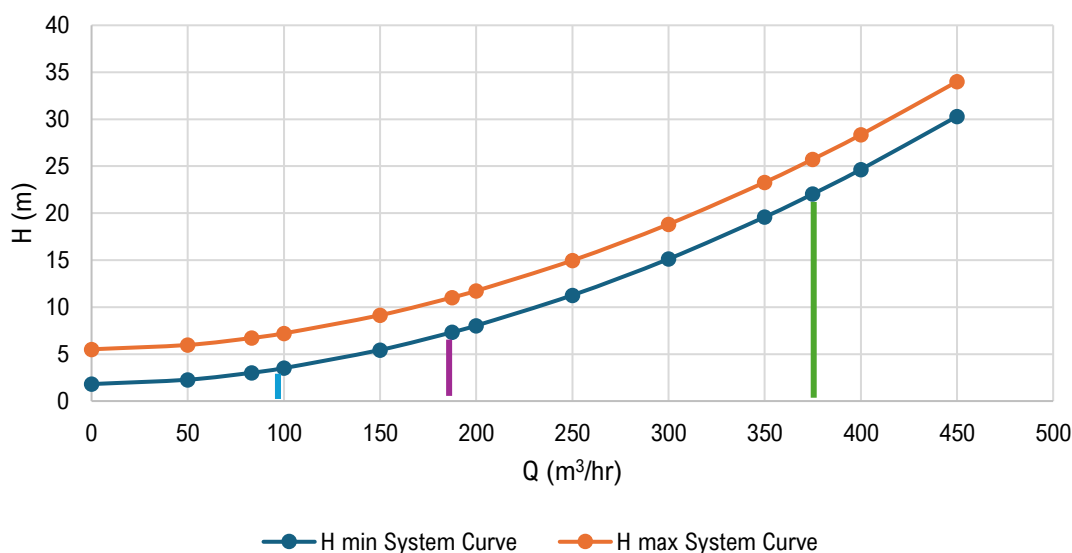
PSPT 1.1.2 RAS pumps (B)

Refer drawing 1843.30.WPB.14.D001.

Three self-priming centrifugal pumps (two duty, one standby) complete with electrical motors are required to pump activated sludge (RAS) of up to 5% mass per mass from the sump of the new RAS Pump Station to the inlet of the Biological Reactor.

Each pump shall be fitted with a Variable Frequency Drive and shall be able to operate at the following duties:

Speed	Flow (l/s)	Minimum Total Operating Head (m)	Maximum Total Operating Head (m)
Max	52	22.04	25.74
Intermediate	35	7.33	11.03
Low	23	3.02	6.12



Each pump at its rated speed shall be designed to retain adequate liquid in the pump casing to ensure automatic re-priming in a complete open system without suction or discharge check valves and with a dry suction leg.

The openings and passages of the pump shall be large enough to permit the passage of a sphere of 75 mm in diameter. The pump shall be equipped with a removable cover plate weighing not more than 30 kg, allowing complete access to the pump interior without disturbing suction or discharge piping.

The pump shall also be fitted with a replaceable wear plate and eradicator impeller. Replacement of the wear plate, impeller and seal shall be accomplished through the removable cover plate. The entire rotating assembly, which includes the bearings, shaft, seal and impeller, shall be removable as a unit without disturbing pump-volute or piping.

The pump motors offered are to be selected for a kW rating of 5 % above the maximum kW rating for the impeller size installed. Performance particulars and characteristic curves shall be submitted at the time of tendering.

Pump casings and impellers shall be of close-grained cast iron. Impellers shall be of single or 2-vane, semi-open, non-clog design, with integral pump-out vanes on the back shroud and shall thread onto a pump shaft of stainless steel. Means shall be provided for external adjustment of the impeller to the wear plate.

The shaft shall be covered and protected with a removable sleeve. The shaft shall be contained within a bearing pedestal of ample size with heavy duty ball thrust bearing and radial bearing of adequate size to withstand all imposed loads. Bearing shall be oil lubricated, with the bearing pedestal cooled by pumped liquid.

The pumps shall incorporate moulded one piece tapered suction check valves that can be removed or installed through the removable cover plate opening without disturbing the suction piping.

The pump volute casing shall contain no openings of a lesser diameter than the sphere size specified. Screens or any internal devices that create a maintenance nuisance or interfere with priming and performance of the pump will not be permitted.

The pedestal base of the pump shall be of cast iron with moulded flanges of adequate size to accommodate the holding down bolts.

One of the RAS pumps shall be connected to the standby power supply system i.e. a power failure occurs. The pump shall automatically start once the standby generator comes online.

The option should be available to run all pumps simultaneously.

Each pump shall be supplied with a pedestal-mounted emergency stop push button as well as the required spring-loaded air release mechanisms and return pipework and valves, and electromagnetic flow meter.

Two glycerine filled pressure gauges with a range of 0 – 300 kPa shall be installed on the delivery side of each pump together with the required isolating valves and non-return valves.

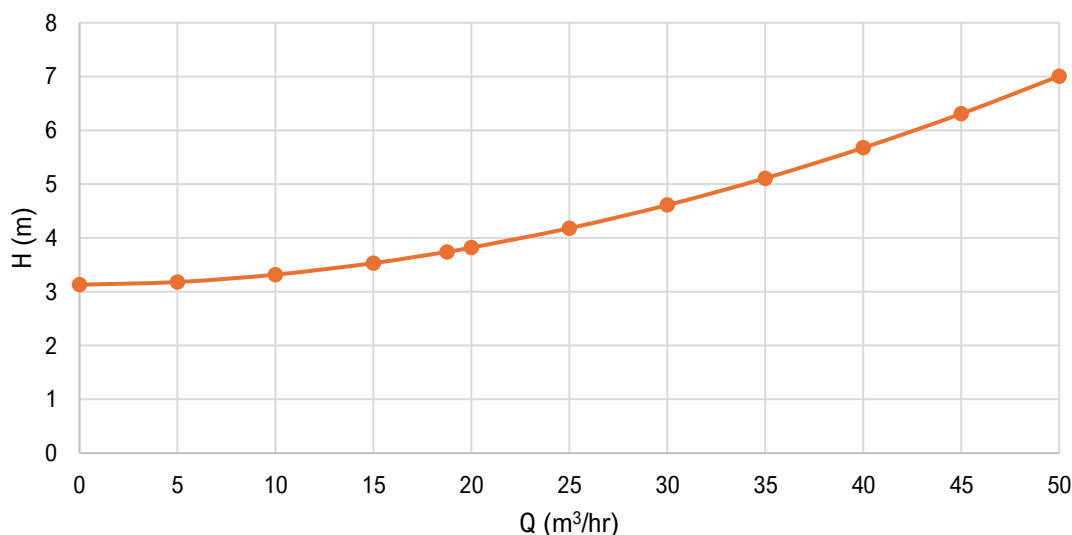
PSPT 1.1.3 WAS Pumps (C)

Two of the Existing Centrifugal Pumps (2 duty) shall be replaced

Two centrifugal pumps complete (1 duty 1 standby) with electrical motor shall be installed in the existing Pump House/MCC Room to pump activated sludge from the Outlet Chamber of the Biological Reactor to the existing Sludge Pump Station.

Each pump shall be fitted with a Variable Frequency Drive and shall be able to operate at the following duties:

Speed	Flow (l/s)	Total Operating Head (m)
Max	6.9	4.18
Intermediate	5.2	3.74



The selected pumps shall be suitable to pump Waste Activated Sludge with a solid's concentration of up to 2.0% (20,000mg/l). The free passage through the pump should be as large as possible, but not less than 60mm diameter.

Each pump shall be equipped with a pedestal mounted emergency stop button.

One glycerine filled pressure gauge with a range of 0-200 kPa shall be fitted to the common discharge manifold.

The pumps shall be installed into the existing pump station and the **Tenderers shall include in the rate tendered for the pumps all necessary pipework and civil works modifications required for the installation of the new pumps.**

Each pump shall be manually started and stopped from the relevant MCC panel in Manual mode and provision shall be made for continuous operation for extended periods. The pumps shall also be connected to the standby power supply system and if a pump or pumps were running prior to a power failure, such pump(s) shall automatically start once the standby generator

PSPT 1.1.4 Sludge pumps (D)

One of the Existing Self-Priming Pumps shall be replaced

The pumps shall be of the horizontal self-priming centrifugal type specifically designed for the handling of thickened sludge from the Gravity Thickener. Each pump at its rated speed shall be designed to retain adequate liquid in the pump casing to ensure automatic re-priming in a complete open system without suction or discharge check valves and with a dry suction leg.

The openings and passages of the pump shall be large enough to permit the passage of a sphere of 75 mm in diameter. The pump shall be equipped with a removable cover plate weighing not more than 30 kg, allowing complete access to the pump interior without disturbing suction or discharge piping.

The pump shall also be fitted with a replaceable wear plate and eradicator impeller. Replacement of the wear plate, impeller and seal shall be accomplished through the removable cover plate. The entire rotating assembly, which includes the bearings, shaft, seal and impeller, shall be removable as a unit without disturbing pump-volute or piping.

The pump motors offered are to be selected for a kW rating of 5 % above the maximum kW rating for the impeller size installed. Performance particulars and characteristic curves shall be submitted at the time of tendering.

Pump casings and impellers shall be of close-grained cast iron. Impellers shall be of single or 2-vane, semi-open, non-clog design, with integral pump-out vanes on the back shroud and shall thread onto a pump shaft of stainless steel. Means shall be provided for external adjustment of the impeller to the wear plate.

The shaft shall be covered and protected with a removable sleeve. The shaft shall be contained within a bearing pedestal of ample size with heavy duty ball thrust bearing and radial bearing of adequate size to withstand all imposed loads. Bearing shall be oil lubricated, with the bearing pedestal cooled by pumped liquid.

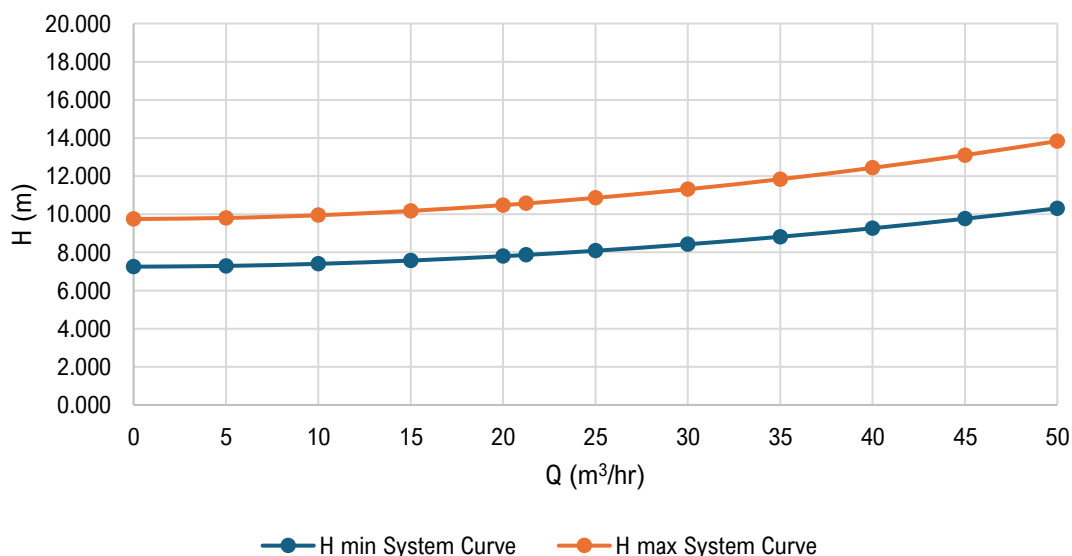
The pumps shall incorporate moulded one piece tapered suction check valves that can be removed or installed through the removable cover plate opening without disturbing the suction piping.

The pump volute casing shall contain no openings of a lesser diameter than the sphere size specified. Screens or any internal devices that create a maintenance nuisance or interfere with priming and performance of the pump will not be permitted.

The pedestal base of the pump shall be of cast iron with moulded flanges of adequate size to accommodate the holding down bolts.

The pumps shall each be rated to deliver at least 5.9 l/s against a total head of approximately 7.87m (min) and 10.48m (max).

The pumps shall be installed into the existing pump station and the **Tenderers shall include in the rate tendered for the pumps all necessary pipework and civil works modifications required for the installation of the new pumps.**



The pumps shall be operated by means of a duty cycle. A cut-out by means of a float level switch will also be required. If the cut-out took place the pump must stop and not restart until the Operator starts it again. The signal of the float level switch should be hard wired into the operation of the pump.

One of the Sludge pumps shall be connected to the standby power supply system i.e. a power failure occurs. The pump shall automatically start once the standby generator comes online.

The option should be available to run all pumps simultaneously.

Each pump shall be equipped with a pedestal-mounted emergency stop button.

2(off) glycerin filled pressure gauges with a range of 0 – 1000 kPa shall be installed on the delivery side of each pump together with the required isolating valves and non-return valves.

The payment item for these pumps has been included under section PTU (refer to clause PSPTU for additional details).

PSPT 1.1.5 Scum Pumps (D)

One of the Existing Submersible Pumps shall be replaced.

One of the existing Self submersible pumps (1 duty,1 standby) shall be replaced and installed in the existing sump. The pumps are required to recycle supernatant and scum from the existing Sludge Pump Station to the Inlet Works downstream of the screens.

Each pump shall be able to deliver approximately 3.5 l/s at an estimated operating head of 13m.

Pumps with shrouded impellers shall not be acceptable and vortex-type pumps are preferred. The free passage through the pump should be as large as possible, but not less than 60mm diameter.

The pumps shall be installed into the existing pump station and the **Tenderers shall include in the rate tendered for the pumps all necessary pipework and civil works modifications required for the installation of the new pumps.**

A duty cycle shall be applied to the pumps. Each pump shall be fitted with a pedestal-mounted emergency stop button.

The pumps shall also be connected to the standby power supply system and if a pump or pumps were running prior to a power failure, such pump(s) shall automatically start once the standby generator comes online.

1(off) glycerin filled pressure gauges with a range of 0 – 200 kPa shall be installed on the delivery side of the pump together with the required isolating valves and non-return valves.

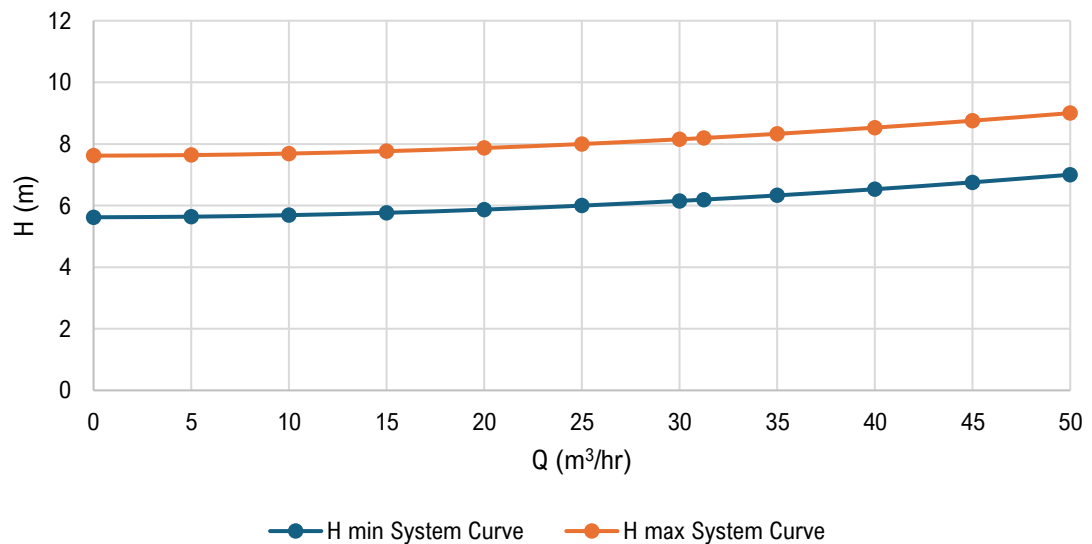
PSPT 1.1.7 Recycle Pumps (F)

The existing Submersible Pumps (2 duty) shall be replaced.

Refer drawing 1843.30.WPA.14.D001.

Two of the existing submersible pumps (1 duty,1 standby) shall be replaced and the new pumps shall be installed in the existing sump of the Recycle Pump Station. The pumps are required to recycle treated effluent from the existing BioFilters back to the splitter box to the Primary Dortmund Tanks.

The pumps shall each be rated to deliver at least 5.9 l/s against a total head of approximately 6.2m (min) and 8.2(max).



Pumps with shrouded impellers shall not be acceptable and vortex-type pumps are preferred. The free passage through the pump should be as large as possible, but not less than 60mm diameter.

The pumps shall be installed into the existing pump station and the **Tenderers shall include in the rate tendered for the pumps all necessary pipework and civil works modifications required for the installation of the new pumps.**

A duty cycle shall be applied to the pumps. Each pump shall be fitted with a pedestal-mounted emergency stop button.

The pumps shall also be connected to the standby power supply system and if a pump or pumps were running prior to a power failure, such pump(s) shall automatically start once the standby generator comes online.

1(off) glycerin filled pressure gauges with a range of 0 – 200 kPa shall be installed on the delivery side of the pump together with the required isolating valves and non-return valves.

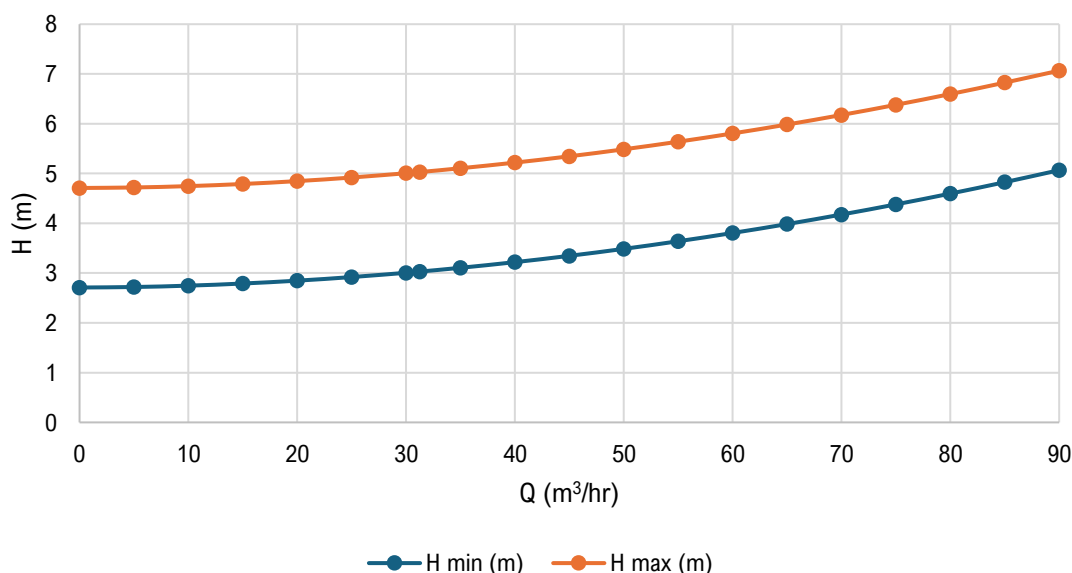
PSPT 1.1.7 RAS Pumps (G)

The existing submersible pumps to be replaced by two Self-Priming Pumps (1 duty, 1 standby).

Refer drawing 1843.30.WPA.14.D001.

Two self-priming centrifugal pumps (one duty, one standby) complete with electrical motors are required to pump activated sludge (RAS) of up to 5% mass per mass from the sump of the new RAS Pump Station to the inlet of the Biological Reactor.

The pumps shall each be rated to deliver at least 8.7 l/s against a total head of approximately 7.87m (min) and 10.48m (max).



Each pump at its rated speed shall be designed to retain adequate liquid in the pump casing to ensure automatic re-priming in a complete open system without suction or discharge check valves and with a dry suction leg.

The openings and passages of the pump shall be large enough to permit the passage of a sphere of 75 mm in diameter. The pump shall be equipped with a removable cover plate weighing not more than 30 kg, allowing complete access to the pump interior without disturbing suction or discharge piping.

The pump shall also be fitted with a replaceable wear plate and eradicator impeller. Replacement of the wear plate, impeller and seal shall be accomplished through the removable cover plate. The entire rotating assembly, which includes the bearings, shaft, seal and impeller, shall be removable as a unit without disturbing pump-volute or piping.

The pump motors offered are to be selected for a kW rating of 5 % above the maximum kW rating for the impeller size installed. Performance particulars and characteristic curves shall be submitted at the time of tendering.

Pump casings and impellers shall be of close-grained cast iron. Impellers shall be of single or 2-vane, semi-open, non-clog design, with integral pump-out vanes on the back shroud and shall thread onto a pump shaft of stainless steel. Means shall be provided for external adjustment of the impeller to the wear plate.

The shaft shall be covered and protected with a removable sleeve. The shaft shall be contained within a bearing pedestal of ample size with heavy duty ball thrust bearing and radial bearing of

adequate size to withstand all imposed loads. Bearing shall be oil lubricated, with the bearing pedestal cooled by pumped liquid.

The pumps shall incorporate moulded one piece tapered suction check valves that can be removed or installed through the removable cover plate opening without disturbing the suction piping.

The pump volute casing shall contain no openings of a lesser diameter than the sphere size specified. Screens or any internal devices that create a maintenance nuisance or interfere with priming and performance of the pump will not be permitted.

The pedestal base of the pump shall be of cast iron with moulded flanges of adequate size to accommodate the holding down bolts.

One of the RAS pumps shall be connected to the standby power supply system i.e. a power failure occurs. The pump shall automatically start once the standby generator comes online.

The option should be available to run all pumps simultaneously.

Each pump shall be supplied with a pedestal-mounted emergency stop push button as well as the required spring-loaded air release mechanisms and return pipework and valves, and electromagnetic flow meter.

2(off) glycerine filled pressure gauges with a range of 0 – 100 kPa shall be installed on the delivery side of each pump together with the required isolating valves and non-return valves.

PSPT 1.1.8 Chlorine Booster Pump (H)

Refer to drawing 1843.30.WNA.14.D001

Two submersible water pumps (1 duty, 1 standby) shall be installed in the new chlorine contact basin to supply motive water to the chlorine dosing plant.

The pumps shall be supplied complete with relevant pipework and valves, self-cleaning strainer, 100-L pressure vessel, pressure switch and electromagnetic flow meter.

The pumps shall each be rated to deliver at least 3.0 l/s at 3 bar pressure and due to the high-pressure requirement, borehole type pumps, installed in the near-horizontal position, is envisaged. The final duty shall be determined based on the chlorine dosing requirements.

A duty cycle shall be applied to the pumps. The duty pump shall be controlled by the pressure switch on the rising main – a high pressure shall switch the pump off, while a low-pressure setting shall start the pump again. The pressure vessel is required to prevent the continuous starting and stopping of the pump.

Although no level sensing or transmission will be required for the pump sump (chlorine contact basin) other than the ultrasonic level probe used for flow measurement, a float level switch shall be installed to prevent the process water pump from running dry and the signal from this switch shall be hard-wired in the operation of the pumps.

Each pump shall be equipped with a pedestal-mounted emergency stop button.

The pumps shall also be connected to the standby power supply system and if a pump or pumps were running prior to a power failure, such pump(s) shall automatically start once the standby generator comes online.

END OF SECTION

PSPTQ PRIMARY SEWAGE TREATMENT EQUIPMENT

This specification, read together with the applicable Particular Specifications, describes the Employer's Requirements of the Mechanical Plant to be checked and commissioned under this Contract.

The Contractor shall ensure that the installed system shall suit and meet the objectives of the installation in terms of the Employer's Requirements. Any/all items deemed necessary for the effective and safe operation of the system, and which are not specifically measured in the respective schedules shall be included in the tender offer and clearly highlighted.

PSPTQ-1 INLET WORKS COMPONENTS TO BE SUPPLIED

The existing inlet works to be included: -

- (a) One vertical mechanically front raked screen (10mm apertures) to suit the existing channel width of 1.0m – Screens No.1;
- (b) One screening wash press with inclined chute complete with washing system to be installed at the Inlet Mechanical Screen (with washing system complete);
- (c) Removal of all redundant equipment at the Inlet Works

PSPTQ-2 INSTRUMENTATION AND ELECTRICAL INSTALLATION

Relevant instrumentation calibration and electrical supply has been specified and measured under the electrical scope of works.

PSPTQ-3 SCREENING EQUIPMENT

PSPTQ-3.1 Mechanical Front Raked Screens (10 mm Openings)

ONE front raked mechanical screens shall be installed at the Inlet Works to the plant. The clear openings between the bars shall not exceed 10 mm.

Each of the screens shall be capable of handling a peak flow of 191 l/s. The channel width is 1000 mm and the maximum flow depth to be confirmed on site.

Stationary or rotary drum screens shall not be considered for these applications.

A mechanical torque limiter must be installed on the motor to protect the motor and gearbox when the screen rake gets stuck. This is in addition to the overcurrent protection on the electrical motor in the control panel. The motor must be provided to IP55 protection.

The frame shall be formed entirely from 4,5mm thick plate and shall be recessed to accommodate the scraping mechanism, chain guides and idler sprockets in order to maximise the width of the screenfield in the channel.

The frame shall be accurately set into position into the necessary recesses in the channel walls and invert and shall be grouted securely into place. Fixing bolts shall not be used. The screen shall be set at 15 degrees to the vertical unless detailed elsewhere. The frame shall be fully welded to the sole plate, the screen plane and the rear screenings retention plate. It shall also be fully welded to the head plate, the discharge chute and the closure plate between the underside of the discharge chute and the top channel. At the upstream face of the unit, box section cross members shall be securely welded to the side members of the frame at regular intervals between a point above the maximum top water level and the head of the screen. These cross members shall form the supports for removable transparent cover panels.

The screens will be operated as a timer-based electrical standard.

PSPTQ-3 MEASUREMENT AND PAYMENT

Measurement and payment shall be done in accordance with the methods stated below.

PSPTQ-3.1 Design, Drawings and General

Pay Item	Unit
Provide drawings and design information as specified	Sum

PSPTQ-3.2 Supply, and Delivery to Site of the following equipment

Pay Item	Unit
(a) Vertical mechanically raked screens	No.
(d) Screening press with inclined chute	Sum
(c) Removal and safe disposal of redundant mechanical equipment off-site	Sum

PSPTQ-3.3 Installation, Commissioning, Testing and Handing Over of the following Plant

Pay Item	Unit
(a) Vertical mechanically raked screens	No.
(d) Screening press with inclined chute	Sum
(c) Removal and safe disposal of redundant mechanical equipment off-site	Sum

END OF SECTION

PSPTS BIOLOGICAL FILTERS

PSPTS-1 SCOPE

This section of the Contract covers the design, supply, installation, commissioning, testing, and handing over in complete working order of the rotating spraying equipment for the three existing Module 1 Biological Filters:

PSPTS-2 ROTARY DISTRIBUTOR

The biofilters on which the rotating assemblies are equipped each has an internal diameter of 24.41 m. The scope will include the disassembly and disposal of the existing rotating distribution assembly (2 off), and the design, supply, delivery, installation and commissioning of a new distribution arms system complete fitted onto the existing inlet to the Biofilters No.2 only.

The equipment offered must be capable of functioning satisfactorily over a wide range of temperatures and weather conditions with a minimum of attention. The speed of rotation of the distributor shall be slow but reliable even at the minimum specified rate of flow. Preference will be given to equipment in which the rotation of the distributor is achieved solely by jet reaction. Below the nozzles on the distributor arm, stainless steel splash plates shall be mounted to disperse the jets.

The rotating sprayer assemblies consist of a centre column centre bearing assembly, the distribution system for dividing the flow into equal portions between the 4 spreading arms, spreading arms complete with supporting cables.

The spreading system shall be designed to provide a uniform spreading of the settled sewage over the entire area of the biological filter. There is no variation in loading of the biological filter surface.

The 200 mm diameter inlet pipework to the bio-filter has already been installed and terminates at the top of a centre column.

Any items replaced from the rotating assembly shall be manufactured from mild steel, and the corrosion protection shall be heavy-duty hot-dipped galvanising in accordance with the relevant corrosion protection specifications.

PSPTS-2.1 REQUIRED DUTIES

One new distributor for a biological filter with an internal diameter of 24.41 metres and an average media depth of 2,2 metres is required. The distributor shall be capable of handling a peak flow of 17.36 litres per second and a minimum flow of 8.68 litres per second. The distributor shall be equipped with 4 sprinkler arms.

If the specified flows or number of arms do not fall within standard ranges of available distributors, Tenderers may offer the nearest available size on condition that the maximum capacity of the distributor is not less than the required maximum flow of 17.36 litres per second.

The speed of rotation of the distributor shall be as slow as possible, but reliable even at the minimum specified rate of flow.

PSPTS-2.2 TESTING

In order to establish the performance of the equipment the Contractor shall carry out in situ tests that are witnessed by a representative of the Engineer. The Contractor shall provide all staff, materials and make all necessary arrangements to conduct the tests.

Where witnessed Site tests are required, the Contractor shall conduct trial test runs and satisfy himself that the test results are in accordance with the requirements specified, before notifying

the Engineer. The Contractor shall be liable for the cost incurred by other parties in the event of an abortive test requiring a retest.

Site testing shall be conducted to confirm:

- i. Correct rotational speed at both maximum and minimum flow.
- ii. Even distribution of liquid over media, by in-situ measurement of accumulated volume over a period of 15 minutes at 5 points, equally spaced along the radius of the filter. Volume measurement of each selected point shall be conducted over a radial length of not less than 50mm.

PSPTS-2.3 SPARES, TOOLS AND LUBRICANTS

Spares, special tools and lubricants are to be supplied with the plant included under this Section of the Contract. Details are to be listed in the schedule following the "Technical Data Sheets".

PSPTS-2.4 BOLTS

Holding down bolts which are to be built into concrete work for securing the plant shall be supplied and installed under this section of the Contract. If required, grouting up of these bolts will be done by the mechanical contractor after completion of setting up of the plant.

All bolts and nuts shall be galvanised.

PSPTS-2.5 CORROSION PROTECTION

The following corrosion protection shall be used.

Inside of Centre Column Galvanised or Copon EP 2300

Inside of sprinkler arms Galvanised or Copon EP 2300

PSPTS-3 MEASUREMENT AND PAYMENT

Measurement and payment shall be done in accordance with the methods stated below.

PSPTS-3.1 Refurbishment and modification of existing Equipment

Pay Item	Unit
PSPTS 6.1.3 Removal and disposal off-site of existing equipment (only upon written instruction from the Engineer),	Sum

END OF SECTION

PSPTMa VERTICAL SHAFT STIRRERS

PSPTMa 3.1.1 Equipment Required for Biological Reactor

Unless otherwise states here within, all vertical stirrers shall confirm to the relevant requirements stipulated under Particular Specification PTMa: Mechanical Mixers included in the Scope of Works.

Three platform mounted vertical shaft fixed speed mechanical stirrers are required to keep the organic solids in suspension in the anoxic zone of the biological reactor as well as the aerobic zone (space left for future aerator).

Each stirrer shall be installed on a suspended platform. The total size of the anoxic compartment is roughly 15.5m x 28.6m x 3.3m depth for a volume of 1463 m³. The total volume of the aerobic zone is 1500m³ with a water depth of 4.6m, the stirrer will be installed in the first third of the tank.

In *Manual* model, the stirrers shall be stopped and started from the MCC panel. In *Auto* mode, the stirrers shall be timer-controlled. All mixers shall be linked to the standby generator and thus remain operational during periods of power failure.

The power input of the stirrers shall be in the region of 5 - 8 Watt/m³ and should tenderers wish to deviate from this value, this shall be motivated. On this basis, it is envisaged that each stirrer will be equipped with a 7.5 kW electrical motor conforming to Particular Specification PXC (*Low voltage electrical motors*).

The equipment offered shall be suitable for continuous, outdoor operation.

The tendered price shall include for the complete unit and shall make provision for, but not limited to the stirrer (impeller), motor, gearbox, baseplate, holding down bolts etc.

Each stirrer shall be equipped with an emergency stop button.

END OF SECTION

PSPTJ VERTICAL SHAFT AERATORS

PSPTJ-3 Bridge-mounted vertical shaft aerators

PSPTJ-3.1 General requirements

Two vertical shaft fixed speed mechanical aerators are required to obtain nitrification and oxidation of carbonaceous material. The aerators shall be equipped with fix speed motors suitable for continuous operation in outdoor conditions.

Based on the target DO concentration of 1.5 – 2.0 mg/l, the Oxygen Uptake Rate (OUR) in the aerobic zone in the short term is approximately 36.13 kgO/hr.

Each aerator shall be mounted on a suspended concrete platform to each aerate an effective process volume of 15.5 x 9.5 x 3.6m water depth. Based on these figures, two 30 kW aerators shall be installed under this contract.

Aerators shall be started manually at the relevant starter panel (if the selector switch is in *Manual*) or operated on a timer-basis for the selector switch is set to *Auto*.

NOTE: The final motor size shall be confirmed once the contract has been awarded, and the guaranteed aeration efficiency of the offered equipment has been established. The above figures must be taken as merely indicative for tendering purposes.

The conditions under which the transfer of oxygen shall be guaranteed by the Tenderer in his tender submission shall be:

- Maximum immersion.
- Depth of basin: 4.4 to 4.6m
- Target dissolved oxygen concentration of 1,5 - 2,0 mg/l
- Mixed liquor temperature of 14 - 22°C;
- At approximately 100 mamsl;
- α and β factors of 0.85 and 0.95 respectively.

The tendered price shall include for the complete unit and shall make provision for, but not limited to the aerator (impeller), shaft, motor, gearbox, baseplate, holding down bolts etc.

Each aerator shall be equipped with an emergency stop button.

END OF SECTION

PSPTD DIGESTER EQUIPMENT

PSPTD 1 Digester mixing equipment

The two existing digesters will be converted to completely mixed units and for this purpose the design has been based on external mixing systems. Alternative mixing systems shall be considered and evaluated on a life cycle costing calculation taking account of initial capital costs for the civil and mechanical works as well as the long-term operational costs, which will mainly be electricity charges. In the event that an alternative is offered, the associated civil requirements shall be clearly stated in order to execute the necessary calculations.

- Sludge solids percentage: 2-6%
- Density of the sludge: 1015 kg/m³
- Inlet sludge temperature (T1): 10 - 20° C Site specific.
- Outlet sludge temperature (Tso): 45° C
- Temperature of sludge within the digester (T2): 35° C (mesophilic digestion)

The mixing system shall be adequately sized to turn the contents of the tank every 2.5 hours i.e. the approximately 545 m³ sludge contents shall be turned 10 times per day and the pumping system shall thus be designed to deliver at least 203 m³/hr with the tank at full capacity.

The power input of the impeller shall be in the region of 5 - 8 Watt/m³ and should tenderers wish to deviate from this value, this shall be motivated. On this basis, it is envisaged that each mixer will be equipped with a 7.5 kW electrical motor conforming to Particular Specification PXC (Low voltage electrical motors) and PTD Item 5.3.6 (Mechanical equipment for heated and unheated digestion).

A CFD analysis does not have to be submitted with the tender; however, the tenderer has to provide a proposal depicting how the system will be tested to ensure it is functioning according to specifications.

In order to install the new equipment, allowance shall be made to clean the unit prior to installation. The contents at the bottom of the digester shall contain organic matter and grit which might have solidified. The contents of the digester shall be removed and spoiled at the nearest suitable disposal facility. The disposal will fall under a hazardous waste. Empty and cleaning will be measured under a separate Pay Item.

PSPTD 1.1 ANCILLARY PUMP EQUIPMENT AND PIPEWORK

Fully detailed drawings showing the proposed layout of pumps and pipework shall be submitted. The design of pumps and existing pipework must be confirmed on site as no detailed drawings are available. The pipework to be supplied under this Contract is for all additional pipework that may be required for the installation of the new pumps and the connection thereof onto the existing pipework. If required, each pump set shall be fitted with the necessary approved pipework, calibrated glycerine-filled pressure gauges suitably dampened against vibration, flexible couplings, pipe supports, bends, resilient seal gate valves and non-return valves (suitable for 10 bar pressure rating), and with appropriate connections and stopcocks for fitting the necessary pressure gauges. Pressure gauges shall be supplied on each pump's suction and delivery side. Gauges shall be fitted with clog-free in-line pressure sensors with flexible rubber sleeves of the membrane type.

Each discharge pressure gauge shall have a maximum reading of not more than twice the closed valve pressure of the pump.

END OF SECTION

PSPTU CHLORINE DOSING EQUIPMENT

This project specification should be read on conjunction with Particular Specification PTU.

PSTPU-1 SCOPE

Effluent from the four Secondary Settling Tanks will gravitate to a new Chlorine Channel constructed under this contract. The existing dosing system is housed in a Chlorine Building adjacent to the existing contact channel which will be demolished under this contract. The new channel will be built in the same location as the existing channel.

The existing chlorination system must be removed and replaced with a new system suitable for the for the ultimate design capacity of the plant (6Ml/d). The chlorinator shall be capable of introducing gaseous chlorine in solution up to a maximum rate of 60 kg chlorine per hour.

Accurate closing down to a rate of 5 kg chlorine per hour must also be possible.

The plant is required to administer chlorine at a manually set rate (base rate), but with the quantity of chlorine automatically adjusted, with the actual flow of the effluent to which the chlorine is added.

The offer shall include all the equipment necessary for adjusting the quantity of chlorine for the actual flow in accordance with the set rate. It must be able to accept a 4-20ma signal from the existing flow meters.

The dosing equipment shall be calibrated in grams per hour and shall have a manual setting of the dosing range.

Feedwater for the chlorinators and other make-up water required will be supplied from the motive water pump installed under this contract.

All pipework required by the system must be supplied and all existing pipework is to be removed.

PSPTU-2 SPARE PARTS

All spare parts shall be ex-stock at a supplier located in the closest Metropolitan Area.

PSPTU-3 DETAILS OF OFFER

Tenderers shall submit full details of the offer for each item and shall illustrate by means of brochures, sketches, photographs, suppliers catalogue etc. The offer and brochures /catalogue must correspond.

PSPTU-5 REMOVAL OF EXISTING CHLORINE DOSING EQUIPMENT

The Contract will include the removal and safe disposal of the redundant liquid chlorine system complete.

PSPTU-6 MEASUREMENT AND PAYMENT

Add the following to the Clauses:

PSPTU-6.6.5	Supply and free issue of a Regulation 7 first aid kit complete	Sum
PSPTU-6.6.6	All regulation safety signage	Sum
PSPTU-6.6.7	Removal of existing Chlorine equipment (as indicated and agreed upon by the Engineer) and safe off-site disposal	Sum

END OF SECTION

C3.3.2.2 Particular Specifications for Mechanical Works

PLK	Manufacture and Supply of Valves
PLKA	Sluice and Channel Gates, Adjustable Weirs, Handstops, Stoplogs
PLN	Manufacture, Supply and Testing of Steel Pipes
PLQ	Corrosion Protection of Steel Pipes and Fittings
PLT	On-line Flow meters (General)
PT	Pumps
PTD	Digester Equipment
PTG	Gear Boxes
PTJ	Vertical Shaft Aerators
PTMa	Mechanical Mixers
PTP	Hoisting Equipment
PTR	Sedimentation Tanks
PTS	Biological Filters
PTU	Chlorine Dosing Equipment
PTV	Corrosion Protection
PXC	Low Voltage Electrical Motors

For particular specifications, refer to Volume 2.

END OF SECTION

SECTION C3.3.3: PROJECT SPECIFICATIONS FOR ELECTRICAL WORKS

The Standard Specifications do not cover all the different types of work included in the Contract. The general requirements for portions of the Works not covered by the Standard Specifications are described in the Particular Specifications included under Part C3.6.7.

The Clauses under section C3.6.6 (referred to as Project Specifications) are numbered “PS” and refers to the clauses in the Standard or Particular Specifications. New clauses not covered by clauses in the Standard or Particular Specifications, if included here, are also designated “PS” followed by a number.

The various documents listed under sections C3.6.6, shall be treated as mutually explanatory. However, should any requirement of section C3.6.6 conflict with any requirement of the Standard Specification or with any requirement of the Particular Specifications, then the requirement of section C3.6.6 shall prevail.

PSEGEN GENERAL

PSEGEN.A ABBREVIATIONS

AI	Analogue Inputs
AO	Analogue Outputs
C&I	Control and Instrumentation
COC	Certificate of Compliance
CPU	Central Processing Unit
DB	Distribution Board
DI	Digital Input
DO	Digital Output
EC&I	Electrical, Control and Instrumentation
FT	Flow Transmitter
GA	General Arrangement
HMI	Human Machine Interface
LT	Level Transmitter
LV	Low Voltage
FDS	Functional Description Specification
FM	Flow Meter
MCC	Motor Control Centre
MV	Medium Voltage
O&M	Operations & Maintenance
OHL	Overhead Line
PLC	Programmable Logic Controller
PST	Primary Settling Tank
PT	Pressure Transmitter
RCC	Regulatory Conformance Certificate
RIO	Remote I/O
SABS	South African Bureau of Standards
SLD	Single Line Diagram
SOW	Scope of Work
SST	Secondary Settling Tank
TB	Turbidity sensor
TT	Temperature Transmitter
VSD	Variable Speed Drive

WTW	Water Treatment Works
WWTW	Wastewater Treatment Works
S/S	Substation
M/S	Miniature Substation

PSEGEN. B DESIGN AND DRAWINGS

The Contractor shall be responsible for the complete and detailed designs for all electrical equipment and installations required for the project. The general electrical specifications following hereafter shall serve as a basis for all designs and they set out the design requirements for the project as a whole. Any design work and drawings issued with the project specifications are to be viewed as concept designs and have been prepared to serve as an extension of the specifications. They have also been prepared to assist with pricing of the project requirements. Drawings issued with this specification shall also serve the purpose of setting a minimum drawing and documentation standard required for the project.

If the specifications in this section conflict regarding mechanical equipment required and electrical control equipment specified, the engineer must be informed not later than two weeks before the tender close. The engineer will duly clarify the matter or issue an addendum.

All design work shall be backed up with detailed design calculations and these calculations shall be made available to the Engineer for checking and approval purposes.

The Contractor shall be responsible for the design, execution and completion of the Works in accordance with Clause 4.1 of the general conditions of contact. This shall include, inter alia, the compilation of the following:

- a. General arrangement (GA) drawings for all electrical and electronic installations as required;
- b. Process and Instrumentation Diagrams (P&ID's) for the system as a whole.
- c. Medium Voltage and low voltage coordination calculations and settings
- d. Motor List
- e. Instrumentation Lists
- f. Loop diagrams
- g. Cable schedules
- h. Technical and dimensional drawings of electrical and electronic equipment.
- i. Performance documents for electrical and electronic equipment such as medium voltage switchgear, soft starters, variable speed drives for proposed pumps etc.
- j. All equipment shall be submitted for approval.

The Contractor may use the specified performance criteria for tender purposes. However, all equipment specifications and duties are to be checked and confirmed as correct prior to ordering any equipment. Clause 5.1 of the general conditions of the contract shall apply in this regard.

PSEGEN.D TESTING

For all equipment provided, the correct operation of the equipment and the achievement of the specified performance requirements shall be demonstrated to the Engineer prior to the commissioning of the Works. Specific testing requirements are specified under each equipment specification (if required or applicable) as well as in Volume 3.

PSEGEN.E MEASUREMENT AND PAYMENT

The method for measurement and payment shall be done according to the following method, unless specified otherwise:

Pay item	Unit

PSEGEN.E.1 DESIGNS, DRAWINGS AND GENERAL

Provide design drawings and design information as specified, including general layout, wiring diagrams, and process and instrumentation diagrams (P&IDs)..... Sum

PSEGEN.E.2 MANUFACTURING, SUPPLY AND DELIVERY ON-SITE

Rate tendered to include for all material, equipment, plant, testing apparatus, labour, manufacturing, factory applied corrosion protection, factory acceptance testing if applicable, transport, import duties, handling and possibly double handling, delivery to and off-loading at Site as well as temporary storage prior to installation.

PSEGEN.E.2 INSTALLATION WORK

Rate tendered to include all plant, tools, labour, rigging, handling, placing into position, aligning, fixing, grouting, repair to damaged corrosion protection and getting ready for testing and commissioning.

PSEGEN.E.3 TESTING AND COMMISSIONING

Rate tendered to include the drafting of the necessary testing and commissioning plans, attendance of required local and/or overseas specialists, testing apparatus, instruments and equipment, any/all chemicals and consumables as are necessary for testing purposes and to prove performance, any/all temporary works, any/all sampling and analysis and compilation of final commissioning report.

PSEGEN. F GENERAL

When design drawings are produced for electrical switchboards a detailed circuit schematic shall be produced for every incomer, feeder or motor circuit. The provision of typical circuits shall not be accepted.

A protection and grading study shall be carried out for substations and according to the requirements of the particular specification.

The contractor shall be responsible for liaising with Eskom, to determine the upstream protection relay settings and values to grade with. These values shall be included within the grading study and shall form the basis for determining all relay settings.

The grading study and all settings shall be well documented and available for checking if called for by the engineer. Arc flash detection shall be provided for the entire switchboard as per the general specification requirements.

The upgrade of the medium voltage equipment will require planned shut down procedures to ensure certain parts of the upgrade can be implemented. Careful planning, methodologies and shall be necessary to limit the supply outages to a minimum to prevent plant operation disruptions as far as possible. The contractor shall submit a detail method statement of the shutdown and detailed program to the Engineer for approval before any work may commence. It is the responsibility of the contractor to submit the method statement at the start of the contract.

Workplan and proposed methodologies shall also be required for electrical equipment transport and entry to all the buildings.

PSEGEN. G SCOPE OF WORK

Design, Supply, Installation and Commissioning of all Electrical and Electronic Systems, whereas the mechanical equipment will be supplied under the Mechanical scope of work.

1. Main MCC – (Installed in Existing Generator Room)
 - a. Small Power and Lighting
 - b. Site lighting
 - c. Supply, installation, and connection of all cable trays, wire ways, conduit, draw and outlet boxes, and sleeves, as required.
 - d. Supply, installation, and connection of all cables, control circuit, wiring and conductors, as required.
 - e. Supply, installation, connection, and testing of an earthing/bonding system.
 - f. Supply, installation, commissioning of earthing and lightning protection,
 - g. Excavations for all cable trenches, compaction, backfill, and making good of existing surfaces
 - h. Associated instrumentation
2. Chlorine, MCC, Sludge and Supernatant Buildings
 - a. The design, manufacture, supply, testing, and inspection at the manufacturer's premises, installation, connection, testing and commissioning Motor Control Centre
 - b. As required, Design, supply, install, and connect all cable trays, wire ways, conduit, draw and outlet boxes, and sleeves.
 - c. Design, supply, install, and connect control circuit, wiring and conductors, as required.
 - d. Design, supply, installation, connection, and testing of an earthing/bonding, earthing and lightning protection system.
 - e. Excavations for all cable trenches, compaction, backfill, and making good of existing surfaces.
 - f. All circuit equipment for new small power and lighting installations, i.e. socket outlets, light switches, isolators, etc.
 - g. Testing, commissioning, and handing over of the complete MV installation in accordance with the requirements of the Electrical Contracting Board of South Africa and the issue of a Certificate of Compliance.
3. Communication [Programmable Logic Controller]

Fibre Optic communication, Programmable logic controllers, network, managed Network Switches and associated instrumentation.

The aim of this specification entails the connection and subsequent control and monitoring of the different PLC Units installed in the different areas [substations, MCC and miniature substations] off to a central SCADA system, which shall all be connected via a multimode Fibre Optic communication cable.

PSEGEN. H ELECTRICAL AND ELECTRONIC SERVICING OF MECHANICAL EQUIPMENT

Although the Engineer has taken precautions to ensure that all mechanical equipment are serviced in terms of the required electrical and electronic systems the nature of the Contract will require the Contractor to familiarise himself with the equipment and ensure that these allowance are sufficient. Should any equipment require additional electrical and electronic systems, or if the Contractor intends to provide additional equipment, it shall be accepted that his tender offer has made provision for this. The Contract will take full responsibility to ensure that all equipment offered or required for operation as per the intended use shall be serviced in full with the required electrical and electronic equipment. If there is no specific allowance made in the detailed specifications the Contract shall use an equivalent specification contained in this document, or where no such equivalent is available, inform the Engineer in writing and request that such a specification be made available.

END OF SECTION

PSEPMS MINIATURE SUB-STATIONS

PSEPMS-1 Scope of Work

One [x1] miniature substation forms part of this specification and shall be supplied and installed under this contract.

The miniature substations should be supplied, installed and commissioned according to the following particular and project specifications. The ring main unit is specified under the ring main unit section and will be housed inside the miniature substation.

The tenderer shall allow for the following [refer to particular specification]:

- Enclosures shall be 3CR12 and shall be powder coated green avocado green.
- Refer to particular specification.
- Outdoor units and the tenderer shall allow for plinth for each miniature substation.

PSEPMS-7 Medium Voltage Compartment

PSRMU covers the scope for medium voltage ring main units and shall be read in conjunction with this specification.

PSEPMS-16 Transformer Compartment

One [x1] 500kVA miniature substation transformer shall have a no-load voltage ratio of **11kV/420/242V** with "off-load" tap changers with **2.5%** and **5%** taps. The transformer impedance should be as low as possible, **with values less than 5.1% deemed acceptable**.

Transformer windings are to be constructed from copper. In addition to the standard fittings detailed on Table 1 of SABS 780, the transformer must be provided with an **oil-level gauge** and **oil drain plug**.

In addition to the standard fittings detailed on Table 1 of SANS 780, each transformer must be provided with the following.

- An oil-level gauge;
- Oil drain plug;
- Bolted tank cover;
- Oil level Trip and Alarm contacts.

PSEPMS-17 Low Voltage Compartment

PSEPMS-17.A Miniature Substation No.1 [M/S No.1 – 500kVA]

The following low voltage circuit breakers shall be provided in the low voltage compartments:

Fault level: 20kA

Qty	Description	Location
1	800Amp continuous current rated TP distribution MCCB monitoring and all accessories: Plus	Main Circuit Breaker
Set	800/1Amp continuous current rated current transformer: Plus	Current inputs
1	Ammeter scaled 0 - 800Amp: Plus	Ammeter
1	3 Position Selector switch	R-W-B phase indication
3	2Amp HRC fuse holders and fused links: Plus	Voltage inputs
1	Front panel mounted LCD digital display supply network analyser comprising of combined voltage, current, maximum demand power measurement and power factor correction measurement complete with Communications module must be provided, communication links with PLC/DCS Units. The communication interface must comply with either of the following: a) Profibus-DP b) Profinet c) Industrial Ethernet d) Modbus TCP/IP Under no circumstances, shall the use of proprietary protocols be allowed: Plus	Power Analyser
4	800Amp continuous current rated copper busbars: Plus	3 Phase + N
1	600Amp continuous current rated copper busbar: Plus	Earth
4	315Amp continuous current rated HRC fuse holders and fused links: Plus	Surge arrestors connection fuses
1	Three Phase combined class 1&2 surge arrestor unit connection type 2: Plus	Surge arrestor plus signals
1	700Amp continuous current rated TP distribution MCCB with electronic trip: Plus	Allowance for feeder breaker Container MCC Building
One	Compartment comprising the following:	Area Lighting
1	63Amp HRC fuse holders and fused links: Plus	Area Lighting Protection
1	63Amp continuous current rated TP MCCB with electronic trip, monitoring relays with automatic reset and all accessories: Plus	Area Lighting
Set	63/5Amp continuous current rated current transformer: Plus	Current inputs

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Phase 2A - Upgrade and Extension of the Umzinto Wastewater Treatment Works From 2.5 MI to 4.0 MI
Construction and Commissioning of Civil - Mechanical and Electrical Works
Portion 4: Particular Specifications
Section C3.3.3 Detailed Specifications for Electrical Works
EPMS: Miniature Sub-Stations

Qty	Description	Location
1	Ammeter scaled 0-63Amp: Plus	Ammeter
1	3 Position Selector switch	R-W-B phase indication
3	2Amp HRC fuse holders and fused links: Plus	Voltage inputs
1	Volt meter	Volt Meter
1	7 Position Selector switch	R-W-B phase indication
1	80Amp continuous current rated TP Type 2 Contactor: Plus	Area lighting contactor
1	5Amp continuous current rated SP MCCB: Plus	Area Lighting
1	5Amp continuous current rated SP MCCB: Plus	Coil Protection
1	Digital Time switch equal and similar digital with 100-hour standby capacity.	Digital Timer Switch

END OF SECTION

PSERMU RING MAIN UNITS [RMU]

Substations as detailed below shall be provided with an 11kV ring main units as specified and in the standard specification for 11kV ring main units.

PSERMU-1.1 Scope of Works

PSERMU-1.2 Current and Fault Ratings Limitations

Nominal system voltage	: 11kV
Rated impulse withstand voltage	: 95kV
Rated frequency	: 50Hz
Rated busbar current	: 630A
Rated breaking capacity	: 25kA for 3 seconds
Power frequency withstand voltage	: 28kV (r.m.s) minimum (sea level)
Number of busbars	: Single 3 phase
Metal	: As per Particular Specification

PSERMU-1.3 Basic Construction

The switchgear assembly shall consist of free-standing dead-front steel structures containing circuit breaker compartments and circuit breakers, primary bus system, ground bus system, auxiliary compartments and control devices, control bus (as required) and connection provisions for primary, ground, and control circuits. All the parts of the switchboard shall be able to withstand any mechanical stresses, which may develop out of normal duty or during maximum short circuit conditions without any damage or distortion to any part. The instrument and relay panel shall form an integral part of the switchboard with all the instruments and protection relays flush mounted.

The switchboard shall be equipped with arc venting off venting system and front doors and panels shall be reinforced with special door locks to withstand explosion forces associated with maximum short circuit conditions. Panels shall be manufactured from steel with a minimum thickness of 2 mm.

The following ring main units shall be provided under this contract, as listed in the Table below;

Qty	Description	Location
1	Ring Main unit specified below will be housed in the miniature substation No.1 [outdoor Unit housed inside 3CR12 miniature substation and an plinth shall be catered for]	Container Building

Ring main units offered under this contract must conform in full to the requirements of SANS. **OUTDOOR** type fitted fully sealed cable boxes and cable termination box.

Clamps for heat shrinkable medium voltage cable ends shall be provided in the medium voltage cable termination box.

All the bolts used to bolt the different parts of the panel together shall be provided with jack nuts or another approved method to secure the nuts. No Self-Tapping Screws Shall Be Allowed. All the bolts and nuts visible from the outside shall be chromed and of the dome type.

PSERMU-2.18.1 Current Transformers

PSERMU-2.18.1.A Miniature Substation No.1 Ring Main Unit [M/S No.1]

Qty	Description	Location
Two	Medium Voltage Panels comprising the following:	Miniature Substation Isolators - Incomer and Feeder
1	Refer to particular specification	Incomer and Feeder
One	Medium Voltage Panel comprising the following:	500kVA 11kV / 400V Transformer Feeder
1	Set 100/1A 15VA Class 10P10 current transformers for over current and earth fault protection [Tender shall select all components to preferred manufacturers]	Protection C.T's

PSERMU-2.18.3 Low Voltage Compartment [Protection]

PSERMU-2.18.3.A Miniature Substation No.1 Ring Main Unit [M/S No.1]

QTY	DESCRIPTION	LOCATION
Two	Medium Voltage Panel comprising the following:	Miniature Substation Isolators - Incomer and Feeder
One	The Isolators shall come with Fuses rated for the maximum current. [Tender shall select all components to preferred manufacturers]	Fuses
1	Trip/neutral/close selector switch [Tender shall select all components to preferred manufacturers]	Selector switch
1	Local/Remote switch [Tender shall select all components to preferred manufacturers]	Local remote
All	Indication lights [Tender shall select all components to preferred manufacturers]	Indication
1	Front panel mounted "chicken switch" socket for switching of circuit breaker from a safe distance [Tender shall select all components to preferred manufacturers]	Chicken switch
Sum	ALL Incomers shall be fitted with medium voltage Dehnguard nominal discharge current of 10kA.	Surge Protection
One	Medium Voltage Panel comprising the following:	500kVA 11kV / 400V Transformer
1	Self-Powered Transformer protection Relay O/C and E/F plus O/C high sets relay. Protection Relay with settings between 15% and 200% for O/C and between 20% and 80% for E/F	Relay

QTY	DESCRIPTION	LOCATION
	elements. The Transformer protection shall come with the following items: 1) Transformer temperature alarm and trip, 2) Oil level alarm and trip, [Tender shall select all components to preferred manufacturers]	
3	Instantaneous ammeters with saturation C.T.'s [Tender shall select all components to preferred manufacturers]	CT's
1	Trip/neutral/close selector switch [Tender shall select all components to preferred manufacturers]	Selector switch
1	Local/Remote switch [Tender shall select all components to preferred manufacturers]	Local remote
All	Indication lights [Tender shall select all components to preferred manufacturers]	Indication
1	Front panel mounted "chicken switch" socket for switching of circuit breaker from a safe distance [Tender shall select all components to preferred manufacturers]	Chicken switch

END OF SECTION

PSPMC MOTOR CONTROL CENTRES AND DISTRIBUTION BOARDS

PSPMC-1 Scope of Works

Tenderer shall allow for the proper liaison with all other contractors to ensure proper functioning of all equipment supplied, installed and commissioned under this Contract.

Distribution Boards shall be installed in the positions indicated on the drawings and shall comply with SANS 1765. Electrical Contractors are advised to order their distribution boards from a reputable manufacturer, as inferior-quality boards will not be accepted.

All equipment offered under this Contract shall be selected to be equal (or better) of make as far as possible. The tenderer shall provide equipment for motor starter panels that is at least Type 2 coordinated. If moulded case circuit breakers and miniature circuit breakers are cascaded, supportive documentation must be supplied with the tender and the tenderer shall allow for the proper labelling as required by SANS.

Motor control centres (MCC) and distribution boards (DB) as specified shall be provided in the following locations;

NUMBER	DESCRIPTION	LOCATION
A	Substation No.1 Motor Control Centre	'24 Head of Works MCC
B	Four [x4] Variable Frequency Drives situated at Inlet Works MCC	'24 Head of Works MCC
C	Substation No.2 Motor Control Centre	'24 Primary Sedimentation, Ultra-Fine Screens and '24 BNR Reactor MCC
D	Substation No.3 Motor Control Centre	Sludge Management MCC
E	Substation No.4 Motor Control Centre	'24 Membrane Reactor and UV MCC
F	Eight [x8] Variable Frequency Drives situated at '24 Membrane Reactor and UV MCC	'24 Membrane Reactor and UV MCC
G	Five [x5] Variable Frequency Drives situated at '24 Membrane Reactor and UV MCC	'24 Membrane Reactor and UV MCC
H	Five [x5] Variable Frequency Drives situated at '24 Membrane Reactor and UV MCC	'24 Membrane Reactor and UV MCC
I	Sixteen [x16] Variable Frequency Drives situated at '24 Membrane Reactor and UV MCC	'24 Membrane Reactor and UV MCC
J	Substation No.4 Motor Control Centre	'24 Membrane Reactor Re-use Pump Station MCC
K	Substation No.5 Motor Control Centre	Maturation, Tertiary Treatment and Disinfection MCC
L	Six [x6] Variable Frequency Drives situated at '24 Membrane Reactor and UV MCC	'24 Membrane Reactor and UV MCC

PSPMC-6.A Main Motor Control Centre [MCC No.01]

Type: These specification shall be considered as minimum design requirement in terms of the Contractor's Tender offer. The Electrical and Electronic Contractor(s) shall coordinate with the Mechanical Contractor to ensure sufficient allowance is made in their tender offer to provide a fit for purpose unit/system.

The motor control centre or distribution board shall be manufactured accordance to Particular Specification. The equipment referenced below does not relieve the contractor of his responsibilities in terms of quality, dimensions and proper functioning of the system.

The motor control centre board or distribution board shall be of the free-standing floor-mounted type with a minimum IP rating of 54 (insect-proofed enclosure). The motor control centre or distribution board shall be constructed with a minimum of 2mm 3CR12 stainless steel which will rest on a 3CR12 stainless steel rigid channel and shall be bolted down in position by means of M16 high tensile stainless-steel bolts grouted into the concrete floor, the bolts shall be inside the board.

The panel door shall be provided with a locking system suitable for padlocking. The locking system shall consist of a 3CR12 stainless steel 3-way locking mechanism locking the door at the top, middle and bottom. The unit doors shall be capable of being opened at least 110 degrees.

Sufficient provision for ventilation and heat dissipation as per the equipment ratings and manufacturers requirements shall be allowed for. Screwed-on engraved labels in English shall be provided below all switchgear and equipment on and in the panels, to facilitate identification. All unpainted parts shall be plated for corrosion resistance.

Supply: 3 x 150mm² 4C CU PVC SWA PVC cable plus 3 x 70mm² bare copper earth cable feeder from 500kVA Miniature substation & Generator.

Colour: Painted Light Orange – B26 (SANS 1091:2012) external, White arc-free internal (see Painting and Finishing).

Fault Level: 20kA.

Sectioning: Multi-section, Form 3b or Form 4 to SANS IEC 60439.

Future: 10% for future extension space.

Cable Entry: Incoming and Outgoing – Bottom. MCC gland plates shall be 3CR12 sheet steel, unpainted or aluminium.

Base: Single 100x50x6mm thick channel iron base with mitred corners and cross-bracing between every 2nd tier.

Qty	Description	Identification
One	Panels comprising the following	Incomer Section
1	800Amp continuous current rated TP (triple pole) Molded Case circuit breaker complete with opening / closing release with sufficient auxiliary contacts and complete with: Control unit with adjustable overload and short circuit protection with time discrimination micrologic unit, Electrical operating mechanism for remote closing of circuit breaker, 231V AC operation,	Main Circuit Breaker

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PMC: Motor Control Centres and Distribution Boards

Qty	Description	Identification
	Separate panel mounted circuit breaker close push button equal or similar to Schneider Electric: Plus	
Set	800/1 Amp current transformer: Plus	Current inputs
3	2 Amp HRC fuse holders and fused links: Plus	Voltage inputs
1	Front panel mounted LCD digital display supply network analyser comprising of combined voltage, current, maximum demand power measurement and power factor correction measurement complete with network card: Plus	Network analyser
4	800Amp tint copper bus bars [appearance shall be aluminium], suitable clamps shall be used, and no drilling shall be allowed on the busbars [cubic system shall be used]: Plus	3 Phase + N
1	500Amp tint copper bus bars [appearance shall be aluminium], suitable clamps shall be used, and no drilling shall be allowed on the busbars [cubic system shall be used]: Plus	Earth
4	315Amp continuous current rated HRC fuse holders and fused links: Plus	Surge arrestors connection fuses
1	Three Phase combined class 1&2 Surge Arrester: Plus	Surge arrestor plus signals
3	2Amp continuous current rated HRC fuse holders and fused links: Plus	Indicator Lamp Protection
3	Robust LED indicator lamps connected load side of the circuit breaker.	Indicators for 3 Phase (Red , White and Blue Indications)
1	Front panel mounted "chicken switch" socket for switching of circuit breaker from a safe distance [Tender shall select all components to preferred manufacturers]	Chicken switch
1	Relay for under voltages, phase sequence, and phase loss in three phase Plus	Protection relay
One	Panels comprising the following	Distribution Section
1	630Amp continuous current rated MCCB with door interlock (setting set to Amp) including electronic trip unit: Plus	Main
4	630Amp copper bus bars: Plus	3 Phase + N
1	400Amp copper bus bar: Plus	Earth
1	80Amp TP continuous current rated MCB complete: Plus	MCC Room DB

Qty	Description	Identification
1	160Amp continuous current rated MCCB: Plus	MCC Supernatant
1	500Amp continuous current rated MCCB: Plus	MCC No.2
1	60Amp continuous current rated MCCB: Plus	MCC No.3
1	60Amp continuous current rated MCCB: Plus	MCC No.3
1	125Amp continuous current rated MCCB: Plus	Main DB
1	160Amp continuous current rated MCCB: Plus	Package Plant
1	160Amp continuous current rated MCCB: Plus	Package Plant
3	80Amp continuous current rated MCCB: Plus	Allowance
3	100Amp continuous current rated MCCB : Plus	Allowance
Four	Panel comprising the following:	Digester Mixing System No.1 - No.4 - DG No.1
1	11kW TP continuous current rated motor protection MCCB complete with extended rotary handle for door interlocking [Mechanical operating handle for circuit-breaker, including door interlock, self-aligning spindle and padlocking facility] (Estimated and shall be coordinated with mechanical contractor to ensure correct supplies to mechanical equipment): Plus	Main
Set	Continuous current rated core balanced current transformers: Plus	Current inputs
3	2 Amp HRC fuse holders and fused links: Plus	Voltage inputs
1	11kW three-phase heavy-duty vector control variable frequency drive complete with 1) Programmable cards, 2) Communication card & 3) Encoder interface card. All necessary harmonic filters shall be included: EMC filter, line choke motor chokes and sinus filters shall be included. The following minimum protection parameters shall be available on the Variable frequency drive: • Thermal • Output Phase loss • Drive overheat • Over voltage • Under voltage • Frequency meter • Locked rotor • Phase rotation • Under current (Estimated and shall be coordinated with mechanical contractor to ensure correct supplies to mechanical equipment): Plus	Variable frequency drive

Qty	Description	Identification
All	A separate door mountable display and programming control unit shall be front door mounted.	Separate display unit for VSD Drives with all parameters
All	Communications module must be provided, communication links with PLC/DCS Units. The communication interface must comply with either of the following: a) Profibus-DP b) Profinet c) Industrial Ethernet d) Modbus TCP/IP Under no circumstances, shall the use of proprietary protocols be allowed: Plus	Communication module for VSD
1	6Amp continuous current rated SP MCB: Plus	Variable frequency drive fans supply
All	Extraction fans in panel door for cooling of variable speed drives in accordance with manufacturers specifications: Plus	Fans for Variable Speed
All	Reset push button for pump casing temperature trip condition: Plus	Pump casing temperature trip reset (If provided on pump sets)
All	Thermistor relay: Plus	(If provided on pump sets)
All	Thermistor trip indication: Plus	(If provided on pump sets)
All	Thermistor reset button: Plus	(If provided on pump sets)
1	Running hour meter: Plus	Running Hour Meter
All	All equipment necessary for remote emergency stop device	All
1	Manual-off-auto-remote selector switch: Plus	Selector Switch
All	Monitoring and control equipment: Plus	Control & Monitoring functions
1	10Amp continuous current rated SP MCB: Plus	Heater Supply
1	Continuous current rated Ammeter: Plus	Heater ammeter
All	All equipment necessary for remote emergency stop device	All necessary equipment
All	Relays and auxiliary contacts necessary for:	
All	Refer to Common Control cubicle	Refer to common control

Qty	Description	Identification
One	Cubicle comprising the following: [Common Control - Digester Mixing Pump No.1 - No.4]	Digester Mixing No.1 - No.4
1	10Amp sized continuous current rated SP + N door interlocked MCB: Plus	Main Circuit Breaker
1	Manual - Off - Auto selector switch: Plus	Selector Switch
1	Mixing Pump will be operated as Two duty and Two standby unit. A timer shall be provided for duty rotation of pump sets after a 24-hour period of time. In the event of a pump failure the duty cycle must be transferred to the next available pump set. Timer will be disabled in the event when one pump set is out of commission: Plus	Timer control in manual mode
1	Duty rotation timer and flip-flop relay that will rotate duty cycle between duty and standby pump sets on a daily basis. If standby pump set is not available duty pump set will remain in operation: Plus	Duty rotation in manual mode
All	The following Indication lights (LED type); Red – 'Motor Stopped'; Green - 'Motor Running'; Yellow – 'Motor Tripped: Plus	Indication lights
All	All equipment necessary for remote motor status, speed monitoring and control.	Control and monitoring
All	Relays, auxiliary contacts, indicating lights, wiring and reset buttons necessary for the following	
All	Interlocking with emergency stop stations on all motors to lockout main circuit breaker, if emergency stop is pressed the standby pump must automatically start: Plus	All motors shall have E-Stops
All	Interlock timer & relays to limit starts per hour, per the manufacturer's requirements, predetermined starts per hour allowed: Plus	Starts per Hour
All	Interlock motor sets as Two duty and Two standby unit in manual as well as automatic mode of operation: Plus	Interlocks duty and standby.
All	Extraction fans in panel door for cooling in accordance with manufacturers specifications. If the Fans do not work in manual as well as automatic mode of operation, the start shall be interlocked to not to be able to start. Unhealthy status will displayed on indication: Plus	Extraction fan interlocks
All	Interlock pump in manual as well as automatic mode of operation with level control system. A predetermined low level will stop the pumps: Plus	Level protection

Qty	Description	Identification
All	Interlock motor with pressure sensors in common delivery and common suction pump line in automatic mode of operation. Predetermined low pressure will stop the duty motor and predetermined high pressure will stop the duty motor. If a predetermined pressure is not obtained the duty motor sets, will stop and will ramp down. During start up and shut down this function must be bypassed for a predetermined period. Motor sets will only be able to start once pressure trip has been manually been reset: Plus	Pressure sensors
All	All Interlocks as described under operation of plant [PSEPLC-15]	Additional interlocks and writeup
All	The mixing process of the digesters shall be controlled automatically through a Programmable Logic Controller (PLC). The system will operate in a sequence where two duty motors are programmed to run for an adjustable period of time. Once this set operating time has elapsed, the PLC will initiate a countdown timer during which the motors will remain idle. Upon the completion of the countdown timer, the mixing operation will resume automatically for another predetermined duration. This alternating cycle of operation and rest will continue as programmed in the PLC to ensure efficient and consistent mixing. The final operating times for both the duty cycle and the rest period will be configurable and adjustable within the PLC settings and on the HMI. Manual the motor shall be started and stopped from the MCC : Plus	
All	All motor/pump information and signals statuses shall be available on the PLC system: Plus.	Signals statuses
Four	Panel comprising the following:	Digester Mixing System No.1 – No.4 – DG No.2
1	11kW TP continuous current rated motor protection MCCB complete with extended rotary handle for door interlocking [Mechanical operating handle for circuit-breaker, including door interlock, self-aligning spindle and padlocking facility] (Estimated and shall be coordinated with mechanical contractor to ensure correct supplies to mechanical equipment): Plus	Main
Set	Continuous current rated core balanced current transformers: Plus	Current inputs
3	2 Amp HRC fuse holders and fused links: Plus	Voltage inputs
1	11kW three phase heavy duty vector control variable frequency drive complete with 1) Programmable cards, 2) Communication card & 3) Encoder interface card. All necessary harmonic filters shall be included, EMC filter, line choke motor chokes and sinus filters all shall be inclusive.	Variable frequency drive

Qty	Description	Identification
	The following minimum protection parameters shall be available on the Variable frequency drive: • Thermal • Output Phase loss • Drive overheat • Over voltage • Under voltage • Frequency meter • Locked rotor • Phase rotation • Under current (Estimated and shall be coordinated with mechanical contractor to ensure correct supplies to mechanical equipment): Plus	
All	A separate door mountable display and programming control unit shall be front door mounted.	Separate display unit for VSD Drives with all parameters
All	Communications module must be provided, communication links with PLC/DCS Units. The communication interface must comply with either of the following: a) Profibus-DP b) Profinet c) Industrial Ethernet d) Modbus TCP/IP Under no circumstances, shall the use of proprietary protocols be allowed: Plus	Communication module for VSD
1	6Amp continuous current rated SP MCB: Plus	Variable frequency drive fans supply
All	Extraction fans in panel door for cooling of variable speed drives in accordance with manufacturers specifications: Plus	Fans for Variable Speed
All	Reset push button for pump casing temperature trip condition: Plus	Pump casing temperature trip reset (If provided on pump sets)
All	Thermistor relay: Plus	(If provided on pump sets)
All	Thermistor trip indication: plus	(If provided on pump sets)
All	Thermistor reset button: Plus	(If provided on pump sets)
1	Running hour meter: Plus	Running Hour Meter
All	All equipment necessary for remote emergency stop device	All
1	Manual-off-auto-remote selector switch: Plus	Selector Switch

Qty	Description	Identification
All	Monitoring and control equipment: Plus	Control & Monitoring functions
1	10Amp continuous current rated SP MCB: Plus	Heater Supply
1	Continuous current rated Ammeter: Plus	Heater ammeter
All	All equipment necessary for remote emergency stop device	All necessary equipment
All	Relays and auxiliary contacts necessary for:	
All	Refer to Common Control cubicle	Refer to common control
One	Cubicle comprising the following: [Common Control - Digester Mixing Pump No.1 - No.4]	Digester Mixing No.1 - No.4
1	10Amp sized continuous current rated SP + N door interlocked MCB: Plus	Main Circuit Breaker
1	Manual – Off - Auto selector switch: Plus	Selector Switch
1	Mixing Pump will be operated as Two duty and Two standby unit.,A timer shall be provided for duty rotation of pump sets after a 24-hour period of time. In the event of a pump failure the duty cycle must be transferred to the next available pump set. Timer will be disabled in the event when one pump set is out of commission: Plus	Timer control in manual mode
1	Duty rotation timer and flip-flop relay that will rotate duty cycle between duty and standby pump sets on a daily basis. If standby pump set is not available duty pump set will remain in operation: Plus	Duty rotation in manual mode
All	The following Indication lights (LED type); Red – 'Motor Stopped'; Green - 'Motor Running'; Yellow – 'Motor Tripped: Plus	Indication lights
All	All equipment necessary for remote motor status, speed monitoring and control.	Control and monitoring
All	Relays, auxiliary contacts, indicating lights, wiring and reset buttons necessary for the following	
All	Interlocking with emergency stop stations on all motors to lockout main circuit breaker, if emergency stop is pressed the standby pump must automatically start: Plus	All motors shall have E-Stops
All	Interlock timer & relays to limit starts per hour, per the manufacturer's requirements, predetermined starts per hour allowed: Plus	Starts per Hour

Qty	Description	Identification
All	Interlock motor sets as Two duty and Two standby unit in manual as well as automatic mode of operation: Plus	Interlocks duty and standby.
All	Extraction fans in panel door for cooling in accordance with manufacturers specifications. If the Fans do not work in manual as well as automatic mode of operation, the start shall be interlocked to not to be able to start. Unhealthy status will displayed on indication: Plus	Extraction fan interlocks
All	Interlock pump in manual as well as automatic mode of operation with level control system. A predetermined low level will stop the pumps: Plus	Level protection
All	Interlock motor with pressure sensors in common delivery and common suction pump line in automatic mode of operation. Predetermined low pressure will stop the duty motor and predetermined high pressure will stop the duty motor. If a predetermined pressure is not obtained the duty motor sets, will stop and will ramp down. During start up and shut down this function must be bypassed for a predetermined period. Motor sets will only be able to start once pressure trip has been manually been reset: Plus	Pressure sensors
All	All Interlocks as described under operation of plant [PSEPLC-15]	Additional interlocks and writeup
All	The mixing process of the digesters shall be controlled automatically through a Programmable Logic Controller (PLC). The system will operate in a sequence where two duty motors are programmed to run for an adjustable period of time. Once this set operating time has elapsed, the PLC will initiate a countdown timer during which the motors will remain idle. Upon the completion of the countdown timer, the mixing operation will resume automatically for another predetermined duration. This alternating cycle of operation and rest will continue as programmed in the PLC to ensure efficient and consistent mixing. The final operating times for both the duty cycle and the rest period will be configurable and adjustable within the PLC settings and on the HMI. Manual the motor shall be started and stopped from the MCC: Plus	
All	All motor/pump information and signals statuses shall be available on the PLC system: Plus.	Signals statuses
One	Panel comprising the following:	PLC Equipment as specified under PLC descriptions
One	Panel comprising the following:	UPS Equipment as specified under UPS descriptions

PSPMC-6.B Motor Control Centre BNR Reactor [MCC No.2]

Type: These specification shall be considered as minimum design requirement in terms of the Contractor's Tender offer. The Electrical and Electronic Contractor(s) shall coordinate with the Mechanical Contractor to ensure sufficient allowance is made in their tender offer to provide a fit for purpose unit/system.

The motor control centre or distribution board shall be manufactured accordance to Particular Specification. The equipment referenced below does not relieve the contractor of his responsibilities in terms of quality, dimensions and proper functioning of the system.

The motor control centre board or distribution board shall be of the free-standing floor mounted type with a minimum IP rating of 54 (insect proofed enclosure). The motor control centre or distribution board shall be constructed with a minimum of 2mm 3CR12 stainless steel which will rest on a 3CR12 stainless steel rigid channel and shall be bolted down in position by means of M16 high tensile stainless-steel bolts grouted into the concrete floor, the bolts shall be inside the board.

The panel door shall be provided with a locking system suitable for padlocking. The locking system shall consist of a 3CR12 stainless steel 3-way locking mechanism locking the door at the top, middle and bottom. The unit doors shall be capable of being opened at least 110 degrees.

Sufficient provision for ventilation and heat dissipation as per the equipment ratings and manufacturers requirements shall be allowed for. Screwed-on engraved labels in English shall be provided below all switchgear and equipment on and in the panels, to facilitate identification. All unpainted parts shall be plated for corrosion resistance.

Supply: 2 x 150mm² 4C CU PVC SWA PVC cable plus 3 x 70mm² bare copper earth cable feeder from Main MCC No.1.

Colour: Painted Light Orange – B26 (SANS 1091:2012) external, White arc-free internal (see Painting and Finishing).

Fault Level: 45kA.

Sectioning: Multi-section, Form 3b or Form 4 to SANS IEC 60439

Future: 10% for future extensions space.

Cable Entry: Incoming and Outgoing – Bottom. MCC gland plates shall be 3CR12 sheet steel, unpainted or aluminium.

Base: Single 100x50x6mm thick channel iron base with mitred corners and cross-bracing between every 2nd tier.

Qty	Description	Identification
One	Cubicle comprising the following:	Incomer
1	400Amp continuous current rated MCCB with door interlock including electronic trip unit: Plus	Main
Set	400/5Amp continuous current rated current transformer: Plus	Current inputs
3	2Amp HRC fuse holders and fused links: Plus	Voltage inputs
1	Front panel mounted LCD digital display supply network analyser comprising of combined voltage, current, maximum demand power measurement and	Power analyser

Qty	Description	Identification
	power factor correction measurement complete with Communications module must be provided, communication links with PLC/DCS Units and equal or similar PM2230. The communication interface must comply with either of the following: a) Profibus-DP b) Profinet c) Industrial Ethernet d) Modbus TCP/IP Under no circumstances, shall the use of proprietary protocols be allowed: Plus	
4	400Amp plated copper bus bars: Plus	3 Phase + N
1	300Amp plated copper bus bars: Plus	Earth
4	315Amp continuous current rated HRC fuse holders and fused links: Plus	Surge arrestors connection fuses
1	Three Phase class 1 & 2 surge arrestor unit connection type 2 as per SANS 10142-1: Plus	Surge arrestor plus signals
3	2Amp continuous current rated HRC fuse holders and fused links: Plus	Indicator Lamp Protection
3	Robust LED indicator lamps connected load side of the circuit breaker.	Indicators for 3 Phase (Red, White and Blue Indications)
All	Phase failure, phase rotation and phase imbalance, voltage, and frequency relay.	Relay for protection
One	Panel [Cubicle] comprising the following: [Cascading to be completed by the contractor]	Site Distribution
1	80Amp continuous current rated TP MCCB door interlocked: Plus	Main
1	60Amp continuous current rated SP MCB: Plus	Local DB
1	20Amp continuous current rated SP MCB: Plus	3kVA UPS feeder
Three	Panel comprising the following:	Aerators No.1 – No.3
1	45kW TP continuous current rated motor protection MCCB complete with extended rotary handle for door interlocking [Mechanical operating handle for circuit-breaker, including door interlock, self-aligning spindle and padlocking facility] (Estimated and shall be coordinated with mechanical contractor to ensure correct supplies to mechanical equipment): Plus	Main
Set	Continuous current rated core balanced current transformers: Plus	Current inputs

Qty	Description	Identification
3	2 Amp HRC fuse holders and fused links: Plus	Voltage inputs
1	45kW three phase heavy duty vector control variable frequency drive complete with 1) Programmable cards, 2) Communication card & 3) Encoder interface card. All necessary harmonic filters shall be included, EMC filter, line choke motor chokes and sinus filters all shall be inclusive. The following minimum protection parameters shall be available on the Variable frequency drive: • Thermal • Output Phase loss • Drive overheat • Over voltage • Under voltage • Frequency meter • Locked rotor • Phase rotation • Under current (Estimated and shall be coordinated with mechanical contractor to ensure correct supplies to mechanical equipment): Plus	Variable frequency drive
All	A separate door mountable display and programming control unit shall be front door mounted.	Separate display unit for VSD Drives with all parameters
All	Communications module must be provided, communication links with PLC/DCS Units. The communication interface must comply with either of the following: a) Profibus-DP b) Profinet c) Industrial Ethernet d) Modbus TCP/IP Under no circumstances, shall the use of proprietary protocols be allowed: Plus	Communication module for VSD
1	6Amp continuous current rated SP MCB: Plus	Variable frequency drive fans supply
All	Extraction fans in panel door for cooling of variable speed drives in accordance with manufacturers specifications: Plus	Fans for Variable Speed
All	Reset push button for pump casing temperature trip condition: Plus	Pump casing temperature trip reset (If provided on pump sets)
All	Thermistor relay: Plus	(If provided on pump sets)

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Qty	Description	Identification
All	Thermistor trip indication: Plus	(If provided on pump sets)
All	Thermistor reset button: Plus	(If provided on pump sets)
1	Running hour meter: Plus	Running Hour Meter
All	All equipment necessary for remote emergency stop device	All
1	Manual-off-auto-remote selector switch: Plus	Selector Switch
All	Monitoring and control equipment: Plus	Control & Monitoring functions
1	10Amp continuous current rated SP MCB: Plus	Heater Supply
1	Continuous current rated Ammeter: Plus	Heater ammeter
All	All equipment necessary for remote emergency stop device	All necessary equipment
All	Relays and auxiliary contacts necessary for:	
All	Refer to Common Control cubicle	Refer to common control
One	Cubicle comprising the following: [Common Control - Aerators No.1 – No.3]	Aerators No.1 – No.3
1	10Amp sized continuous current rated SP + N door interlocked MCB: Plus	Main Circuit Breaker
1	Manual – Off - Auto selector switch: Plus	Selector Switch
1	Aerators will be operated as three duty and Zero standby unit. A timer shall be provided for duty rotation of pump sets after a 24-hour period of time. In the event of a pump failure the duty cycle must be transferred to the next available pump set. Timer will be disabled in the event when one pump set is out of commission: Plus	Timer control in manual mode
1	Duty rotation timer and flip-flop relay that will rotate duty cycle between duty and standby pump sets on a daily basis. If standby pump set is not available duty pump set will remain in operation: Plus	Duty rotation in manual mode
All	The following Indication lights (LED type); Red – 'Motor Stopped'; Green - 'Motor Running'; Yellow – 'Motor Tripped: Plus	Indication lights
All	All equipment necessary for remote motor status, speed monitoring and control.	Control and monitoring

Qty	Description	Identification
All	Relays, auxiliary contacts, indicating lights, wiring and reset buttons necessary for the following	
All	Interlocking with emergency stop stations on all motors to lockout main circuit breaker, if emergency stop is pressed the standby pump must automatically start: Plus	All motors shall have E-Stops
All	Interlock timer & relays to limit starts per hour, per the manufacturer's requirements, predetermined starts per hour allowed: Plus	Starts per Hour
All	Interlock motor sets as Three duty and Zero standby unit in manual as well as automatic mode of operation: Plus	Interlocks duty and standby.
All	Extraction fans in panel door for cooling in accordance with manufacturers specifications. If the Fans do not work in manual as well as automatic mode of operation, the start shall be interlocked to not to be able to start. Unhealthy status will displayed on indication: Plus	Extraction fan interlocks
All	Interlock pump in manual as well as automatic mode of operation with level control system. A predetermined low level will stop the pump: Plus	Level protection
All	The system will utilize three aerators controlled by a dissolved oxygen (DO) analyzer. As the dissolved oxygen levels in the system increase, the speed of the aerators will be adjusted accordingly to maintain the desired oxygen level. Specifically, when the DO levels rise, the aerators will increase their speed, injecting more air into the system to maintain the target DO concentration. This target dissolved oxygen level is an adjustable setpoint within the PLC (Programmable Logic Controller) system, allowing operators to modify the desired DO concentration as necessary for the system's requirements. The control system will continuously monitor the DO levels and dynamically adjust the aerators' speed to ensure that the oxygen levels stay within the predefined range, promoting system stability and efficiency: Plus	Pressure sensors
All	All RTD sensors shall be interlocked in manual and in automatic mode of operation to protect motors.	RTD Protection
All	Interlock all predetermined temperature settings in manual and auto mode of operation. The temperature settings shall be as per the manufacturer's recommendations: Plus	If supplied by mechanical Contractor - Temperature Protection

Qty	Description	Identification
All	All Interlocks as described under operation of plant [PSEPLC-15]	Additional interlocks and writeup
Four	Panels comprising the following	Primary Sedimentation Tank's No.1 - No.2
1	1.5kW TP continuous current rated motor protection MCCB complete with extended rotary handle for door interlocking [Mechanical operating handle for circuit-breaker, including door interlock, self-aligning spindle and padlocking facility] (Estimated and shall be coordinated with mechanical contractor to ensure correct supplies to mechanical equipment): Plus	Main
1	1.5kW continuous current rated thermal magnetic motor circuit breakers with adjustable current setting and auxiliary contact (monitor trip condition) (Estimated and shall be coordinated with mechanical contractor to ensure correct supplies to mechanical equipment): Plus	Actuator supply
Set	Continuous current rated current transformer: Plus	Current inputs
3	2 Amp HRC fuse holders and fused links: Plus	Voltage inputs
1	1.5kW (3) phase heavy duty vector control variable frequency drive complete with 1) Programmable cards, 2) Communication card & 3) Encoder interface card. All necessary harmonic filters shall be included, EMC filter, line choke motor chokes and sinus filters all shall be inclusive. The following minimum protection parameters shall be available on the Variable frequency drive: • Thermal • Output Phase loss • Input phase loss • Drive overheat • Over voltage • Under voltage • Frequency meter • Locked rotor • Phase rotation • Under current • Torque detection for motor on bridge • Speed or torque control • Braking unit via re-injection to the line supply (Estimated and shall be coordinated with mechanical contractor to ensure correct supplies to mechanical equipment): Plus	Variable frequency drive
All	A separate door mountable display and programming control unit shall be front door mounted.	Separate display unit for VSD Drives with all parameters

Qty	Description	Identification
All	Communications module must be provided, communication links with PLC/DCS Units. The communication interface must comply with either of the following: a) Profibus-DP b) Profinet c) Industrial Ethernet d) Modbus TCP/IP Under no circumstances, shall the use of proprietary protocols be allowed: Plus	Communication module for VSD
1	6Amp continuous current rated SP MCB: Plus	Variable frequency drive fans supply
1	Turn knob speed adjustment by means of current source (4-20mA): Plus	Manual speed control
1	Set of Stop/Start push buttons: Plus	Stop/Start Push Buttons
1	Mains operated timer to limit starts per hour: Plus	Limit Starts
All	Extraction fans in panel door for cooling of variable speed drives in accordance with manufacturers specifications: Plus	Fans for Soft Starter
1	Reset push button for pump casing temperature trip condition: Plus	Pump casing temperature trip reset
All	Thermister relay: Plus	(If provided on pump sets)
All	Thermister trip indication: Plus	(If provided on pump sets)
All	Thermister reset button: Plus	(If provided on pump sets)
1	Manual-off-auto-remote selector switch: Plus	Selector Switch
All	Monitoring and control equipment: Plus	Control & Monitoring functions
1	10Amp continuous current rated SP MCB: Plus	Heater Supply
1	Continuous current rated Ammeter: Plus	Heater supply
All	All equipment necessary for remote motor status, speed monitoring and control.	Control and monitoring
Sum	Timer to operate control system, manufacturer shall equal and similar to City of Cape town's specification: Plus	Timer Control

Qty	Description	Identification
All	Relays, auxiliary contacts, indicating lights, wiring and reset buttons necessary for the following	
	• Interlocking with emergency stop station: Plus	
	• Interlock in manual mode of operation to desludge on a timer based while in and automatic operation to desludge on adjustable predetermined timer via the PLC, pre-set intervals selected by the operator in order to optimise the thickening of the sludge: Plus	
	• Manual mode of operation the primary sedimentation tanks shall be started via the stop / start push buttons on system. Automatic mode of operation the primary sedimentation tanks shall be started and run consciously: Plus	
	• Interlock in manual and automatic with torque setting on variable speed drive to trip primary sedimentation tank in the event of over-torque trip. Manual reset will be required once torque trip has been initiated.	
	• Interlock with torque limit switch in manual and automatic mode of operation, supplied by others [mechanical contractor]. Part of this scope is to supply limit switches under the motor control centre on the torque limit switch to trip once limit has been reached: Plus	
Three [3]	Panels comprising the following:	Anaerobic zone mixers No.1 – No.3
1	5.5kW TP continuous current rated motor protection MCCB complete with extended rotary handle for door interlocking [Mechanical operating handle for circuit-breaker, including door interlock, self-aligning spindle and padlocking facility] (Estimated and shall be coordinated with mechanical Contractor to ensure correct supplies to mechanical equipment): Plus	Main
1	5.5kW heavy duty soft starter complete with ventilation fans on the unit and on the compartment door as well as a separate door mounted soft starter controller. The bypass circuit shall be connected to only bypass the semi-conductor section of the soft starter and maintain the integral motor protection of the soft starter. The following parameters shall be available on the Soft Starter: • Soft Start • Kickstart • Current Limit • Pump Control	Soft Starter

Qty	Description	Identification
	• Sensorless Linear Speed Acceleration and Deceleration • Torque Control • Dual Ramp Start • Full Voltage Start • Preset Slow Speed • Coast • Soft Stop • Smart Motor Braking • Slow Speed with Braking • Accu-Stop • Integrated Motor Overload Protection • Metering • Real Time Clock • Motor Winding Heater Function • Diagnostic Faults and Alarms • Automatic Tuning of Motor Parameters • Protection and diagnostics [Amps, volts, kW, kWh, MW, MWH, elapsed time, power factor, motor thermal capacity usage] • Alarms [Overload, underload, undervoltage, overvoltage, unbalance, jam, stall, and ground fault] • Pump Control [starting and stopping period. Starting time is adjustable. Stopping time is adjustable]. Communications module must be provided, communication links with PLC/DCS Units. The communication interface must comply with either of the following [Network Communications]: - Profibus-DP - Profinet - Industrial Ethernet - Modbus TCP/IP Under no circumstances, shall the use of proprietary protocols be allowed: Plus	
1	A separate door mountable display / HMI and programming control unit shall be front door mounted which connected to protection relay. The following features shall be available on the display / HMI as listed below: • All Indication lights as specified under particular specification shall be displayed on the door mounted display: Plus • Running hour meter shall be displayed on the door mounted display • Motor switching state • Current in phases 1, 2, 3 and maximum current • Phase voltage 1, 2, 3 • Active power	Separate display unit

Qty	Description	Identification
	• Apparent power • Power factor • Phase unbalance • Phase sequence • Time to trip • Temperature rise, motor model • Remaining cooling time of the motor • Temperature • Actual value, analog signals • Motor operating hours • Motor stop times • Number of motor starts • Number of overload trips	
All	Set of Stop/Start push buttons: Plus	Stop/Start Push Buttons
All	Mains operated timer to limit starts per hour: Plus	Limit Starts
All	Power factor capacitors shall correct to a minimum of 98%, complete with all accessories (Fuses, Circuit breaker and Contactor) to complete the installation: Plus	Power Factor capacitors
All	Extraction fans in panel door for cooling of Soft Starter drives in accordance with manufacturers specifications: Plus	Fans for Soft Starter
All	Continuous current rated current transformer: Plus	Current inputs
All	2 Amp HRC fuse holders and fused links: Plus	Voltage inputs
All	Set of Stop/Start push buttons: Plus	Stop/Start Push Buttons
1	Mains operated timer to limit starts per hour: Plus	Limit Starts
All	Power factor capacitors shall correct to a minimum of 98%, complete with all accessories (Fuses, Circuit breaker and Contactor) to complete the installation: Plus	Power Factor capacitors
All	Reset push button for pump casing temperature trip condition: Plus	Pump casing temperature trip reset
All	Thermister relay: Plus	(If provided on pump sets)
All	Thermister trip indication: Plus	(If provided on pump sets)
All	Thermister reset button: Plus	(If provided on pump sets)
1	Manual-off-auto-remote selector switch: Plus	Selector Switch
All	Monitoring and control equipment: Plus	Control & Monitoring functions

Qty	Description	Identification
All	10Amp continuous current rated SP MCB: Plus	Heater Supply
All	Heater ammeter: Plus	Heater Ammeter
All	All equipment necessary for remote motor status, speed monitoring and control.	Control and monitoring
1	Starting delay timer for sequence starting on motors: Plus	Sequence starting
All	Relays, auxiliary contacts, indicating lights, wiring and reset buttons necessary for the following	
	Interlocking with emergency stop stations on all motors to lockout main circuit breaker: Plus	All motors shall have E-Stops
	Manual mode of operation the mixer shall be started via the stop / start push buttons on system. Automatic mode of operation the mixers tanks shall be started and run consciously: Plus	
	Interlock mixers with level control system. A predetermined low level will stop all mixers: Plus	
Three [x3]	Panels comprising the following	A-Recycle No.1 – No.3
1	5.5kW TP continuous current rated motor protection MCCB complete with extended rotary handle for door interlocking [Mechanical operating handle for circuit-breaker, including door interlock, self-aligning spindle and padlocking facility] (Estimated and shall be coordinated with mechanical contractor to ensure correct supplies to mechanical equipment): Plus	Main
Set	Continuous current rated core balanced current transformers: Plus	Current inputs
3	2 Amp HRC fuse holders and fused links: Plus	Voltage inputs
1	5.5kW (3) phase heavy duty vector control variable frequency drive complete with 1) Programmable cards, 2) Communication card & 3) Encoder interface card. All necessary harmonic filters shall be included, EMC filter, line choke motor chokes and sinus filters [distance of the motor is far and Sinus filters shall be included] all shall be inclusive. The following minimum protection parameters shall be available on the Variable frequency drive: - Thermal - Output Phase loss - Input phase loss	Variable frequency drive

Qty	Description	Identification
	• Drive overheat • Over voltage • Under voltage • Frequency meter • Locked rotor • Phase rotation • Under current • Torque detection for motor on bridge • Speed or torque control • Braking unit via re-injection to the line supply • Earth leakage set to trip at 300mA. (Estimated and shall be coordinated with mechanical contractor to ensure correct supplies to mechanical equipment): Plus	
All	A separate door mountable display and programming control unit shall be front door mounted.	Separate display unit for VSD Drives with all parameters
All	Communications module must be provided, communication links with PLC/DCS Units. The communication interface must comply with either of the following: a) Profibus-DP b) Profinet c) Industrial Ethernet d) Modbus TCP/IP Under no circumstances, shall the use of proprietary protocols be allowed: Plus	Communication module for VSD
1	6Amp continuous current rated SP MCB: Plus	Variable frequency drive fans supply
1	Turn knob speed adjustment by means of current source (4-20mA): Plus	Manual speed control
1	Set of Stop/Start push buttons: Plus	Stop/Start Push Buttons
1	Mains operated timer to limit starts per hour: Plus	Limit Starts
All	Extraction fans in panel door for cooling of variable speed drives in accordance with manufacturers specifications: Plus	Fans for Soft Starter
1	Reset push button for pump casing temperature trip condition: Plus	Pump casing temperature trip reset
All	Thermister relay: Plus	(If provided on pump sets)
All	Thermister trip indication: Plus	(If provided on pump sets)

Qty	Description	Identification
All	Thermister reset button: Plus	(If provided on pump sets)
1	Manual-off-auto-remote selector switch: Plus	Selector Switch
All	Monitoring and control equipment: Plus	Control & Monitoring functions
1	10Amp continuous current rated SP MCB: Plus	Heater Supply
1	Continuous current rated Ammeter: Plus	Heater supply
1	Indication light and reset push button for pump motor seal leak protection sensor: Plus	Motor seal leak
1	Seal leak protection relays	Seal leak relay
All	All equipment necessary for remote emergency stop device	All
1	Pump sets will be operated as Two duty and One standby units in worst case scenarios. Normal operation shall be Two duty and one standby with rotation. A timer shall be provided for duty rotation of pump sets after a 24 hour period of time. In the event of a pump failure the duty cycle must be transferred to the next available pump set. Timer will be disabled in the event when one pump set is out of commission: Plus	Timer control in manual mode
1	Duty rotation timer and flip-flop relay that will rotate duty cycle between duty and standby pump sets on a daily basis. If standby pump set is not available duty pump set will remain in operation: Plus	Duty rotation in manual mode
All	Relays, auxiliary contacts, indicating lights, wiring and reset buttons necessary for the following	
	Interlock timer shall be provided for duty rotation of after a 24 hour period of time. Timer will be disabled in the event when motor is out of commission: Plus	
	Interlock with emergency stop to trip and lock out the starter, available standby pump to become duty pumps: Plus	
	Interlock motors to prevent simultaneously starting of all motors in the automatic mode of operation after a power failure: Plus	
	The variable speed drives shall be programmed in manual and in automated mode of operation to ramp up the motor speed to reduce the starting current to a minimum [all shall be similar programmed]. In the event that motor receive a	

Qty	Description	Identification
	stop or manual stop command, the motor will be the first ramp down to limit the water surge to the maximum allowable. Once the motor has stopped, only then can the standby pump start or attempt to start: Plus	
	The pump sets shall be interlocked to prevent pump sets to be start simultaneously in both manual and automatic modes of operation. In manual mode of operation the operator must select which pump set which will be used and the normal start pressures will be exactly similar to the Automated PLC mode of operation: Plus	
	The variable speed drives shall be programmed in automated mode of operation to control the speed of the A-Recycle pump sets via the flow rates. The operator will select the desired flow rate on the SCADA or HMI and duty motors shall be controlled via the variable speed drive to achieve the desired flow rates selected by the operator.	
	Each train has an A-recycle pump station to recycle mixed liquor from the final aerobic zone back to the anoxic zone. An operator set pump station delivery rate shall be regulated in terms of the respective reactor train influent flow meters. The pumps shall have VFDs to track the diurnal flow pattern of the influent. The operator shall have to option to activate all the pumps (i.e. four (2) duty, (1) standby). A maximum recycle ration of 6.5 shall be achievable.	
Three [x3]	Panels comprising the following	RAS No.1 – No.3
1	5.5kW TP continuous current rated motor protection MCCB complete with extended rotary handle for door interlocking [Mechanical operating handle for circuit-breaker, including door interlock, self-aligning spindle and padlocking facility] (Estimated and shall be coordinated with mechanical contractor to ensure correct supplies to mechanical equipment): Plus	Main
Set	Continuous current rated core balanced current transformers: Plus	Current inputs
3	2 Amp HRC fuse holders and fused links: Plus	Voltage inputs
1	5.5kW (3) phase heavy duty vector control variable frequency drive complete with 1) Programmable cards, 2) Communication card & 3) Encoder interface card. All necessary harmonic filters shall be included, EMC filter, line choke motor chokes and sinus filters [distance of the motor is far and Sinus filters shall be included] all shall be inclusive.	Variable frequency drive

Qty	Description	Identification
	The following minimum protection parameters shall be available on the Variable frequency drive: • Thermal • Output Phase loss • Input phase loss • Drive overheat • Over voltage • Under voltage • Frequency meter • Locked rotor • Phase rotation • Under current • Torque detection for motor on bridge • Speed or torque control • Braking unit via re-injection to the line supply • Earth leakage set to trip at 300mA. (Estimated and shall be coordinated with mechanical contractor to ensure correct supplies to mechanical equipment): Plus	
All	A separate door mountable display and programming control unit shall be front door mounted.	Separate display unit for VSD Drives with all parameters
All	Communications module must be provided, communication links with PLC/DCS Units. The communication interface must comply with either of the following: a) Profibus-DP b) Profinet c) Industrial Ethernet d) Modbus TCP/IP Under no circumstances, shall the use of proprietary protocols be allowed: Plus	Communication module for VSD
1	6Amp continuous current rated SP MCB: Plus	Variable frequency drive fans supply
1	Turn knob speed adjustment by means of current source (4-20mA): Plus	Manual speed control
1	Set of Stop/Start push buttons: Plus	Stop/Start Push Buttons
1	Mains operated timer to limit starts per hour: Plus	Limit Starts
All	Extraction fans in panel door for cooling of variable speed drives in accordance with manufacturers specifications: Plus	Fans for Soft Starter
1	Reset push button for pump casing temperature trip condition: Plus	Pump casing temperature trip reset

Qty	Description	Identification
All	Thermister relay: Plus	(If provided on pump sets)
All	Thermister trip indication: Plus	(If provided on pump sets)
All	Thermister reset button: Plus	(If provided on pump sets)
1	Manual-off-auto-remote selector switch: Plus	Selector Switch
All	Monitoring and control equipment: Plus	Control & Monitoring functions
1	10Amp continuous current rated SP MCB: Plus	Heater Supply
1	Continuous current rated Ammeter: Plus	Heater supply
1	Indication light and reset push button for pump motor seal leak protection sensor. Plus	Motor seal leak
1	Seal leak protection relays	Seal leak relay
All	All equipment necessary for remote emergency stop device	All
1	Pump sets will be operated as four duty and zero standby units in worst case scenarios. Normal operation shall be three duty and one standby with rotation. A timer shall be provided for duty rotation of pump sets after a 24 hour period of time. In the event of a pump failure the duty cycle must be transferred to the next available pump set. Timer will be disabled in the event when one pump set is out of commission: Plus	Timer control in manual mode
1	Duty rotation timer and flip-flop relay that will rotate duty cycle between duty and standby pump sets on a daily basis. If standby pump set is not available duty pump set will remain in operation: Plus	Duty rotation in manual mode
All	Relays, auxiliary contacts, indicating lights, wiring and reset buttons necessary for the following	
	Interlock timer shall be provided for duty rotation of after a 24 hour period of time. Timer will be disabled in the event when motor is out of commission: Plus	
	Interlock with emergency stop to trip and lock out the starter, available standby pump to become duty pumps: Plus	
	Interlock motors to prevent simultaneously starting of all motors in the automatic mode of operation after a power failure: Plus	

Qty	Description	Identification
	The variable speed drives shall be programmed in manual and in automated mode of operation to ramp up the motor speed to reduce the starting current to a minimum [all shall be similar programmed]. In the event that motor receive a stop or manual stop command, the motor will be the first ramp down to limit the water surge to the maximum allowable. Once the motor has stopped, only then can the standby pump start or attempt to start: Plus	
	The pump sets shall be interlocked to prevent pump sets to be start simultaneously in both manual and automatic modes of operation. In manual mode of operation the operator must select which pump set which will be used and the normal start pressures will be exactly similar to the Automated PLC mode of operation: Plus	
	The variable speed drives shall be programmed in automated mode of operation to control the speed of the RAS pump sets via the flow rates. The operator will select the desired flow rate on the SCADA or HMI and duty motors shall be controlled via the variable speed drive to achieve the desired flow rates selected by the operator.	
	Each biological reactor. An operator set pump station delivery rate shall be regulated in terms of the respective influent flow meters. The pumps shall have VFDs to track the diurnal flow pattern of the influent. The operator shall have to option to activate all the pumps (i.e. two (2) duty, (1) standby). A maximum RAS of 2.25 shall be achievable.	
Three [x3]	Panels comprising the following	WAS No.1 – No.3
1	5.5kW TP continuous current rated motor protection MCCB complete with extended rotary handle for door interlocking [Mechanical operating handle for circuit-breaker, including door interlock, self-aligning spindle and padlocking facility] (Estimated and shall be coordinated with mechanical contractor to ensure correct supplies to mechanical equipment): Plus	Main
Set	Continuous current rated core balanced current transformers: Plus	Current inputs
3	2 Amp HRC fuse holders and fused links: Plus	Voltage inputs
1	5.5kW (3) phase heavy duty vector control variable frequency drive complete with 1) Programmable cards, 2) Communication card & 3) Encoder interface card. All necessary harmonic filters shall be included, EMC filter, line choke motor chokes and	Variable frequency drive

Qty	Description	Identification
	sinus filters [distance of the motor is far and Sinus filters shall be included] all shall be inclusive. The following minimum protection parameters shall be available on the Variable frequency drive: • Thermal • Output Phase loss • Input phase loss • Drive overheat • Over voltage • Under voltage • Frequency meter • Locked rotor • Phase rotation • Under current • Torque detection for motor on bridge • Speed or torque control • Braking unit via re-injection to the line supply • Earth leakage set to trip at 300mA. (Estimated and shall be coordinated with mechanical contractor to ensure correct supplies to mechanical equipment): Plus	
All	A separate door mountable display and programming control unit shall be front door mounted.	Separate display unit for VSD Drives with all parameters
All	Communications module must be provided, communication links with PLC/DCS Units. The communication interface must comply with either of the following: a) Profibus-DP b) Profinet c) Industrial Ethernet d) Modbus TCP/IP Under no circumstances, shall the use of proprietary protocols be allowed: Plus	Communication module for VSD
1	6Amp continuous current rated SP MCB: Plus	Variable frequency drive fans supply
1	Turn knob speed adjustment by means of current source (4-20mA): Plus	Manual speed control
1	Set of Stop/Start push buttons: Plus	Stop/Start Push Buttons
1	Mains operated timer to limit starts per hour: Plus	Limit Starts
All	Extraction fans in panel door for cooling of variable speed drives in accordance with manufacturers specifications: Plus	Fans for Soft Starter

Qty	Description	Identification
1	Reset push button for pump casing temperature trip condition: Plus	Pump casing temperature trip reset
All	Thermister relay: Plus	(If provided on pump sets)
All	Thermister trip indication: Plus	(If provided on pump sets)
All	Thermister reset button: Plus	(If provided on pump sets)
1	Manual-off-auto-remote selector switch: Plus	Selector Switch
All	Monitoring and control equipment: Plus	Control & Monitoring functions
1	10Amp continuous current rated SP MCB: Plus	Heater Supply
1	Continuous current rated Ammeter: Plus	Heater supply
1	Indication light and reset push button for pump motor seal leak protection sensor: Plus	Motor seal leak
1	Seal leak protection relays	Seal leak relay
All	All equipment necessary for remote emergency stop device	All
1	Pump sets will be operated as four duty and zero standby units in worst case scenarios. Normal operation shall be three duty and one standby with rotation. A timer shall be provided for duty rotation of pump sets after a 24 hour period of time. In the event of a pump failure the duty cycle must be transferred to the next available pump set. Timer will be disabled in the event when one pump set is out of commission: Plus	Timer control in manual mode
1	Duty rotation timer and flip-flop relay that will rotate duty cycle between duty and standby pump sets on a daily basis. If standby pump set is not available duty pump set will remain in operation: Plus	Duty rotation in manual mode
All	Relays, auxiliary contacts, indicating lights, wiring and reset buttons necessary for the following	
	Interlock timer shall be provided for duty rotation of after a 24 hour period of time. Timer will be disabled in the event when motor is out of commission: Plus	
	Interlock with emergency stop to trip and lock out the starter, available standby pump to become duty pumps: Plus	

Qty	Description	Identification
	Interlock motors to prevent simultaneously starting of all motors in the automatic mode of operation after a power failure: Plus	
	The variable speed drives shall be programmed in manual and in automated mode of operation to ramp up the motor speed to reduce the starting current to a minimum [all shall be similar programmed]. In the event that motor receive a stop or manual stop command, the motor will be the first ramp down to limit the water surge to the maximum allowable. Once the motor has stopped, only then can the standby pump start or attempt to start: Plus	
	The pump sets shall be interlocked to prevent pump sets to be start simultaneously in both manual and automatic modes of operation. In manual mode of operation the operator must select which pump set which will be used and the normal start pressures will be exactly similar to the Automated PLC mode of operation: Plus	
	The variable speed drives shall be programmed in automated mode of operation to control the speed of the WAS pump sets via the flow rates. The operator will select the desired flow rate on the SCADA or HMI and duty motors shall be controlled via the variable speed drive to achieve the desired flow rates selected by the operator: Plus	
	An operator set pump station delivery rate shall be regulated in terms of the respective influent flow meters. The pumps shall have VFDs to track the diurnal flow pattern of the influent. The operator shall have to option to activate all the pumps (i.e. two (2) duty, (1) standby). A maximum RAS of 2.25 shall be achievable: Plus	
One	Panel comprising the following:	PLC Equipment as specified under PLC descriptions
One	Panel comprising the following:	UPS Equipment as specified under UPS descriptions

END OF SECTION

PSEMCC-6.C CHLORINE MOTOR CONTROL CENTRE [MCC No.3]

Type: The motor control centre or distribution board shall be manufactured accordance to Particular Specification. The equipment referenced below does not relieve the contractor of his responsibilities in terms of quality, dimensions, and proper functioning of the system. The Electrical contractor responsibility is to coordinate with the mechanical contractor in terms of P&ID's, motor sizes, operation of the plant and provide all equipment which is offered by the Mechanical Contractor.

The motor control centre board or distribution board shall be of the free-standing pedestal mounted type with a minimum IP rating of 42 (Indoor). The motor control centre or distribution board shall be constructed with a minimum of **2mm 3CR12** steel which will rest on a rigid channel iron. Tenderer shall refer to the particular specification.

The panel door shall be provided with a locking system suitable for padlocking. The locking system shall consist of a **3CR12** 3-way locking mechanism locking the door at the top, middle and bottom. The unit doors shall be capable of being opened at least 110 degrees.

The board shall be provided with readily removable, sectionalized, rigidly supported unpainted 3CR12 cable and support gland plates along the entire length of the board and at least 230 mm above floor level.

Sufficient provision for ventilation and heat dissipation as per the equipment ratings and manufacturers requirements shall be allowed for. The contractor shall prove to the Engineer by means of Anemometer or Differential that the requirements and manufacturer's requirements are met. The systems shall be designed to allow for 10% for future extensions.

Supply: 1 x 35mm² 4C Cu PVC SWA PVC cable plus a 1 x 25mm² bare copper cable from the ozone motor control center [MCC 1]

Colour: Painted Light Orange – B26 (SANS 1091:2012) external, White arc-free internal (see Painting and Finishing).

Fault Level: 6kA.

Sectioning: Multi-section, Form 3b or Form 4 to SANS IEC 60439.

Future: 10% for future extensions space.

Cable Entry: Incoming and Outgoing – Bottom. MCC gland plates shall be 3CR12 sheet steel, unpainted or aluminium.

Base: Single 100x50x6mm thick channel iron base with mitred corners and cross-bracing between every 2nd tier.

Equipment will be the following:

Qty	Description	Identification
One	Cubicle comprising the following:	Incomer
1	40Amp continuous current rated MCB with door interlock: Plus	Main
Set	40/5Amp continuous current rated current transformer: Plus	Current inputs
3	2Amp HRC fuse holders and fused links: Plus	Voltage inputs
1	Front panel mounted LCD digital display supply network analyser comprising of combined voltage, current, maximum demand power measurement and power factor correction measurement complete with Communications module must be provided, communication links with PLC/DCS Units. The communication interface must comply with either of the following: a) Profibus-DP b) Profinet c) Industrial Ethernet d) Modbus TCP/IP Under no circumstances, shall the use of proprietary protocols be allowed: Plus	Power analyser
4	40Amp plated copper bus bars: Plus	3 Phase + N
1	25Amp plated copper bus bars: Plus	Earth
4	125Amp continuous current rated HRC fuse holders and fused links: Plus	Surge arrestors connection fuses
1	Three Phase class 2 surge arrestor unit connection type 2 as per SANS 10142-1: Plus	Surge arrestor plus signals
3	2Amp continuous current rated HRC fuse holders and fused links: Plus	Indicator Lamp Protection
3	Robust LED indicator lamps connected load side of the circuit breaker.	Indicators for 3 Phase (Red, White and Blue Indications)
All	Phase failure, phase rotation and phase imbalance, voltage, and frequency relay.	Relay for protection
One	Panel [Cubicle] comprising the following: [Cascading to be completed by the contractor]	Site Distribution
1	80Amp continuous current rated TP MCCB door interlocked: Plus	Main
1	60Amp continuous current rated SP MCB: Plus	Local DB
1	20Amp continuous current rated SP MCB: Plus	UPS feeder
One	Panels comprising the following:	Local DB

Qty	Description	Identification
1	25Amp continuous current rated TP MCB: Plus	Main distribution Circuit breaker
1	40Amp continuous current rated SP + N Earth Leakage without overload protection: Plus	Earth leakage for plug circuits P1 – P2
2	20Amp continuous current rated SP MCB: Plus	Switch socket outlets P1-P3
1	10Amp continuous current rated SP MCB: Plus	Area Lighting Circuit L2
1	Digital time switch with a 100-hour standby capacity.	Area Lighting Day/Night control for Area lighting Control
1	10Amp continuous current rated SP MCB: Plus	Lighting Circuit L1
One [x1]	Panel comprising the following: [Each cubicle contains 2 Starters]	Chlorine Fans No.1 – No.2
1	3kW TP continuous current rated motor protection MCCB complete with extended rotary handle for door interlocking [Mechanical operating handle for circuit-breaker, including door interlock, self-aligning spindle and padlocking facility] (Estimated and shall be coordinated with mechanical contractor to ensure correct supplies to mechanical equipment): Plus	Main
2	1.5kW TP continuous current rated motor protection MCCB complete with extended rotary handle for door interlocking [Mechanical operating handle for circuit-breaker, including door interlock, self-aligning spindle and padlocking facility] (Estimated and shall be coordinated with mechanical contractor to ensure correct supplies to mechanical equipment): Plus	Main
6	Continuous current rated current transformer: Plus	Current inputs
6	2 Amp HRC fuse holders and fused links: Plus	Voltage inputs
2	1.5kW Type 2 Coordination Direct-on-line motor starter complete with motor manager controller (Estimated and shall be coordinated with mechanical contractor to ensure correct supplies to mechanical equipment): Plus : Plus Motor Manager Communications module must be provided, communication links with PLC/DCS Units. The communication interface must comply with either of the following [Network Communications]: a) Profibus-DP b) Profinet c) Industrial Ethernet d) Modbus TCP/IP Under no circumstances, shall the use of proprietary protocols be allowed: Plus	Direct Online starters

Qty	Description	Identification
2	A separate door mountable display / HMI and programming control unit shall be front door mounted which connected to protection relay. The following features shall be available on the display / HMI as listed below: • All Indication lights as specified under particular specification shall be displayed on the door mounted display: Plus • Running hour meter shall be displayed on the door mounted display: Plus • Motor switching state • Current in phases 1, 2, 3 and maximum current • Phase voltage 1, 2, 3 • Active power • Apparent power • Power factor • Phase unbalance • Phase sequence • Time to trip • Temperature rise, motor model • Remaining cooling time of the motor • Temperature • Actual value, analog signals • Motor operating hours • Motor stop times • Number of motor starts • Number of overload trips • Communication Module The communication interface must comply with either of the following [Network Communications]: a) Profibus-DP b) Profinet c) Industrial Ethernet d) Modbus TCP/IP Under no circumstances, shall the use of proprietary protocols be allowed: Plus	Separate display unit
All	Power factor capacitors shall correct to a minimum of 98%, complete with all accessories (Fuses, Circuit breaker and Contactor) to complete the installation: Plus	Power Factor capacitors
All	All equipment necessary for remote motor status, speed monitoring and control.	Control and monitoring
All	Relays, auxiliary contacts, indicating lights, wiring and reset buttons necessary for the following	
All	See Common Control cubicles for each different poly system below	All
One	Cubicle comprising the following: [Common Control for Chlorine Fans No.1 – No.2]	Chlorine Fans No.1 – No.2
1	10Amp sized continuous current rated SP + N door interlocked MCB: Plus	Main Circuit Breaker

Qty	Description	Identification
1	Manual – Off - Auto selector switch: Plus	Selector Switch
All	All equipment necessary for remote motor status, speed monitoring and control.	Control and monitoring
All	Relays, auxiliary contacts, indicating lights, wiring and reset buttons necessary for the following	
	Interlock motors to prevent simultaneously starting of all motors in the automatic and manual mode of operation after a power failure: Plus	
	Pump set statuses shall be available on the SCADA system: Plus: Plus	
	Limit switches on two doors will activate the fans to operate for predetermined time period. Limits switches, cable work and all accessories shall be priced all include under the MCC. The Contractor to allow 30m kabel for each limit switch: Plus	
	If limit switches is not triggered for predetermined time period a timer will active to run the fans for predetermined time period: Plus	
	Interlock in manual and Automatic to not run fans on timer or limit switch once a chlorine leak is detected. The fan system shall be activated via manual via the stop and start push buttons outside the building. The push buttons shall be activated once the chlorine gas detection has been triggered: Plus	
All	All Cubicles comprising the following: [Cascading to be completed by the contractor]	All Chlorine Panels Required
All	All continuous current rated thermal magnetic motor circuit breakers with adjustable current setting and auxiliary contact (monitor trip condition) (Estimated and shall be coordinated with Mechanical Contractor to ensure correct supplies to mechanical equipment): Plus	All feeders [Allowance]
All	Any and all panels that are required by supplier to ensure efficient and functional system operating as per intended use and fit for purpose. Contractor to liaise with supplier prior to submitting Tender Offer.	
All	The Contractor will take full responsibility to ensure that all equipment offered or required for operation as per the intended use shall be serviced in full with the required electrical and electronic equipment: Plus	Coordination
All	All Electrical and Electronic Chlorine equipment including instrumentation and controls necessary for the safe and efficient running of the system	All
All	The Electrical and Electronic Contractor shall allow for all cables, instrumentation, PLC's, HMI's, SCADA connections and interface required, E-Stops, enclosures, MCC, lighting and small power that may be required all in accordance particular specification.	All

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EMCC: Chlorine Motor Control Centre (MCC No.3)

Qty	Description	Identification
All	Relays, auxiliary contacts, indicating lights, wiring and reset buttons necessary to complete the plant as follows:	
All	All signals from motors and instrumentation shall be connected to the PLC, HMI and SCADA: Plus	All
One	Panels comprising the following:	Chlorination Equipment
All	Co-ordination necessary with mechanical sub-contractor for electrical supplies to the mechanical scope of supply and monitoring and control functions	
All	Terminations for monitoring and control functions	Monitoring
All	Terminations for chlorine gas dosing control by means of raw water inflow. Supply power to chlorinator and controller shall form part of this contract: Plus	Chlorine dosing
All	Terminations for chlorine gas cylinder scales: Plus	Gas container content
All	Terminations for gas leak alarm: Plus	Chlorine leak
All	Terminations for monitoring and control functions	Monitoring
All	Co-ordination necessary with mechanical sub-contractor for electrical supplies to the mechanical scope of supply and monitoring and control functions	
One	Panel comprising the following:	Chlorine Process Water No.1 – No.2
1	5.5kW TP continuous current rated motor protection MCCB complete with extended rotary handle for door interlocking [Mechanical operating handle for circuit-breaker, including door interlock, self-aligning spindle and padlocking facility] (Estimated and shall be coordinated with mechanical contractor to ensure correct supplies to mechanical equipment): Plus	Main
2	1.5kW TP continuous current rated motor protection MCCB complete with extended rotary handle for door interlocking [Mechanical operating handle for circuit-breaker, including door interlock, self-aligning spindle and padlocking facility] (Estimated and shall be coordinated with mechanical contractor to ensure correct supplies to mechanical equipment): Plus	Main
6	Continuous current rated current transformer: Plus	Current inputs
6	2 Amp HRC fuse holders and fused links: Plus	Voltage inputs
2	1.5kW Type 2 Coordination Direct-on-line motor starter complete with motor manager controller (Estimated and shall be coordinated with mechanical contractor to ensure correct supplies to mechanical equipment): Plus : Plus	Direct Online starters

Qty	Description	Identification
	Motor Manager Communications module must be provided, communication links with PLC/DCS Units. The communication interface must comply with either of the following [Network Communications]: a) Profibus-DP b) Profinet c) Industrial Ethernet d) Modbus TCP/IP Under no circumstances, shall the use of proprietary protocols be allowed: Plus	
2	A separate door mountable display / HMI and programming control unit shall be front door mounted which connected to protection relay. The following features shall be available on the display / HMI as listed below: • All Indication lights as specified under particular specification shall be displayed on the door mounted display: Plus • Running hour meter shall be displayed on the door mounted display: Plus • Motor switching state • Current in phases 1, 2, 3 and maximum current • Phase voltage 1, 2, 3 • Active power • Apparent power • Power factor • Phase unbalance • Phase sequence • Time to trip • Temperature rise, motor model • Remaining cooling time of the motor • Temperature • Actual value, analog signals • Motor operating hours • Motor stop times • Number of motor starts • Number of overload trips • Communication Module The communication interface must comply with either of the following [Network Communications]: a) Profibus-DP b) Profinet c) Industrial Ethernet d) Modbus TCP/IP Under no circumstances, shall the use of proprietary protocols be allowed: Plus	Separate display unit
All	Power factor capacitors shall correct to a minimum of 98%, complete with all accessories (Fuses, Circuit breaker and Contactor) to complete the installation: Plus	Power Factor capacitors
All	All equipment necessary for remote motor status, speed monitoring and control.	Control and monitoring

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EMCC: Chlorine Motor Control Centre (MCC No.3)

Qty	Description	Identification
All	Relays, auxiliary contacts, indicating lights, wiring and reset buttons necessary for the following	
All	See Common Control cubicles for each different poly system below	All
One	Cubicle comprising the following: [Common Control for Chlorine Process Water Pump No.1 – No.2]	Chlorine Process Water Pump No.1 – No.2
1	10Amp sized continuous current rated SP + N door interlocked MCB: Plus	Main Circuit Breaker
1	Manual – Off - Auto selector switch: Plus	Selector Switch
All	All equipment necessary for remote motor status, speed monitoring and control.	Control and monitoring
All	Relays, auxiliary contacts, indicating lights, wiring and reset buttons necessary for the following	
	Interlock motors to prevent simultaneously starting of all motors in the automatic and manual mode of operation after a power failure: Plus	
	Pump set statuses shall be available on the SCADA system: Plus	
	The process pump will begin operating when the start push button on the MCC is activated and pressed.	
All	Interlocking with emergency stop stations on all motors to lockout main circuit breaker, if emergency stop is pressed the standby pump must automatically start: Plus	All motors shall have E-Stops
All	Interlock timer & relays to limit starts per hour, per the manufacturer's requirements, predetermined starts per hour allowed: Plus	Starts per Hour
All	Interlock motor sets as one duty and one standby unit in manual as well as automatic mode of operation: Plus	Interlocks duty and standby
One	Panel comprising the following: (Panel door shall be purple powder coated)	PLC Equipment as specified under PLC
One	Panel comprising the following: (Panel door shall be purple powder coated)	UPS for PLC Equipment as specified under PLC

END OF SECTION

PSPMC-6.D Sludge & Supernatant Pump Station Motor Control Centre [MCC No.04]

Type: These specification shall be considered as minimum design requirement in terms of the Contractor's Tender offer. The Electrical and Electronic Contractor(s) shall coordinate with the Mechanical Contractor to ensure sufficient allowance is made in their tender offer to provide a fit for purpose unit/system.

The motor control centre or distribution board shall be manufactured accordance to Particular Specification. The equipment referenced below does not relieve the contractor of his responsibilities in terms of quality, dimensions and proper functioning of the system.

The motor control centre board or distribution board shall be of the free-standing floor mounted type with a minimum IP rating of 54 (insect proofed enclosure). The motor control centre or distribution board shall be constructed with a minimum of 2mm 3CR12 stainless steel which will rest on a 3CR12 stainless steel rigid channel and shall be bolted down in position by means of M16 high tensile stainless-steel bolts grouted into the concrete floor, the bolts shall be inside the board.

The panel door shall be provided with a locking system suitable for padlocking. The locking system shall consist of a 3CR12 stainless steel 3-way locking mechanism locking the door at the top, middle and bottom. The unit doors shall be capable of being opened at least 110 degrees.

Sufficient provision for ventilation and heat dissipation as per the equipment ratings and manufacturers requirements shall be allowed for. Screwed-on engraved labels in English shall be provided below all switchgear and equipment on and in the panels, to facilitate identification. All unpainted parts shall be plated for corrosion resistance.

Supply: 25mm² 4C CU PVC SWA PVC cable plus 16mm² bare copper earth cable feeder from MCC No.1.

Colour: Painted Light Orange – B26 (SANS 1091:2012) external, White arc-free internal (see Painting and Finishing).

Fault Level: 10kA.

Sectioning: Multi-section, Form 3b or Form 4 to SANS IEC 60439.

Future: 10% for future extensions space.

Cable Entry: Incoming and Outgoing – Bottom. MCC gland plates shall be 3CR12 sheet steel, unpainted or aluminium.

Base: Single 100x50x6mm thick channel iron base with mitred corners and cross-bracing between every 2nd tier.

Qty	Description	Identification
One	Panels comprising the following	Incomer Section
1	100Amp continuous current rated TP (triple pole) Molded Case circuit breaker complete with opening / closing release with sufficient auxiliary contacts and complete with: Control unit with adjustable overload and short circuit protection with time discrimination micrologic unit, Electrical operating mechanism for remote closing of circuit breaker, 231V AC operation,	Main Circuit Breaker

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PMC: Sludge & Supernatant Pump Station Motor Control Centre (MCC No.4)

Qty	Description	Identification
	Separate panel mounted circuit breaker close push button equal or similar to Schneider Electric: Plus	
Set	100/1 Amp current transformer: Plus	Current inputs
3	2 Amp HRC fuse holders and fused links: Plus	Voltage inputs
1	Front panel mounted LCD digital display supply network analyzer comprising of combined voltage, current, maximum demand power measurement and power factor correction measurement complete with network card: Plus	Network analyser
4	100Amp tint copper bus bars [appearance shall be aluminium], suitable clamps shall be used, and no drilling shall be allowed on the busbars [cubic system shall be used]: Plus	3 Phase + N
1	60Amp tint copper bus bars [appearance shall be aluminium], suitable clamps shall be used, and no drilling shall be allowed on the busbars [cubic system shall be used]: Plus	Earth
4	315Amp continuous current rated HRC fuse holders and fused links: Plus	Surge arrestors connection fuses
1	Three Phase combined class 1&2 Surge Arrester: Plus	Surge arrestor plus signals
3	2Amp continuous current rated HRC fuse holders and fused links: Plus	Indicator Lamp Protection
3	Robust LED indicator lamps connected load side of the circuit breaker.	Indicators for 3 Phase (Red , White and Blue Indications)
1	Front panel mounted "chicken switch" socket for switching of circuit breaker from a safe distance [Tender shall select all components to preferred manufacturers]	Chicken switch
1	Relay for under voltages, phase sequence, and phase loss in three phase: Plus	Protection relay
One	Panels comprising the following	Distribution Section
1	32Amp continuous current rated MCCB with door interlock (setting set to Amp) including electronic trip unit: Plus	Main
4	60Amp copper bus bars: Plus	3 Phase + N
1	40Amp copper bus bar: Plus	Earth
1	20Amp TP continuous current rated MCB complete: Plus	MCC Room DB

Qty	Description	Identification
Two	Panel comprising the following:	Supernatant Pump No.1 – No.2
1	7.5kW TP continuous current rated motor protection MCCB complete with extended rotary handle for door interlocking [Mechanical operating handle for circuit-breaker, including door interlock, self-aligning spindle and padlocking facility] (Estimated and shall be coordinated with mechanical contractor to ensure correct supplies to mechanical equipment): Plus	Main
Set	Continuous current rated core balanced current transformers: Plus	Current inputs
3	2 Amp HRC fuse holders and fused links: Plus	Voltage inputs
1	7.5kW three phase heavy duty vector control variable frequency drive complete with 1) Programmable cards, 2) Communication card & 3) Encoder interface card. All necessary harmonic filters shall be included, EMC filter, line choke motor chokes and sinus filters all shall be inclusive. The following minimum protection parameters shall be available on the Variable frequency drive: • Thermal • Output Phase loss • Drive overheat • Over voltage • Under voltage • Frequency meter • Locked rotor • Phase rotation • Under current (Estimated and shall be coordinated with mechanical contractor to ensure correct supplies to mechanical equipment): Plus	Variable frequency drive
All	A separate door mountable display and programming control unit shall be front door mounted.	Separate display unit for VSD Drives with all parameters
All	Communications module must be provided, communication links with PLC/DCS Units. The communication interface must comply with either of the following: a) Profibus-DP b) Profinet c) Industrial Ethernet d) Modbus TCP/IP Under no circumstances, shall the use of proprietary protocols be allowed: Plus	Communication module for VSD
1	6Amp continuous current rated SP MCB: Plus	Variable frequency drive fans supply

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PMC: Sludge & Supernatant Pump Station Motor Control Centre (MCC No.4)

Qty	Description	Identification
All	Extraction fans in panel door for cooling of variable speed drives in accordance with manufacturers specifications: Plus	Fans for Variable Speed
All	Reset push button for pump casing temperature trip condition: Plus	Pump casing temperature trip reset (If provided on pump sets)
All	Thermistor relay: Plus	(If provided on pump sets)
All	Thermistor trip indication: Plus	(If provided on pump sets)
All	Thermistor reset button: Plus	(If provided on pump sets)
1	Running hour meter: Plus	Running Hour Meter
All	All equipment necessary for remote emergency stop device	All
1	Manual-off-auto-remote selector switch: Plus	Selector Switch
All	Monitoring and control equipment: Plus	Control & Monitoring functions
1	10Amp continuous current rated SP MCB: Plus	Heater Supply
1	Continuous current rated Ammeter: Plus	Heater ammeter
All	All equipment necessary for remote emergency stop device	All necessary equipment
All	Relays and auxiliary contacts necessary for:	
All	Refer to Common Control cubicle	Refer to common control
One	Cubicle comprising the following: [Common Control – Supernatant Pump No.1 – No.2]	Supernatant Pump No.1 – No.2
1	10Amp sized continuous current rated SP + N door interlocked MCB: Plus	Main Circuit Breaker
1	Manual – Off - Auto selector switch: Plus	Selector Switch
1	Mixing Pump will be operated as One duty and One standby unit. A timer shall be provided for duty rotation of pump sets after a 24-hour period of time. In the event of a pump failure the duty cycle must be transferred to the next available pump set. Timer will be disabled in the event when one pump set is out of commission: Plus	Timer control in manual mode
1	Duty rotation timer and flip-flop relay that will rotate duty cycle between duty and standby pump sets on a daily	Duty rotation in manual mode

Qty	Description	Identification
	basis. If standby pump set is not available duty pump set will remain in operation: Plus	
All	The following Indication lights (LED type); Red – 'Motor Stopped'; Green - 'Motor Running'; Yellow – 'Motor Tripped: Plus	Indication lights
All	All equipment necessary for remote motor status, speed monitoring and control.	Control and monitoring
All	Relays, auxiliary contacts, indicating lights, wiring and reset buttons necessary for the following	
All	Interlocking with emergency stop stations on all motors to lockout main circuit breaker, if emergency stop is pressed the standby pump must automatically start: Plus	All motors shall have E-Stops
All	Interlock timer & relays to limit starts per hour, per the manufacturer's requirements, predetermined starts per hour allowed: Plus	Starts per Hour
All	Interlock motor sets as One duty and One standby unit in manual as well as automatic mode of operation: Plus	Interlocks duty and standby.
All	Extraction fans in panel door for cooling in accordance with manufacturers specifications. If the Fans do not work in manual as well as automatic mode of operation, the start shall be interlocked to not to be able to start. Unhealthy status will displayed on indication: Plus	Extraction fan interlocks
All	Interlock pump in manual as well as automatic mode of operation with level control system. A predetermined low level will stop the pumps: Plus	Level protection
All	Interlock motor with pressure sensors in common delivery and common suction pump line in automatic mode of operation. Predetermined low pressure will stop the duty motor and predetermined high pressure will stop the duty motor. If a predetermined pressure is not obtained the duty motor sets, will stop and will ramp down. During start up and shut down this function must be bypassed for a predetermined period. Motor sets will only be able to start once pressure trip has been manually been reset: Plus	Pressure sensors
All	All Interlocks as described under operation of plant [PSEPLC-15]	Additional interlocks and writeup
All	All motor/pump information and signals statuses shall be available on the PLC system: Plus	Signals statuses
Two	Panel comprising the following:	Sludge Pump No.1 – No.2
1	7.5kW TP continuous current rated motor protection MCCB complete with extended rotary handle for door	Main

Qty	Description	Identification
	interlocking [Mechanical operating handle for circuit-breaker, including door interlock, self-aligning spindle and padlocking facility] (Estimated and shall be coordinated with mechanical contractor to ensure correct supplies to mechanical equipment): Plus	
Set	Continuous current rated core balanced current transformers: Plus	Current inputs
3	2 Amp HRC fuse holders and fused links: Plus	Voltage inputs
1	7.5kW three phase heavy duty vector control variable frequency drive complete with 1) Programmable cards, 2) Communication card & 3) Encoder interface card. All necessary harmonic filters shall be included, EMC filter, line choke motor chokes and sinus filters all shall be inclusive. The following minimum protection parameters shall be available on the Variable frequency drive: • Thermal • Output Phase loss • Drive overheat • Over voltage • Under voltage • Frequency meter • Locked rotor • Phase rotation • Under current (Estimated and shall be coordinated with mechanical contractor to ensure correct supplies to mechanical equipment): Plus	Variable frequency drive
All	A separate door mountable display and programming control unit shall be front door mounted.	Separate display unit for VSD Drives with all parameters
All	Communications module must be provided, communication links with PLC/DCS Units. The communication interface must comply with either of the following: a) Profibus-DP b) Profinet c) Industrial Ethernet d) Modbus TCP/IP Under no circumstances, shall the use of proprietary protocols be allowed: Plus	Communication module for VSD
1	6Amp continuous current rated SP MCB: Plus	Variable frequency drive fans supply
All	Extraction fans in panel door for cooling of variable speed drives in accordance with manufacturers specifications: Plus	Fans for Variable Speed

Qty	Description	Identification
All	Reset push button for pump casing temperature trip condition: Plus	Pump casing temperature trip reset (If provided on pump sets)
All	Thermistor relay: Plus	(If provided on pump sets)
All	Thermistor trip indication: Plus	(If provided on pump sets)
All	Thermistor reset button: Plus	(If provided on pump sets)
1	Running hour meter: Plus	Running Hour Meter
All	All equipment necessary for remote emergency stop device	All
1	Manual-off-auto-remote selector switch: Plus	Selector Switch
All	Monitoring and control equipment: Plus	Control & Monitoring functions
1	10Amp continuous current rated SP MCB: Plus	Heater Supply
1	Continuous current rated Ammeter: Plus	Heater ammeter
All	All equipment necessary for remote emergency stop device	All necessary equipment
All	Relays and auxiliary contacts necessary for:	
All	Refer to Common Control cubicle	Refer to common control
One	Cubicle comprising the following: [Common Control – Sludge Pump No.1 – No.2]	Sludge Pump No.1 – No.2
1	10Amp sized continuous current rated SP + N door interlocked MCB: Plus	Main Circuit Breaker
1	Manual – Off - Auto selector switch: Plus	Selector Switch
1	Sludge Pump will be operated as One duty and One standby unit. A timer shall be provided for duty rotation of pump sets after a 24-hour period of time. In the event of a pump failure the duty cycle must be transferred to the next available pump set. Timer will be disabled in the event when one pump set is out of commission: Plus	Timer control in manual mode
1	Duty rotation timer and flip-flop relay that will rotate duty cycle between duty and standby pump sets on a daily basis. If standby pump set is not available duty pump set will remain in operation: Plus	Duty rotation in manual mode

Qty	Description	Identification
All	The following Indication lights (LED type); Red – 'Motor Stopped'; Green - 'Motor Running'; Yellow – 'Motor Tripped: Plus	Indication lights
All	All equipment necessary for remote motor status, speed monitoring and control.	Control and monitoring
All	Relays, auxiliary contacts, indicating lights, wiring and reset buttons necessary for the following	
All	Interlocking with emergency stop stations on all motors to lockout main circuit breaker, if emergency stop is pressed the standby pump must automatically start: Plus	All motors shall have E-Stops
All	Interlock timer & relays to limit starts per hour, per the manufacturer's requirements, predetermined starts per hour allowed: Plus	Starts per Hour
All	Interlock motor sets as One duty and One standby unit in manual as well as automatic mode of operation: Plus	Interlocks duty and standby.
All	Extraction fans in panel door for cooling in accordance with manufacturers specifications. If the Fans do not work in manual as well as automatic mode of operation, the start shall be interlocked to not to be able to start. Unhealthy status will displayed on indication: Plus	Extraction fan interlocks
All	Interlock pump in manual as well as automatic mode of operation with level control system. A predetermined low level will stop the pumps: Plus	Level protection
All	Interlock motor with pressure sensors in common delivery and common suction pump line in automatic mode of operation. Predetermined low pressure will stop the duty motor and predetermined high pressure will stop the duty motor. If a predetermined pressure is not obtained the duty motor sets, will stop and will ramp down. During start up and shut down this function must be bypassed for a predetermined period. Motor sets will only be able to start once pressure trip has been manually been reset: Plus	Pressure sensors
All	All Interlocks as described under operation of plant [PSEPLC-15]	Additional interlocks and writeup
All	All motor/pump information and signals statuses shall be available on the PLC system: Plus.	Signals statuses
All	Sludge pump will operate on the level of the Digester system and when the level is low the duty motor start and fill the digester.	
All	The system will utilize actuators to control the flow of sludge between two digesters, Digester One and Digester Two. Sludge pumps will operate based on sludge levels within the digesters, with an automated process to alternate filling between the two digesters.	All

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Qty	Description	Identification
	When one digester reaches its optimal level, the actuator will close, and the system will then start the next duty motor to fill the second digester. A manual valve, which was previously used to switch between digesters, will be replaced by this automated actuator system.	
One	Panel comprising the following:	PLC Equipment as specified under PLC descriptions
One	Panel comprising the following:	UPS Equipment as specified under UPS descriptions

END OF SECTION

PSEPLC PROGRAMMABLE LOGIC CONTROLLERS

PS EPLC-1 Scope

Programmable logic controllers shall be provided in MCC enclosure (with glass panel) and as specified in the following locations:

Tenderer shall allow for the proper liaison with all other contractors to ensure proper functioning of all equipment supplied, installed and commissioned under this Contract.

In the event of there being conflicting specifications between the specifications in this section with regard to mechanical equipment required and electrical control equipment specified, this must be brought to the attention of the Engineer not later than one week before the tender close, who will duly clarify the matter or issue an addendum in this regard.

All equipment offered under this Contract shall be selected to be equal (or better) of make as far as possible.

Programmable Logic Controllers (PLC's), Uninterruptable Power Supply (UPS's) and Human Machine Interfaces (HMI) shall be provided in the following locations;

Number	Description	Location
A	Main Motor Control Centre [MCC No.01] PLC	Container MCC
B	Substation No.1 ['24 Head of Works] Motor Control Centre PLC] Pump Enclosure Remote I/O [x4]	'24 Head of Works Pump Station
C	Substation No.2 Motor Control Centre ['24 Primary Sedimentation, Ultra-Fine Screens and '24 BNR Reactor] PLC	'24 Primary Sedimentation, Ultra-Fine Screens and '24 BNR Reactor MCC
D	Substation No.3 Motor Control Centre [Sludge Management] PLC	Sludge Management MCC
E	Substation No.4 Motor Control Centre ['24 Membrane Reactor and UV] PLC	'24 Membrane Reactor and UV MCC
F	Substation No.4 ['24 Membrane Reactor and UV] Membrane Module A & B Enclosure Remote I/O [x16]	'24 Membrane Reactor and UV MCC
G	Substation No.4 Motor Control Centre [MBR Re-Use Pump Station] PLC	MBR Re-Use Pump Station
H	Substation No.4 ['24 Membrane Reactor and UV] Re-Use Pump Enclosure Remote I/O [x6]	MBR Re-Use Pump Station
I	Motor Control Centre [Maturation, Tertiary Treatment and Disinfection] PLC	Maturation, Tertiary Treatment and Disinfection
J	Wireless Connection Enclosures Throughout the Plant	Throughout the Plant

K	Substation No.5 Motor Control Centre	Maturation, Tertiary Treatment and Disinfection MCC
L	Medium Voltage Switchgear Rooms PLC	Medium Voltage Switchgear Rooms PLC

PS EPLC-6 Programmable Logic Controllers Hardware

PS EPLC-6.A Containerised Main Motor Control Centre [MCC No.01] PLC

Type: The motor control center panel builder shall allow a minimum of a full tier for programmable logic controller equipment as specified below. The equipment referenced below does not relieve the contractor of his responsibilities in terms of quality, dimensions, and proper functioning of the system.

Colour: Purple powder coated

Equipment: UPS, CPU, I/O modules and a HMI.

Commination Medium: Ethernet

Protocol: Equal or similar to either of the following a) Modbus, b) DeviceNet or c) Profibus

Equipment will be the following:

Qty	Description	Identification
One	Cubicle comprising the following: (Cubicle door shall be purple powder coated)	UPS supply
1	16Amp sized continuous current rated SP + N door interlocked protection MCB (Estimated and shall be confirmed by contractor and all calculations shall be supplied to Engineer for approval): Plus	Main Circuit Breaker UPS
1	Change over switch from Normal / UPS power selection: Plus	Maintenance purposes
1	10Amp sized continuous current rated SP + N door interlocked protection MCB (Estimated and shall be confirmed by contractor and all calculations shall be supplied to Engineer for approval): Plus	Main Circuit Breaker
1	Estimated Industrial 3kVA Pure Sine Wave UPS equal or similar to APC line, the UPS shall provide battery standby power for at least 3-hour back-up. The UPS (Estimated and shall be confirmed by contractor and all calculations shall be supplied to Engineer for approval). Batteries shall be rated at 60% load during a power failure. The UPS shall come complete with communication interface and shall comply with either of the following: a) Profibus-DP b) Profinet c) Industrial Ethernet d) Modbus TCP/IP Under no circumstances, shall the use of proprietary protocols be allowed: Plus	UPS with 3-hour back-up to cater for all instrumentation, HMI and PLC. Warranty shall be a minimum of 2 years. With minimum of Lead acid batteries.

Qty	Description	Identification
	Contractor to allow for powder coated mild steel cage and locks to be supplied and installed under this contract. The cage shall be lockable and protect the UPS from theft. It can be Inside or outside the PLC, both options are acceptable: Plus	
All	Relays and contactors for automatic transfer to UPS power once the UPS power is restored: Plus	Automatic change over
All	Termination blocks necessary for signal cable connections from motors and instrumentation: Plus	All Terminals
All	Halogen free wiring ducts, covers, fix-O-Rapid, rapid clip for din rails, rapid clip for base plate shall be used: Plus	All
All	UPS monitoring functions as specified: Plus	UPS
1	6Amp continuous current rated SP MCB (Estimated and shall be confirmed by contractor and all calculations shall be supplied to Engineer for approval): Plus	PLC supply
1	2Amp continuous current rated SP MCB (Estimated and shall be confirmed by contractor and all calculations shall be supplied to Engineer for approval): Plus	HMI supply
6	2Amp continuous current rated SP MCB (Estimated and shall be confirmed by contractor and all calculations shall be supplied to Engineer for approval): Plus	All instrumentation shall be on UPS: NTU, pH, FIT, PIT and LIT.[Allowance]
One	Cubicle comprising the following: (Cubicle door shall be purple powder coated)	PLC Cubicle
1	6Amp continuous current rated SP door interlocked protection MCCB (Estimated and shall be confirmed by contractor and all calculations shall be supplied to Engineer for approval): Plus	Main Circuit Breaker PLC
1	230V/24DC stabilized power supply for 24V DC inputs to PLC input modules. (Power supply shall have adequate capacity for the application) (Estimated and shall be confirmed by contractor and all calculations shall be supplied to Engineer for approval): Plus	Power Supply
1	Industrial layer No.1 100/1000Mb managed switch which suits the application, complete with at least 4 x fiber optic ports, PLC, switch shall be from the same manufacturer: Plus	Communications with Fiber Optic cable
1	PLC processor unit complete with CPU base plate, bus terminators, Ethernet communication with I/O modules that will satisfy the application with at least the following minimum specifications: - Discrete I/O processor capacity 1024 I/O Multi-rack configuration capability, - Analogue I/O processor capacity 256 I/O multi-rack configuration capability, - Execution time per instruction 0.12 µs Boolean 0.17 µs double-length words 0.25 µs single-length words	PLC CPU

Qty	Description	Identification
	1.16 μ s floating points - Number of instructions per ms 6.4 Kinst/ms 65 % Boolean + 35 % fixed arithmetic 8.1 Kinst/ms 100% Boolean - Embedded communication service: Bandwidth management & Ethernet TCP/IP - Application structure 1 cyclic/periodic master task 1 periodic fast task - System overhead 0.13ms for fast task 0.7ms for master task - Shall comply with the following standards: IEC 61131-2 UL 508 EN 61131-2 CSA C22.2 No 142 CSA C22.2 No 213 Class I Division 2 The CPU selected shall be provided with 50% additional spare capacity for the plant: Plus	
All	High performance signal modules for digital and analog I/O plus provide 10% Spare I/O capacity for plant: Plus	Input and Output modules
All	Interposing relays for surge protection of field statuses to PLC: Plus	Surge Protection
All	Termination blocks necessary for signal cable connections from all motors and instrumentation: Plus	All Terminals
All	Halogen free wiring ducts, covers, fix-O-Rapid, rapid clip for din rails, rapid clip for base plate shall be used: Plus	All
All	Tenderers shall allow 10% of I/O specified [see list below] to be protected with digital and analog Surge arrestor modules. All Digital and Analogue signals leaving the main structure lighting and earthing protection must be protected via signal arrestors: Plus	Surge Protection for all signals
One	Cubicle comprising the following: (Cubicle door shall be purple powder coated)	HMI
1	2Amp continuous current rated SP door interlocked protection MCCB (Estimated and should be confirmed): Plus	Main Circuit Breaker PLC UPS
1	230V/24DC stabilized power supply for HMI unit: Plus	Supply
1	Human machine interface advanced touchscreen panel HD pixels VGA-10" TFT graphic Terminals" colour touch screen with sufficient flash memory, soft function and static function keys and Ethernet communication port. Software as may be required shall be provided: Plus [Contractor to allow for flap Infront of screen which is UV resistant and can prevent all UV rays to damage to the screen]. UV flap or cover shall have design life of 10 years and guarantee shall be supplied.	HMI
All	Software programming for indication of the following monitoring functions on the HMI display and all I/O as indicated in schedule of supervisory and control I/O's underneath.	
All	1. Alarm history page: Plus	Alarm history
All	2. Alarm setup page: Plus	Setup page

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Qty	Description	Identification
All	3. Graphic displays shall be used for variable parameter indications: Plus	Displays
All	4. Animated mimic displays shall be used for equipment displays: Plus	Displays
All	5. Password protected settings: Plus	Protection
All	6. All information protection settings, control and monitoring functions shall be displayed: Plus	Displays
All	7. All Instrumentation settings, monitoring and control functions: Plus	Displays
All	8. All monitoring and control functions as indicated schedule of supervisory and control I/O's underneath: Plus	Displays

PS EPLC-6.A Schedule of Supervisory and Control I/O For Containerised Main Motor Control Centre

[MCC No.01] PLC

Description	RTD In	Analog In	Analog Out	24V DC In	24V DC Out	Volt Free Out	Network Link		
							Scada	HMI	Plant
Power Analyzer values to be captured in PLC and displayed on plant and Scada, HMI and distributed through plant and linked to other power analyzers – Apparent Power, Power, Reactive Power, line and phase Voltages, Line and phase Currents, Power Factor, all billing information.							All	All	All
UPS healthy [Allowance]							All	All	All
UPS trip [Allowance]							All	All	All
UPS Normal/Fail [Allowance]							All	All	All
UPS Low Battery [Allowance]							All	All	All
UPS DC voltage below recommended voltage [Allowance]							All	All	All
Digester Mixing System No.1 – No.4 – DG No.1 motor run/stop							8	8	8
Digester Mixing System No.1 – No.4 – DG No.1 motor healthy							4	4	4
Digester Mixing System No.1 – No.4 – DG No.1 man-off-auto				8			8	8	8
Digester Mixing System No.1 – No.4 – DG No.1 motor trip							4	4	4
Digester Mixing System No.1 – No.4 – DG No.1 variable speed control		4	4				8	8	8
Digester Mixing System No.1 – No.4 – DG No.1 E-Stop				4			4	4	4
Digester Mixing System No.1 – No.4 – DG No.1 Common Pressure		2					2	2	2
Digester Mixing System No.1 – No.4 – DG No.1 Flow and trending		2		2			4	4	4
Digester Mixing System No.1 – No.4 – DG No.2 motor run/stop							8	8	8
Digester Mixing System No.1 – No.4 – DG No.2 motor healthy							4	4	4
Digester Mixing System No.1 – No.4 – DG No.2 man-off-auto				8			8	8	8
Digester Mixing System No.1 – No.4 – DG No.2 motor trip							4	4	4
Digester Mixing System No.1 – No.4 – DG No.1 variable speed control		4	4				8	8	8
Digester Mixing System No.1 – No.4 – DG No.2 E-Stop				4			4	4	4
Digester Mixing System No.1 – No.4 – DG No.2 Common Pressure		2					2	2	2
Digester Mixing System No.1 – No.4 – DG No.2 Flow and trending		2		2			4	4	4
Digester Level No.1 – No.2		2					2	2	2

Description	RTD In	Analog In	Analog Out	24V DC In	24V DC Out	Volt Free Out	Network Link		
							Scada	HMI	Plant
Contractor to allow for additional 10% spare capacity	All	All	All	All	All	All	All	All	All

PS EPLC-6.B Motor Control Centre BNR Reactor [MCC No.2] PLC

Type: The motor control center panel builder shall allow a minimum of a full tier for programmable logic controller equipment as specified below. The equipment referenced below does not relieve the contractor of his responsibilities in terms of quality, dimensions, and proper functioning of the system.

Colour: Purple powder coated

Equipment: UPS, CPU, I/O modules and a HMI.

Commination Medium: Ethernet

Protocol: Equal or similar to either of the following a) Modbus, b) DeviceNet or c) Profibus

Equipment will be the following:

Qty	Description	Identification
One	Cubicle comprising the following: (Cubicle door shall be purple powder coated)	UPS supply
1	16Amp sized continuous current rated SP + N door interlocked protection MCB (Estimated and shall be confirmed by contractor and all calculations shall be supplied to Engineer for approval): Plus	Main Circuit Breaker UPS
1	Change over switch from Normal / UPS power selection: Plus	Maintenance purposes
1	10Amp sized continuous current rated SP + N door interlocked protection MCB (Estimated and shall be confirmed by contractor and all calculations shall be supplied to Engineer for approval): Plus	Main Circuit Breaker
1	Estimated Industrial 3kVA Pure Sine Wave UPS equal or similar to APC line, the UPS shall provide battery standby power for at least 3-hour back-up. The UPS (Estimated and shall be confirmed by contractor and all calculations shall be supplied to Engineer for approval). Batteries shall be rated at 60% load during a power failure. The UPS shall come complete with communication interface and shall comply with either of the following: a) Profibus-DP b) Profinet c) Industrial Ethernet d) Modbus TCP/IP Under no circumstances, shall the use of proprietary protocols be allowed: Plus Contractor to allow for powder coated mild steel cage and locks to be supplied and installed under this contract. The cage shall be lockable and protect the UPS from theft. It can be Inside or outside the PLC, both options are acceptable: Plus	UPS with 3-hour back-up to cater for all instrumentation, HMI and PLC. Warranty shall be a minimum of 2 years. With minimum of Lead acid batteries.

Qty	Description	Identification
All	Relays and contactors for automatic transfer to UPS power once the UPS power is restored: Plus	Automatic change over
All	Termination blocks necessary for signal cable connections from motors and instrumentation: Plus	All Terminals
All	Halogen free wiring ducts, covers, fix-O-Rapid, rapid clip for din rails, rapid clip for base plate shall be used: Plus	All
All	UPS monitoring functions as specified: Plus	UPS
1	6Amp continuous current rated SP MCB (Estimated and shall be confirmed by contractor and all calculations shall be supplied to Engineer for approval): Plus	PLC supply
1	2Amp continuous current rated SP MCB (Estimated and shall be confirmed by contractor and all calculations shall be supplied to Engineer for approval): Plus	HMI supply
6	2Amp continuous current rated SP MCB (Estimated and shall be confirmed by contractor and all calculations shall be supplied to Engineer for approval): Plus	All instrumentation shall be on UPS: NTU, pH, FIT, PIT and LIT. [Allowance]
8	2Amp continuous current rated SP MCB (Estimated and shall be confirmed by contractor and all calculations shall be supplied to Engineer for approval): Plus	Industrial Communication No.1 – No.8
One	Cubicle comprising the following: (Cubicle door shall be purple powder coated)	PLC Cubicle
1	6Amp continuous current rated SP door interlocked protection MCCB (Estimated and shall be confirmed by contractor and all calculations shall be supplied to Engineer for approval): Plus	Main Circuit Breaker PLC
1	230V/24DC stabilized power supply for 24V DC inputs to PLC input modules. (Power supply shall have adequate capacity for the application) (Estimated and shall be confirmed by contractor and all calculations shall be supplied to Engineer for approval): Plus	Power Supply
1	Industrial layer No.1 100/1000Mb managed switch which suits the application, complete with at least 4 x fiber optic ports, PLC, switch shall be from the same manufacturer: Plus	Communications with Fiber Optic cable
1	PLC processor unit complete with CPU base plate, bus terminators, Ethernet communication with I/O modules that will satisfy the application with at least the following minimum specifications: - Discrete I/O processor capacity 1024 I/O Multi-rack configuration capability, - Analogue I/O processor capacity 256 I/O multi-rack configuration capability, - Execution time per instruction 0.12 µs Boolean 0.17 µs double-length words 0.25 µs single-length words 1.16 µs floating points	PLC CPU

Qty	Description	Identification
	- Number of instructions per ms 6.4 Kinst/ms 65 % Boolean + 35 % fixed arithmetic 8.1 Kinst/ms 100% Boolean - Embedded communication service: Bandwidth management & Ethernet TCP/IP - Application structure 1 cyclic/periodic master task 1 periodic fast task - System overhead 0.13ms for fast task 0.7ms for master task - Shall comply with the following standards: IEC 61131-2 UL 508 EN 61131-2 CSA C22.2 No 142 CSA C22.2 No 213 Class I Division 2 The CPU selected shall be provided with 50% additional spare capacity for the plant: Plus	
All	High performance signal modules for digital and analog I/O plus provide 10% Spare I/O capacity for plant: Plus	Input and Output modules
All	Interposing relays for surge protection of field statuses to PLC: Plus	Surge Protection
All	Termination blocks necessary for signal cable connections from all motors and instrumentation: Plus	All Terminals
All	Halogen free wiring ducts, covers, fix-O-Rapid, rapid clip for din rails, rapid clip for base plate shall be used: Plus	All
All	Tenderers shall allow 10% of I/O specified [see list below] to be protected with digital and analog Surge arrestor modules. All Digital and Analogue signals leaving the main structure lighting and earthing protection must be protected via signal arrestors: Plus	Surge Protection for all signals
One	Cubicle comprising the following: (Cubicle door shall be purple powder coated)	HMI
1	2Amp continuous current rated SP door interlocked protection MCCB (Estimated and should be confirmed): Plus	Main Circuit Breaker PLC UPS
1	230V/24DC stabilized power supply for HMI unit: Plus	Supply
1	Human machine interface advanced touchscreen panel HD pixels VGA-10" TFT graphic Terminals" colour touch screen with sufficient flash memory, soft function and static function keys and Ethernet communication port. Software as may be required shall be provided: Plus [Contractor to allow for flap Infront of screen which is UV resistant and can prevent all UV rays to damage to the screen]. UV flap or cover shall have design life of 10 years and guarantee shall be supplied.	HMI
All	Software programming for indication of the following monitoring functions on the HMI display and all I/O as indicated in schedule of supervisory and control I/O's underneath.	
All	1. Alarm history page: Plus	Alarm history
All	2. Alarm setup page: Plus	Setup page

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Qty	Description	Identification
All	3. Graphic displays shall be used for variable parameter indications: Plus	Displays
All	4. Animated mimic displays shall be used for equipment displays: Plus	Displays
All	5. Password protected settings: Plus	Protection
All	6. All information protection settings, control and monitoring functions shall be displayed: Plus	Displays
All	7. All Instrumentation settings, monitoring and control functions: Plus	Displays
All	8. All monitoring and control functions as indicated schedule of supervisory and control I/O's underneath: Plus	Displays

PS EPLC-6.B Schedule Of Supervisory And Control I/O For Motor Control Centre BNR Reactor [MCC No.2] PLC

Description	RTD In	Analog In	Analog Out	24V DC In	24V DC Out	Volt Free Out	Network Link		
							Scada	HMI	Plant
Power Analyzer values to be captured in PLC and displayed on plant and SCADA, HMI and distributed through plant and linked to other power analyzers– Apparent Power, Power, Reactive Power, line and phase Voltages, Line and phase Currents, Power Factor, all billing information.							All	All	All
UPS healthy [Allowance]							All	All	All
UPS trip [Allowance]							All	All	All
UPS Normal/Fail [Allowance]							All	All	All
UPS Low Battery [Allowance]							All	All	All
UPS DC voltage below recommended voltage [Allowance]							All	All	All
Aerator No.1 – No.3 motor run/stop							6	6	6
Aerator No.1 – No.3 motor healthy							3	3	3
Aerator No.1 – No.3 man-off-auto				6			6	6	6
Aerator No.1 – No.3 motor trip							3	3	3
Aerator No.1 – No.3 variable speed control		3	3				6	6	6
Aerator No.1 – No.3 E-Stop				3			3	3	3
Dissolved Oxygen No.1 – No.2		2		2			4	4	4
PST No.1 – No.2 motor run/stop							4	4	6
PST No.1 – No.2 motor healthy							2	2	2
PST No.1 – No.2 man-off-auto				4			4	4	4
PST No.1 – No.2 motor trip							2	2	2
PST No.1 – No.2 variable speed control		2	2				4	4	4
PST No.1 – No.2 E-Stop				2			2	2	2
Anoxic Mixer No.1 – No.3 motor run/stop							6	6	6
Anoxic Mixer No.1 – No.3 motor healthy							3	3	3
Anoxic Mixer No.1 – No.3 man-off-auto				6			6	6	6
Anoxic Mixer No.1 – No.3 motor trip							3	3	3
Anoxic Mixer No.1 – No.3 E-Stop				3			3	3	3
Dissolved Oxygen Meter		2		2			4	4	4
A – Recycle Pump No.1 – No.3 motor run/stop							6	6	6
A – Recycle Pump No.1 – No.3 motor healthy							3	3	3
A – Recycle Pump No.1 – No.3 man-off-auto				6			6	6	6
A – Recycle Pump No.1 – No.3 motor trip							3	3	3
A – Recycle Pump variable speed control		3	3				6	6	6
A – Recycle Pump No.1 – No.3 E-Stop				3			3	3	3
A – Recycle Pump No.1 – No.3 Flow Meter		1		1			1	1	1

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Description	RTD In	Analog In	Analog Out	24V DC In	24V DC Out	Volt Free Out	Network Link		
							Scada	HMI	Plant
Ras Pump No.1 – No.4 motor run/stop							6	6	6
Ras Pump No.1 – No.4 motor healthy							3	3	3
Ras No.1 – No.4 man-off-auto				6			6	6	6
Ras Pump No.1 – No.4 motor trip							3	3	3
Ras Pump variable speed control		3	3				6	6	6
Ras Pump No.1 – No.4 E-Stop				3			3	3	3
Ras Pump No.1 – No.4 Flow Meter		1		1			1	1	1
Was Pump No.1 – No.3 motor run/stop							6	6	6
Was Pump No.1 – No.3 motor healthy							3	3	3
Was No.1 – No.3 man-off-auto				6			6	6	6
Was Pump No.1 – No.3 motor trip							3	3	3
Was Pump variable speed control		3	3				6	6	6
Was Pump No.1 – No.3 E-Stop				3			3	3	3
Was Pump No.1 – No.3 Flow Meter		1		1			1	1	1
Level		6					6	6	6
Contractor to allow for additional 10% spare capacity	All	All	All	All	All	All	All	All	All

PS EPLC-6.C CHLORINE MOTOR CONTROL CENTRE [MCC No.3] PLC

Type: The motor control center panel builder shall allow a minimum of a full tier for programmable logic controller equipment as specified below. The equipment referenced below does not relieve the contractor of his responsibilities in terms of quality, dimensions, and proper functioning of the system.

Colour: Purple powder coated

Equipment: UPS, CPU, I/O modules and a HMI.

Commination Medium: Ethernet

Protocol: Equal or similar to either of the following a) Modbus, b) DeviceNet, c) Profinet or d) Profibus

Equipment will be the following:

Qty	Description	Identification
One	Cubicle comprising the following: (Cubicle door shall be purple powder coated)	UPS supply
1	16Amp sized continuous current rated SP + N door interlocked protection MCB (Estimated and shall be confirmed by contractor and all calculations shall be supplied to Engineer for approval): Plus	Main Circuit Breaker UPS
1	Change over switch from Normal / UPS power selection: Plus	Maintenance purposes
1	10Amp sized continuous current rated SP + N door interlocked protection MCB (Estimated and shall be confirmed by contractor and all calculations shall be supplied to Engineer for approval): Plus	Main Circuit Breaker
1	Estimated Industrial 3kVA Pure Sine Wave UPS equal or similar to APC line, the UPS shall provide battery standby power for at least 3-hour back-up. The UPS (Estimated and shall be confirmed by contractor and all calculations shall be supplied to Engineer for approval). Batteries shall be rated at 60% load during a power failure. The UPS shall come complete with communication interface and shall comply with either of the following: a) Profibus-DP b) Profinet c) Industrial Ethernet d) Modbus TCP/IP Under no circumstances, shall the use of proprietary protocols be allowed: Plus Contractor to allow for powder coated mild steel cage and locks to be supplied and installed under this contract. The cage shall be lockable and protect the UPS from theft. It can be Inside or outside the PLC, both options are acceptable: Plus	UPS with 3-hour back-up to cater for all instrumentation, HMI and PLC. Warranty shall be a minimum of 2 years. With minimum of Lead acid batteries.
All	Relays and contactors for automatic transfer to UPS power once the UPS power is restored: Plus	Automatic change over
All	Termination blocks necessary for signal cable connections from motors and instrumentation: Plus	All Terminals
All	Halogen free wiring ducts, covers, fix-O-Rapid, rapid clip for din rails, rapid clip for base plate shall be used: Plus	All

Qty	Description	Identification
All	UPS monitoring functions as specified: Plus	UPS
1	6Amp continuous current rated SP MCB (Estimated and shall be confirmed by contractor and all calculations shall be supplied to Engineer for approval): Plus	PLC supply
1	2Amp continuous current rated SP MCB (Estimated and shall be confirmed by contractor and all calculations shall be supplied to Engineer for approval): Plus	HMI supply
1	2Amp continuous current rated SP MCB (Estimated and shall be confirmed by contractor and all calculations shall be supplied to Engineer for approval): Plus	All instrumentation shall be on UPS: NTU, pH, FIT, PIT and LIT. [Allowance]
One	Cubicle comprising the following: (Cubicle door shall be purple powder coated)	PLC Cubicle
1	6Amp continuous current rated SP door interlocked protection MCCB (Estimated and shall be confirmed by contractor and all calculations shall be supplied to Engineer for approval): Plus	Main Circuit Breaker PLC
1	230V/24DC stabilized power supply for 24V DC inputs to PLC input modules. (Power supply shall have adequate capacity for the application) (Estimated and shall be confirmed by contractor and all calculations shall be supplied to Engineer for approval): Plus	Power Supply
1	Industrial layer No.1 100/1000Mb managed switch which suits the application, complete with at least 4 x fiber optic ports, PLC, switch shall be from the same manufacturer: Plus	Communications with Fiber Optic cable
1	PLC processor unit complete with CPU base plate, bus terminators, Ethernet communication with I/O modules that will satisfy the application with at least the following minimum specifications: - Discrete I/O processor capacity 1024 I/O Multi-rack configuration capability, - Analogue I/O processor capacity 256 I/O multi-rack configuration capability, - Execution time per instruction 0.12 µs Boolean 0.17 µs double-length words 0.25 µs single-length words 1.16 µs floating points - Number of instructions per ms 6.4 Kinst/ms 65 % Boolean + 35 % fixed arithmetic 8.1 Kinst/ms 100% Boolean - Embedded communication service: - Bandwidth management & Ethernet TCP/IP - Application structure 1 cyclic/periodic master task 1 periodic fast task - System overhead 0.13ms for fast task 0.7ms for master task - Shall comply with the following standards: IEC 61131-2 UL 508 EN 61131-2 CSA C22.2 No 142 CSA C22.2 No 213 Class I Division 2	PLC CPU

Qty	Description	Identification
	The CPU selected shall be provided with 50% additional spare capacity for the plant: Plus	
All	High performance signal modules for digital and analog I/O plus provide 10% Spare I/O capacity for plant: Plus	Input and Output modules
All	Interposing relays for surge protection of field statuses to PLC: Plus	Surge Protection
All	Termination blocks necessary for signal cable connections from all motors and instrumentation: Plus	All Terminals
All	Halogen free wiring ducts, covers, fix-O-Rapid, rapid clip for din rails, rapid clip for base plate shall be used: Plus	All
All	Tenderers shall allow 10% of I/O specified [see list below] to be protected with digital and analog Surge arrestor modules. All Digital and Analogue signals leaving the main structure lighting and earthing protection must be protected via signal arrestors: Plus	Surge Protection for all signals
One	Cubicle comprising the following: (Cubicle door shall be purple powder coated)	HMI
1	2Amp continuous current rated SP door interlocked protection MCCB (Estimated and should be confirmed): Plus	Main Circuit Breaker PLC UPS
1	230V/24DC stabilized power supply for 24V DC inputs to PLC input modules. (Power supply shall have adequate capacity for the application) (Estimated and shall be confirmed by contractor and all calculations shall be supplied to Engineer for approval): Plus	Power Supply
1	Human machine interface advanced touchscreen panel HD pixels VGA-10" TFT graphic Terminals" colour touch screen with sufficient flash memory, soft function and static function keys and Ethernet communication port. Software as may be required shall be provided: Plus [Contractor to allow for flap Infront of screen which is UV resistant and can prevent all UV rays to damage to the screen]. UV flap or cover shall have design life of 10 years and guarantee shall be supplied.	HMI
All	Software programming for indication of the following monitoring functions on the HMI display and all I/O as indicated in schedule of supervisory and control I/O's underneath.	
All	1. Alarm history page: Plus	Alarm history
All	2. Alarm setup page: Plus	Setup page
All	3. Graphic displays shall be used for variable parameter indications: Plus	Displays
All	4. Animated mimic displays shall be used for equipment displays: Plus	Displays
All	5. Password protected settings: Plus	Protection
All	6. All information protection settings, control and monitoring functions shall be displayed: Plus	Displays

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Qty	Description	Identification
All	7. All Instrumentation settings, monitoring and control functions: Plus	Displays
All	8. All monitoring and control functions as indicated schedule of supervisory and control I/O's underneath: Plus	Displays

PS EPLC-6.C SCHEDULE OF SUPERVISORY AND CONTROL I/O'S FOR CHLORINE MOTOR

CONTROL CENTRE [MCC No.3] PLC

Description	RTD In	Analog In	Analog Out	24V DC In	24V DC Out	Volt Free Out	Network Link		
							Scada	HMI	Plant
Power Analyzer values to be captured in PLC and displayed on plant and SCADA, HMI and distributed through plant and linked to other power analyzers– Apparent Power, Power, Reactive Power, line and phase Voltages, Line and phase Currents, Power Factor, all billing information.							All	All	All
UPS healthy [Allowance]							All	All	All
UPS trip [Allowance]							All	All	All
UPS Normal/Fail [Allowance]							All	All	All
UPS Low Battery [Allowance]							All	All	All
UPS DC voltage below recommended voltage [Allowance]							All	All	All
Chlorine gas cylinder weight No.1 – No.2		2					2	2	2
Chlorine Actuated Regulators Pre and Post			2				2	2	2
Chlorine Analyzer		1					1	1	1
Plant Outlet Flow Meter		1					1	1	1
Chlorine Gas Leak				1			1	1	1
Chlorine Fans No.1 – No.2 Start / Stop					4		4	4	4
Chlorine Fans No.1 – No.2 Trip				2			2	2	2
Chlorine Fans No.1 – No.2 Healthy				2			2	2	2
Limit switches on doors No.1 – No.2				2			2	2	2
Chlorine Process Water No.1 – No.2 Start / Stop					4		4	4	4
Chlorine Process Water No.1 – No.2 Trip				2			2	2	2
Chlorine Process Water No.1 – No.2 Healthy				2			2	2	2
Chlorine Process Water No.1 – No.2 Level		1					1	1	1
Plant Outflow		1		1			2	2	2
Plant pH		1		1			2	2	2
Contractor to allow for additional 5% spare capacity	All	All	All	All	All	All	All	All	All

PS EPLC-6.D Sludge & Supernatant Pump Station Motor Control Centre [MCC No.04] PLC

Type: The motor control center panel builder shall allow a minimum of a full tier for programmable logic controller equipment as specified below. The equipment referenced below does not relieve the contractor of his responsibilities in terms of quality, dimensions, and proper functioning of the system.

Colour: Purple powder coated

Equipment: UPS, CPU, I/O modules and a HMI.

Commination Medium: Ethernet

Protocol: Equal or similar to either of the following a) Modbus, b) DeviceNet or c) Profibus

Equipment will be the following:

Qty	Description	Identification
One	Cubicle comprising the following: (Cubicle door shall be purple powder coated)	UPS supply
1	16Amp sized continuous current rated SP + N door interlocked protection MCB (Estimated and shall be confirmed by contractor and all calculations shall be supplied to Engineer for approval): Plus	Main Circuit Breaker UPS
1	Change over switch from Normal / UPS power selection: Plus	Maintenance purposes
1	10Amp sized continuous current rated SP + N door interlocked protection MCB (Estimated and shall be confirmed by contractor and all calculations shall be supplied to Engineer for approval): Plus	Main Circuit Breaker
1	Estimated Industrial 3kVA Pure Sine Wave UPS equal or similar to APC line, the UPS shall provide battery standby power for at least 3-hour back-up. The UPS (Estimated and shall be confirmed by contractor and all calculations shall be supplied to Engineer for approval). Batteries shall be rated at 60% load during a power failure. The UPS shall come complete with communication interface and shall comply with either of the following: a) Profibus-DP b) Profinet c) Industrial Ethernet d) Modbus TCP/IP Under no circumstances, shall the use of proprietary protocols be allowed: Plus Contractor to allow for powder coated mild steel cage and locks to be supplied and installed under this contract. The cage shall be lockable and protect the UPS from theft. It can be Inside or outside the PLC, both options are acceptable: Plus	UPS with 3-hour back-up to cater for all instrumentation, HMI and PLC. Warranty shall be a minimum of 2 years. With minimum of Lead acid batteries.
All	Relays and contactors for automatic transfer to UPS power once the UPS power is restored: Plus	Automatic change over
All	Termination blocks necessary for signal cable connections from motors and instrumentation: Plus	All Terminals
All	Halogen free wiring ducts, covers, fix-O-Rapid, rapid clip for din rails, rapid clip for base plate shall be used: Plus	All

Qty	Description	Identification
All	UPS monitoring functions as specified: Plus	UPS
1	6Amp continuous current rated SP MCB (Estimated and shall be confirmed by contractor and all calculations shall be supplied to Engineer for approval): Plus	PLC supply
1	2Amp continuous current rated SP MCB (Estimated and shall be confirmed by contractor and all calculations shall be supplied to Engineer for approval): Plus	HMI supply
6	2Amp continuous current rated SP MCB (Estimated and shall be confirmed by contractor and all calculations shall be supplied to Engineer for approval): Plus	All instrumentation shall be on UPS: NTU, pH, FIT, PIT and LIT. [Allowance]
8	2Amp continuous current rated SP MCB (Estimated and shall be confirmed by contractor and all calculations shall be supplied to Engineer for approval): Plus	Industrial Communication No.1 – No.8
One	Cubicle comprising the following: (Cubicle door shall be purple powder coated)	PLC Cubicle
1	6Amp continuous current rated SP door interlocked protection MCCB (Estimated and shall be confirmed by contractor and all calculations shall be supplied to Engineer for approval): Plus	Main Circuit Breaker PLC
1	230V/24DC stabilized power supply for 24V DC inputs to PLC input modules. (Power supply shall have adequate capacity for the application) (Estimated and shall be confirmed by contractor and all calculations shall be supplied to Engineer for approval): Plus	Power Supply
1	Industrial layer No.1 100/1000Mb managed switch which suits the application, complete with at least 4 x fiber optic ports, PLC, switch shall be from the same manufacturer: Plus	Communications with Fiber Optic cable
1	PLC processor unit complete with CPU base plate, bus terminators, Ethernet communication with I/O modules that will satisfy the application with at least the following minimum specifications: - Discrete I/O processor capacity 1024 I/O Multi-rack configuration capability, - Analogue I/O processor capacity 256 I/O multi-rack configuration capability, - Execution time per instruction 0.12 μs Boolean 0.17 μs double-length words 0.25 μs single-length words 1.16 μs floating points - Number of instructions per ms 6.4 Kinst/ms 65 % Boolean + 35 % fixed arithmetic 8.1 Kinst/ms 100% Boolean - Embedded communication service: - Bandwidth management & Ethernet TCP/IP - Application structure 1 cyclic/periodic master task 1 periodic fast task - System overhead 0.13ms for fast task 0.7ms for master task	PLC CPU

Qty	Description	Identification
	Shall comply with the following standards: IEC 61131-2 UL 508 EN 61131-2 CSA C22.2 No 142 CSA C22.2 No 213 Class I Division 2 The CPU selected shall be provided with 50% additional spare capacity for the plant: Plus	
All	High performance signal modules for digital and analog I/O plus provide 10% Spare I/O capacity for plant: Plus	Input and Output modules
All	Interposing relays for surge protection of field statuses to PLC: Plus	Surge Protection
All	Termination blocks necessary for signal cable connections from all motors and instrumentation: Plus	All Terminals
All	Halogen free wiring ducts, covers, fix-O-Rapid, rapid clip for din rails, rapid clip for base plate shall be used: Plus	All
All	Tenderers shall allow 10% of I/O specified [see list below] to be protected with digital and analog Surge arrestor modules. All Digital and Analogue signals leaving the main structure lighting and earthing protection must be protected via signal arrestors: Plus	Surge Protection for all signals
One	Cubicle comprising the following: (Cubicle door shall be purple powder coated)	HMI
1	2Amp continuous current rated SP door interlocked protection MCCB (Estimated and should be confirmed): Plus	Main Circuit Breaker PLC UPS
1	230V/24DC stabilized power supply for HMI unit; Plus	Supply
1	Human machine interface advanced touchscreen panel HD pixels VGA-10" TFT graphic Terminals" colour touch screen with sufficient flash memory, soft function and static function keys and Ethernet communication port. Software as may be required shall be provided: Plus [Contractor to allow for flap Infront of screen which is UV resistant and can prevent all UV rays to damage to the screen]. UV flap or cover shall have design life of 10 years and guarantee shall be supplied.	HMI
All	Software programming for indication of the following monitoring functions on the HMI display and all I/O as indicated in schedule of supervisory and control I/O's underneath.	
All	1. Alarm history page: Plus	Alarm history
All	2. Alarm setup page: Plus	Setup page
All	3. Graphic displays shall be used for variable parameter indications: Plus	Displays
All	4. Animated mimic displays shall be used for equipment displays: Plus	Displays
All	5. Password protected settings: Plus	Protection
All	6. All information protection settings, control and monitoring functions shall be displayed: Plus	Displays

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EPLC: Programmable Logic Controllers

Qty	Description	Identification
All	7. All Instrumentation settings, monitoring and control functions: Plus	Displays
All	8. All monitoring and control functions as indicated schedule of supervisory and control I/O's underneath: Plus	Displays

PS EPLC-6.D SCHEDULE OF SUPERVISORY AND CONTROL I/O FOR SLUDGE & SUPERNATANT PUMP STATION MOTOR CONTROL CENTRE [MCC NO.04] PLC

Description	RTD In	Analog In	Analog Out	24V DC In	24V DC Out	Volt Free Out	Network Link		
							Scada	HMI	Plant
Power Analyzer values to be captured in PLC and displayed on plant and SCADA, HMI and distributed through plant and linked to other power analyzers– Apparent Power, Power, Reactive Power, line and phase Voltages, Line and phase Currents, Power Factor, all billing information.							All	All	All
UPS healthy [Allowance]							All	All	All
UPS trip [Allowance]							All	All	All
UPS Normal/Fail [Allowance]							All	All	All
UPS Low Battery [Allowance]							All	All	All
UPS DC voltage below recommended voltage [Allowance]							All	All	All
Supernatant Pump No.1 – No.2 motor run/stop							4	4	4
Supernatant Pump No.1 – No.2 motor healthy							2	2	2
Supernatant Pump No.1 – No.2 man-off-auto				4			4	4	4
Supernatant Pump No.1 – No.2 motor trip							2	2	4
Supernatant Pump No.1 – No.2 variable speed control		2	2				4	4	4
Supernatant Pump No.1 – No.2 E-Stop				2			2	2	2
Supernatant Pump No.1 – No.2 Common Pressure		1					1	1	1
Supernatant Pump No.1 – No.2 Flow and trending		1		1			2	2	2
Sludge Pump No.1 – No.2 motor run/stop							4	4	4
Sludge Pump No.1 – No.2 motor healthy							2	2	2
Sludge Pump No.1 – No.2 man-off-auto				4			4	4	4
Sludge Pump No.1 – No.2 motor trip							2	2	4
Sludge Pump No.1 – No.2 variable speed control		2	2				4	4	4
Sludge Pump No.1 – No.2 E-Stop				2			2	2	2
Sludge Pump No.1 – No.2 Common Pressure		1					1	1	1
Sludge Pump No.1 – No.2 Flow and trending		1		1			2	2	2
Sump Level		1					1	1	1
Contractor to allow for additional 10% spare capacity	All	All	All	All	All	All	All	All	All

PS EPLC-15 Operation Of Plant

PS EPLC-15.1 Operation and control philosophy

A The final Operation and Control Philosophy shall be draft by the Contract for approval by the Engineer but these specifications shall be used as the basis of the design philosophy. The OCP has been divided in to the specific unit process under specified headings.

END OF SECTION

PS ECIS ELECTRICAL DISTRIBUTION SYSTEM

PS ECIS-1 Scope of Works

Equipment shall be provided as specified and indicated on the drawings on the site of the Works.

PS ECIS-2 Pressure Sensors

Electronic pressure transducers reading the suction or delivery pressure of a pipeline shall be supplied and installed under this contract where specified. The suction pressure transducers will serve the dual function of producing an alarm at low suction pressure and trip the pump-set via the PLC and will be **hardwired** to the motor panel. The alarm will be triggered when the pump suction pressure drops to 1,3 times the 3% NPSH of the pump and will power the pumps down through the normal shut down procedure when the pressure drops to 1,1 times the 3% head loss at cavitation level.

Pressure transmitters shall be equal to or better than that described in the relevant Particular Specification.

PS ECIS-2.A Pressure Sensors

Type: Pipe Connected

Supply: 1mm² x 2pr twisted PVC SWA PVC (individually and overall screened).

Colour: Electric orange

Equipment will be the following:

Qty	Description	Identification
1	Supply and install absolute and gauge pressure sensor and probes. The transmitter shall be equal or similar to Cerabar PMC71 from Endress and Hauser with extended probes to the pipeline. The transmitter will be installed inside the enclosure: Plus	Controller
All	Pipe connections to pipeline and coordination with mechanical contractor: Plus	Mechanical Contractor coordination
All	Terminals and interconnecting monitoring and control wiring: Plus	Connection and monitoring
All	Earthing and bonding across the probes.	Earthing

PS ECIS-3 Flow Meter Equipment

Magnetic and turbine type flow meters will be supplied and installed by the mechanical or civil contractor. The above mentioned flow meter controllers as free issue items will have to be installed under this contract in flow meter kiosks complete with a supply of electricity, surge protection and earthing system.

Clamp on flow meters will be supplied and installed under this contract. The Contractor shall coordinate with the mechanical contractor if all requirements are met regarding the clamp on flow meters.

PS ECIS-3.An Ultrasonic Flow Meter

Type: Outdoor powder coated 316 stainless steel frame mounted with lockable front door and transparent window for meter reading purposes. Transparent window must be covered with top hinged powder coated 316 stainless steel cover for ultra violet protection of controller.

Supply: 2.5mm² x 3 core PVC SWA PVC cable plus 10mm² bare copper earth plus 1mm² x 4pr twisted PVC SWA PVC (individually and overall screened)

Colour: Electric orange

Fault level: 5kA

Equipment will be the following:

Qty	Description	Identification
1	10Amp Continues Rated SP MCB: Plus	Main
All	Single Phase class 2 surge arrestor unit connection type 2 as per SANS 10142-1: Plus	Surge arrestor
1	Supply and install clamp-on flow meter controller equal or similar to Prosonic Flow 91 complete with Modbus RS232 communication: Plus	Controller
All	316 stainless steel Pipe connections to pipeline and coordination with mechanical contractor: Plus	Mechanical Contractor coordination
All	Terminals and interconnecting monitoring and control wiring: Plus	Connection and monitoring
All	Signal & Data Surge protection unit suitable for the application equal or similar to Blitzductor XT from DEHNguard..	Signal & Data Surge Protection

PS ECIS-3.B Mag Flow Meter

Type: Outdoor powder coated 316 stainless steel frame mounted with lockable front door and transparent window for meter reading purposes. Transparent window must be covered with top hinged powder coated 316 stainless steel cover for ultra violet protection of controller.

Supply: 2.5mm² x 3 core PVC SWA PVC cable plus 10mm² bare copper earth plus 1mm² x 4pr twisted PVC SWA PVC (individually and overall screened)

Colour: Electric orange

Fault level: 5kA

Equipment will be the following:

Qty	Description	Identification
1	10Amp Continues Rated SP MCB: Plus	Main
All	Single Phase class 2 surge arrestor unit connection type 2 as per SANS 10142-1: Plus	Surge arrestor

Qty	Description	Identification
All	Front panel mounted LCD display for instantaneous flow and totalized flow counter.	Display
All	Mag-Flow Controller supplied by mechanical contractor. Free issue item which must be installed in enclosure: Plus	Mag-flow
All	316 stainless steel Pipe connections to pipeline and coordination with mechanical contractor: Plus	Mechanical Contractor coordination
All	Terminals and interconnecting monitoring and control wiring: Plus	Connection and monitoring
All	Signal & Data Surge protection unit suitable for the application equal or similar to Blitzductor XT from DEHNguard..	Signal & Data Surge Protection

PS ECIS-3.C Flume & Weir Flow Meter Installation

Type: Outdoor powder coated 316 stainless steel steel frame mounted with lockable front door and transparent window for meter reading purposes. Transparent window must be covered with top hinged powder coated 316 stainless steel cover for ultra violet protection of level controller.

Supply: 2.5mm² x 3 core PVC SWA PVC cable plus 10mm² bare copper earth plus 1mm² x 4pr twisted PVC SWA PVC (individually and overall screened).

Colour: Electric orange

Fault level: 5kA

Equipment will be the following:

Qty	Description	Identification
1	10Amp Continues Rated SP MCB: Plus	Main
All	Single Phase class 2 surge arrestor unit connection type 2 as per SANS 10142-1: Plus	Surge arrestor
All	Ultrasonic level controller equal and similar to FMU90 and one flow meter transducer sensor unit mounted on grade 316 stainless steel bracket inside a ventilated grade 316 stainless steel enclosure on top level measurement including cabling and all accessories: Plus	Level Controller & Transducer [flume flow]
All	Terminals and interconnecting monitoring and control wiring: Plus	Connection and monitoring
All	Signal & Data Surge protection unit suitable for the application equal or similar to Blitzductor XT from DEHNguard.	Signal & Data Surge Protection

PS ECIS-4 Electronic Level Control

An electronic intelligent level transducers shall be supplied and installed on a grade 316 stainless steel brackets and a ball type level sensor as indicated.

Field mounted level sensors shall be installed complete with local surge protection and earthing system. The level controllers shall be installed inside kiosk and mounted as specified. Stainless steel brackets, onto which the level sensors shall be screwed, shall be bolted to the wall; their mounting brackets being modified accommodate the insertion of the level sensors.

PS ECIS-4.A Float Switch Level Control

Type: The Float switch FTS20 Endress and Hauser for point level detection All accessories, 316 stainless steel clamp, wall bracket, float switch hanger, weight, cable and all bolts and nuts to complete the installation.

Supply: 1.5mm² x 2pr twisted PVC SWA PVC (individually and overall screened) to all applicate MCC, all cable work shall be added in schedule of quantities.

Equipment will be the following:

Qty	Description	Identification
All	Float switch level sensor equal and similar to FTS20 Endress and Hauser made from high impact and shock resistant material. All accessories, 316 stainless steel clamp, wall bracket, float switch hanger, weight, cable and all bolts and nuts to complete the installation: Plus	Ball type level for manual stop
All	Terminals and interconnecting monitoring and control wiring: Plus	Connection and monitoring
All	Signal & Data Surge protection unit suitable for the application equal or similar to Blitzductor XT from DEHNgard..	Signal & Data Surge Protection

PS ECIS-4.B Radar Level Kiosks

Type: Outdoor powder coated 316 stainless steel frame mounted with lockable front door and transparent window for meter reading purposes. Transparent window must be covered with top hinged powder coated 316 stainless steel cover for ultraviolet protection of level controller.

The Contractor shall ensure that all ultra-sonic level sensors are installed in a manner which limits interference from scum build up and/or turbulence at the top water level. The Contractor shall install scum dissipations and/or turbulence reducing systems (e.g. slotted 316 stainless steel pipe protruding min TWL) underneath sensors where such interference can occur on the level sensor signal. The Contractor shall submit details of level sensor installation for approval by the Engineer prior to acquiring and installing any associated equipment.

Supply: 2.5mm² x 3 core PVC SWA PVC cable plus 10mm² bare copper earth plus 1mm² x 4pr twisted PVC SWA PVC (individually and overall screened).

Colour: Electric orange

Fault level: 5kA

Equipment will be the following:

Qty	Description	Identification
1	10Amp Continues Rated SP MCB: Plus	Main
All	Single Phase class 2 surge arrestor unit connection type 2 as per SANS 10142-1 equal or similar to Dehngard.	Surge arrestor

Qty	Description	Identification
	DVMTT255 with remote indicator panel & remote signalling contacts connected to the SCADA: Plus	
1	Radar level controller equal and similar to Endress and Hauser and Radar Controller and remote transducer equal and similar to Micropilot FMR50. The transducer shall be remotely mounted on grade 316 stainless steel bracket inside a ventilated grade 316 stainless steel enclosure on on the structure for level measurement including cabling and all accessories: Plus	Level Controller & Two Transducers EX rated
All	Terminals and interconnecting monitoring and control wiring: Plus	Connection and monitoring
All	Signal & Data Surge protection unit suitable for the application equal or similar to Blitzductor XT from DEHNGuard.	Signal & Data Surge Protection

PS ECIS-4.C ULTRASONIC LEVELS

Type: Transducer unit shall be mounted on grade 304 stainless steel bracket and enclosed to suite the application. The transducer enclosure shall specially be made for the transducer and enclose the entire transducer except the optical of the transducer. The transducer enclosure shall be made with grade 304 stainless steel to protect it from the elements and be bolted to bracket. All bolts and nuts shall be 304 stainless steel. The bracket and enclosure shall be sent to Engineer for approval before production.

Supply: 10mm² bare copper earth plus 1mm² x 2pr twisted PVC SWA PVC (individually and overall screened).

Equipment will be the following:

Qty	Description	Identification
All	Ultrasonic level equal and similar to FMU30 transducer sensor unit mounted on grade 304 stainless steel bracket inside a ventilated grade 304 stainless steel enclosure measurement including cabling and all accessories: Plus	Level Transducer
All	Terminals and interconnecting monitoring and control wiring: Plus	Connection and monitoring
All	Earthing and bonding on bracket and connected to the earth.	Earthing

PS ECIS-7 pH Sensors

pH meters shall be provided at the in positions as indicated on the construction drawings. The pH meters shall be provide complete with sensor support and support brackets secured to structures. Cables shall be installed in grade galvanised steel pipes or galvanised cable trays secured to the structure walls.

PS ECIS-7.A pH Sensors

Type: Outdoor powder coated 316 stainless steel frame mounted with lockable front door and

transparent window for meter reading purposes. Transparent window must be covered with top hinged powder coated 316 stainless steel cover for ultra violet protection of level controller.

Supply: 2.5mm² x 3 core PVC SWA PVC cable plus 10mm² bare copper earth plus 1mm² x 4pr twisted PVC SWA PVC (individually and overall screened).

Colour: Electric orange

Fault level: 5kA

Equipment will be the following:

Qty	Description	Identification
1	10Amp Continues Rated SP MCB: Plus	Main
All	Single Phase class 2 surge arrestor unit connection type 2 as per SANS 10142-1 equal or similar to Dehnguard. DVMTT255 with remote indicator panel & remote signalling contacts connected to the SCADA: Plus	Surge arrestor
All	Controller equal and similar to Endress and Hauser Controller including cabling and all accessories: Plus	Controller
2	Transducer equal and similar to Endress and Hauser pH Sensors unit mounted on grade 316 stainless steel bracket inside a ventilated grade 316 stainless steel enclosure: Plus	Transducer
All	Terminals and interconnecting monitoring and control wiring: Plus	Connection and monitoring
All	Signal & Data Surge protection unit suitable for the application equal or similar to Blitzductor XT from DEHNGuard.	Signal & Data Surge Protection

PS ECIS-8 Turbidity Sensors for Low to Medium Range Turbidity Measurements Sensors

Turbidity sensors shall be provided complete with sample water piping. The turbidity sensors shall be provided complete with controller communication cables. Cables shall be installed in 316 stainless steel pipes secured to the structure walls.

Turbidity sensors shall be equal and similar to Endress and Hauser plus controller series.

PS ECIS-8.A Turbidity Sensors

Type: Outdoor powder coated 316 stainless steel frame mounted with lockable front door and transparent window for meter reading purposes. Transparent window must be covered with top hinged powder coated 316 stainless steel cover for ultra violet protection of level controller.

Supply: 2.5mm² x 3 core PVC SWA PVC cable plus 10mm² bare copper earth plus 1mm² x 4pr twisted PVC SWA PVC (individually and overall screened).

Colour: Electric orange

Fault level: 5kA

Equipment will be the following:

Qty	Description	Identification
1	10Amp SP + N Continues Rated SP + N Isolator mounted in IP65 weatherproof casing: Plus	Main
All	Single Phase class 2 surge arrestor unit connection type 2 as per SANS 10142-1: Plus	Surge arrestor
1	Supply and install Turbidity transmitter equal and similar Endress and Hauser: Plus	Turbidity Analyser
1	Supply and install of Endress and Hauser controller complete with Modbus RS232 communication: Plus	Controller unit
All	Calibration module for Endress and Hauser: Plus	Calibration purposes
All	Calibration cylinder	Calibration purposes
All	Signal & Data Surge protection unit suitable for the application equal or similar to Blitzductor XT from DEHNguard.	Signal & Data Surge Protection

PS ECIS-9 Rotating Bridge Brush Gear

The brush gear was be supplied and installed under this contract, but the motor and emergency stop cables and cable mounting equipment must be supplied and installed under this contract.

Cable sleeve to the brush gear position were provided under the under a previous contract.

PS ECIS-10 Chlorine Sensors

Chlorine sensors shall be provided complete with sample water piping as indicated on the drawings. The chlorine sensors shall be provided complete with controller communication cables. Cables shall be installed in 316 stainless steel pipes secured to the structure walls.

Sensors shall be equal and similar to Endress and Hauser plus controller series.

PS ECIS-10.A Chlorine Sensors

Type: Outdoor powder coated 316 stainless steel frame mounted with lockable front door and transparent window for meter reading purposes. Transparent window must be covered with top hinged powder coated 316 stainless steel cover for ultra violet protection of level controller.

Supply: 2.5mm² x 3 core PVC SWA PVC cable plus 10mm² bare copper earth plus 1mm² x 4pr twisted PVC SWA PVC (individually and overall screened).

Colour: Electric orange

Fault level: 5kA

Equipment will be the following:

Qty	Description	Identification
1	10Amp SP + NI Continues Rated SP + N Isolator mounted in IP65 weatherproof casing: Plus	Main
All	Single Phase class 2 surge arrestor unit connection type 2 as per SANS 10142-1: Plus	Surge arrestor
1	Supply and install Chlorine meter equal and similar Endress and Hauser against inside wall: Plus	Chlorine Analyser
1	Supply and install of Endress and Hauser controller complete with Modbus RS232 communication: Plus	Controller unit
All	Pipe connections to pipe line and coordination with mechanical contractor to allow all pipe connections: Plus	Mechanical Contractor coordination
All	Calibration module for Endress and Hauser: Plus	Calibration purposes
All	Calibration cylinder	Calibration purposes
All	Signal & Data Surge protection unit suitable for the application equal or similar to Blitzductor XT from DEHNguard.	Signal & Data Surge Protection

PS ECIS-12 Dissolved Oxygen Meters

Dissolved oxygen probes shall be provided at suitable locations as indicated on the P&ID's. The final location of the probes shall be confirmed on site after award of the Contract. The DO probes shall be provided complete with 316 stainless steel swivel-type support brackets secured to reactor structure [all bolts, nuts, brackets shall be 316 stainless steel]. The swivel bracket shall be at least 6m long and swivel bracket shall be made to easily move the sensor around. Cables shall be installed in grade 316 stainless steel pipes or grade 316 stainless steel cable trays secured to the structure walls. **The DO probe shall typically be located approximately 1m below the water level and locked into position by the swivel bracket.**

Type: Outdoor powder coated 316 stainless steel frame mounted with lockable front door and transparent window for meter reading purposes. Transparent window must be covered with top hinged powder coated 316 stainless steel cover for ultraviolet protection of controller.

Supply: 2.5mm² x 3 core PVC SWA PVC cable plus 10mm² bare copper earth plus 1mm² x 4pr twisted PVC SWA PVC (individually and overall screened)

Colour: Electric orange

Fault level: 5kA

The following equipment shall be supplied and installed:

Qty	Description	Identification
1	10Amp Continues Rated SP MCB: Plus	Main
All	Single Phase class 2 surge arrestor unit connection type 2 as per SANS 10142-1 equal or similar to Dehnguard.	Surge arrestor

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ECIS: Electrical Distribution System

Qty	Description	Identification
	DVMTT255 with remote indicator panel & remote signalling contacts connected to the SCADA: Plus	
1	Supply and installation of Hach Dual Digital Controller C/W Modbus Protocol to Suit LDO Sensors complete with Modbus RS232 communication: Plus	Controller
All	The Contractor to supply self-cleaning compressor system to maintain and clean dissolved oxygen (DO) probes in a process environment. The system must automatically remove buildup and contaminants on the probe surface to ensure accurate measurements and reduce manual maintenance.	
All	Pipe connections to pipe line and coordination with mechanical contractor to allow all pipe connections: Plus	Mechanical Contractor coordination
1	Supply and install DO sensors at reactor DO metering positions as indicated on drawings. Both DO meters shall be connected to the above controller shall be equal or similar to Hach with self-cleaning module mounted on grade 316 stainless steel bracket position on structure: Plus	DO sensors (external equipment)
All	Terminals and interconnecting monitoring and control wiring: Plus	Connection and monitoring
All	Signal & Data Surge protection unit suitable for the application equal or similar to Blitzductor XT from DEHNguard.	Signal & Data Surge Protection

END OF SECTION

PS EG&M GENERAL AND MISCELLANEOUS

PS EG&M-3 Emergency Stop Push Buttons and Weatherproof Isolators

Grade 316 stainless steel pedestal mounted emergency stop stations shall be provided at all motor installations as specified.

Emergency stop pedestals at submersible pump sets shall be installed on a wider than normal grade 316 stainless steel emergency stop pedestal that will house the motor cable terminations as specified in the Particular Specification.

PS EG&M-8 Notices And Danger Plates

This specification deals with the provision of Notices and Danger Plates and signage as required in terms of the Occupational Health and Safety Act No. 85 of 1993, as well as any other notices that may be required by law or by the nature of the finished Works.

All building signage on equipment's shall be covered under this contract, it is the Contractor responsibility to familiarize himself with applicable standards referred in particular specification and supply all necessary signage.

PS EG&M-8.2 Materials And Finish

Outdoor signs shall be either of vitreous enameled type or of cast aluminum with raised or embossed letters.

The colours and sizes of letters and colours of background shall be in accordance with requirements of SANS 0140 and as approved by the Engineer.

Symbolic signs shall conform to the requirements of SANS 1186.

The following building names shall be added under the Notices and Danger Plates:

- Inlet Works (2 signs)
- Gravity Thickener (2 signs)
- Main MCC Container (2 signs per number)
- Digester No.1 – No.2 (4 signs overall [2 signs for each module])
- Office Building (2 Signs)
- Ablution Building (2 Signs)
- Package Plant (2 signs)
- Sludge and Supernatant (2 Signs)
- Primary Sedimentation Tank No.1 – No.2 (2 signs per number)
- Secondary Sedimentation Tank No.1 – No.3 (2 signs per number)
- Aeration Tank (2 signs per number)
- Anoxic Tank (2 signs per number)
- Biofilter Recycle Pump station (2 signs per number)
- Ras Pump station (2 Signs)
- Was Pump Station (2 Signs)
- Chlorine Room (2 Signs)
- Chlorine Contact Tank (2 signs per number)
- Biofilter No.1 (2 signs per number)

PS EG&M-9 Fire Extinguishers

5kg CO2 and powder fire extinguishers shall be supplied and installed in all pump stations and treatment plant buildings in accordance with the requirements of the Local Authority. Each fire extinguisher shall have extinguisher cabinet, mounting bracket, tags, seals, inspection label, tags, and double sided signage above the extinguisher.

The following locations shall be fitted with fire extinguishers:

- Main MCC (2 Unit per number, mounted next to substation)
- MCC No.2 (2 Unit per number, mounted next to MCC)
- MCC No.3 (2 Unit per number, mounted next to MCC)
- Office Building (1 Unit per number, mounted next to DB)

END OF SECTION

PS ESLS SITE LIGHTING

PS ESLS-1 SCOPE

This specification, read together with the applicable Particular Specifications included under section C3.4.2.2 covers the performance specifications, design parameters, manufacture, supply and delivery to site, installation, testing, adjustment and commissioning of the site lighting to be provided under this Contract.

PS ESLS-2 15m HIGH MASTS

Supply and install Three (x6) 15m high scissor mast as indicated on the site layout drawing, complete with mast foundation and earthing system, final positions will be determined on site by the engineer or his representative. Provide three (x4) LED type M on top of each mast.

Type: M	135W Neutral White LED Floodlight. The luminaire consists of an LED engine, power supply and spigot compartment. It shall be secured by stainless steel latches and an access screw. The LED engine, consisting of the LED light source and the power supply, shall be easily replaceable. Both compartments are rated IP66. Electronic temperature monitoring prevents overheating of LEDs and power supply, positioned directly next to LEDs. The luminaire housing shall be manufactured of marine-grade aluminum. Equal or similar to Omistar from Beka.

END OF SECTION

PS ESGS STANDBY GENERATOR

PS ESGS-1 SCOPE

This specification is read together with the applicable Particular Specifications. The performance specifications, design parameters, manufacture, supply and delivery to site, installation, testing, adjustment and commissioning of the generator are to be provided under this Contract.

All components shall correspond with the preferred manufacturer.

Scope and Equipment shall be as follows:

Controller	–	Yes, equal or similar to Deepsea
Change over shall include	–	Voltage, frequency, undervoltage, phase rotation relay with a timer shall be per the specifications.
AMF & Change Over	–	Motorized Breakers only.
AMF & Change Over panel	–	Shall be built by the MCC manufacturer at the same standard Motor Control Centre particular Specification.
AMF & Changeover	–	Yes, shall build with same equipment as the motor control centre panel builders equipment.
Additional Diesel Storage	–	Yes, 1000 liters fitted separate Tank. The Rates will include commissioning and provision of sufficient Diesel to run the Generator and not stop for 54 Hours .
Exhaust	–	Yes, the exhaust will be extended outside the container, positioned to avoid blowing toward the pump station building, and will be manufactured from 3CR12.

The Programmable Logic Controller (PLC) shall be provided by the contractor responsible for the overall site layout. This ensures that all equipment is sourced from the same manufacturer, maintaining consistency and compatibility across the system. The specific programmer for the PLC has been outlined in the PLC section of the contract.

The generator's PLC and Human-Machine Interface (HMI) shall be programmed with a timer function in manual mode. This feature will allow operators to set the generator start time based on the Eskom load shedding schedule. By pre-starting the generator before the load shedding begins, the plant can continue to operate smoothly without interruption.

Once the timer is set, the generator will automatically start and switch over to generator power, maintaining the plant's operation until Eskom power is restored. Upon restoration of Eskom power, the system will automatically switch back to Eskom supply, ensuring a seamless transition and protecting the equipment from potential damage during shutdown and startup sequences.

The following functions will be programmed by the designated programmer:

- Controlled Stop of All Motors: Ensuring that all running motors are stopped in a controlled manner to prevent damage.
- Controlled Stop of All Processes: Gradually stopping all processes to avoid abrupt shutdowns and potential issues.

- Controlled Start Sequence of the Plant: The contractor shall detail the start-up sequence for the plant and submit it for approval. This sequence will be crucial for ensuring the plant starts up efficiently and safely.
- Sequence Upon Eskom Power Restoration: The same controlled start sequence will be performed once Eskom power is restored, ensuring a smooth transition back to the primary power source.

All of the starting and stopping of the entire plant and programming shall be sent for the Engineer for approval.

PSESGS-3 GENERATOR DETAILS

The contractor shall make sure that the space provided for the generator and plinth dimensions are sufficient for the generator offered under this contract, all the generators shall be outdoor type and housed within a container.

An automatic mains failure and change over system shall be provided for and the generator set shall be housed within an container [See Drawings]. All electrical equipment associated with starting and stopping of the set, protection of the set, indications and starting battery charger shall be provided.

Weatherproof Purpose Modified standard ISO container [See drawings], enclosing the generating set completely with its Control Panel, Switch Gear and a Weatherproof Purpose Modified standard ISO container for Fuel Tank. Suitably treated, painted and bolted to the duplex base frame and mounted on concrete plinth.

Suitable openings are provided for fresh air inlet, hot air outlet, all manufactured from steel and screened with wire mesh to prevent the ingress of birds and rodents.

Lockable-hinged doors are provided on both sides fitted with container door camlocks for access to the generating set, the control panel, connection arrangements and service parts.

The size has been determined and the Generator shall be as follows:

Containerized Standby Generator Size	–	1 x 500kVA Generator
Containerized Bulk Fuel Tank	–	1 x 10 00 liter
Primary Voltage	–	400V

PSESGS-7.2 COMPOSITION OF THE STANDBY GENERATOR SYSTEM

Containers for generator

The shelter is a standard ISO Sea Freight container per ISO 1496 and must be converted for the explicit use of housing a diesel generator set for the proper operating conditions of the equipment. The shelter shall be sealed to resist water ingress to IP54.

The exterior envelope size of the container:

Generator

Height	Length	Width
2.7m	6m	2.35m [Estimated refer to supplier]

The interior envelope size of the shelter equipment compartment shall be derived from sufficient insulation thickness to provide a minimum insulating factor of R10 or better.

Wall sections: All wall sections must meet an insulation factor of R10 or better and adhere to ISO 1496-1. Interior walls shall be insulated with suitable material (minimum 50mm thickness) and cover with sonic liner.

Floor: The floor section shall consist of standard ISO flooring. Cover with a commercial grade aluminum plates or equivalent material with easy to clean properties.

Roof: The roof shall have an anti-skid surface; Ceiling must meet an insulation factor of R10 or better.

Generator Access

The generator must be accessible for maintenance from two doors on either side of the container.

Generator Ventilation

The generator requires ventilation to the outside of the container for intake, exhaust and hot air dissipation. Install to suit equipment. The generator ventilation system is to be designed for a maximum rise in temperature of 10°C over the ambient temperature.

Equipment Cutouts

Cutouts for cable feeders, generator air intake and outlet, and exhaust cut-outs will be required. Also, generator supply line feed through is required through the bulkhead. Sizes and locations to suit equipment install.

Exterior Finish

All exterior surfaces including walls, roof, doors, under belly and exposed hardware require a rust inhibitive paint, beige or desert sand in colour. Sign writing or logo application for external finish is N/A.

Roof Canopy

The Contractor shall allow for roof canopy to cover the container. Beams and purlins sizes to be determined based on structural calculations for the required span, loading conditions, and roof design. The beams shall be painted with a corrosion-resistant coating for sea level, especially in coastal or high-humidity environments and shall be same colour as the container. Chromadek Roof Sheeting with thickness of 0.5mm shall be used. Chromadek coating in accordance with SANS 1274 with a primer coat, intermediate coat, and topcoat. The standard Chromadek coating is polyester-based with UV resistance and comes in a range of colours.

PSESGS-8 GENERATOR SIGNALS

The following additional equipment shall be available in order to monitor the following items from the Generator, however it not only limited to the below referenced items.

The Contractor shall allow for all items to be displayed on the HMI:

Generator healthy
Generator trip
Generator run/stop
Generator E-Stop

Generator bulk fuel tank level Analogue Monitor / Alarm / Trip
Generator Engine and Alternator temperature
Generator Engine and Alternator temperature Trip / Alarm
Generator Engine water level Alarm / Trip
Generator Engine Oil Level Alarm / Trip
Generator Alternator Charging Operational
Generator Engine Temperature
Generator Normal/Fail
Generator Low Battery
Generator DC voltage below 12 Volt
Generator Low Oil level
Generator Overload
Generator circulation Pump Run / Stop / Healthy Statuses
All Generator information shall be displayed on HMI in Main MCC
Power Analyzer values to be captured in PLC and displayed on plant and HMI and distributed through plant and linked to other power analyzers– Apparent Power, Power, Reactive Power, line and phase Voltages, Line and phase Currents, Power Factor, all billing information.

END OF SECTION

PS ESPL ELECTRICAL INSTALLATION IN BUILDINGS AND ON STRUCTURES

PS ESPL-1 SCOPE

The scope for the distribution board sections shall include everything to provide a complete small power distribution and lighting system. The design of the distribution board will allow for single and three phase supplies to equipment on site.

PS ESPL-4 LIGHT FITTINGS

Note: All luminaires must be approved by the Engineers representative prior to the installation of or any order being placed. Only light fittings as well as all light fitting components carrying the SABS mark of approval will be acceptable. All fluorescent light fittings shall be equipped with electronic control gear.

The contractor submission process mandates that each of the skilled labourers and the contractor undergo comprehensive training to acquire certification in the precise installation procedures outlined in the contract documents. As an integral component of the technical submission, the contractor is obligated to verify that all personnel have successfully completed courses at the supplier's premises, thereby gaining the necessary experience and knowledge to proficiently install and commission all luminaires as specified in the agreement.

A critical facet of this commitment is for the contractor to maintain a meticulous record, detailing the individuals responsible for the installation, along with the specific dates and locations where each luminaire was installed. Quality control measures are imperative to ensure that the designated personnel assume accountability for the luminaires they have installed, thereby upholding the standards outlined in the contract. This comprehensive approach not only guarantees the adherence to installation specifications but also underscores the contractor's commitment to excellence in executing the project. The Contractor shall ensure that the ingress protection of the proposed fittings is not compromised under any circumstances as part of his installation. CCG or Pratley equipment, SABS-certified, shall be used to maintain full compliance with the specifications and proposed equipment. All IP-rated fittings shall come with a minimum of 1.5 meters of double-insulated silicone cable pre-installed by the manufacturer.

Type A	:	55W LED enclosed dust, moisture, vandal and corrosion proof luminaire. The luminaire shall consist of a high-pressure die-cast marine grade aluminium body with a robust clear polycarbonate diffuser and shall be designed to operate 55W LED's lamps. Equal or similar to Roughguard from Beka
Type B	:	55W LED enclosed dust, moisture, vandal and corrosion proof luminaire. The luminaire shall consist of a high-pressure die-cast marine grade aluminium body with a robust clear polycarbonate diffuser and shall be designed to operate 55W LED's lamps. Equal or similar to Roughguard from Beka plus 1hour EMG maintained (emergency).
Type C	:	27W fluorescent enclosed dust, moisture, vandal and corrosion proof Zone 2 luminaire. The luminaire shall consist of an Injection-moulded, flame retardant polycarbonate with a robust clear polycarbonate diffuser and shall be designed to operate LED's of up to 65W, and fluorescent lamps up to 80W. Equal or similar to Vapourline from Beka.

Type D	:	27W fluorescent enclosed dust, moisture, vandal and corrosion proof <u>Zone 2</u> luminaire. The luminaire shall consist of an Injection-moulded, flame retardant polycarbonate with a robust clear polycarbonate diffuser and shall be designed to operate LED's of up to 65W, and fluorescent lamps up to 80W. Equal or similar to Vapourline from Beka plus 1hour EMG maintained (emergency).
Type E	:	55W LED enclosed dust, moisture, vandal and corrosion proof luminaire. The luminaire shall consist of a high-pressure die-cast marine grade aluminium body with a robust clear polycarbonate diffuser and shall be designed to operate 55W LED's lamps. Equal or similar to Roughguard from Beka.
Type F	:	55W LED enclosed dust, moisture, vandal and corrosion proof luminaire. The luminaire shall consist of a high-pressure die-cast marine grade aluminium body with a robust clear polycarbonate diffuser and shall be designed to operate 55W LED's lamps. Equal or similar to Roughguard from Beka plus 1hour EMG maintained (emergency).
Type G	:	18W LED Bulkhead warm white enclosed dust, moisture, vandal and corrosion proof luminaire. The luminaire shall consist of a high-pressure die-cast marine grade aluminium body with a robust clear polycarbonate diffuser and shall be designed to operate 18W LED's lamps. Equal or similar to Bekabulk from Beka.
Type H	:	18W LED Bulkhead warm white enclosed dust, moisture, vandal and corrosion proof luminaire. The luminaire shall consist of a high-pressure die-cast marine grade aluminium body with a robust clear polycarbonate diffuser and shall be designed to operate 18W LED's lamps. Equal or similar to Bekabulk from Beka plus 1hour EMG maintained (emergency).
Type I	:	19W LED Bulkhead warm white enclosed dust, moisture, vandal and corrosion proof luminaire. The luminaire shall consist of a high-pressure die-cast marine grade aluminium body with a robust clear polycarbonate diffuser and shall be designed to operate 19W LED's lamps. Equal or similar to Roughguard Beka.
Type J	:	19W LED Bulkhead warm white enclosed dust, moisture, vandal and corrosion proof luminaire. The luminaire shall consist of a high-pressure die-cast marine grade aluminium body with a robust clear polycarbonate diffuser and shall be designed to operate 19W LED's lamps. Equal or similar to Roughguard Beka plus 1hour EMG maintained (emergency).
Type K	:	100W HPS Street Light robustly constructed, weatherproof, hailproof, corrosion proof and vandal resistant luminaire. The luminaire gear compartment shall be manufactured from high-pressure die-cast aluminium to ensure excellent heat dissipation and optimum strength. It shall be covered by a hinged non-corrosive lid which allows access to the control gear and spigot mounting. The luminaire shall be designed designed to operate 250/400 Watt mercury vapour and 150/250/400 Watt high-pressure sodium lamps. Equal or similar to Bekasun from Beka.
Type L	:	135W Neutral White LED Floodlight. The luminaire consists of an LED engine, power supply and spigot compartment. It shall be secured by stainless steel latches and an access screw. The LED engine, consisting of the LED light source and the power supply, shall be easily replaceable. Both compartments are rated IP66. Electronic temperature monitoring prevents overheating of LEDs and power supply, positioned directly next to LEDs. The luminaire housing shall be manufactured of marine grade aluminium. Equal or similar to Omistar from Beka.

Type M	:	135W Neutral White LED Floodlight. The luminaire consists of an LED engine, power supply and spigot compartment. It shall be secured by stainless steel latches and an access screw. The LED engine, consisting of the LED light source and the power supply, shall be easily replaceable. Both compartments are rated IP66. Electronic temperature monitoring prevents overheating of LEDs and power supply, positioned directly next to LEDs. The luminaire housing shall be manufactured of marine grade aluminium. Equal or similar to Omistar from Beka.
Type N	:	52W LEDNOVA Zone 2 Surface Mounted luminaire. IP 66 rating is supported by a certified SABS test report. Equal or similar to Lednova from Beka
Type O	:	52W LEDNOVA Zone 2 Surface Mounted luminaire. IP 66 rating is supported by a certified SABS test report. Equal or similar to Lednova from Beka plus 1hour EMG maintained (emergency).

PS ESPL-A MCC Building

PS ESPL-A.1 Light Switches

Number	Description	Location
S1-S2	16Amp surface mounted light switch with a digital timer and programmable timer to switch of luminaires after predetermined time minimum IP65.	1.35m above final floor level

PS ESPL-A.2 Socket Outlets

Number	Description	Location
P1-P4	16Amp surface mounted socket outlets.	1.35m above final floor level

PS ESPL-A.3 Three Phase and Multi Pin Socket Outlets

Number	Description	Location
WP1-WP4	40Amp TP 5-pins, one for each phase, neutral and earth, equal and similar to Waco aluminium die-cast type complete with Socket top.	1.35m above final floor level

PS ESPL-A.4 Light Fittings

Light fittings shall be equal and similar to the requirements of the general technical specification as specified under.

Number	Description	Location
L1-L04	Luminaries fitted against concrete	A
L5-L08	Luminaries fitted against concrete	B
L09-L12	Luminaries fitted against concrete 2300mm AFFL	G

PS ESPL-A.5 Wall Mounted Distribution Boards (Surface Mounted Type)

Type: Outdoor wall mounted with front access, shall be as specified under particular specification PEI 4.10 & PEI 4.11 and be built from 3CR12 stainless steel.

The distribution board shall be tested as per the SANS 1973-1, SANS 1973-3, SANS 1973-8, SANS 1473-1, SANS 1765 and SANS 10142-1.

Supply: 16mm² 4core PVC SWA PVC cable plus a 10mm² bare copper earth cable from Ozone Building motor control centre.

Colour: White

Fault level: 10kA

Equipment will be the following;

Qty	Description	Identification
One	Panels comprising the following:	Incomer
1	32Amp continuous current rated TP MCCB with electronic trip: Plus	Main
4	60Amp continuous current rated copper bus bars: Plus	3 Phase + N
1	60Amp continuous current rated copper bus bar: Plus	Earth
1	Three Phase Class 2 Surge protection unit connection type 2 as per SANS 10142-1: Plus	Surge arrestor plus signals
1	63Amp SP + N earth leakage without overload protection: Plus	Earth Leakage
2	20Amp continuous current rated SP MCB: Plus	Socket Circuit
1	16Amp continuous current rated TP MCB: Plus	Area Lighting
1	25Amp continuous current rated TP Contactor: Plus	Area lighting contactor
1	5Amp continuous current rated SP MCB: Plus	Area Lighting
1	5Amp continuous current rated SP MCB: Plus	Area lighting Coil Protection
1	Time switch equal and similar Schneider electric ITA digital with 100 hour standby capacity.	Area Lighting Digital Timer Switch
2	10Amp continuous current rated SP MCB: Plus	Internal Lighting

PSESPL-B Main MCC Container Building

PSESPL-B.1 Light Switches

Number	Description	Location
S1 – S4	One lever 16Amp 2-way surface mounted light. Manufactured from tough impact resistant thermoplastic which provides strength and durability The light switch will be housed inside weatherproof protection IP55 rated enclosure. The enclosure shall have protective membrane, which will allow the operator to comfortably operate the switch through the membrane. Equal or similar to Schneider Electric IP55 weatherproof range.	1.25m above final floor level

PSESPL-B.2 Socket Outlets

Number	Description	Location
P1-P4	20Amp surface mounted Double switch socket outlet. Manufactured from tough impact resistant thermoplastic which provides strength and durability. The switch socket	1.35m above final floor level

	outlet will be housed inside weatherproof protection IP55 rated enclosure. The enclosure shall have protective membrane, which will allow the operator to comfortably operate the switch through the membrane. Equal or similar to Schneider Electric IP55 weatherproof range.	

PSESPL-B.4 Light Fittings

Light fittings shall be equal and similar to the requirements of the general technical specification as specified under.

Number	Location	Type
L01 – L04	Luminaries fitted against concrete against structure 2300mm AFFL	A [4 lights in generator]
L05 – L08	Luminaries fitted against concrete against structure 2300mm AFFL	B [4 lights in generator]

PSESPL-B.6 Bosal Conduit

Qty	Description	Mounted
All	25mm Bosal conduit including all accessories: Plus	Surface mounted
All	25mm conduit saddles and all accessories: Plus	Surface mounted
All	Solid Coupling Galvanized & Female Threaded Adaptor Galvanized & Male Threaded Adaptor Galvanized	Surface mounted
All	Round Conduit box plus cover and all accessories	Surface mounted

PSESPL-B.7 Pratley Junction Boxes or GCC Boxes

Qty	Description	Mounted
All	Pratley Ex e/n Ezee-Fit Junction Box plus corrosion resistant cover which will suite the application.	Surface Mounted

PS ESPL-B.8 Wiring Cable

Qty	Description	Mounted
All	The Engineer will not reference all the cables. It is the responsibility of Contractor to allow for all wiring for all the equipment as specified above. Single core and multicore cable shall be 600 / 1000V SANS 1011 complaint. These cables are only a guide and Contractors must make due allowance for all cabling to complete the works in its entirety.	Surface and flush mounted

PSESPL-B. 6.2 Local Wall Mounted Distribution Board (Surface Mounted Type)

Type: Theses specification shall be considered as minimum design requirement in terms of the Contractor's Tender offer. The Electrical and Electronic Contractor(s) shall coordinate with the Civil Contractor to ensure sufficient allowance is made in their tender offer to provide a fit for purpose unit/system.

The distribution board shall be manufactured accordance to Particular Specification. The equipment referenced below does not relieve the contractor of his responsibilities in terms of quality, dimensions and proper functioning of the system.

The motor control centre board or distribution board shall be of the surface mounted type with a minimum IP rating of 42 (insect proofed enclosure). The motor control centre or distribution board shall be constructed with a minimum of 2mm 3CR12 stainless steel and shall be bolted into position by means of M16 high tensile stainless-steel bolts grouted into the wall, the bolts shall be inside the board.

The panel door shall be provided with a locking system suitable for padlocking. The locking system shall consist of a 3CR12 stainless steel 3-way locking mechanism locking the door at the top, middle and bottom. The unit doors shall be capable of being opened at least 110 degrees.

The board shall be provided with readily removable, sectionalized, rigidly supported unpainted 316 cable end support gland plates along the entire length of the board.

Sufficient provision for ventilation and heat dissipation as per the equipment ratings and manufacturers requirements shall be allowed for. Screwed-on engraved labels in English shall be provided below all switchgear and equipment on and in the panels, to facilitate identification. All unpainted parts shall be plated for corrosion resistance.

Supply Normal: 35mm² 4C Cu PVC SWA PVC cable plus 25mm² Bear Copper Earth Cable from the Main MCC.

Colour: Painted Light Orange – B26 (SANS 1091:2012) external, White arc-free internal (see Painting and Finishing).

Fault Level: 6kA [20kA Main MCC] – Cascading Distribution Breakers shall be added in MCC to reduce at DB to 6kA.

Sectioning: Multi-section, Form 3b or Form 4 to SANS IEC 60439.

Future: 5% for future extensions space.

Cable Entry: Incoming and Outgoing – Top and Bottom 3CR12 Unpainted.

Qty	Description	Identification
One	Panels comprising the following [Orange]	Incomer
1	32Amp continuous current rated TP (triple pole) MCCB circuit breaker complete sufficient auxiliary contacts to monitor if open or closed position. Equal or similar to Schneider Electric: Plus	Main Circuit Breaker
4	60Amp tint copper bus bars [appearance shall be aluminium], suitable clamps shall be used, and no drilling shall be allowed on the busbars [cubic system shall be used]: Plus	3 Phase + N
1	60Amp tint copper bus bars [appearance shall be aluminium], suitable clamps shall be used, and no drilling shall be allowed on the busbars [cubic system shall be used]: Plus	Earth

Contract No: UGU-07-1689-2025 - Umzinto Wastewater Treatment Works & Outfall Sewers Upgrade and Rehabilitation
Phase 2A - Upgrade and Extension of the Umzinto Wastewater Treatment Works From 2.5 MI to 4.0 MI
Construction and Commissioning of Civil - Mechanical and Electrical Works
Portion 4: Particular Specifications
Section C3.3.3 Detailed Specifications for Electrical Works
ESPL: Electrical Installation in Buildings and on Structures

Qty	Description	Identification
4	125Amp continuous current rated HRC fuse holders and fused links: Plus	Surge arrestors connection fuses
1	Three Phase Class 2 surge arrestor unit connection type 2 as per SANS 10142-1: Plus	Surge arrestor plus signals
3	Robust LED indicator lamps connected load side of the circuit breaker.	Indicators for 3 Phase (Red, White and Blue Indications)
1	Relay for under voltages, phase sequence, and phase loss in three phases: Plus	Protection relay
One	Panels comprising the following [Orange]	Distribution Section
1	63Amp SP + N earth leakage without overload protection: Plus	Earth Leakage for each phase [one for each phase]
2	20Amp continuous current rated SP MCB: Plus	Socket Circuits
1	63Amp TP + N earth leakage with overload protection: Plus	Earth Leakage for welding socket [one for each phase]
2	10Amp continuous current rated SP MCB: Plus	Lighting Circuit allowances
1	16Amp continuous current rated TP MCB: Plus	Electrocutor Circuit
1	25Amp continuous current rated TP Type2 Coordinated Contactor: Plus	Electrocutor Circuit contactor, type 2 coordination
1	6Amp continuous current rated SP MCB: Plus	Electrocutor Circuit
1	6Amp continuous current rated SP MCB: Plus	Electrocutor Circuit Coil Protection

Qty	Description	Identification
1	Time switch equal and similar Schneider electric ITA digital with 100 hour standby capacity: Plus	Electrocutor Circuit Digital Timer Switch
3	10Amp continuous current rated SP MCB: Plus	Electrocutor Circuits
1	20Amp continuous current rated SP + N MCB: Plus	Access Control Feeder
2	20Amp continuous current rated SP + N MCB: Plus	HVAC Feeder

PS ESPL-A.7 Air conditioner No.1 – No.2 (Surface Mounted Type)

Type: Allow for two inverter type wall-mount Aircon units with Fast Cooling, 18,000 BTU/h for Motor control centre room as per specification.

ESPL-C Supernatant Building

PS ESPL-C.1 Light Switches

Number	Description	Location
S1-S2	16Amp surface mounted light switch with a digital timer and programmable timer to switch of luminaires after predetermined time minimum IP65.	1.35m above final floor level

PS ESPL-C.2 Socket Outlets

Number	Description	Location
P1-P4	16Amp surface mounted socket outlets.	1.35m above final floor level

PS ESPL-C.3 Three Phase and Multi Pin Socket Outlets

Number	Description	Location
WP1	40Amp TP 5-pins, one for each phase, neutral and earth, equal and similar to Waco aluminium die-cast type complete with Socket top.	1.35m above final floor level

PS ESPL-C.4 Light Fittings

Light fittings shall be equal and similar to the requirements of the general technical specification as specified under.

Number	Location	Type
L1-L04	Luminaries fitted against concrete	A
L5-L08	Luminaries fitted against concrete	B
L09-L12	Luminaries fitted against concrete 2300mm AFFL	G

PS ESPL-C.5 Wall Mounted Distribution Boards (Surface Mounted Type)

Type: Outdoor wall mounted with front access, shall be as specified under particular specification PEI 4.10 & PEI 4.11 and be built from 3CR12 stainless steel.

The distribution board shall be tested as per the SANS 1973-1, SANS 1973-3, SANS 1973-8, SANS 1473-1, SANS 1765 and SANS 10142-1.

Supply: 16mm² 4core PVC SWA PVC cable plus a 10mm² bare copper earth cable from Ozone Building motor control centre.

Colour: White

Fault level: 10kA

Equipment will be the following;

Qty	Description	Identification
One	Panels comprising the following:	Incomer
1	40Amp continuous current rated TP MCCB with electronic trip: Plus	Main
4	60Amp continuous current rated copper bus bars: Plus	3 Phase + N
1	60Amp continuous current rated copper bus bar: Plus	Earth
1	Three Phase Class 2 Surge protection unit connection type 2: Plus	Surge arrestor plus signals
2	63Amp SP + N earth leakage without overload protection: Plus	Earth Leakage
3	20Amp continuous current rated SP MCB: Plus	Socket Circuit
1	20Amp continuous current rated TP MCB: Plus	Area Lighting
1	32Amp continuous current rated TP Contactor: Plus	Area lighting contactor
1	5Amp continuous current rated SP MCB: Plus	Area Lighting
1	5Amp continuous current rated SP MCB: Plus	Area lighting Coil Protection
1	Time switch equal and similar Schneider electric ITA digital with 100 hour standby capacity.	Area Lighting Digital Timer Switch

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Portion 4: Particular Specifications
Section C3.3.3 Detailed Specifications for Electrical Works
ESPL: Electrical Installation in Buildings and on Structures

Qty	Description	Identification
1	16Amp continuous current rated TP MCB: Plus	Internal Lighting
1	25Amp continuous current rated TP Contactor: Plus	Internal Lighting contactor
1	5Amp continuous current rated SP MCB: Plus	Internal Lighting
1	5Amp continuous current rated SP MCB: Plus	Internal Lighting Coil Protection
1	16Amp continuous current rated SP MCB: Plus	Internal Lighting which is controlled from light switch timer
1	10Amp continuous current rated SP MCB: Plus	Internal Lighting

PSESPL-D Chlorine Building

PSESPL-D.1 Light Switches

Number	Description	Location
S1 – S2	One lever 16Amp 2-way surface mounted light. Manufactured from tough impact resistant thermoplastic which provides strength and durability. The light switch will be housed inside weatherproof protection IP55 rated enclosure. The enclosure shall have protective membrane, which will allow the operator to comfortably operate the switch through the membrane. Equal or similar to Schneider Electric IP55 weatherproof range.	1.25m above final floor level

PSESPL-D.2 Socket Outlets

NUMBER	Description	Location
P1-P4	20Amp surface mounted Double switch socket outlet. Manufactured from tough impact resistant thermoplastic which provides strength and durability. The switch socket outlet will be housed inside weatherproof protection IP55 rated enclosure. The enclosure shall have protective membrane, which will allow the operator to comfortably operate the switch through the membrane. Equal or similar to Schneider Electric IP55 weatherproof range.	1.35m above final floor level

PSESPL-D.4 Light Fittings

Light fittings shall be equal and similar to the requirements of the general technical specification as specified under.

Number	Location	Type
L01 – L04	Luminaries fitted against concrete against structure 2300mm AFFL	A
L05 – L08	Luminaries fitted against concrete against structure 2300mm AFFL	B
L09-L12	Luminaries fitted against concrete 2300mm AFFL	G

PSESPL-D.6 Bosal Conduit

Qty	Description	Mounted
All	25mm Bosal conduit including all accessories: Plus	Surface mounted
All	25mm conduit saddles and all accessories: Plus	Surface mounted
All	Solid Coupling Galvanized & Female Threaded Adaptor Galvanized & Male Threaded Adaptor Galvanized	Surface mounted
All	Round Conduit box plus cover and all accessories	Surface mounted

PSESPL-D.7 Pratley Junction Boxes or GCC Boxes

Qty	Description	Mounted
All	Pratley Ex e/n Ezee-Fit Junction Box plus corrosion resistant cover which will suite the application.	Surface Mounted

PS ESPL-D.8 Wiring Cable

Qty	Description	Mounted
All	The Engineer will not reference all the cables. It is the responsibility of Contractor to allow for all wiring for all the equipment as specified above. Single core and multicore cable shall be 600 / 1000V SANS 1011 complaint. These cables are only a guide and Contractors must make due allowance for all cabling to complete the works in its entirety.	Surface and flush mounted

PSESPL-D. 6.2 Local Wall Mounted Distribution Board (Surface Mounted Type)

Type: Theses specification shall be considered as minimum design requirement in terms of the Contractor's Tender offer. The Electrical and Electronic Contractor(s) shall coordinate with the Civil Contractor to ensure sufficient allowance is made in their tender offer to provide a fit for purpose unit/system.

The distribution board shall be manufactured accordance to Particular Specification. The equipment referenced below does not relieve the contractor of his responsibilities in terms of quality, dimensions and proper functioning of the system.

The motor control centre board or distribution board shall be of the surface mounted type with a minimum IP rating of 42 (insect proofed enclosure). The motor control centre or distribution board shall be constructed with a minimum of 2mm 3CR12 stainless steel and shall be bolted into position by means of M16 high tensile stainless-steel bolts grouted into the wall, the bolts shall be inside the board.

The panel door shall be provided with a locking system suitable for padlocking. The locking system shall consist of a 3CR12 stainless steel 3-way locking mechanism locking the door at the top, middle and bottom. The unit doors shall be capable of being opened at least 110 degrees.

The board shall be provided with readily removable, sectionalized, rigidly supported unpainted 316 cable end support gland plates along the entire length of the board.

Sufficient provision for ventilation and heat dissipation as per the equipment ratings and manufacturers requirements shall be allowed for. Screwed-on engraved labels in English shall be provided below all switchgear and equipment on and in the panels, to facilitate identification. All unpainted parts shall be plated for corrosion resistance.

Supply Normal: 16mm² 4C Cu PVC SWA PVC cable plus 10mm² Bear Copper Earth Cable from the Main MCC.

Colour: Painted Light Orange – B26 (SANS 1091:2012) external, White arc-free internal (see Painting and Finishing).

Fault Level: 6kA [20kA Main MCC] – Cascading Distribution Breakers shall be added in MCC to reduce at DB to 6kA.
Sectioning: Multi-section, Form 3b or Form 4 to SANS IEC 60439.
Future: 5% for future extensions space.
Cable Entry: Incoming and Outgoing – Top and Bottom 3CR12 Unpainted.

Qty	Description	Identification
One	Panels comprising the following [Orange]	Incomer
1	32Amp continuous current rated TP (triple pole) MCCB circuit breaker complete sufficient auxiliary contacts to monitor if open or closed position. Equal or similar to Schneider Electric: Plus	Main Circuit Breaker
4	60Amp tint copper bus bars [appearance shall be aluminium], suitable clamps shall be used, and no drilling shall be allowed on the busbars [cubic system shall be used]: Plus	3 Phase + N
1	60Amp tint copper bus bars [appearance shall be aluminium], suitable clamps shall be used, and no drilling shall be allowed on the busbars [cubic system shall be used]: Plus	Earth
4	125Amp continuous current rated HRC fuse holders and fused links: Plus	Surge arrestors connection fuses
1	Three Phase Class 2 surge arrestor unit connection type 2 as per SANS 10142-1: Plus	Surge arrestor plus signals
3	Robust LED indicator lamps connected load side of the circuit breaker.	Indicators for 3 Phase (Red, White and Blue Indications)
1	Relay for under voltages, phase sequence, and phase loss in three phases Plus	Protection relay
One	Panels comprising the following [Orange]	Distribution Section
1	63Amp SP + N earth leakage without overload protection: Plus	Earth Leakage for each phase [one for each phase]
2	20Amp continuous current rated SP MCB: Plus	Socket Circuits

Qty	Description	Identification
1	63Amp TP + N earth leakage with overload protection: Plus	Earth Leakage for welding socket [one for each phase]
2	10Amp continuous current rated SP MCB: Plus	Lighting Circuit allowances
1	16Amp continuous current rated TP MCB: Plus	Electrocutor Circuit
1	25Amp continuous current rated TP Type2 Coordinated Contactor: Plus	Electrocutor Circuit contactor, type 2 coordination
1	6Amp continuous current rated SP MCB: Plus	Electrocutor Circuit
1	6Amp continuous current rated SP MCB: Plus	Electrocutor Circuit Coil Protection
1	Time switch equal and similar Schneider electric ITA digital with 100 hour standby capacity: Plus	Electrocutor Circuit Digital Timer Switch
3	10Amp continuous current rated SP MCB: Plus	Electrocutor Circuits
1	20Amp continuous current rated SP + N MCB: Plus	Access Control Feeder
2	20Amp continuous current rated SP + N MCB: Plus	HVAC Feeder

END OF SECTION

PS EMCA MULTICORE CABLES AND EARTHWIRES

PS EMCA-1 Scope

Schedules of cables associated with sections of works are listed below under the relevant sections.

1. All earth wires shall be bare copper conductors, unless otherwise specified and cables shall be of the type as specified.
2. These cables are only a guide and Contractors must make due allowance for all cabling to complete the works in its entirety.
3. Before ordering cables the contractor shall obtain the correct cable lengths by measuring required cable lengths on site.

PS EMCA-8 Cable Trays And Cable Ladders

All cable trays and cable ladders shall be stainless steel **304** type. Cable trays will only be acceptable for cable supports where small cables are involved.

Vertically installed cable ladders shall be used for floor mounted cable support purposes.

PS EMCA-9 Installation Of Cables

It is the responsibility of the contractor, as a design and build contract, to ensure the correct supply and signal cabling is specified and utilized for the relevant electrical and electronic equipment.

In order to support the cable sections, the following information and documentation should be supplied before project implementation;

1. Equipment schedules (motor, valves, etc.);
2. Instrumentation list,
3. Motor List ,
4. Cable Schedule;
5. Actuator and valve list;

END OF SECTION

PB1 LABOUR INTENSIVE COMPETENCIES OF SUPERVISORY AND MANAGEMENT STAFF

Contractors shall only engage supervisory and management staff in labour intensive works who have completed the skills programme outlined in Table 1.

Personnel	NQF Level	Unit Standard Titles	Skills Programme description
Foreman / Supervisor	4	Implement Labour Intensive Construction Systems and Techniques	This unit standard must be completed; and
		Use Labour Intensive Construction Methods to Construct and Maintain Drainage	Any one of these 3 unit standards
		Use Labour Intensive Construction Methods to Construct and Maintain Water and Sanitation Services	
		Use Labour Intensive Construction Methods to Construct, Repair and Maintain Structures	
Site Agent / Manager (i.e. the most senior representative that is resident on the site)	5	Manage Labour Intensive Construction Processes	Skills programme against this single unit standard

PB2 EMPLOYMENT OF UNSKILLED AND SEMI-SKILLED WORKERS IN LABOUR-INTENSIVE WORKS

PB2.1 Requirements for the sourcing and engagement of Labour

PB2.1.1 Unskilled and semi-skilled labour required for the execution of all labour intensive works shall be engaged strictly in accordance with prevailing legislation in accordance with the Code of Good Practice for the Expanded Public Works Programme.

- a) the average worker completes 5 tasks per week in 40 hours or less; and
- b) the weakest worker completes 5 tasks per week in 55 hours or less.

PB2.1.2 The contractor must revise the time taken to complete a task whenever it is established that the time taken to complete a weekly task is not within the requirements of PB2.1.3.

PB2.1.3 The Contractor shall, through all available community structures, inform the local community of the labour intensive works and the employment opportunities presented thereby. Preference must be given to people with previous practical experience in construction and / or who come from households:

- a) where the head of the household has less than a primary school education;
- b) that have less than one full time person earning an income;
- c) where subsistence agriculture is the source of income.
- d) those who are not in receipt of any social security pension income

PB2.1.4 The Contractor shall endeavour to ensure that the expenditure on the employment of temporary workers is in the following proportions:

- a) 55 % women;
- b) 40% youth who are between the ages of 16 to 35; and
- c) 2% on persons with disabilities.

PB3 SPECIFIC PROVISIONS PERTAINING TO SANS 1914-5

PB3.1 Definitions

Targeted labour: Unemployed persons employed as local labour on the project.

PB3.2 Contract participation goals

PB3.2.1 The contract participation goal is as prescribed in the conditions and shall be measured in the performance of the contract to enable the employment provided to targeted labour to be quantified.

PB3.2.2 The wages and allowances used to calculate the contract participation goal shall, with respect to both time-rated and task rated workers, comprise all wages paid and any training allowance paid in respect of agreed training programmes.

PB3.3 Terms and conditions for the engagement of targeted labour

Further to the provisions of Sub-Clause 3.3.2 of SANS 1914-5, written contracts shall be entered into with targeted labour.

PB3.4 Variations to SANS 1914-5

PB3.4.1 The definition for net amount shall be amended as follows:

Financial value of the contract upon completion, exclusive of any value added tax or sales tax which the law requires the employer to pay the contractor.

PB3.4.2 The schedule referred to in 5.2 shall in addition reflect the status of targeted labour as women, youth and persons with disabilities and the number of days of formal training provided to targeted labour.

PB3.5 Training of targeted labour

PB3.5.1 The contractor shall provide all the necessary on-the-job training to targeted labour to enable such labour to master the basic work techniques required to undertake the work in accordance with the requirements of the contract in a manner that does not compromise worker health and safety.

PB3.5.2 Accredited training may be provided before the commencement of a project.

PB3.5.3 The cost of accredited training of targeted labour will be funded through various funding sources such as National Skills Fund from the Department of Higher Education and Training, funds from the Implementing Public body, funding from SETAS etc. This training should take place as close to the project site as practically possible. The Public Body implementing the project must ensure that training applications for beneficiaries are made by its relevant project manager assisted by relevant training officials from the National Department of Public Works.

PB3.5.4 The Public Body must ensure that preference for the training of beneficiaries in technical skills over life skills is made. In addition, the public body is required to maximise opportunities for training to beneficiaries before the implementation of projects.

PB3.5.5 The Public Body must ensure that workers who have received training will be placed on the project to work after receiving the training.

PB3.5.6 If a provisional sum for training is made in the contract the contractor shall pay an allowance equal to 100% of the daily wage rate to workers who attend accredited training.

PB3.5.7 Proof of compliance with the requirements of 3.5.2 to 3.5.6 must be provided by the Contractor to the Employer prior to submission of the final payment certificate.

PB4 GENERIC LABOUR-INTENSIVE SPECIFICATION

The Generic Labour-intensive specification below is the same as SANS 1921-5, Construction and management requirement for works contracts- Part 5: Earthworks activities which are to be performed by hand and should be included in the scope of works without amendment or modification as set out below.

a) Scope

This specification establishes general requirements for activities which are to be executed by hand involving the following:

- i) trenches having a depth of less than 1.5 meters
- ii) stormwater drainage
- iii) low-volume roads and sidewalks
- iv) Concrete paving Preparation
- v) Refurbishment of existing structures

b) Precedence

Where this specification is in conflict with any other standard or specification referred to in the Scope of Works to this Contract, the requirements of this specification shall prevail.

c) Hand excavatable material

Hand excavatable material is material:

a) granular materials:

- i. whose consistency when profiled may in terms of table 1 be classified as very loose, loose, medium dense, or dense; or
- ii. where the material is a gravel having a maximum particle size of 10mm and contains no cobbles or isolated boulders, no more than 15 blows of a dynamic cone penetrometer is required to penetrate 100mm;

b) cohesive materials:

- i. whose consistency when profiled may in terms of table 1 be classified as very soft, soft, firm, stiff and stiff / very stiff; or
- ii. where the material is a gravel having a maximum particle size of 10mm and contains no cobbles or isolated boulders, no more than 8 blows of a dynamic cone penetrometer is required to penetrate 100mm;
- iii. whose consistency when profiled may in terms of Table 1 be classified as very soft, soft, firm, stiff and stiff / very stiff; or

Note:

- 1) A boulder, a cobble and gravel is material with a particle size greater than 200mm, between 60 and 200mm.
- 2) A dynamic cone penetrometer is an instrument used to measure the in-situ shear resistance of a soil comprising a drop weight of approximately 10 kg which falls through a height of 400mm and drives a cone having a maximum diameter of 20mm (cone angle of 60° with respect to the horizontal) into the material being used.

Table 1: Consistency of materials when profiled			
GRANULAR MATERIALS		COHESIVE MATERIALS	
Very loose	Crumbles very easily when scraped with a geological pick.	Very soft	Geological pick head can easily be pushed in as far as the shaft of the handle.
Loose	Small resistance to penetration by sharp end of a geological pick.	Soft	Easily dented by thumb; sharp end of a geological pick can be pushed in 30-40mm; can be moulded by fingers with some pressure.
Medium dense	Considerable resistance to penetration by sharp end of geological pick.	Firm	Indented by thumb with effort; sharp end of a geological pick can be pushed in up to 10 mm; very difficult to mould with fingers; can just be penetrated with an ordinary hand spade.
Dense	Very high resistance to penetration by the sharp end of geological pick; requires many blows for excavation.	Stiff	Can be indented by thumb-nail; slight indentation produced by pushing geological pick point into soil; cannot be moulded by fingers.
Very dense	High resistance to Repeated blows of a geological pick.	Very stiff	Indented by thumb-nail with difficulty; slight indentation produced by blow of a geological pick point.

Trench excavation:

All hand excavatable material in trenches having a depth of less than 1,5 metres shall be excavated by hand.

Compaction of backfilling to trenches (areas not subject to traffic):

Backfilling to trenches shall be placed in layers of thickness (before compaction) not exceeding 100mm. Each layer shall be compacted using hand stampers.

1. to 90% Mod AASHTO density;
2. such that in excess of 5 blows of a dynamic cone penetrometer (DCP) is required to penetrate 100 mm of the backfill, provided that backfill does not comprise more than 10% gravel of size less than 10mm and contains no isolated boulders, or
3. such that the density of the compacted trench backfill is not less than that of the surrounding undisturbed soil when tested comparatively with a DCP.

Excavation:

All hand excavatable material including topsoil classified as hand excavatable shall be excavated by hand. Harder material may be loosened by mechanical means prior to excavation by hand.

The excavation of any material which presents the possibility of danger or injury to workers shall not be excavated by hand.

Clearing and grubbing:

Grass and small bushes shall be cleared by hand.

Shaping:

All shaping shall be undertaken by hand.

Loading:

All loading shall be done by hand, regardless of the method of haulage.

Haul:

Excavation material shall be hauled to its point of placement by means of wheelbarrows where the haul distance is not greater than 150 m.

Offloading:

All material, however transported, is to be off-loaded by hand, unless tipper-trucks are utilised for haulage.

Spreading:

All material shall be spread by hand.

Compaction:

Small areas may be compacted by hand provided that the specified compaction is achieved.

Grassing:

All grassing shall be undertaken by sprigging, sodding, or seeding by hand.

Stone pitching and rubble concrete masonry:

All stone required for stone pitching and rubble concrete masonry, whether grouted or dry, must be collected, loaded, off loaded and placed by hand.

Sand and stone shall be hauled to its point of placement by means of wheelbarrows where the haul distance is not greater than 150m.

Grout shall be mixed and placed by hand.

Manufactured Elements:

Elements manufactured or designed by the Contractor, such as manhole rings and cover slabs, precast concrete planks and pipes, masonry units and edge beams shall not individually, have a mass of more than 320kg. In addition, the items shall be large enough so that four workers can conveniently and simultaneously acquire a proper handhold on them.

END OF SECTION

PLK MANUFACTURE AND SUPPLY OF VALVES

PLK 1 SCOPE

This section of the Specification includes the manufacture, testing and supply of valves for the conveyance of raw or potable water at ambient temperatures in pipes under pressure.

PLK 2 STANDARDS

The most recent issues of the following standard specifications will apply for the purposes of this Specification.

SANS 144	:	Cast-iron single door non-return valves
SANS 191	:	Cast steel gate valves
SANS 192	:	Cast steel single door non-return valves
SANS 664	:	Cast iron gate valves for waterworks
SANS 665	:	Cast iron gate valves for general purposes
BS 5155	:	Cast iron and carbon steel Butterfly valves
ISO 2441	:	Pipeline flanges for general use - shapes and dimensions of pressure tight surfaces
SANS 1123	:	Steel pipe flanges
SIS 05 5900	:	Pictorial surface preparation standard for painting steel surfaces

PLK 3 MATERIALS

PLK 3.1 Sluice Valves

- PLK 3.1.1 The valve body, bonnet, thrust dome, gate and glands shall be of cast iron or cast steel as specified and depending on the required test pressures.
- PLK 3.1.2 The stuffing box shall be of ample depth to afford sufficient space for long period packing and the design shall be such as to allow the gland to be easily and conveniently repacked under pressure.
- PLK 3.1.3 Body and gate sealing rings shall be of bronze, gunmetal or stainless steel. RSV gate shall be nitrile rubber covered, and fully encapsulated. The rubber shall not be removed from the guides of the gate.
- PLK 3.1.3 Spindles shall be of high grade stainless steel.

PLK 3.1.4 An isolating valve must be able to check the specified water pressure from both sides.

PLK 3.2 Butterfly Valves

PLK 3.2.1 Valve bodies and discs shall be of high-grade cast-iron or cast steel as specified and depending on the required test pressures.

PLK 3.2.2 The disc shaft or stub-shafts shall be of stainless steel located in self-lubricating bearings.

PLK 3.2.3 Sealing rings, seal retaining rings, body seatrings and associated screws shall be of stainless steel.

PLK 3.2.4 A butterfly valve must be able to check the specified water pressure from both sides.

PLK 3.3 Reflux Valves

PLK 3.3.1 Valve bodies shall be of cast iron or cast steel depending on the specification or test pressures.

PLK 3.3.2 Valve doors shall be of cast iron or cast steel.

PLK 3.3.3 The valve body and doors or disc shall be fitted with replaceable stainless steel body and door seat rings.

PLK 3.4 Air Valves

PLK 3.4.1 Function

Air valves are required to perform any combination of the following functions:

- Uninterrupted high volume air discharge through a large orifice during pipe filling.
- Uninterrupted high volume air intake through a large orifice during pipe emptying.
- Discharge of pressurised air through a small orifice during normal operation.
- Surge alleviation mechanism during rapid air discharge or rejoining of separated water columns.

PLK 3.4.2 Closing mechanism, construction and design

PLK 3.4.2.1 The air release and vacuum break valve shall be of a compact single chamber design with solid cylindrical High Density Polyethylene control floats. Floats of spherical design shall not be accepted. Any hollow float design will not be acceptable due to implosion and distortion making sealing difficult or impossible.

PLK 3.4.2.2 The ends of the cylinder shall be of fusion bonded epoxy powder coated mild steel, secured by means of stainless steel tie rods.

PLK 3.4.2.3 Floats shall be housed in a tubular stainless steel or corrosion protected body, secured by means of stainless steel fasteners.

PLK 3.4.2.4 The seats, spindles, guides, etc shall be of a suitable non-corroding metal with sufficient clearance and shall be designed to prevent abrasion of the ball or float when subjected to frequent operation.

PLK 3.4.2.5 The seats of the orifices shall not have sharp edges and shall be designed so as not to damage the ball or float when subjected to pressure.

PLK 3.4.2.6 The valve shall have an integral surge alleviation mechanism which shall operate automatically to limit transient pressure rise or shock induced by closure due to high velocity air discharge or the subsequent rejoining of separated water columns.

The limitation of pressure rise must be achieved by deceleration of approaching water prior to valve closure.

Relief mechanisms that act subsequent to valve closure cannot react in the low millisecond time span required and are therefore unacceptable.

The performance capability of an integral surge alleviation mechanism shall be substantiated through third party testing, conducted by a recognized authority.

PLK 3.4.2.7 Large orifice sealing shall be effected by the flat force of the control float seating against a nitrile rubber 'O' Ring housed in a dovetail groove circumferentially surrounding the large orifice.

Sealing in any other form shall not be accepted due to the vulcanizing of the float or the wedging of the float in the large orifice.

PLK 3.4.2.8 Discharge of pressurized air shall be controlled by the seating and unseating of a small orifice on a natural rubber seal affixed to the control float.

Valves with slotted air release apertures shall not be considered.

PLK 3.4.2.9 The intake/discharge orifice area shall be equal to the nominal size of the valve i.e. a 200 mm valve shall have a 200 mm intake/discharge orifice.

Valves up to and including 200mm NB shall incorporate an over pressure safety feature that will fail without an explosive effect, such as is normally the case when highly compressed air is released suddenly. This feature shall consist of easily replaceable components such as gaskets, seals or the like.

PLK 3.4.2.10 The valve construction shall be proportioned with regard to material strength characteristics, so that deformation, leaking or damage of any kind does not occur by submission to 2 times the designed working pressure.

PLK 3.4.3 Testing

PLK 3.4.3.1 Manufacturers' published performance data must be substantiated by third party testing from a recognized test authority.

PLK 3.4.3.2 A high pressure strength and leak test whereby the valve is filled with water and pressurized to 2 times the rated working pressure which shall be held for a period of 2 minutes. Any leaking, weeping and sweating shall be a reason for rejection. These tests must be on total, completed units including floats.

PLK 3.4.3.3 Any imported valves shall be retested locally in all areas of specification.

PLK 3.4.4 Isolating valves for air valves

PLK 3.4.4.1 Each air valve shall be provided with a suitable double flanged resilient seal gate valve to isolate the air valve from the main.

PLK 3.4.4.2 The isolating valves shall be capable of operating in a horizontal position and shall be provided with a handwheel for operation and gearing is not required.

PLK 3.4.4.3 Each isolating valve shall be provided with a handwheel fitted to the spindle in an approved manner and shall have directional indication so cast into a recess on the upper surface of the rim that the top of the letter, arrows and rim are at the same level.

PLK 3.4.5 Drains

PLK 3.4.5.1 All air valves be provided with drain cocks so that the body of the valve can be drained when isolated from the pipeline. Cast steel gate valves shall be provided for this purpose.

PLK 3.4.6 Pressure gauge fitting

PLK 3.4.6.1 A 12-mm cast steel full bore gate valve shall be fitted to the spool piece between the isolating valve and the air valve flanges for attaching a pressure gauge.

PLK 3.5 Ring needle valves

PLK 3.5.1 The valve body shall be of spheroidal graphite iron or cast-steel with supporting feet. The body seat shall be of stainless steel and shall be replaceable or may be deposit welded on a removable body section.

PLK 3.5.2 For ring needle valves the piston (plunger) shall be of cast stainless steel with replaceable resilient seal to obtain drop tightness, held in place by a retaining ring of stainless steel and corrosion resistant screws.

PLK 3.5.3 For spherical ball valves, the eccentrically supported ball plug shall be of cast stainless steel or spheroidal graphite iron with replaceable resilient seal to obtain drop-tightness, held in place by a retaining ring of stainless steel and corrosion resistant screws. The valve body shall include an access door to permit adjustment or replacement of the valve seal without dismantling the valve.

PLK 3.6 Manufacture

PLK 3.6.1 General

PLK 3.6.1.1 The design pressure of the valves shall not be less than the pressure specified subject to a minimum of 1 000 kPa.

PLK 3.6.1.2 All valves shall be double-flanged with bolt holes drilled off-centre all in accordance with the requirements of SANS 1123 or as otherwise specified.

PLK 3.6.1.3 The Tenderer shall give as a function of the downstream pressure the maximum acceptable discharge of water through the valves without risks of vibration and cavitation. The Tenderer shall also submit the head-loss characteristics of the valves.

PLK 3.6.1.4 The design pressure will be hand stamped on the top edge of the flanges of valves in kPa.

PLK 3.6.1.5 If specified, valves shall be supplied with by-passes to be bolted on to the body of the valve and not to the adjoining pipework.

PLK 3.6.1.6 Valves shall be fitted with position indicators if specified. Fully closed, fully open and intermediate positions shall be indicated in corrosive proof and robust design indicators.

PLK 3.6.1.7 Arrows shall be cast on all handwheels together with the wording "OPEN" or "CLOSE". The closing direction shall be clockwise unless otherwise specified.

In the case of cap top valves, an aluminium disc of at least 100 mm diameter and with the same wording and arrows shall be slipped over the spindle and retained by the cap.

PLK 3.6.1.8 All valves shall be supplied complete including bolts, nuts, washers and gaskets in accordance with the class of valve. Bolts shall be of sufficient length to allow not more than three screw threads to protrude outside units after complete tightening of the assembly. Gaskets for flanged joints shall be of compressed asbestos fibre to BS 2815 Grade A and full faced with a minimum thickness of 3 mm for pressures up to and including 1 600 kPa cloth-inserted rubber may be used.

PLK 3.6.1.9 Where isolating valves are required to be equipped with extended off-set spindles, the spindles shall be equipped with sufficient universal joints to ensure satisfactory valve operation. All spindle extensions shall be secured to permanent structures with galvanised clamps to the Engineer's approval. The rate for such valve items shall include for any required clamps, extensions joint, etc.

Handwheels on such extended spindles shall be mounted on plain-ended spindle or handwheel pedestal as specified or indicated on the construction drawings.

Isolating valve operation:

Cap top	CT
Handwheel	HW
Electric actuator	EA
Pneumatic actuator	PA
Handwheel spindle extension	HSE
Plain ended spindle extension	PESE
Platform-mounted handwheel pedestal	PMP
Handwheel pedestal on wall support bracket	HPWB
Stub handwheel pedestal on wall support bracket	SHWB
Grid-mounted handwheel pedestal	GMP

PLK 3.6.1.10 The following information shall accompany the tender:

- Description
- Flange Drilling
- Maximum working pressure
- Maximum unbalanced pressure
- Test pressure
- Manufacturers number
- Material of components
- Gearing
- Accessories

PLK 3.6.2 Sluice Valves

PLK 3.6.2.1 Double-flanged, wedge-gate, internal (non-rising) spindle sluice valves of the waterworks pattern are required to comply fully with SANS 191 or SANS 664 where applicable.

PLK 3.6.2.2 Only full-way valves will be accepted (i.e. the gate must be clear of the waterway in the fully open position).

PLK 3.6.2.3 The maximum force required to turn the handwheel at the maximum torque shall not be greater than 100 N per hand at the handwheel run (Total effort = 200 N) when operating at an unbalanced pressure equal to the rated working pressure of the valve. This may be achieved with the aid of gearing of a suitable ratio.

Where gears are used replaceable shear pins shall be provided to prevent damage to the valve if excessive pressure is used.

PLK 3.6.3 Butterfly Valves

PLK 3.6.3.1 Horizontal spindle type butterfly valves complete with gearing, handwheels and flanged at both ends with separate bolting for joining to the adjacent pipework is required.

PLK 3.6.3.2 Wafer valves or valves fitted with studs for attachment to the adjacent flanges are not permitted.

PLK 3.6.3.3 Valves shall be drop-tight when closed and metal to metal sealing is not acceptable.

PLK 3.6.3.4 All resilient seals shall be removable and readily replaceable on Site with the valve in position.

PLK 3.6.3.5 Resilient seals shall be retained by corrosion resistant securing elements to prevent corroding in position (e.g. bolts, set screws, etc.)

PLK 3.6.3.6 The valve-water seal shall be of the following types:

- a resilient seal fixed to the edge of the disc by corrosion resistant securing elements sealing on a stainless steel or bronze insert fixed in the body.
- a resilient seal fixed to the body of the valve by corrosion resistant securing elements sealing on a stainless steel or bronze insert fixed in the edge of the discs.

PLK 3.6.4 Reflux Valves

PLK 3.6.4.1 Reflux valves shall be double-flanged, SANS 1551.

PLK 3.6.4.2 Valve bodies and seals shall be free of pockets that will allow dirt accumulation and prevent the doors from closing fully.

PLK 3.6.4.3 Stops or an approved resilient material shall be fitted into the body to prevent the doors from fluttering under full flow conditions.

PLK 3.6.4.4 Valves shall be designed to allow for rapid but non-slamming closing characteristics.

PLK 3.6.5 Air Valves

PLK 3.6.5.1 Air valves shall be supplied with double-flanged, wedgegate internal (non-rising) spindle sluice valves for isolation, which unless otherwise specified shall conform in all respects to this specification.

PLK 3.6.6 Ring needle valves

PLK 3.6.6.1 Ring needle valves used as auto closing valves shall fulfil the following functions:

- Electrical operation (isolating and control) suitable for opening and closing against the specified pressure and for continuous operation in any intermediate position.
- Automatic as well as manual mode control.
- Automatic reflux action for quick closure by means of drop-weight and hydraulic dash pot in case of power failure or motor protective tripping.
- Adjustable closing time and adjustable closing characteristic.

PLK 3.6.6.2 The totally enclosed flanged-on gearbox shall include the following:

- Either an electro-mechanical unit comprising:
 - a totally enclosed brushless electromagnetic gear clutch for quick closing;
 - a totally enclosed directly mounted electric valve actuator with integral electric controls and auxiliary handwheel for manual operation;
- or an electro-hydraulic unit comprising:
 - an oil hydraulic lift cylinder for opening the valve;
 - a totally enclosed directly mounted electronic driven oil pump and oil reservoir. The oil pump and reservoir may be individually mounted on each valve or a centralised system may be employed to feed more than one valve and/or pumpline;
 - a solenoid operated hydraulic control valve which shall be de-energised to initiate closure of the valve.

PLK 3.6.6.3 Either of the above actuators shall also be provided with:

- limit switches for signalling the “open”, “closed” and intermediate “10%” positions and further control functions as required;
- a directly mounted oil hydraulic dashpot with the necessary control valves for adjusting closing time and operating characteristic;
- means to operate the valve manually;
- valve shaft (stub shafts) of high tensile stainless steel located in bushes of zinc-free bronze;
- a drop weight lever arm of steel with adjustable cast iron drop weight. The lever arm shall be keyed or splined to the shaft.

PLK 3.6.6.4 The overhang shaft carrying the drop weight lever arm shall be supported at its bearing housing from the foundation block.

PLK 3.6.6.5 Travel of the drop weight shall be restrained for reasons of safety at either end of the lever arm.

PLK 3.6.6.6 The control valves shall be arranged for selection of either manual-electric or automatic-electric operation controlled from the pump control console. Push buttons “open”, “close” and “stop” for piloting these valves, when throttling is required, shall be incorporated in each pump control console, as well as

indicator lamps showing “closed” (green) “intermediate” (amber) “open” (red) positions. In addition, a selector switch “manual/automatic” shall be incorporated, the automatic position being in conjunction with pump starting. A further “test” selector switch shall be mounted inside the panel to permit manual-electric testing of the equipment without running the pumpset.

PLK 3.6.6.7 In the “automatic” mode the valve shall open automatically from the fully closed to fully open position when the pumpset is started, likewise closing automatically, when the pumpset is to be shut down. In the “manual” mode the valve shall open automatically to at least the “10% open” intermediate position, whereafter manual selection of the valve position shall be enabled.

- Each valve shall be interlocked with the pump starter. When the pump is to be stopped, the valve shall close slowly to prevent water hammer either by means of the electric actuator or by releasing hydraulic pressure in the lift cylinder by means of control valves before the pumpset is tripped and stopped by interlocked relays.
- Similarly, the valve shall be arranged so that the pump can be started only when the valve is fully closed. The valve shall open only when the starting operation is completed and the motor is up to speed.

PLK 3.6.6.8 The control valves shall have automatic reflux action features to close by drop-weight, controlled by an oil hydraulic dashpot, in the event of power failure or motor protective tripping. The drop-weight shall be released by a solenoid operated clutch or a valve which is constantly energised during pumping operations. Closing time and characteristics shall be adjustable to minimise water hammer.

PLK 3.6.6.9 It shall be possible to energise the “manual” mode only when:

- the associated pump is running.
- the valve is at least 10% open as indicated by the “intermediate” lamp.
- the valve is in the “test” mode

Selection of the “manual” mode shall not affect the automatic reflux action.

When the opening of the valve has been set manually, the valve shall maintain this position in the absence of any further action.

PLK 3.6.6.10 “Test” mode: With both isolating valves closed and electrically interlocked, a test facility shall be provided to enable the maintenance personnel to manually operate the valve without the pumpset running by selection from inside the pump control console.

PLK 3.6.6.11 Valves shall be designed to operate free of cavitation in intermediate positions.

PLK 3.6.7 Electric Actuators

PLK 3.6.7.1 When specified, in the Project Specification the valves shall be fitted with electric, motor-driven flood-proof IP 68 actuators of robust design, capable of closing the valves under all unbalanced pressures.

- PLK 3.6.7.2 The Tenderer shall state the maximum torque required to operate the valve in his Tender. In determining this maximum torque an allowance shall be made for any deterioration that could be expected to occur in the bearings during the life of the valve. The actuator shall be capable of transmitting twice this maximum torque without any of its components suffering permanent damage. This shall be proven to the Engineer's satisfaction by workshop tests.
- PLK 3.6.7.3 The actuators shall be capable of restraining the valve in any position under all possible conditions of operation, and shall not, in any circumstances, be capable of becoming self-motorised as a result of the dynamic torque loading on the disc or plunger.
- PLK 3.6.7.4 All gearing shall be manufactured in accordance with BS 436 Class C and shall be machine cut. All components requiring lubrication shall be adequately lubricated and totally enclosed flood-proof casing fabricated in cast iron and/or die cast aluminium to suit the service weather proof casing whether the valve is to be installed in the open or under cover. Actuators shall also be fitted with mechanical stops to prevent excessive turning and shall be provided with replaceable shear pins.
- PLK 3.6.7.5 Handwheels shall be fitted to all actuators. The direction of rotation to close the valve shall be clockwise when viewed from above the end of the input shaft and from the position of operation. In addition, they shall be clearly and indelibly marked with an arrow showing the direction of closing and the words "Close" and "Toe".
- PLK 3.6.7.6 Whether the valve is actuator driven or manually operated, the maximum force required to turn the handwheel at the maximum torque defined above shall not be greater than 100 N per hand at the handwheel rim. (Total effort = 200 N.) For large valves the minimum of complete revolutions of the handwheel to move the valve gate from fully open to fully closed shall not be less than 100.
- PLK 3.6.7.7 All electric actuators shall be provided with reversing contactors: local and remote control shall be provided; a device making the local control non-operative shall also be provided on the relevant remote control panel.
- PLK 3.6.7.8 After factory tests, the actuators shall be removed from the valve and delivered to Site in separate boxes to safeguard against damage.

PLK 3.6.8 Protection

All materials and workmanship to comply with relevant SANS specifications.

PLK 3.6.8.1 Internal Protection

Internal surfaces of valve bodies and discs shall be grit blasted to a Sa 2½ of SIS 05 50 00 finish. Successive coats of an approved non-toxic epoxy resin paint suitable for spray application (Cupon EP 2300 or similar) shall then be applied to give a final dry film thickness of 250 µm. Drying times between successive layers shall be strictly in accordance with the requirements of the paint manufacturer.

As an alternative to the protection as specified above, the Contractor may be required to use either a solventless epoxy paint system or a fusion bonded epoxy powder coating as specified in the Project Specification.

PLK 3.6.8.2 External Protection

External surfaces of valve bodies shall be wire brushed to a A 3 of SIS 05 59 00 standard and painted with one layer zinc chromate primer (dried film thickness 50 µm). This will be followed by two alkyd-based undercoats (each coat 25 µm thick) and one alkyd-based enamel finishing coat (dried film thickness 25 µm). Final colour will be as specified by the Engineer.

Machined flanges will be painted with a protective coating of shellac or similar.

PLK 3.7 Tolerances

Tolerances as specified in the appropriate SANS or BS standards shall apply to this Contract.

PLK 4 TESTING AND INSPECTION

PLK 4.1 Testing by Manufacturer

The Manufacturer shall carry out all tests to ensure that valve materials conform to the requirements of the relevant SABS or BS Specification. These tests will not necessarily be attended by the Engineer but records must be kept and all test results shall be made available to the Engineer.

PLK 4.2 Testing by Independent Body

The Engineer may appoint an independent recognised body to conduct control tests. Samples required for such tests will be provided by the Manufacturer free of charge and sampling will be done by this body in accordance with the relevant SANS or BS Specification.

The cost of such control tests will be borne by the Employer.

PLK 4.3 Inspection

PLK 4.3.1 Visual, operational and dimensional inspection of valves as well as inspection of protective coatings will be carried out by the Engineer and/or the Manufacturer in the Manufacturers workshops prior to the despatch of valves to site.

PLK 4.3.2 Inspection by the Engineer shall in no way relieve the Manufacturer of any of his obligations to design, manufacture and supply valves strictly in accordance with the Specification.

PLK 4.4 Hydrostatic Testing

PLK 4.4.1 All hydrostatic tests will be witnessed by the Engineer and the Manufacturer will give at least one week prior notification to the Engineer of the proposed dates for such tests.

PLK 4.4.2 Valve bodies will be close end tested to at least 1,5 times the working pressure. Test pressures will be maintained for at least 5 minutes and valve bodies will be water tight in all respects at the test pressure.

PLK 4.4.3 Assembled valves will be open-end tested to 1,5 x working pressure for materials strength and soundness. Valves will be drop tight from both directions over the complete range of pressures from 0 to 1,5 x working pressure.

PLK 4.4.4 Each valve will be supplied with a test certificate certifying that it complies in all respects with the requirements of this Specification.

PLK 5 MEASUREMENT AND PAYMENT

PLK 5.1 General

Tendered prices shall include for the following unless otherwise specified in the Project Specification.

- Protective coatings as specified.
- Couplings and/or jointing material for each type of valve.
- Packing and temporary protection against damage during transport and delivery.
 - Temporary storage and maintenance if required.
 - Delivery and storage of material on site or in a store as specified.
 - Testing and inspections at Manufacturer's works.

PLK 5.2 Valves will be measured per unit of each type

END OF SECTION

PORTION 4: C 3.4 – PARTICULAR SPECIFICATIONS

PLQ CORROSION PROTECTION OF PIPES AND FITTINGS

PLQ 1 SCOPE

This specification covers various corrosion protection systems for cast iron, steel and stainless steel pipes and fittings for the conveyance of water at ambient temperatures.

PLQ 2 CORROSION PROTECTION SYSTEMS

The following corrosion protection systems shall apply unless otherwise specified on the drawings, project specifications and schedule of quantities.

PLQ 2.1 Buried steel pipework

- a) Pipe diameter up to 150mm

Pipework shall be hot-dipped galvanized unless otherwise specified.

After installation, the pipework shall be protected with a Denso HT Petrolatum tape wrapping system as specified in this specification.

- b) Pipe diameter larger than 150mm

Specials, fittings and couplings shall be lined and coated with epoxy paint.

After installation the specials and fittings shall be protected with the Denso Ultraflex 1250/300 and MDP 032 tape wrapping system as specified in PLQ 11.1.

Standard pipe lengths shall be lined with epoxy paint and coated with fusion bonded medium density polyethylene (MDPE) or Bituguard or 3LPE as specified in this specification unless otherwise specified in the Project Specifications or the Bill of Quantities or on the Drawings.

PLQ 2.2 Pipework inside chambers

- a) Pipe diameter up to 150mm

Pipework shall be hot-dipped galvanized.

The outside end of fittings cast into the walls of the chamber shall be protected with a Denso HT Petrolatum tape wrapping system.

- b) Pipe diameter larger than 150mm

Fittings, specials and couplings shall be coated and lined with epoxy paint.

The outside end of the fitting cast into the wall as well as couplings outside the chamber shall be protected with a Denso HT Petrolatum tape wrapping system.

PLQ 2.3 Pipework exposed to sunlight

- a) Pipe diameter up to 150mm

Pipework shall be hot-dipped galvanized.

Pipe surface shall be prepared for re-coatable silver polyurethane acrylic site application.

After installation the pipe shall be painted with re-coatable silver polyurethane acrylic.

- b) Pipe diameter larger than 150mm
Pipework shall be lined with epoxy paint.

Pipes shall be coated in the factory with two component inorganic zinc silicate primer (100 micron) plus one coat of silver polyurethane acrylic (60 micron).

A second coat of polyurethane acrylic (60 micron) must be applied on site. The inorganic zinc silicate must be repaired with "single pack zinc rich epoxy primer".

PLQ 2.4 Exposed pipework inside buildings

- a) Pipe diameter up to 150mm

Pipework shall be hot-dipped galvanized.

Pipe surface shall be prepared for re-coatable polyurethane site application.

After installation the pipe shall be painted with re-coatable polyurethane to the Employers colour coding specification.

- b) Pipe with diameter larger than 150mm

Pipes, fittings and couplings shall be lined and coated with epoxy paints.

After installation the pipework shall be painted with re-coatable polyurethane to the Employers colour coding specification.

PLQ 2.5 Pipework inside water retaining structures

All stainless steel pipework inside water retaining structures and cast into the walls or floor of water retaining structures shall be lined and coated with epoxy paint.

All stainless steel shall be 316L.

PLQ 3 SURFACE PREPARATION

Contractors must submit information on the cleaning methods to be used in meeting the specified requirements. Contractors must further provide the Engineer with the manufacturer's guarantee that the requirements have been met.

PLQ 3.1 Surface preparation of steel surfaces

All projections, sharp edges, layers that have formed and tool marks must be removed from the surface so that the surface is smooth, and it must be abrasive blast cleaned in accordance with sections 2, 3 and 4 of SABS Code of Practice 064 so that it meets the following requirements:

- (a) A grade of cleanliness of Sa 3 of ISO 8501-1 when tested by SABS test method 767.
- (b) A surface profile between 60mm and 85mm when tested by SABS test method 772.
- (c) Free from dust and debris to at least 0,2% when tested by SABS test method 769.

PLQ 3.2 Surface preparation of galvanized surfaces

Surfaces to be coated shall **not** be passivated.

Galvanized steel surfaces shall be degreased prior to coating, using either a water soluble solvent degreaser in accordance with SABS 1344 and the manufacturer's instructions, or a mild acid-detergent degreasing solution to be approved by the Engineer.

Large areas shall be prepared by sweep-blasting with non-metallic abrasive. Cracking, flaking or any form of de-lamination of the zinc coating due to excessive blast-cleaning shall not be permitted. Removal of zinc by blast-cleaning shall not exceed 10 µm.

Surfaces that cannot be sweep-blasted shall be abraded manually or mechanically with abrasive paper grade 220 or by using non-metallic abrasive pads.

Finally, all dust and debris shall be removed by vacuum-cleaning.

Epoxy primer for galvanised surfaces shall be applied immediately after surface preparation to a minimum dry thickness of 50 µm.

PLQ 3.3 Surface preparation of stainless steel surfaces

Oil and grease contamination shall be removed by:

- Steam-cleaning
- An emulsifiable or aqueous detergent, or
- An alkaline cleaning solution.

Stainless steel surfaces shall be blast-cleaned with stainless steel grit or non-metallic abrasive. The use of steel shot and steel or cast iron grit is strictly prohibited.

The grade of cleanliness shall be at least Sa 2½.

Surface profile shall be in the range of 30 to 50 µm.

Where blasting is impractical, the surface shall be roughened manually with abrasive paper grade 220, disc grinders or flapper wheel abrasive pads. In all instances, clean, uncontaminated equipment must be used.

Dust and debris shall be removed by vacuum-cleaning.

PLQ 4 HOT-DIP GALVANIZING

Unless otherwise specified, steel pipes up to 150 mm dia shall be hot-dipped galvanized. Hot-dip galvanizing to be in accordance with SABS 763 – 1988 except that minimum thickness shall be 55 micorn. Cut ends and small damaged areas shall be repaired by the application of a zinc-rich epoxy (single pack) to SABS 763 (ZINC GALV 1 – Dulux or POLY GALV – Plascon).

Only heavy duty galvanising will be approved and all items to be provided with a SABS approval certificate.

PLQ 5 EPOXY PAINTS

Epoxy paint shall comply to SABS 1217. Surface preparation shall be abrasive blast cleaning to Sa 3 of ISO 8501-1.

The following will be applicable where epoxy paint is specified:

- Lining of pipes with nominal diameter equal or larger than 600 mm and standard pipe lengths of 9,144 m, 12,192 m and 18,288 m:

Solvent free epoxy (Sigmaline 523 or Pipecoat SF or similar approved by Engineer), with a minimum dry film thickness of 400 micron and a maximum dry film thickness of 500 micron.

- Lining and coating if all other pipes, specials and fittings, except where multi-purpose epoxy coating is specified:

Solvent borne epoxy (Carboguard 891 or Sigmaguard 720 or similar approved by Engineer) with a minimum dry film thickness of 400 micron.

Epoxy paint and the repair kit for the repair of epoxy shall be from the same manufacturer.

Edges with epoxy paint shall have a radius of 3 mm or 50 % of the pipe wall thickness (smaller of two).

Where another type of coating is specified, epoxy paint lining shall continue around pipe edge for each of the following:

- *Flanged end*

Onto both flange faces, extending for 50 mm (min) onto pipe outer wall beyond flange.

- *Ends suitable for straight or stepped couplings or flange adapters*

Onto pipe outer wall for 250 mm (min) from pipe end.

- *Ends suitable for flange adapters, incorporating a restraining flange*

Onto pipe outer wall from pipe end, up to and including both faces of the restraining flange as well as 50 mm (min) beyond the restraining flange.

The following specification shall be applicable to pipes, specials and fittings to be painted with epoxy.

- In the factory:

Abrasive blast cleaning of complete steel surface to Sa 3 of ISO 8501-1. Apply epoxy paint to 100mm from pipe end.

- On site:

Abrasive blast cleaning of steel surface to Sa 3 of ISO 8501-1 and 50 mm of painted surface to a surface profile of 60 – 85 microns.

Apply epoxy repair kit from the same manufacturer as the factory applied epoxy to a minimum dry film thickness of 400 micron. The type of epoxy repair kit shall be subject to the approval of the Engineer.

The painted area shall be tested for pinholes and thickness.

PLQ 6 UV-RESISTANT MULTI-PURPOSE EPOXY PAINT

Multi-purpose epoxy shall be of the high build, modified aluminium epoxy mastic type, containing at least 90% solids.

PLQ 7 RE-COATABLE POLYURETHANE

The area to be over-coated shall be abraded with abrasive paper grade 220 to a uniform matt finish.

The surface shall be vacuum-cleaned to remove dust and debris.

Over-coat with a 40 µm minimum layer of Re-coatable Polyurethane in accordance with the Employer's colour code.

PLQ 8 FUSION BONDED, MEDIUM DENSITY, POLYETHYLENE COATINGS (MDPE)

An uniform MDPE coating must be obtained by dipping the already prepared and heated pipe into a fluidified bed of MDPE powder which then fuses directly on to the heated surface.

A coating thickness of between 1,8 mm to 2,3 mm depending on the outside diameter (OD) of the pipe and the service for which it is required must be obtained with the coating extending around the ends of the pipe to underlap the concrete lining for Sinta Joint pipes by a minimum of 25 mm.

- OD < 508 mm : coating thickness = 1,8mm
- 508 mm ≤ OD ≤ 762 mm : coating thickness = 2,0mm
- OD > 762 mm : coating thickness = 2,3mm

Fusion bonded MDPE coatings shall comply to AS 4321 and must meet the applicable SABS requirements for this type of pipe protection. Surface preparation shall be abrasive blast cleaning to Sa 3 of ISO 8501-1.

PLQ 9 POLYMER MODIFIED BITUMEN (BITUGUARD)

Bitugard coating shall be in accordance with SANS 1178 and BS EN 10300, Type A Heavy Duty with a minimum thickness of 4mm.

Surface preparation shall be abrasive blast cleaning to Sa3 of ISO 8501-1.

PLQ 10 THREE LAYER POLYETHYLENE COATING (3LPE)

3LPE coating to be in accordance with CSA Z245.20 - 21 with the following minimum thicknesses:

- Fusion bonded epoxy (FBE) layer: 300 micron
- Adhesive layer: 200 micron
- High density polyethylene layer:
 - Nominal pipe diameter up to and including 250 mm – 2,0 mm
 - Nominal pipe diameter greater than 250 mm but less than 600 mm – 2,5 mm
 - Nominal pipe diameter of 600 mm and greater - 3,0 mm

A polyethylene layer cut back shall be provided at pipe ends as follows:

Pipe ends shall be supplied as bare steel, free of all coating, for a distance of 100 mm (+25/-0mm) from the pipe end. In addition, each pipe end shall be left without polyethylene / adhesive coating so that a 20 mm (+10/-0mm) FBE toe protrudes on the steel beyond the cutback polyethylene coating layer.

The ends of the coating shall be bevelled at 30° to 45°.

Surface preparation shall be abrasive blast cleaning to Sa3 of ISO 8501-1.

After blast cleaning and prior to the application of the FBE layer, the pipe surface shall be pre-treated by acid wash. A method statement for the acid wash supported by product data and the PQT results shall be provided for the review of the Engineer before commencement of the coating process.

PLQ 11 JOINT COATING SYSTEMS

PLQ 11.1 MDPE and three layer polyethylene (3LPE) coating

The unprotected area at welded joints shall be protected as follows:

- The cutback of the coating shall be 100 mm from the pipe ends.
- Chamfer any raised edges or steps in the existing coating.
- The factory applied polyethylene pipe surface to which the cold tape wrapping is to be applied shall be abraded with 40 grit abrasive paper or sweep blasted for 100mm beyond the steel surface toe.
- Abrasive blast clean the steel surface to Sa 3 of ISO 8501-1.
- For 3LPE apply Denso Protal 7200 liquid epoxy to the blast cleaned surface and adjacent prepared factory FBE coating to a minimum dry film thickness of 400 micron.
- The entire joint surface to be wrapped shall be primed with Denso Primer D.
Priming shall not be carried out further ahead of physical tape wrapping than a maximum of 4 hours.

Ensure the primer is dust free prior to application of a tape wrap system. If the primer has become severely contaminated with dust, a re-prime shall be carried out. Heavy contamination with sand or dirt shall require cleaning of the surface with a manufacturer recommended cleaning solvent (e.g. Denso Cleaning Solvent) and re-application of the primer.

Allow approximately 30 minutes drying time or until the primer is tacky to the touch.

- The inner wrap shall consist of a 100 mm wide conformable polyethylene backed modified bitumen mastic tape, compliant with the requirements of SANS 1117 type C (Denso Ultraflex 1250/300)

Peel back approx. 0,5 m of interleaving. Align the edge of the 100 mm wide tape 50 mm onto the primed, factory applied, polyethylene pipe coating. Press down firmly.

Before spiral wrapping commences, a full circumferential wrap of tape is applied by hand with sufficient tension to narrow the width of tape between 1 and 2 mm.

Whilst maintaining tape tension as described above, the tape shall be applied spirally. Remove interleaving as wrapping proceeds.

The tape shall be applied to ensure that a minimum 25 mm overlap shall be achieved.

- The outer wrap shall consist of a 100 mm wide medium density adhesive polyethylene compliant with the requirements of SANS 1117 Type B&D (Denso MDP 032).

Centre 100 mm wide outer-wrap tape on the edge of the applied inner wrap tape on the factory applied coating. Press down firmly. Before spiral wrapping commences, a full circumferential wrap of tape is applied by hand with sufficient tension to narrow the width of tape between 1 and 2 mm. Whilst maintaining tape tension as described above, the tape shall be applied spirally.

The tape shall be applied to ensure that a minimum 55% overlap shall be achieved.

The tape shall be applied to a minimum width of 50 mm beyond the applied inner tape-wrapped area onto the primed shop applied coating.

Ensure that the tape is in full contact with the underlying surface with no wrinkles, fish-mouths or bubbles.

- Holiday detection shall be carried out in accordance with NACE RP0188.

Damaged areas on MDPE coatings shall be repaired in accordance with the specifications and guidelines of the coating manufacturer.

PLQ 11.2 Polymer Modified Bitumen (Bituguard) Coating

The unprotected area at welded joints to be coated with Denso Primer D and wrapped with Densotherm HD heat applied bitumen wrapping with a minimum thickness of 5 mm.

Surface preparation shall be abrasive blast cleaned to Sa3 of ISO 8501-1.

PLQ 12 DENSO HT PETROLATUM TAPE WRAPPING SYSTEM

Denso HT Petrolatum tape wrapping system shall be used for the wrapping of buried flange and flexible joints and buried galvanized pipes and where specified in the Specifications, Bill of Quantities or Drawings.

PLQ 12.1 General

Surface preparation shall be abrasive blast cleaning to Sa3 of ISO 8501-1.

Chamfer any raised edges or steps in the existing coating.
Apply Denso Priming Solution.

Apply Denso HT Tape of appropriate width uniformly in a spiral fashion to give a 55% overlap on the pipe and for not less than 200 mm along the length of the intact factory coating.

Apply uniform tension to ensure the tape is smooth and free from wrinkles. Do not apply excessive tension that will stretch the tape nor insufficient or uneven tension that will give rise to air bubbles and wrinkles.

PLQ 12.2 Flexible couplings and flanges

Apply Denso Mastic so as to create a smooth profile suitable for over-wrapping. Wrap a suitable width of Denso HT Tape over the coupling. Ensure that there are not air voids under the tape. Apply a double layer of Denso Layflat polyethylene sheeting over the whole length of the repair and for 100mm beyond each end of the repair. Tape the ends of the Layflat with two complete turns of 100 mm wide adhesive Denso PVC tape to seal the ends.

Denso fabric backed mastic blanket can be used as an alternative for Denso HT Tape. After priming, pack potential air void areas such as under the bolts with Denso Mastic. Place the mastic Blanket in position and press it into all air voids. Start under the pipe and work upwards. Over wrap the Mastic Blanket with two layers of Denso Layflat sheeting and secure the ends with 100mm wide adhesive Denso PVC tape. If the pipe runs through very wet soils it is recommended that Denso S105 Paste be used in preference to Denso Priming Solution and the couplings be wrapped with Denso PVC Self Adhesive Tape using a 55% overlap in place of the Layflat Sheeting.

PLQ 12.3 Welded joints and straight pipe lengths

After completion of Denso HT Tape wrapping and approval by the Engineer, apply 0,3mm adhesive PVC outerwrap with 55% overlap over the whole length of the wrapping and for 100mm beyond each end.

PLQ 13 CUT BACK AT PIPE ENDS

The exposed grit blasted bare steel surface at the ends of pipes, specials and fittings to be welded on site shall not be painted with any product in the factory and shall be protected against corrosion after installation.

PLQ 14 ADDITIONAL EXTERNAL PROTECTION FOR PIPES CAST INTO CHAMBER WALLS

After the concrete has cured for 7 days, wire brush or scabble the exterior and interior surfaces of the wall to remove laitance. Dry brush to remove all loose powder.

Mix ABE Super Laykold and water (1:1 ratio) and apply as a primer to the concrete and the pipe surfaces. After 1 hour apply a thick coat of ABE Super Laykold to the concrete and the pipe and immediately embed 250mm wide ABE non-woven polyester membrane "SBP" into the Super Laykold. After 3 hours apply another coat of Super Laykold.

This additional protection is required on the inside and outside of chamber walls.

There must be no contact between the steel pipe and the chamber reinforcement.

PLQ 15 MEASUREMENT AND PAYMENT

Corrosion protection and painting shall not be measured separately. The price for corrosion protection and painting shall be deemed to be included in the price for the pipe, fitting or special.

END OF SECTION

PLN MANUFACTURE, SUPPLY AND TESTING OF STEEL PIPES

PLN 1 SCOPE

This specification covers the manufacture and supply of bare, electric welded low carbon steel pipes and steel pipe special items for the conveyance of water at ambient temperatures and at medium pressures.

PLN 2 STANDARDS

Pipes and specials shall be manufactured, tested and inspected in accordance with the latest issues of the following standard specifications unless amended in subsequent clauses in this specification.

a) Pipes

SABS 719 : Steel Grades A, B and C
SABS 1431 : Steel Grades 300 WA
API 5L : Steel Grades, X42, X46, X52, X56 and X60

b) Specials

- Specials of 150 mm nominal diameters and smaller to be manufactured with pipe conforming to SABS 62 (heavy duty) or ASTM Schedule 40 to suit specified pressures.
- Specials larger than 150 mm nominal diameter shall be manufactured from pipes complying with this specification.
- The radiographic technique, adjudication of radiographs and repair of defects shall be in accordance with API 1104.

c) Qualifications of Welders

All manual or semi-automatic welds and repair welds shall only be undertaken by welders qualified under the tests laid down in accordance with API 1104.

d) Non-destructive Tests and Adjudication

- Radiographic inspection: API 1104
- Ultrasonic inspection: API 5L

e) In this Specification reference is made to the latest issues of the following specifications:

SABS 719
API 5L
API 1104
ASME Section V
BS 2971
BS 2633

PLN 3 STRESSES

- a) All pipes shall be hydrostatically tested as described in PLN 6.5 to a pressure such as to produce a circumferential tensile stress in the steel of not less than 85% of the minimum yield stress.
- b) The design stress for pipes subjected to the specified design pressures shall be 60% of the minimum yield stress of the steel.

PLN 4 PROCESS OF MANUFACTURE FOR PIPES

PLN 4.1 Pipes shall be manufactured by an approved semi-automatic submerged-arc welding process or shall be electric resistance welded. Where semi-automatic submerged-arc welding is employed, at least one pass shall be made on the inside and at least one pass on the outside. The number of longitudinal weld seams shall not exceed:

- a) one seam for pipes up to 1 000mm nominal diameter
- b) two seams for pipes larger than 1 000mm and up to 2 000mm nominal diameter

Circumferential welds by semi-automatic submerged-arc welding method for factory double jointed pipes shall have at least one pass on the inside and at least one pass on the outside.

PLN 4.2 Welds

SABS 719, BS 2971 and BS 2633 shall generally apply.

For fusion welded pipes and specials, the internal weld bead shall not protrude more than 1mm into the bore of the pipe or special.

For electric resistance welded pipes, the height of upset metal and flash on the inner surface shall not exceed 1,0mm.

For pipes to be jointed by butt welding, the internal weld bead shall be ground flush with the pipe body for a length of 200mm from ends to be jointed.

For pipes to be coupled by flexible couplings, external weld reinforcement or upset metal and flash shall be ground flush with the pipe body for a length of 200mm from the end to be coupled.

PLN 5 DIMENSIONAL REQUIREMENTS

PLN 5.1 Pipes

All dimensions will be in accordance with SABS 719 clause 4.

PLN 5.2 Specials

The tolerances on specials will be in accordance with BS 534, Section 4.

Unless shown otherwise, branch and manifold sections of Tees to have a common centre line and of Scour Tees to have a common invert line.

All dimensions on layout dwgs or item details are outer face to outer face, i.e. overall.

Position dimensions for puddle flanges and restraining flange refers to centre of flanges.

PLN 6 TESTING AND INSPECTION AT MANUFACTURER'S WORKS AND AT SITE

PLN 6.1 General

Factory and Site inspection, supervision of tests and adjudication of test records shall be carried out by an independent Inspectorate.

All tests and inspections at the factory and on site shall be at the expense of the Contractor who shall provide all necessary testing facilities, labour, instruments, equipment and samples that might be required, free of charge.

The Inspectorate shall be afforded every facility during the course of manufacture and testing to enable the inspection to be carried out effectively.

All test samples shall be selected by the appointed Inspectors and all instruments used for testing purposes shall be approved by the Inspectors and if in the opinion of the Inspectors any instrument should require calibration, such instruments shall be calibrated at the expense of the Contractor by the SABS or such other body as may be approved by the Inspectorate.

No mechanical working or straining of pipes and specials shall be allowed after testing and inspection.

PLN 6.2 Visual Inspection

All finished pipes and specials shall be visually examined and shall be free of injurious defects as defined in API 5L Section 10.7.

PLN 6.3 Non-destructive Inspection

PLN 6.3.1 Ultrasonic Inspection

Pipes shall be made by an approved welding process and 100 percent of all longitudinal or spiral welds on straight pipes shall be checked with an approved ultrasonic method capable of continuous and uninterrupted inspection of the weld seam in accordance with API 5L Section 9.10, 9.11 and 9.12 except that the equipment shall be checked with an applicable reference standard at least twice every working run.

PLN 6.3.2 Radiographic Inspection

a) Longitudinal Weld Pipe

All electric fusion welded pipes, shall be inspected by radiological methods for a distance of 200 mm from each pipe end.

b) Spiral Weld Pipe

All electric fusion welded pipes shall be inspected by radiological methods for a distance of 100 mm from each end of each length of pipe and of the complete "H" at all scalp and welds including 150 mm of the spiral welds in both directions away from the intersection points with the scalp and welds.

c) Circumferential Butt Welds

100 percent of the length of circumferential butt welds shall be examined unless consistently acceptable results are obtained. Then the number of welds so to be tested may be reduced by mutual agreement between the Engineer, the Inspectorate and the Contractor.

d) Specials

100 percent of all manual or semi-automatic welds in specials shall be examined radiographically unless consistently acceptable results are obtained. Then the number of welds so to be tested may be reduced.

Where specials cannot be hydrostatically tested, all welds shall be liquid penetrate tested as per ASME Section V.

e) Repairs

Straight Piping :

100 percent of the total length of all repairs shall be examined radiographically unless repairs are done prior to ultrasonic inspection and such repairs pass ultrasonic inspection. Then no radiographic inspection of same is required.

f) Pipes for Rail, Road and River Crossings: 100 percent of the total length of all welds shall be examined radiographically.

PLN 6.4 Hydrostatic Testing

- a) Each individual straight pipe shall be subjected to a hydrostatic test in accordance with the methods described in API 5L, Section 5. Test pressures shall be such as to produce tensile fibre stresses in the pipe wall of not less than 85% of the minimum specified yield strength of the steel or shall be 9 MPa whichever is the lesser. Leaks or sweats shall be considered injurious defects.
- b) Should it not be possible to hydrostatically test straight piping and/or specials the through liquid penetrate test as per ASME Section V shall be done on all welds over and above the non-destructive tests specified above. This shall only be applicable with the prior written approval of the Engineer.

PLN 6.5 Repair of Injurious Defects

Injurious defects found by non-destructive testing of welds, visual examination, hydrostatic testing or determined by any other means to exceed the limitations in API 5L, Section 10.7 shall be repaired in accordance with API 5L Section 10.8 and 10.9 but subject always to the requirements of this specification.

PLN 6.6 Destructive Testing

PLN 6.6.1 The following destructive tests shall be performed in accordance with SABS 719 clause 7.2 on the first pipe and thereafter on one pipe of each 500 subsequent pipes.

- a) Transverse Tensile Test
- b) Root Bent Test (Electric Fusion Welds)
- c) Flattening Test (Electric Resistance Welds)

PLN 6.6.2 Sampling for Destructive Tests

a) **First Sample**

A section long enough to provide all the test specimens and material shall be cut from the selected pipe.

b) **Second Sample**

If the test specimens and material from the first selected pipe fail to pass any of the tests, a section long enough to provide the appropriate specimens for the tests failed by the first sample shall be cut from two further pipes.

c) **Third Sample**

If the test specimen from the second sample fails to pass the test(s) a similar section shall be cut from each of a further ten pipes.

d) **Compliance**

The piping shall be considered as complying with the specification if after testing of the first or the second or the third sample no defect is found.

PLN 7 FLANGES

- a) Material shall be steel plates to conform to the requirements of SABS 1123 (1977), unless otherwise specified.
- b) Dimensions and drilling shall be in accordance with SABS 1123 (1977) unless otherwise specified. Flanges for 64 bar working pressure shall be in accordance with BS4504:1969. Dimensions not covered by SABS 1123 and BS4504, shall be in accordance with NWS 1676 Revision 0.
- c) All flanges shall be of the steel-plate for welding type and shall have flat joint faces unless otherwise specified.
- d) Connecting surfaces shall be in accordance with SABS 1123 clause 4.5.
- e) Puddle flanges need not be drilled. Where puddle flanges are slanted to an item, special flanges are required. Such flanges need not be circular, but shall meet the specified pressure rating and must protrude at least 100 mm outside item outer wall.
- f) Provide appropriate bolt units, consisting of a standard length bolt, nut and two washers of a material to conform to the requirements of SABS 1123 where applicable, otherwise to the requirements of the Engineer for each set of flanges and for flange adaptor to flange installations.

NB: The shortest standard bolt or stud that protrudes beyond the nut by a minimum of two threads, when the assemblies are fully tightened, shall be used. A washer shall be fitted under all bolt/screw heads and nuts.

- g) Gaskets for flanged connections shall be of aramid and glass fibre with nitrile rubber binder to BS 7531, ring type with a minimum thickness of 3 mm, unless otherwise specified.
- h) Should certain equipment e.g. valves, etc. only be supplied with specific flange drilling, the Contractor must arrange for adjacent flanged items to have the same drilling prior to the manufacture of such items.
- i) Some flexible couplings to be restrained by means of a restraining flange. The diameter, number and length of the long restraining bolts as well as any possible pipe wall thickening to be designed by manufacturer for specified pressures. The seal retaining flange on the flexible coupling may be factory machine scalloped to accommodate the long bolts. Provide all the necessary nuts, washers, etc. for the restraining bolts.

Restraining flanges need not have all the bolt holes specified in the applicable flange drilling table. Only those required for the long restraining bolts need to be provided; these holes should, however, comply with the applicable flange drilling table and be spaced equally on the flange PCD and symmetrically around the flange centre lines.

Restraining bolts to be positioned so as to not clash with any stubs specified for an item.

- j) Blank flanges for pipes equal to or greater than 400 dia to be provided with two approved lifting handles.

PLN 8 FLEXIBLE COUPLINGS AND FLANGE ADAPTORS

Flexible couplings and flange adaptors shall be the Viking Johnson or Klamflex type.

Manufacture of straight and stepped couplings (SR-C + ST-C) as well as flange adaptors (FA) to be approved by Engineer. Couplings must be able to withstand hydrostatic test pressures of 1.5 times the specified design pressures and coupling flanges must be designed to withstand all stresses due to

tightening of the bolts. Rubber rings shall generally comply to SABS 974 Class F. Flexible couplings shall be supplied complete with all necessary bolts, nuts and rubber jointing rings.

Coupling installation gaps to be to approved supplier's specification.

Applicable to all flange adaptors:

- Studs may not be welded onto flange.
- Flange to be drilled and tapped for threaded studs where applicable.
- Drilling to suit connecting flange.

PLN 9 MARKING OF PIPES

All pipes and specials shall be clearly hand stamped alongside a longitudinal or spiral weld on one end of the pipe with the following.

- a) Grade and thickness of steel
- b) Serial number of the pipe or specials
- c) Nominal diameter
- d) Hydraulic test pressure

END OF SECTION

PLT FLOW METERS

PLT 1 SCOPE

This section of the Specification deals with the supply, delivery, installation and commissioning of:

- (a) in line ultrasonic flow meters;
- (b) clamp on ultrasonic flow meters
- (c) flanged mechanical turbine meters
- (d) electromagnetic flow meters.

PLT 2 IN-LINE ULTRASONIC FLOW METERS

PLT 2.1 General Requirements

An in-line ultrasonic flow meter will consist of:

- i) Two machined, stainless steel, weld-on sockets with inserted perspex windows, which are held by two plastic flanges secured with stainless steel bolts and spring washers.

The tenderer shall be responsible for the welding of the sockets on to the pipeline, as well as making good all corrosion protection according to applicable specifications.

- ii) Two 1 MHz sensing units, connected via co-axial cables of 50 ohms, with a minimum length of 12 m, to the transmitter.

The sensing units are to be removable under full pressure, while the pipeline is operating.

Both sensing units shall be electrically isolated from the pipeline.

- i) A transmitter that shall have two output circuits:
 - (1) One circuit for the 4-20 mA output signal to drive an indicator, and if later required a recorder, with maximum load capacity of 1 000 ohm.
 - (2) The second circuit to drive a 24 V integrator, with a 2% zero flow cut off.

All power requirements other than 230 V will have to be provided for by the successful Tenderer.

The transmitter shall have facilities to adjust for the various pipe diameter and flow rates.

PLT 3 CLAMP-ON ULTRASONIC FLOW METERS

PLT 3.1 General Requirements

Single channel flow meters operated in transit time or time-of-flight mode shall be provided unless otherwise specified. The flow meter provided shall be capable of measuring the instantaneous flow in a pipeline and give the accumulated flow. The installation shall comprise at least two (2) sensing units (transducers) that are connected via co-axial cables and connected to a signal conversion unit. The signal unit shall be locally programmable and shall be supplied complete with programmer unit. The signal converter shall furthermore have a LCD display for instantaneous flow and totalize flow and shall have a 4-20 mA and pulsed output for remote indications. The signal converter unit will be mounted in an outdoor type cubicle, which will be supplied and installed under the electrical portion of the Contract.

Welding of transducers onto the pipe will not be allowed.

The IP rating for the housing of the transducers shall be *submersible*.

The mountings on the transducers shall be manufactured by stainless steel.

The location of the flow meter installation shall be indicated on the relevant drawings, together with the following general information:

- Pipe outer diameter
- Pipe material
- Pipe wall thickness
- Internal lining
- Average thickness of internal lining
- Fluid to be measured
- Distance between transducers and signal converter

The operating temperature for all equipment shall be minimum -10°C and maximum 55°C.

PLT 3.2 Flow Accuracy

The flow accuracy (velocity) shall be $\pm 1\%$ of reading for pipe diameter greater than 150mm and flow velocities greater than 0.3 m/s. For pipe diameters smaller than 150mm, the flow accuracy shall be $\pm 3\%$.

The overall rangeability or turn-down ratio shall be at least 400:1.

The repeatability for clamp-on transducers shall be 0.2 to 0.5% of full scale reading.

PLT 3.3 Calibration

The Contractor shall allow for the calibration of the flow meter one month after installation by Technology Services International of Eskom enterprises. A certificate of calibration shall be submitted to the Engineer, acceptance of which signifies final completion of the installation.

PLT 3.4 Guarantee Period

The ultrasonic flow meter shall be guaranteed for a period of at least **24 Months** from date of **successful commissioning**.

PLT 4 FLANGED MECHANICAL TURBINE METERS

PLT 4.1 Equipment Preferred

All mechanical turbine meters shall be type Sensus or similar and approved.

PLT 4.2 Accuracy

All mechanical meters supplied in terms of this Contract shall perform to an accuracy of better than $\pm 2\%$ error over the meters operating range i.e. between Q_t (transitional flow) and Q_n (continuous flow). The performance characteristics of the meters offered shall be equal to or better than the values tabled below:

Size (DN) (mm)	Q_{min} (m ³ /h)	Q_t (m ³ /h)	Q_n (m ³ /h)	Q_{max} (m ³ /h)
40	0.3	0.8	40	60
50	0.3	0.8	50	90
80	0.5	0.8	120	200
100	0.8	1.8	230	300
150	1.8	4	450	600
200	4	6	800	1200
250	6	11	1250	1600
300	12	15	1400	2000
400	25	50	2000	3000
500	45	60	3000	4500
600	100	180	3300	6500
800	210	320	6000	12000

PLT 4.3 General Requirements

Meters must be fitted with dry dial registers, which comprise 6 digit cyclometer-type totalizers, registering in kiloliters (kl) or m³. These registers must be sealed to prevent ingress of dirt or moisture. The registers, which are to be fitted as standard, must be able to provide one high frequency opto-type pulse output function and two low frequency reed-type pulse output functions. All flow meters shall be provided complete with frequency converter unit and opto coupler. The frequency converter unit will be mounted in an outdoor type cubicle, which will be supplied and installed under the electrical portion of the Contract.

No consideration will be given to meter types, which necessitate the use of special tools or fitment of any form of gland in the process of connecting pulser units, or, meters which require a register-change to switch from one volume unit per pulse to another. Dismantling of registers for this purpose will not be acceptable. Tenderers are to provide full details of these aspects with their tenders.

Cover bolts must be of stainless steel material to facilitate easy removal of mechanisms. Meter bodies must be coated with a high quality sintered epoxy powder coating, both internally and externally, to provide maximum protection against corrosion.

Although most of the meters will be installed horizontally, it must be possible to install the meters vertically (with flow in the upward direction) or in an inclined position (with flow in the upward direction), should site conditions make this necessary.

Tenderers must provide full details of the minimum lengths of straight pipe required upstream and downstream for each size of meter offered, to ensure that the accuracy of the meters remain within the stated limits, under normal operating conditions. Preference will be given to meter types requiring a minimum of straight pipe upstream and downstream, as installation space and lay lengths are at a premium.

The performance of the meters offered shall not be affected by outside magnetic influences.

Details of head loss across the meters offered shall be provided by the Tenderer.

PLT 5 ELECTROMAGNETIC FLOW METERS

PLT 5.1 General Requirements

All electromagnetic flow meters supplied under this contract shall be for high measuring accuracy i.e. $\pm 0.5\%$ of reading plus 0.05% of full scale. The repeatability or reproducibility of measurement shall be $\pm 0.1\%$ of full scale. The meter shall have a long term zero stability of $\pm 0.2\%$ and linear variation shall be less than 0.2%.

Electrodes shall be manufactured from a high quality metal and shall be removable for cleaning purposes. Removal of electrodes with the line under pressure is preferred.

The minimum downstream and upstream unrestricted straight pipe run required for the specified measurement accuracy shall be stated by the Tenderer.

Although most of the meters will be installed horizontally, it must be possible to install the meters vertically (with flow in the upward direction) or in an inclined position (with flow in the upward direction), should site conditions make this necessary.

The flow meter shall be equipped with a separate mountable signal converter unit complete with sufficient length of signal cable. The signal converter shall be locally programmable and shall be supplied complete with programmer unit. The signal converter shall further more have a LCD display for instantaneous flow and totalized flow and shall have a 4-20 mA and pulsed output for remote indications. The signal converter unit will be mounted in an outdoor type cubicle supplied under the electrical scope of the Contract.

Electromagnetic meters and converters shall be suitable for outdoor installation and shall be adequately protection against lightning.

PLT 6 DIGITAL INDICATOR/INTEGRATOR

The display shall be a 6-digit, 0.56" (14.2mm) High Red L E D, giving a maximum display of 999999. The decimal point shall be selectable.

A flashing display shall be given during totaliser overflow.

The indicator/integrator shall be powered by 230 V AC at 50 Hz.

The indicator/integrator shall be constructed in such a way that it can be calibrated to the required flow and also by means of a selector button, display the accumulated quantity of water released.

The front bezel shall meet NEMA 4/IP65 requirements

The manufacturer of the indicator/integrator shall comply with ISO 9001 and proof of this to be submitted with the tender documents.

The indicator/integrator shall have a lock-out facility to limit operator entry to the programmable settings and totaliser.

The totaliser shall have a programmable time base with a scale factor of 0.001 to 100.0 and a low-end cut-out.

The remote indicator/integrator if required is to be fitted into an IP 66 enclosure in such a way that the flow reading is clearly visible with space available for the labelling and surge protection as specified.

PLT 7 INSTRUMENT PANELS

All panels will comply with the minimum requirements for an IP 65 rating.

All cable entries will be fitted with the appropriate cable gland. All cable glands will comply with IP 68. Each enclosure is to be fitted with an M10 brass bolt and two nuts that will act as an earth bar. All surge protection in the enclosure to be grounded onto this bolt.

a) Local indicator/integrator

An instrument panel is required to house the flow meter power supply unit if required, indicator/integrator and surge protection and shall comply with the following:

1. At least 500 mm high, 400 mm wide and 200 mm deep.
2. Constructed from polycarbonate.

3. The door shall be removable and have concealed hinges and captive, stainless steel hinge pins.
4. Be fitted with a plain painted metal chassis of at least 2.5 mm thick.
5. Be fitted with a polyester internal door for mounting of the totaliser.
6. The external door shall be fitted with a window that allows sight of the totaliser.
7. The external door shall have an extruded polyurethane seal fitted to a groove.
8. Only two closure points that are situated outside the sealed area. At least one of the closure points shall be lockable with a cylindrical barrel type lock and two keys shall be supplied for this lock.
9. Shall be wall mountable with 4 stainless steel brackets giving a space of at least 10 mm between the enclosure and the wall.

b) Remote indicator/integrator (if required)

An instrument panel is required to house the remote indicator/integrator and surge protection and shall comply with the following:

1. Constructed from polycarbonate.
2. The door shall be removable and have concealed hinges and captive, stainless steel hinge pins.
3. Fitted with a polyester internal door or stand-offs for mounting of the totaliser.
4. The external door shall be fitted with a window that allows sight of the totaliser.
5. The external door shall have an extruded polyurethane seal fitted to a groove.
6. Only two closure points which are situated outside the sealed area. At least one of the closure points shall be lockable with a cylindrical barrel type lock and two keys shall be supplied for this lock.
7. Shall be wall mountable with 4 stainless steel brackets giving a space of at least 10 mm between the enclosure and the wall.

PLT 8 SURGE PROTECTION

Single phase 230 V AC medium protection units that are certified to withstand surges of up to 75kA.

Two wire, 230 V AC fine protection units that are certified to withstand surges of up to 40kA.

Two wire, 24 V AC fine protection units that are certified to withstand surges of up to 40kA.

Two explosion proof, pipeline spark gaps rated to withstand surges of up to 100kA, complete with pipeline mounting brackets and a fly lead of at least 300mm.

All surge protection units must be grounded to a common earth point in the panel that houses the ultra-sonic flow meter. If a nut and bolt arrangement is used it shall be at least an M10 and shall be made of brass. Care has to be taken to ensure that the nut and bolt do not negate the IP 65 rating of the enclosure.

PLT 9 SIGNAL CABLE

All signal cable to be 1,5 mm², 4 core, twisted pair, braided screened cable.

PLT 10 EARTHING

The successful Tenderer is to supply 70 mm², stranded copper cable as well as lugs that will fit the cable and an M10 bolt to connect between the equipotential bar and earth mat.

The successful Tenderer is to supply 16 mm², green PVC insulated, stranded copper cable to connect between the common earth at the instrument panel and the equipotential bar.

PLT 11 EQUIPOTENTIAL BAR

An equipotential bar with cover must be suitably mounted within each flow meter chamber. Modular terminals should be provided to accommodate 3 connections of up to 16 mm², 3 connections of 16 - 95 mm² and 3 for flat connections up to 30 mm wide.

PLT 12 LABELS

Two types of labels are required. One for the site and installation name, the other giving details of the flow meter characteristics.

Labels to be manufactured from plastic engraved stock with white lettering on a black base.

Lettering to be 10 or 6 mm high x 5 and 3 mm wide and labels to be at least 105 mm X 30 mm.

All labels to be fitted with at least two strips of 12 mm wide double sided tape that run for the total length of the label.

PLT 13 GENERAL REQUIREMENTS

All screws, brackets, cable saddles, nuts, bolts, washers etc. used in the installation of the equipment shall be from stainless steel.

Before delivery to site all equipment and all parts supplied under this contract will be checked and certified at the supplier's workshop to ensure that they are in working condition by a delegated representative of the client.

PLT 14 COMMISSIONING

The equipment as supplied under this Contract shall be commissioned after **one fault free month** of operation.

If during this month the equipment or any part thereof should fail the successful Tenderer shall repair the equipment at his own expense and once again leave the equipment to operate for one fault free month before commissioning. All costs incurred shall be for the successful Tenderer's account. This cycle to continue until one fault free month has been attained.

END OF SECTION

PT PUMPS

PT 1 SCOPE

This section of the Specification includes the manufacture, testing, protection, supply and off-loading of pumps and base-plates used for the pumping of raw or potable water at ambient temperatures as stated. Pump duties shall be in accordance with the Project Specifications. Electrical motors do not form part of this section of the Specification. This section of the Specification must be read in conjunction with the Project Specification.

This general specification shall be applicable to all pumps. Additional requirements for submersible pumps, axial flow pumps and self-priming-type centrifugal pumps, if required, have been included under clauses PT-7, PT-8 and PT-9.

PT 2 INTERPRETATIONS

PT 2.1 Abbreviations

For the purposes of this Specification the following abbreviations will apply:

BS	-	British Standards Institution
SABS	-	South African Bureau of Standards
DIN	-	German Standards Institute
ISO	-	International Organisation for Standardisation
SIS	-	Swedish Standards

PT 2.2 Standards

Pumps shall comply with this Specification and with the current and most recent issues of the following standards where applicable:

BS 970	Wrought steel in the form of blooms, billets, bars and forgings
BS 1400	Copper alloy ingots and copper and copper alloy castings
BS 3100	Specification for steel castings for general engineering purposes
BS 3468	Austenitic cast iron
BS 4360	Specification for weldable structural steel
BS 4675	Mechanical vibration in rotating and reciprocating machinery
BS 4999	General requirements for rotating electrical machines
BS 5316	Acceptance tests for centrifugal, mixed flow and axial flow pumps

ISO 9906	Hydraulic performance tests of centrifugal pumps
BS 4504	Flanges and bolting for pipes, valves and fittings
SABS 1123	Steel pipe flanges
SIS 05 59 00	Pictorial surface preparation standards for painting steel surfaces

PT 3 MATERIALS

PT 3.1 General

All materials shall possess qualities adequate for the purpose for which they are to be used. All materials and properties claimed for these materials shall, unless specified otherwise in this document, comply with the requirements of the most recent edition of the appropriate South African or other internationally recognised standard specification.

For each type of equipment, the Manufacturer shall indicate the materials used for each of the proposed sub-assemblies. The equipment shall be manufactured using new prime quality materials taking into account the latest technical innovations.

All components shall have a surface finish in relation to their importance, their position and their intended purpose.

Rolled steels and all castings shall be clean and free of blisters, porosity, shrinkage, holes, cracks or other flaws that may be detrimental to their use.

The Tenderer shall indicate in his tender the proposed materials for each component of the assembly.

PT 3.1.1 Castings

No repair of cast components will be permitted without the prior approval of the Engineer.

The filling of casting defects shall be carried out by approved highly qualified welders only, according to approved welding techniques.

Any cast component requiring filling at any fabrication stage after the first anneal shall be subjected to further annealing treatment unless stipulated otherwise.

Cast components shall not be warped or distorted in any way and shall not show any increase in dimensions (beyond that shown on the fabrication drawings) likely to cause interference with other components in the erection of the item of equipment for which they were made. The structure of cast components shall be homogeneous and free of non-metallic impurity. If, at critical points of a cast component, there is too great a concentration of impurities, the component shall be rejected.

PT 3.1.2 Pump Casings

Pump casings shall be of cast iron of at least Grade 220 to BS 1452 or stronger cast steel. The grade of material proposed should be selected appropriate to the quality of water to be pumped as specified in the Project Specification.

PT 3.1.3 *Impellers*

Impellers shall be cast in either phosphor bronze (PBI according to BS 1400 or 1C according to SABS 200), aluminium bronze (AB1 according to BS 1400 or 1E according to SABS 200) or chrome steel (316C11 according to BS 3100, or DIN1.4313), unless otherwise specified in the Project Specification. Cast iron or leaded gunmetal shall not be permitted. Bronze components shall be zinc-free.

PT 3.1.4 *Pump Shafts*

Pump shafts shall be of EN 26 steel to BS 970 or similar.

If a Tenderer wishes to propose an alternative material this should be motivated with details of the benefits to be achieved.

PT 3.1.5 *Stainless Steel*

The stainless steel used shall be of the type easily jointed or fitted by electric welding. Stainless steel which cannot withstand the effects of welding or associated heat treatment will not be accepted. Austenitic grade stainless steel is preferred.

PT 3.1.6 *Fasteners*

Fasteners shall be stainless steel unless otherwise specified.

All high tensile bolts and studs used shall bear the letters HTS stamped or engraved on the end. Washers shall be provided under all bolt heads and nuts. The threads of bolts and studs shall be cleaned and coated with a graphite/grease, copper based or other approved compound before assembly. The threads of all bolts and studs used with the equipment supplied shall be to the same standard. The length of bolts should be such that at least two threads protrude beyond the nuts, but not more than four threads. The threaded end of all bolts must point to the downstream direction of flow.

The Tenderer shall indicate in his tender the materials proposed for each part of assembly.

PT 4 *PLANT*

The Tenderer shall satisfy the Engineer of the sufficiency of the manufacturer's workshops to handle the manufacture, testing and protection of the pumps strictly in accordance with the Specification.

PT 5 *MANUFACTURE*

PT 5.1 *General*

PT 5.1.1 Preference will be given to Pumps with a shaft rotational speed not exceeding 1500 r/min.

PT 5.1.2 Pumps shall be of the highest quality and suitable for continuous operation over long periods with the minimum of maintenance at high sustained efficiency.

PT 5.1.3 End-suction pumps constructed on the back pull-out principle shall be provided with spacer pump motor couplings to enable the pump bearing housing, shaft and impeller to be removed without disturbing the pipework or alignment.

PT 5.1.4 The proposed layout of the pump station is indicated on the drawings accompanying the tender documents. They shall be studied carefully and all alterations to the lay-out, pipework or buildings required to suit the pump offered, shall be set out clearly in letters and drawings accompanying the tender offer. The final layout shall be agreed upon by the Contractor and the Engineer prior to the commencement of manufacture of any of the equipment. Complete work drawings shall be supplied by the Contractor for approval.

All equipment offered as well as all work carried out, shall comply fully with the requirements of the Occupational Health and Safety Act 85/1993 and the Machinery and Operational Safety Act 6/1983.

PT 5.1.5 Taking into consideration specific speed calculations, efficiencies and reliability of the pump sets the proposed pump types shall be justified in the Tender. Double-Suction Axially Split Casing Pumps will be preferred unless otherwise specified in the Project Specification.

PT 5.1.6 Arrangements incorporating multiple pump units coupled in series to achieve the duties specified in the particular specifications will not be favourably considered unless otherwise specified.

PT 5.1.7 The arrangements of impellers shall be such as to reduce the residual axial thrust to a minimum. Designs incorporating a double suction will be preferred.

PT 5.1.8 A design and arrangement of the pump casing which ensures that it is not necessary to disconnect the delivery pipework for the purpose of removing or replacing the complete rotating element will receive favourable consideration.

PT 5.1.9 Suction and delivery details: The orientation of the suction and delivery pipes shall be such as to facilitate maintenance whilst being designed for minimum losses and no air traps.

PT 5.2 Pump Characteristics

PT 5.2.1 The pumps shall have stable, non-overloading characteristics. Closed valve pressure shall be at least 25% higher than the duty pressure.

PT 5.2.2 The Tenderer shall submit with this Tender for each pump offered the following characteristic curves:

with respect to flow (in l/s)

- total head; in metres (0% to 120% of duty flow)
- power absorbed; in kilowatts (50% to 120% of duty flow)
- efficiency; (0% to 120% of duty flow)
- net positive suction head (NPSH) requirements: recommended, 0% head drop, and 3% head drop relative to pump shaft centre line, in the case of horizontal spindle pumps;

with respect to speed:

- torque requirements rated in absolute units.

PT 5.2.3 The Contractor may be called upon to provide further curves at the request of the Engineer, especially for starting and stopping analysis, in connection with surge analysis in the rising mains.

PT 5.2.4 The efficiency curve shall be flat over a wide range in order to provide efficient working with various pump operating conditions. It shall conform to the requirements of the Project Specification.

PT 5.2.5 Unless specified to the contrary, the proposed pumps shall be able to operate without perceptible signs of cavitation in the full range of the operating envelope specified, pump sets running singly or in parallel. Throttling shall not be allowed. Should there be any doubts, the Contractor shall be called upon to carry out an inspection of the pumps and carry out NPSH tests to prove the equipment, at the Contractor's expense. If the pumps are found to be faulty, the Contractor shall be given a 8 weeks to remedy the problem. Thereafter if the Contractor is unable to resolve the problem it shall be cause for rejection.

PT 5.3 Pump Castings

PT 5.3.1 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.

PT 5.3.2 The inspection and testing of castings and test bars shall be in accordance with BS 3100.

PT 5.3.3 The dimension and drillings of the suction and discharge flanges integral with the pump casings shall be to SABS 1123 to design pressures specified.

PT 5.3.4 The pressure rating of the delivery flanges shall be at least equal to the maximum suction static pressure, plus the pump shut-off pressure. The minimum pressure rating of the flanges shall be 1 MPa (10 bar).

PT 5.3.5 All pump casings shall be hydrostatically tested at the Manufacturer's workshop and in the presence of the Engineer or his Representative. The test pressure applied shall be equivalent to 1,5 times the pump shut off head, or alternatively twice the duty head specified, which ever is the greater.

PT 5.3.6 Suitable lifting rings shall be provided on the casings.

PT 5.3.7 The pump casings should be fitted with suitable replaceable stationary bronze wear rings. These wear rings should be appropriately heat treated for operation in conjunction with the impeller, or impeller wear ring material selected.

PT 5.4 Impellers

PT 5.4.1 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.

PT 5.4.2 All water passages shall be machined to a smooth finish. Water passages which cannot be machined shall wherever possible be hand ground and filed to template.

PT 5.4.3 Each impeller shall, after final machining and dressing, be independently statically balanced and the completely assembled rotating element with coupling shall be dynamically balanced.

PT 5.4.4 The first critical speed of the rotating element shall be at least 1,3 times the running speed.

PT 5.4.5 All impellers shall be fitted with wear rings of same material as approved for impellers. These rings shall be secured to the impeller non-corroding screws and be mechanically locked.

PT 5.5 Pump Shaft, Sleeves and Diffusers

PT 5.5.1 Pump shafts shall be of an approved material, and of sufficient dimensions to transmit the power to which they will be subjected without undue torsional or bending stresses and deflection.

- PT 5.5.2** The shafts shall be stress-relieved after initial machinery, and ground to final size.
- PT 5.5.3** 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.
- PT 5.5.4** 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.
- PT 5.5.5** The shafts shall be adequately protected with replaceable sleeves of an approved bronze or other similar approved non-corrodible material at all areas where wear and/or corrosion could possibly be expected. The replaceable shaft sleeves exposed to the pumped water shall be manufactured from a material compatible with the impeller material selected. These sleeves shall be readily removable without causing damage to either the shafts or the sleeves.
- PT 5.6 Shaft Coupling**
- PT 5.6.1** The pump and motor shall be connected by a flexible coupling in such a manner that it shall not uncouple whichever way the impeller maybe rotating.
- PT 5.6.2** The coupling shall accommodate small axial, lateral and angular misalignments without imposing undue stresses on the shaft and bearings. Refer to PT8.3.
- PT 5.6.3** The coupling shall be enclosed in a stationary solid-plate guard to the Engineer's satisfaction.
- PT 5.7 Pump Bearings and Lubrication**
- PT 5.7.1** *Bearings and Lubrication*
- If anti-friction bearings are fitted a design life of at least 40 000 operating hours is required. The bearings in the pump casing together with its lubricating systems shall be suitable for the particular circumstances. The particular type and system offered by the Tenderer shall be fully specified.
- PT 5.7.2** The pump rotating element shall be positively located in the axial direction. If specified, thrust bearings shall be of the tilting pad-type (Michell or similar).
- PT 5.7.3** Journal bearings consisting of white metal lined bronze sleeves split on the horizontal centre-line and lubricated with an oil ring shall be preferred.
- PT 5.7.4** All bearings shall be suitable for shaft rotation in both directions.
- PT 5.7.5** Preferably the same type of bearing will be chosen for motor and pump.
- PT 5.7.6** If not, the necessary allowance shall be made when aligning pump and motor.
- PT 5.7.7** Adequate provision shall be made for the cooling of oil for bearings, particularly as the pumps may run continuously in ambient temperatures of the order of 40°C.
- PT 5.7.8** Oil reservoirs of sufficient capacity shall be fitted with easily accessible oil level indicators, clearly marked to indicate the standing and running oil levels.
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PT 5.7.9 All internal surfaces in continuous contact with the lubricating oil such as oil reservoirs, piping, etc, shall be thoroughly cleaned either chemically or by shot blasting and protected by a method to be approved by the Engineer until such time as the system is charged with oil. No site welding of oil circulating pipes will be permitted.

PT 5.7.10 The entire lubricating system shall be fail safe with alarms set to indicate automatic change-over to the stand-by unit.

PT 5.8 Glands and Seals

PT 5.8.1 Reliability

Reliability of glands is of prime importance. Pumps incorporating low pressure glands where the pressure at the glands does not exceed the main suction supply pressure will be preferred to pumps with shaft glands exposed to higher pressures.

PT 5.8.2 Glands

Low pressure glands of the conventional stuffing box pattern utilising packing rings one each side of lantern rings will be acceptable for the first stage of the pumps. Lantern rings shall be easily removable. The shaft sleeves shall be ground with a polished finish on the wearing surface, and the gap between the sleeve and the follower shall be such that the packing will not be extruded into the gap. Make and type of packing shall be to the approval of the Engineer.

PT 5.8.3 It will be the responsibility of the Contractor to provide filters if the quality of the water necessitates filtration. The flow of water to or from the glands shall be clearly visible.

PT 5.8.4 Mechanical seals

If mechanical seals are called for, they shall require no separate water supply and shall be suitable for the water to be pumped. Seal selection shall be done in collaboration with the seal manufacturer and proof that this has been done may be requested.

If, in the opinion of the seal manufacturer, the quality of the water is such that a flush would be required to the seals, Tenderers are required to provide for a suitable system. Such a system shall be self-contained and inclusive of all necessary separators, filters, connections and auxiliary pipe work to provide the required flow to the seals at the appropriate pressure. The auxiliary pipe work and fittings should be in a suitable grade of stainless steel.

Mechanical seals shall be balanced and proved to be suitable for the water pumped. Spare wearing components shall be supplied and delivered when the pump is installed, the cost being included in the price of the pump.

PT 5.8.5 The Tenderer shall supply with his Tender, full details of all pump seals and glands incorporated showing clearly all proposed materials, finished clearances, etc.

PT 5.9 Pump Vent and Drain Fittings

PT 5.9.1 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. Stainless Steel pipes shall be neatly led from priming cocks, gland and casing drain points to a suitable main tundish. Galvanised drainage pipeworks of adequate size shall be provided and installed to collect the waste water from each pumpset and to lead it to the drain leading to the pumphouse sump.

PT 5.10 Base-plate

PT 5.10.1 The pump and motor base-plate shall be rigid. The upper face of each base-plate upon which the pump and motor are located, shall be machined flat and smooth to ensure that the pump is supported properly directly to the base-plate, without the use of spacers. Provision must be allowed to align the motor correctly to the pump through the use of suitable shims or spacers, the combined height of which should not exceed 3 mm. Drawings of baseplates shall be submitted for approval before manufacture.

PT 5.10.2 For every motor, two jacking bolts at right angles with a lock nut shall be provided at every corner.

PT 5.11 Monitoring Devices

PT 5.11.1 Unless specifically stated in the Project Specification, one or more of the following monitoring items shall be required:

Full details of the sensing equipment (thermocouples, etc.), and of the associated control and monitoring or indicating equipment shall be submitted with the tender offer. Evidence shall also be submitted that adequate spares and services are readily available in this country.

PT 5.11.2 Temperature Sensors

Either thermocouples or resistance temperature detectors shall be installed, depending on which is more suitable to the duty and application.

Location of temperature probes:

- a) Separate temperature probes shall be installed at the sleeve and/or rolling bearings of each pump and motor and at the gland housings of the pump to monitor the temperatures at these points.
- b) The probes shall be spring-loaded to ensure positive contact with the bearing shells or gland stuffing boxes.
- c) Each probe shall be clearly identified by means of an engraved marking on the sheath and shall be individually calibrated. Test certificates covering the calibration results of all temperature probes shall be submitted to the Engineer.
- d) Temperature detectors offered, shall be suitable for operation in conjunction with temperature indicating, monitoring, alarm and trip equipment of Conlog or equivalent design.
- e) If grease lubricated bearings are offered, the Tenderer shall indicate if temperature detectors can in fact be used. If temperature detectors are not feasible, the Tenderer shall indicate alternative means of monitoring bearings.
- f) Pockets for standard mercury filled glass thermometers shall be provided adjacent to all pockets serving temperature indicating instruments. Pockets for standard thermometers shall have chained covers to prevent the ingress of dirt when not in use and shall be so arranged as to permit the accurate measurement of the bearing temperature. The pockets shall contain a small amount of oil and shall therefore be orientated within 30° of the vertical, horizontal pockets are not acceptable.
- g) Each pump casing shall be fitted with a thermo switch, Fenwall, or equal approved make to safeguard the pump in the event of inadvertent sustained operation against a closed

discharge valve. The thermo switches shall be calibrated to close when the temperature of the water in the pump casing exceeds 40°C.

PT 5.11.3 Pressure gauges

- a) Each pump set shall be equipped with two 150 mm dial diameter flush mounting pressure gauges. The gauges shall be calibrated in kilopascal and the angle shall suit the particular application. The gauge shall be filled with glycerine, and the bubble shall be out of the range of usual reading. The gauges shall be of a type that is possible to recalibrate (dead-weight method) and reset on Site.
- b) These meters shall indicate water pressure in kilopascal and shall have a range at least 50% higher than the normal duty point. However, in all cases the gauges must have a range at least 30% higher than the shut off, or maximum, head which the pump is capable of generating with the system conditions taking into consideration the maximum static suction pressure possible.
- c) The meters for the suction side of pumps shall be compound gauges and shall be capable of indicating a negative pressure of up to 100 kPa. However, in all cases the gauges must have a range at least 30% higher than the maximum static suction pressure possible.
- d) All pressure gauges shall be supplied and installed complete with isolating Steel cocks, copper or stainless steel piping, etc. and fitted with a pulsation snubber in stainless steel.

Due to the quality of the water, those submitting tenders should satisfy themselves of the reliable operation of the gauges. Where necessary they must include for the pressure gauges to be fitted with diaphragms. Pipes to pressure gauges neatly supported between tapping point and pressure gauge. Pedestals to the Engineer's approval shall be supplied at a suitable position to house the pressure gauges.

PT 5.11.4 Pump set vibration sensors

- a) Suitable vibration sensors shall be mounted on each pump set to stop it on detection of excessive vibration. The sensors shall be situated as close as possible to those bearings where the highest vibration levels are encountered.
- b) The monitoring of vibration shall be made via a suitable timing device in order to avoid tripping when starting the pump set or during other transitory conditions.
- c) The pumps shall comply with the requirements of BS4999.

PT 5.11.5 Automatic air vents

If an automatic air vent is specified for the pump casing, it shall be fitted with an indicator to show the open and closed positions of the air vent. The air vent shall be suitable for remote operation and the control of the air vent shall be mounted on the control panel inside the pump house.

PT 5.11.6 Gland leakage detection

A device to monitor gland leakage shall be supplied and fitted with adjustable alarm contacts designed to close when gland leakage rises to a pre-set value.

PT 5.11.7 Wear limit switch

Multistage pumps should be fitted with a wear limit switch to protect the pumps against damage after normal wear of the wearing rings have taken place after a period of operation.

PT 5.12 Corrosion Protection

PT 5.12.1 Internal protection

Final coat colours to be confirmed by Engineer prior to delivery to Site. Submersible pumps shall preferably be FBE protected.

All traces of rust, slag, silica or other contaminants shall be removed by mechanical wire brushing. Abrasive blast clean all interior surfaces to SA 2½ (near white) metal finish to the Swedish Standard SIS 05 59 00. The blast profile shall fall within the limits 40 - 60 microns.

A thorough vacuuming of the interior surface shall be carried out to remove all traces of the abrasive grit before application of internal surface finish.

Apply by brush, or airless spray, three coats of an approved two part epoxy coating, or equivalent, to give a dry film thickness of between 50 and 70 microns per coat. The intermediate coat shall be a different colour to the first and final coats. The total minimum dry film thickness for the complete system shall not be less than 150 microns.

PT 5.12.2 External protection

All sharp edges, laminations and protrusions shall be removed by mechanical grinding, whereafter all traces of rust, slag, silica or other contaminants shall be removed by mechanical wire brushing. The entire surface shall be degreased using a suitable water emulsifiable degreaser. Surfaces shall be left clean and dry prior to coating.

One coat of zinc phosphate high build primer shall be applied (Plascon Code UC 183 or similar) by airless spray to a dry film thickness of 75 µm, and left 8 hours to dry.

The primer shall be followed by one coat of universal undercoat, (Plascon Code UC 1 or similar) applied by brush, roller or airless spray to a dry film thickness of 30 µm. This coat shall be left to dry for 16 hours.

The final coat shall be one coat of universal gloss enamel, (Plascon Code G or similar) applied by brush, roller or airless spray to a dry film thickness of 25 µm. This shall be left to dry for 20 hours. Colour will be as directed by the Engineer.

PT 5.12.3 Designation and Information Plates

Each pump shall be supplied with an information plate - preferably chromium plates - secured to the pump casing in a visible position indelibly marked with the following details :

- Maker's name, pump type and serial number
- Year of manufacture
- Rated duty of pump in litres per second
- Head in metres at rated duty
- Pump speed in revs per minute
- Impeller diameter
- Mass of completely assembled pump in kilogram
- Types and sizes of Bearings
- Letters and figures shall be engraved, or embossed, not stamped

PT 5.13 Inter-changeability

Where two or more similar pumpsets are required, the pumps and motors shall be interchangeable in all respects.

PT 5.14 Operating and Maintenance Manual

Three copies of the Operating and Maintenance Manual shall be supplied by the Contractor not later than at the time of commissioning of the installation. This manual will be a prerequisite for commissioning of the plant and a separate manual shall be compiled for each installation.

PT 5.14.1 Contents

The manual shall cover the following aspects in detail, with illustrations and drawings:

- a) Index: Each volume shall have an index following the title page. If there is more than one volume, the first volume shall contain a master index.
- b) A Brief description of the plant and installation.
- c) Pre-commissioning checks: These shall be clear, concise, easy to follow and shall include pre-start checks (e.g. check oil and water, remove locking pin, etc.), safety checks (e.g. personnel cleared from vicinity of water outlets, guards in place, etc.).
- d) Detailed operating instructions: These shall be clear concise, easy to follow and shall include starting procedure, running checks (e.g. no vibration, pressures normal), shut-down procedure, emergency shut-down procedure and action to be taken in response to alarm signals.
- e) Proposed preventative maintenance schedules and programme covering all plant and equipment; the Maintenance chart.
- f) Fault diagnosis and repair procedures: These shall include details of all servicing, replacement and repairs which Artisans or Operating personnel would be expected to carry out on Site. In this section the reader may be referred to suppliers brochures elsewhere in the Manual for specific detail.
- g) Schedule of manufacturing drawings.
- h) Detailed schedule of plant components giving material specifications, part numbers, etc. Where possible, drawings shall be positioned opposite the appropriate text.
- i) Sub-contractor's/Supplier's brochures and instructional literature.
The requirements for the Operation and Maintenance Manual for electric motors are covered elsewhere.
- j) Mothballing procedure.
- k) Schedule of lubricants.

PT 5.14.2 Non availability

Commissioning will not be performed and payments will be deferred if complete. Operating and Maintenance Manuals are not available at the time of commissioning.

PT 5.15 Drawings and Documentation

PT 5.15.1 Drawings

The drawings included in the Tender Documents are the Engineer's proposal for the plant lay-out. Proposed alternatives by the Tenderer indicated on drawings submitted by the Tenderer, shall be considered in allocating the contract. General arrangement drawings must be provided for all equipment.

PT 5.15.2 Before any work is carried out by the Contractor and within six weeks after date of order, the Contractor shall submit detailed working drawings to be approved by the Engineer. Approval of these drawings does not relieve the Contractor from his responsibility for the correctness of the drawings.

PT 5.15.3 Fully dimensioned outline and layout drawings of all plant and equipment shall be supplied including ancillary equipment, giving fully particulars as to the sizes and positions of all anchor bolts, bolt holes and other recesses; vents and drains; oil, gland or cooling and service water; anchor blocks, supports, foundations and embedded parts, including all necessary clearances around items of equipment and the lifting requirements and any other information which may effect the construction of the Pump Station structure.

PT 5.15.4 The magnitude and direction of the thrust forces to be resisted by the foundations or anchor blocks shall be clearly given.

PT 5.15.5 Detailed dimensioned outline drawings of each electric motor, junction box and control console shall be included, showing the position of each panel, clearance space required and the height of each cable gland above the floor.

PT 5.15.6 The above-mentioned information shall be binding once it has been approved by the Engineer. All costs due to alterations made after this approval will be invoiced to the Contractor. The Contractor will be required to formally approve the civil and electric cable routing drawings made by others.

PT 6 TOLERANCES

The tolerances as specified in the Project Specification or the appropriate SABS or BS Standards, shall apply.

PT 7 SUBMERSIBLE PUMPS

PT 7.1 Equipment required

The number and position of all submersible pump sets to be supplied under the Contract shall be stated in the Project Specification.

PT 7.2 Pump/Motor Unit Design and Construction

The pump and motor shall be fully submersible in up to 40 m deep water and shall be a single unit with no shaft coupling between the pump and motor. The pump unit shall automatically and firmly connect to a special discharge connection. The pump, attached to a chain, shall be guided down from the top of the station by two guide bars to the discharge connection at the bottom of the wet

well. There shall be no need for personnel to enter the wet well to secure the pump in position. Sealing of the pump unit to the discharge connection shall be accomplished by a machined metal-to-metal watertight contact or o-ring type seal situated in the pump discharge flange for ease of replacement. No portion of the pump/motor unit shall require any support directly on the floor.

Pump casing shall be from grey cast iron to BS 1452 Grade 260 with smooth surfaces devoid of blow holes or any other irregularities. The pump volute shall be non concentric in design with smooth passages large enough to pass solids and foreign material as indicated in the Project Specification. All bolts, nuts and washers shall be of 304 Stainless Steel. All external and internal metal surfaces in contact with the pumped liquid excluding Stainless Steel or brass, shall be corrosion protected in the factory by epoxy paint or powder coating as described in the Project Specification or General Corrosion Specification.

Sealing design of major components shall incorporate metal to metal contact between machined surfaces. Critical mating surfaces where watertight sealing is essential shall be machined for and fitted with O-rings. Fittings will comprise controlled compression O-rings in two planes and O-ring contact of four sides without the requirements of a specific torque limit. Rectangular sectioned gaskets requiring a specific torque or the use of sealing compounds shall not be considered.

PT 7.3 Cooling System

The fully submerged motor shall be adequately cooled by the surrounding liquid without the need for external cooling liquid.

If required in the Project Specification, a water jacket shall encircle the stator housing of the motor, thus providing heat dissipation for the motor in case of the motor not being completely submerged in liquid. Impeller back vanes shall provide the necessary circulation of the liquid through the water jacket. The cooling media channels and ports shall be non clogging by virtue of their dimensions. External cooling and seal flushing shall also be provided. The cooling system shall provide for continuous pump operation in ambient temperatures of up to 40°C.

PT 7.4 Cable Entry Seal

The cable entry seal shall be tight for a depth of up to 40 metres. The cable(s) shall preferably enter the motor terminal chamber through a loose cast iron sleeve which shall be attached to the cable end in the factory. All cavities between the four cores of the cable and the inside of the sleeve shall be completely filled with approved resin. The sleeve shall have at least a single groove for an o-ring machined into its outer surface. This sleeve shall fit into a machined cavity in the motor terminal chamber and a watertight seal shall be provided by the O-ring. The sleeve shall be equipped with a flange and shall be held in place by Stainless Steel bolts with washers.

Alternative cable entry seal systems may be considered. Details of the cable entry seal shall be provided in the tender offer.

PT 7.5 Bearings

The pump/motor shaft shall rotate on two permanently greased bearings. The non locating upper bearing shall be a single row roller bearing. The lower bearing shall be a double-row angular contact locating bearing to compensate for any axial and radial forces.

PT 7.6 Mechanical Seal

Each pump shall be provided with a tandem mechanical shaft seal system between the pump and motor, consisting of two independent seal assemblies. Seals shall operate in an oil reservoir that hydrodynamically lubricates the lapped seal surfaces at a constant rate. The lower primary seal unit located between the pump housing and the oil chamber, shall contain one stationary and rotating corrosion resistant tungsten carbide ring. The upper unit located between the oil chamber and the motor housing shall contain one stationary and one rotating corrosion resistant tungsten carbide ring. Each seal interface shall be held in contact by its own spring system. The seals shall require neither maintenance nor adjustment. It shall not depend on direction of rotation for sealing. For special applications other seal face materials shall be available. Each pump shall be provided with an oil chamber for the shaft sealing system. The drain and inspection plug shall be accessible from the outside.

PT 7.7 Pump/Motor Shaft

The pump and motor shaft shall be a single unit. The pump shaft is an extension of the motor shaft and shall be from 304 Stainless Steel or EN54 or better. The shaft shall not be in contact with the pumped liquid.

PT 7.8 Impeller

The impeller shall be of 304 Stainless Steel or better and shall be dynamically balanced. The impeller shall be double shrouded and non-clogging. Impellers shall be capable of handling silt, solids and other matter found in the pumped liquid (see the Project Specification for details). Where possible a full vaned, non-vortex type impeller shall be used for maximum hydraulic efficiency, thus reducing operating cost. The impeller shall be keyed to the shaft, retained with an Allen bolt in the impeller. The inertia of the rotating unit shall be provided.

PT 7.9 Wear Rings

An easily replaceable wear ring system shall be used to provide sealing between the volute and the suction inlet of the impeller. The casing wear ring shall be made of brass and shall be held in position by press fit or Allen screws. The impeller wear ring shall be fitted to the suction inlet of the impeller and shall be made of the same material as the impeller. The ring shall be held in position by heat shrink fit or Allen screws.

PT 7.10 Ancillary requirements

Any/all ancillary requirements and additional mechanical items shall be stated in the Project Specification.

PT 8 AXIAL FLOW PUMPS

PT 8.1 Equipment required

The number and position of all submersible pump sets to be supplied under the Contract shall be stated in the Project Specification.

PT 8.2 Impeller

The maximum rotational velocity of the pump impeller shall be submitted with the tender. After assembly of the finished impeller, shaft and mounting flange but before dispatch to Site, the assembled unit shall be dynamically balanced at twice the maximum operating speed of rotation and in addition shall be tested for centricity and correct angular attachment of impeller and flange to shaft, all in the presence of the Engineer or his representative.

PT 8.3 Bearings

All bearings shall be designed for a life of at least 100 000 hours at a B10 rating. In addition, the bearings on the output shaft shall be capable of withstanding the resultant forces caused by the combination of radial and axial loads (imposed by the stirrer) acting simultaneously, and shall be selected such that the following condition is complied with:

$$\frac{\text{actual radial load}}{\text{permissible radial load}} + \frac{\text{actual axial load}}{\text{permissible axial load}} = \text{less than } 1,0$$

(where the 'permissible' loads are the manufacturer's figures for 5 000 hours at a B10 rating).
Tenderers shall indicate what these forces are and how they are accommodated.

Casings shall be made of close grained cast iron and shall be designed such as to prevent moisture from entering.

PT 8.3 Bolts

Holding down bolts and jacking bolts which are to be built into concrete work for securing the plant shall be supplied and installed under this section of the Contract. Grouting up of these bolts will be done by the construction contractor after completion of the setting up of the plant by the Contractor under this Contract.

PT 9 SELF PRIMING CENTRIFUGAL PUMPS

PT 9.1 Equipment required

The number and position of all submersible pump sets to be supplied under the Contract shall be stated in the Project Specification.

PT 9.2 General requirements

The pumps shall be of the self-priming centrifugal type and shall be horizontally mounted and fitted with a Vee-belt drive assembly. The speed shall not exceed 1 450 rpm.

The casings of the pumps shall be high quality close grained cast iron to BS 1452. Means shall be provided in the casing to gain complete access to the pump interior to permit the clearance of blockages and to provide simple access for service and repairs.

All openings, internal passages and internal recirculation ports shall be large enough to permit the passage of a sphere 75 mm in diameter.

The pump shaft shall be contained within a bearing pedestal of ample size to contain heavy duty ball thrust bearing and radial bearing of adequate size to withstand all imposed loads. The bearing shall be oil lubricated, with the bearing pedestal cooled by pumped liquid.

The pump shaft shall be sealed against leakage by a mechanical seal. The seal faces and seat shall be self-aligning.

An air release system shall be provided to release air from the pump casing at its highest point and the pipe shall discharge into the sump. This is to be made of resistant material to the corrosive atmosphere of sewage.

The pumps shall be mounted on base plates of rigid construction, provided with suitable openings for pouring in grout and all necessary holding down bolts to secure the foundations. Concrete work will be finished to approximately 20 mm below the underside of the base plate and when erecting the pump and motor, the Contractor shall arrange for setting each unit to exact line and level by means of steel wedges. Thereafter the contractor will grout in the holding down bolts and grout the base plate to the satisfaction of the pump supplier.

PT 9.3 Ancillary requirements

Any/all ancillary requirements and additional mechanical items shall be stated in the Project Specification.

PT 10 INSPECTION, TESTS AND COMMISSIONING

PT 10.1 General

PT 10.1.1 Contractors shall, if requested make available for inspection, their internal Quality System Manual, their Standard Procedure Manual and their Works Instructions. Preference shall be given to Contractors who have been audited and found to satisfy the requirements of the ISO 9000 Quality system.

PT 10.1.2 Inspection and tests required of the Contractor include the tests and inspections in the workshops and the inspections and tests at Site.

PT 10.1.3 Depending on the results of the tests and inspections, penalties may be applied and, in certain cases, part or all of the equipment may be rejected, as set out hereinafter.

The cost of all tests and inspections shall be included in the Tender. For instance, the cost of commissioning and testing at Site shall be stipulated in the Price Schedule under the section provided or included as part of the cost of erection. (Except for the cost of power and water consumed.) No claim for travelling expenses or further time required for testing will be allowed.

PT 10.1.4 Tenders shall fully acquaint themselves with the properties of the water to be pumped. Any wear of portions of the pump or ancillary equipment that will affect its operating efficiency during the Period of Maintenance will result in the pump set being rejected.

PT 10.1.5 Signs of cavitation pitting on pump parts will not be acceptable.

PT 10.1.6 Leakage from any oil, water or air circuit will not be acceptable.

PT 10.1.7 Leakage at the glands shall be controlled to the minimum required and drained to the Pump Station sump.

PT 10.1.8 Operation of pumps shall be free from undue vibrations throughout the full range of normal running conditions. Vibration levels should not exceed the limits determined by VDI 2059 for good vibration behaviour.

PT 10.1.9 In no case shall temperature-rise above the ambient temperature reach or exceed 40°C for any mechanical component. For temperature-rise of bearings see Clause PT 5.7.7.

- PT 10.1.10** In the case of routine tests concerning standard equipments or material quality control tests, not attended by the Engineer or his Representative, tests reports or certificates in duplicate shall be submitted to the Engineer.
- PT 10.1.11** The Contractor shall notify the Engineer or his Representative in writing two weeks in advance, of the place and dates at which the equipment may be inspected and tested.
- PT 10.1.12** The Engineer or his Representative will inform the Contractor of his intention to attend the test or the inspection and propose a date which suits him. If the date preferred by the Engineer is later than ten days after the first possible date, the Contractor shall be entitled to perform the test or inspection without the presence of the Engineer.
- PT 10.1.13** If on any agreed date the equipment to be inspected or tested is not ready and the test or inspection has to be postponed the Contractor shall be held responsible for the travelling and/or living expenses of the Engineer and/or his Representative.
- PT 10.1.14** When tests and inspection have met the satisfaction of the Engineer or his Representative a certificate of Workshop Acceptance will be issued by the Engineer. The Contractor shall not pack and dispatch to Site any equipment before receiving the relevant "Certificate of Workshop Acceptance."
- PT 10.1.15** The Engineer's acceptance shall in no way relieve the Contractor of any obligation with regards to the Specification.
- PT 10.2 Tests**
- PT 10.2.1 Performance tests**
- Each pump complete with its driving unit shall be tested at the Manufacturer's works, or other location approved by the Engineer to "Class B" requirements of BS 5316 Part 2, and the efficiency carefully measured. Variations from the actual running conditions of the pumps are allowed as defined in the standard. Unless otherwise explicitly mentioned, cavitation tests are required at works.
- PT 10.2.2** The tests shall be witnessed by the Engineer or his Representative and details of the tests and the results obtained, duly signed by the appointed Witness, shall be submitted to the Engineer before despatch of the pumping units from the Manufacturer's workshop.
- PT 10.2.3** The rotating elements of the pumps and motors shall be dynamically balanced before assembly. The residual unbalance should be better than ISO 1940 grade G 6.3. The good balance of the whole pump set will be checked by measuring the absolute vibration on pump and motor bearing housings.
- PT 10.2.4** Tests shall be performed with the pump set on sound foundations, similar to those expected at Site.
- PT 10.2.5** Measurements shall be taken in the three axes at each bearing, i.e. axial and two radial components at right angles to each other.
- PT 10.2.6** Performance and vibration tests as described above are to be performed before installation on Site for all pump sets larger than 22 kW. If these tests are impractical or impossible at the pump manufacturer's works, Tenderers must state this in their Tender and explain the reasons why it is so. The Engineer may be prepared to consider alternative proposals for testing provided these proposals are submitted with the Tender and are clearly described and defined. If this is not done, the Tenderer will arrange to have the tests performed in another workshop at his cost.

PT 10.2.7 All pieces of equipment subject to water, oil or air pressure shall be pressure tested at a pressure not less than one and a half times the design pressure.

PT 10.2.8 Each piece shall withstand the hydrostatic test pressure without exhibiting signs of sweating, undue deformation and stressing, or defect of any kind.

PT 10.2.9 Hydrostatic testing shall be done with blank flanges bolted on the flanges of the piece. The use of tie-bolts or other forms of restraint applied across the blank flanges to restrain the bodies from deflecting under the applied test pressure will not be permitted without the Engineer's approval.

PT 10.2.10 The hydrostatic test pressure shall be maintained for a period of at least 10 minutes.

PT 10.3 Performance Test Results

PT 10.3.1 At Works

- a) The overall percentages of efficiency as calculated from the tests should not be less than the appropriate guaranteed figures at the duty points by more than 3%.
- b) The measured flow rates should not differ from the guaranteed deliveries at any point other than the duty points on the characteristic curves as supplied by the Tenderer by more than 5%.
- c) The NPSH requirement should be met for the specified duty point. Where requested by the Engineer additional tests will be required to demonstrate the pump performance at run out conditions, or where the NPSH available is critical.
- d) Peak to peak vibration displacement shall not be more than 10% higher than the required displacement.
- e) The Contractor will be allowed a period of four weeks to carry out any amendments to the plant which he may consider necessary to meet the guaranteed figures. Any period granted for design amendments shall not extend the Contract Period.
- f) Further tests shall then be carried out at the Contractors expense and if the test results in question are still not within the limits specified, the Engineer shall have the right to:
 - either reject the entire plant and recover all monies already paid to the Contractor,
 - or, let the Contractor continue with the installation of the pump sets which may be subjected to penalties or rejection as defined hereinafter when the performances tests at Site are performed.

PT 10.3.2 At Site

At the time of performance tests at Site:

- should the test results obtained for either efficiency, flow rate, NPSH or vibration still vary beyond the limits indicated in clause PT 7.3.1 above, the Contractor will again be allowed a further four weeks to make such amendments as may be considered necessary and if after these amendments have been made the test results in question are still not within the figures which have been guaranteed, the Engineer reserves the right, according to circumstances, to reject the plant entirely.

- any other discrepancies, abnormal wear or malfunctioning of plant which may be observed during the Acceptance Tests shall be corrected by the Contractor without delay.
- the date of completion shall be the date on which the Acceptance Tests at site have been satisfactorily completed and the plant is in a fully operational state in accordance with the Specification.

PT 10.3.3 Any period granted for design amendments shall extend the Period of Maintenance by a corresponding amount.

PT 10.4 Commissioning

(See pro-forma form to be completed, bound in at the back of the Project Specification).

- a) On completion of mechanical and electrical erection and as soon as water is available and other circumstances permit, the Contractor shall arrange for the commissioning of all units of the pumping plant in the presence of the Engineer. The Contractor shall ensure that his equipment is suitably prepared before giving the Engineer fourteen days notice in writing of the date of commissioning.
- b) Before the commissioning, the Contractor shall satisfy himself and subsequently prove to the Engineer that all items on the following checklist have been checked and are functioning correctly:
 - Visual check of general appearance of plant.
 - Check power supply to motor available.
 - Determine the direction of rotation.
Remove coupling.
Correct if necessary.
 - Check if pump is turning freely by hand.
 - Check axial float of pump.
 - Check thermocouple operation/calibration if required.
 - Check if pump requires gland packing (Mech. seal flushing).
 - Check pumps and motors for correct grade and quantity of bearing lubricants (oil/grease packed).
 - Alignment of pump and motor.
 - Suction isolating valve open (bypass open).
 - Control valve/reflux valve closed.
 - Delivery isolating valve open.
 - Check if discharge line is full of water.
 - Bleed off air on pump and pipe works.
 - Cooling water flow to bearings if installed.
 - Check balancing water if required.
 - Monitoring and operating equipment are functioning correctly.
 - Test run of pump.
 - a) Number of recommended start - stop of motor.
 - b) Bearing temperature (motor and pump).
 - c) Pump speed.
 - d) Suction pressure.
 - e) Discharge pressure.
 - f) (Volts) (Amps) (kW).
 - g) Quantity pump is pumping.
 - h) Vibration levels.

- i) Rundown time of pump and motor.
- j) Simulate an emergency shut-down of pump.
- k) Check pump and pipework for water tightness.

NOTE: The Contractor to ascertain from the Pump Manufacturer whether the items on the check list are sufficient for the successful commissioning of the pumpsets.

- c) The pumpsets shall be run without interruptions separately for at least 4 hours or such further time as may be required to reach stable operating conditions (particularly, motor temperatures shall be stable).
- d) If the prescribed duration cannot be achieved, the initial commissioning shall take place at a date to be agreed upon by the Contractor and the Engineer. It is to be borne in mind that the penalties for late delivery shall be linked with the initial commissioning.
- e) After the above commissioning, the plant shall be run under approved supervision for not less than two months before the Acceptance Tests are conducted. The Contractor must satisfy himself that the operators are in a position to operate the plant safely and correctly should he be absent from Site during this period.
- f) Commissioning shall not be considered to be complete until complete O&M manuals have been supplied and the plant is capable of continuous operation by fully trained operators of the Employer and until two months have elapsed and the plant has passed the Acceptance Tests as specified.
- g) The Acceptance Tests shall be performed only if and when every item of the whole Contract is fulfilled and if and when each piece of equipment, including the monitoring and control devices, is working properly. The Engineer is entitled to postpone the Acceptance Tests if any part of the Contract is not to his satisfaction or if the plant has not been successfully operated for at least 200 hours.
- h) The Certificate of Commissioning for the equipment is issued by the Engineer only when the results of the Acceptance Tests, recorded in a report prepared and submitted by the Contractor, are found satisfactory.
- i) Final Operation and Maintenance Manuals shall be made available before the Certificate of Commissioning is issued.
- j) The Defects Liability Period (or Guarantee Period) commences at the date of the Certificate of Commissioning.
- k) During the first 14 days of operation of the scheme, the Contractor shall be on site to rectify any problems with the scheme within 24 hours of being telephonically notified. During the remainder of the maintenance period, the Contractor shall within 14 days of being notified, commence rectifying any possible problems that the Employer may encounter with the equipment supplied under this Contract.
- l) Should the Contractor fail to meet the above requirements, the Employer may appoint others to undertake the necessary repair work at the Contractor's cost.
- m) After the satisfactory conclusion of the Acceptance Tests on Site and the issue of the Certificate of Commissioning, the Contractor shall guarantee the satisfactory operation and functioning of the entire plant covered by the Certificate of Commissioning for a period of twelve months measured from the date of the Certificate of Commissioning.

- n) The Contractor shall make good, free of all charges, any defects arising during this Period of Maintenance including the replacement of all defective parts and their installation and recommissioning. This guarantee shall apply to all defects arising during proper use of the plant, due to faulty design or maintenance instructions, inferior materials or poor workmanship.
- o) Maintenance by the client's personnel during the Defect Liability Period shall be limited to cleaning and lubrication only as instructed by the Contractor. All other maintenance or adjustments shall be carried out by the Contractor.
- p) The Final Certificate will be issued by the Engineer when the Defects Liability Period has elapsed and all Contractual obligations have been met in accordance with the General Conditions of Contract.

PT 11 INSTALLATION OF PUMP SETS

PT 11.1 Couplings

All pumps are to be matched for coupling to their respective motors. Couplings shall impose no restriction on normal end play or expansion and shall be provided with a removable guard, painted red. The direction of rotation shall be indicated with a clear arrow painted on the exterior of the coupling guard. The latter shall be designed thus to render reversed mounting impossible.

PT 11.2 Grouting of Base-Plates

Base-plates shall only be grouted after the alignment of pump sets has been approved. The Contractor must provide details of the grouting procedure he intends to utilise. Grouting of base-plates shall be done by the Contractor and he shall ensure full grout penetration between each pump base and relevant base-plate.

PT 11.3 Pump Set Alignment

PT 11.3.1 General

It is accepted that all new pump sets have been aligned on the base-plates in the factory. A certain amount of base-plate deformation is possible during transit and installation. Therefore, the alignment shall be rechecked on site following a hot run as specified hereafter.

Two main checks are to be carried out, viz.

- a) angular alignment and
- b) radial alignment of the pump shaft

The checks are to be done on all pump sets.

PT 11.3.2 Preparation

Before any check, the following preparations shall be performed:

- Final grouting to the base-plate shall be completed.
- Driving unit shall be isolated from the power supply. The Contractor shall ensure that no damage can be caused by turning either unit (driving or driven unit).

Couplings should be fixed to their respective shafts and the segments must be free to move relative to each other. Where the method of coupling is too tight to allow free movement between the two half-couplings the rims should be marked so that readings can be taken when the two marks are in line.

PT 11.3.3 Alignment Checks (See attached Data Sheet)

Angular Alignment (See Fig 1)

- i) Clamp two clock gauges diametrically opposite coupling pin holes of the driving or driven half-coupling, the plunger ends resting on the back of the opposite half-coupling.
- ii) With one gauge at the top and one at the bottom set both gauges to zero.
- iii) Turn both couplings through 180°. If the alignment is correct, the readings on the gauges should be numerically the same, although not necessarily zero.
- iv) Adjustment should generally be made on the outboard end of the pump.
- v) Turn both couplings through 90° and set the clock gauges to zero. Repeat step iii).

Note: This method does not require axial location of either half coupling.

Intersection of Axis (Radial Alignment) (See Fig 2)

- i) Clamp one clock gauge into one of the coupling holes in the driving or driven half-coupling, the plunger end of the clock gauge seating on the rim of the other coupling.
- ii) Rotate the couplings together and note the readings at each quarter turn.
- iii) Adjust the position and heights of the units until uniform clock readings are obtained.

Note: Where the operating temperature of a unit has the effect of lifting the centre line of one machine in relation to the other, allowance in the height of the appropriate machine must be made. Height adjustment must be in accordance with the manufacturer's specifications.

PT 11.3.4 Tolerances

- i) **Angular Alignment:** The angle between two half-couplings shall not be more than 0,01° for speeds up to 1500 rpm. This corresponds to a variation of 0,05 mm and 0,02 mm between readings on a 300 mm diameter coupling.
- ii) **Radial Alignment:** If readings vary by more than 0,10 mm (i.e. 0,05 mm eccentricity) for 1500 rpm adjustments shall be made.

PT 11.3.5 Grouting of Base-Plates

- i) A gap of approximately 25 mm is provided between the base-plate and top of the foundation.
- ii) Following approval of initial pump set and pipework alignment, the Contractor shall erect suitable formwork along the base-plate perimeter and shall grout the entire aforesaid gap, foundation bolt pockets and base-plate volume up to the top surface of the base-plate.

appropriate grout holes shall be provided on the base-plate surface for this purpose. The Contractor shall timeously, prior to erection, submit to the Engineer full details of the grout type required, which should attain a design compressive strength of 30 MPa within 10 days.

- iii) Prior to execution of final shaft alignment checks, the grouting operation shall have been completed, the grout adequately cured and all foundation bolts tightened.
- iv) Final alignment control checks to be performed in the presence of the Engineer (or his appointed representative), immediately following a hot run.
- v) Alignment Control Sheets will be completed for every unit checked, and will be signed by both the Engineer and the Contractor. The original copy will be kept by the Engineer and a duplicate by the Contractor.
- vi) For alignment control sheet, see annexures to specifications.

PT 11.3.6 Installation of Dowel Pins

Following approved alignment of pump sets, suitable dowel pins shall be fitted to facilitate correct re-location of pump sets.

PT 11.3.7 Manufacturer's Certificate of Approval

Following wet commissioning of pump sets, the pump manufacturer or his approved supplier shall check the installation and when satisfied shall issue to the Engineer a certificate approving installation in compliance with the manufacturer's specifications.

The Contractor shall furthermore, upon commissioning, perform vibration tests in the horizontal and vertical planes of each and every bearing housing. The results are to be endorsed by the pump and motor manufacturers for acceptability and handed to the Engineer within 14 days from the commencement of the Defects Liability Period.

It is further required of the Contractor to perform same measurements upon each and every maintenance visit during the Defects Liability Period. The results shall be logged and shall be endorsed by the pump and motor manufacturers for acceptability and handed to the Engineer within 7 days after each maintenance site visit.

PT 12 MEASUREMENT AND PAYMENT

Measurement and payment will be done in accordance with the methods stated below:

PT 12.1 Design, Drawings and General

<i>Pay Item</i>	<i>Unit</i>
PT 12.1.1 Provide design drawings and design information as specified.	Sum
PT 12.1.2 Provide operating and maintenance manuals and "as built" drawings as specified.	Sum

PT 12.2 Supply and Delivery to Site

<i>Pay Item</i>	<i>Unit</i>

PT 12.2.1	Pump and motor set complete with pump, motor, couplings, foundation steelwork and baseplate as specified.	No
PT 12.2.2	Ancillary equipment associated with pump installation as specified	Sum
PT 12.3	Installation Work	
	<i>Pay Item</i>	<i>Unit</i>
PT 12.3.1	Pump and motor set complete on base plate	No
	The item shall include taking delivery of materials on site, handling safeguarding, installing, painting, grouting and aligning	
PT 12.3.2	Ancillary equipment associated with pump installation as specified	Sum
PT 12.4	Commissioning	
	<i>Pay Item</i>	<i>Unit</i>
PT 12.4.1	Testing and commissioning of pumps and appertaining pipework.	Sum
PT 12.5	Provision of additional spare equipment	
	<i>Pay Item</i>	<i>Unit</i>
PT 12.5.1	Supply and delivery of specified equipment to the store facility of the Employer	Sum

ALIGNMENT CONTROL SHEET

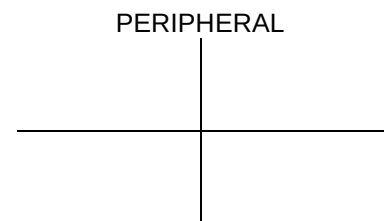
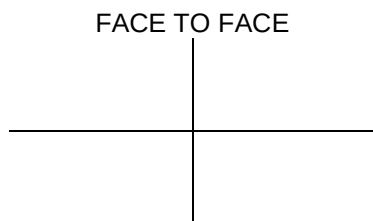
CLIENT:

CONTRACT NO:

STATION: MACHINE TYPE:

UNIT NO: REF NO:

ALIGNMENT BETWEEN:



METHOD OF ALIGNMENT: Dial indicator

READINGS GIVEN IN: mm

ALIGNMENT OF GEAR FITTED TO:

MEASUREMENTS TAKEN ON:

WHICH SHAFT ROTATED:

VIEWED FROM:

DISTANCE BETWEEN SHAFT ENDS:

WHEN SHAFT IN WHICH AXIAL POSITION:

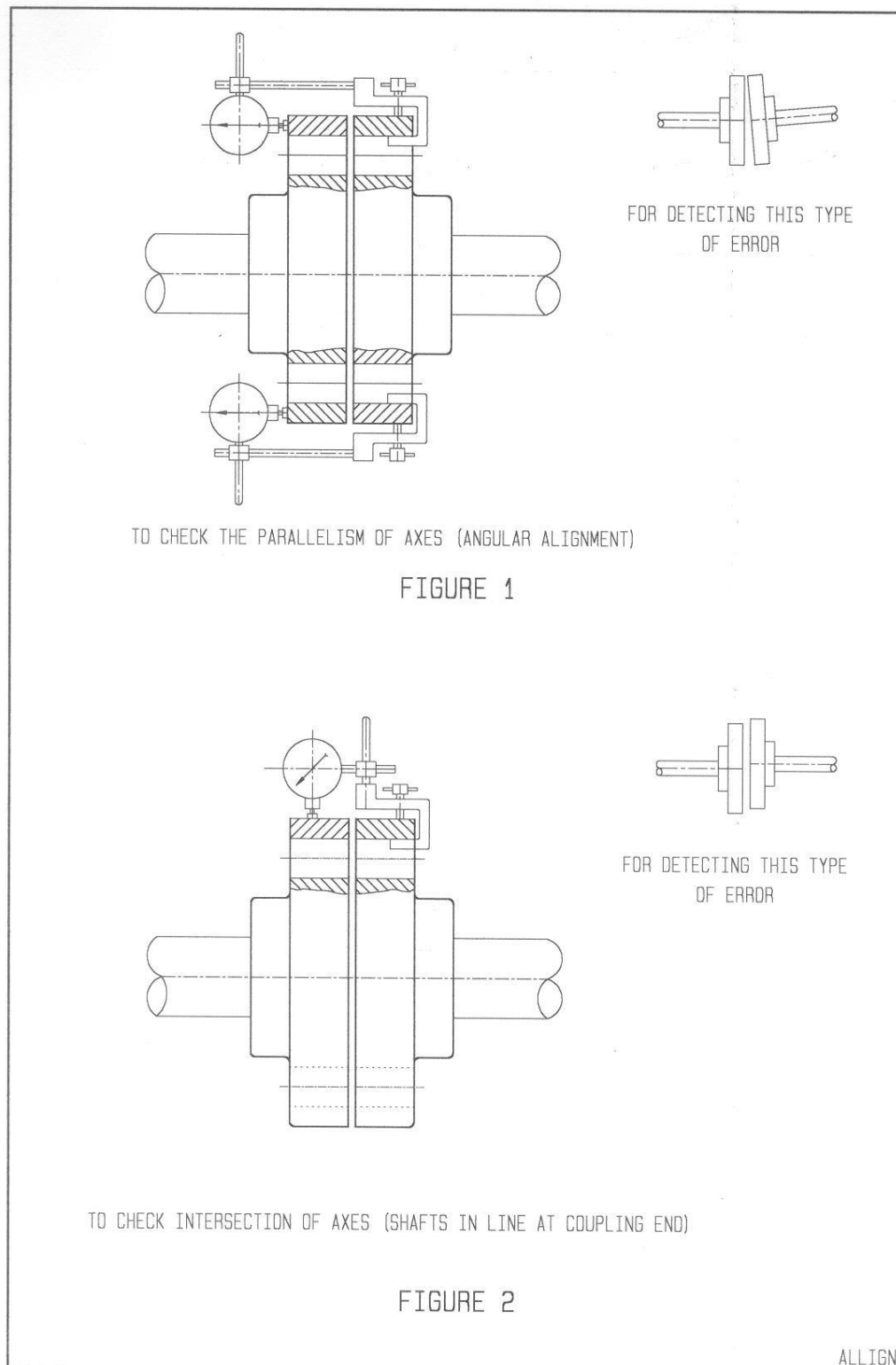
REMARKS: Suction / Delivery pipes connected.
All foundation bolts tightened / loose.
Final grouting done / not done.

Date:

Time:.....

.....
CONTRACTOR

.....
ENGINEER



Contract No: UGU-07-1689-2025 - Umzinto Wastewater Treatment Works & Outfall Sewers Upgrade and Rehabilitation
Phase 2A - Upgrade and Extension of the Umzinto Wastewater Treatment Works From 2.5 Ml to 4.0 Ml
Construction and Commissioning of Civil - Mechanical and Electrical Works
Portion 4: Particular Specifications
PT: Pumps

[illegible]

END OF SECTION

PTD MECHANICAL EQUIPMENT FOR HEATED AND UNHEATED DIGESTION

PTD 1 SCOPE

This specification covers the detailed design parameters, manufacture, supply, delivery to site, storage if required, erection, installation, testing, adjustment, and commissioning of Digesters, Mixer Systems, Heat Exchangers, Boilers/Burners/Water Softening, Gas Storage, and Accumulation Systems, including handing over in complete working order and upholding during the defects notification period. The Specification shall be read with the Project Specification (section C3.4.4.2) and other relevant Particular Specifications.

PTD 2 INTERPRETATIONS

PTD 2.1 Abbreviations

In this Specification the following abbreviations will apply:-

ANSI	: American National Standards Institute
ASTM	: American Society for Testing and Materials
BS	: British Standards Institution
SANS	: South African National Standards
SIS	: Swedish Institute of Standards
DIN	: Deutsch Industry Normen
ISO	: International Organisation for Standardization
ASME	: American Society of Mechanical Engineers
SAECC	: South African Electrolytic Corrosion Committee
AGMA	: American Gear Manufactures Association

PTD 2.2 Standards

All design standards for the mixing and digestion equipment shall be subject to the latest amendments and editions of the following standard specifications:-

SANS 10400	: National Building Regulations
BS 5304	: Code of practice for safeguarding of machinery
SANS 9096-1: 1994	: Testing of welders, where applicable to the type of welding required
BS 292 Part 1: 1987	: Dimensions of ball bearings, cylindrical and spherical roller bearings
SANS 10162-4	: Structural use of Steel Part 4: The design of cold-formed stainless steel structural
SANS 1044-3	: Welding Part 3: The fusion of steel (including stainless steel): Tests for the approval of welding procedures

SANS 10044-4	: Welding Part 4: The fusion welding of steel (including austenitic stainless steel): Tests for the approval of welders working where weld procedure approval is not required.
SANS 10064	: The preparation of steel surfaces for coating
SANS 10102-4	: Selection of pipes for buried pipelines Part 1: General Provisions
SANS 10104	: Hand railing and balustrading (safety aspects)
SANS 10111-2-1	: Engineering Drawing Part 1: General principles Engineering Drawing Part 2: Geometric Tolerancing Section 1
SANS 10341	: Installation and maintenance of bearings – General guidelines
SANS 1700-5-9	: Fasteners Part 5: General requirements & material properties Section 8: Corrosion resistant stainless steel fasteners-Bolts, Screws & Studs
SANS 1700-5-10	: Fasteners Part 5: General requirements & material properties Section 8: Corrosion resistant stainless steel fasteners-Nuts
SANS 1123	: Pipe Flanges
DIN 7081	: Pressure resistant oblong toughened borosilicate glass panes for sight glasses for unrestricted use at low temperatures
BS 3463	: Specification for observation and gauge glasses for pressure vessels
Jis B 8211	: Gauge Glasses for Boilers
SIS 05 59 00	: Pictorial Surface Preparation Standards for Painting Steel Surface
ISO 9000	: Quality management
ASME	: Boiler and Pressure Vessel code section IV: Heating Boilers
IPS-G-SF-900	: General Standard for noise and Vibration

PTD 2.3 General Requirements

This specification must be read in conjunction with the following specifications:-

PTG:	Gearboxes
PTW:	Actuator equipment
PT:	Pumps
PLK:	Manufacture, Supply and Testing of Valves
PLN:	Manufacture, Supply and Testing of Steel Pipework
PLV:	Colour Coding
PTV:	Corrosion Protection

PTD 3 Digester Equipment

PTD 3.1 General Design Parameters

The mechanical equipment for the digestion of primary and waste activated sludge (WAS) shall be designed such that the following requirements are met:-

- Facilitate manufacture, inspection, installation, maintenance, cleaning and repairs;

- Ensure safe and satisfactory operation and an acceptable life expectation under the ambient conditions prevailing at the Site as specified;
- Prevent undue stresses being produced by expansion due to temperatures induced and the changes thereof;
- Limit the maintenance costs to a minimum;
- Comply with the legal requirements in respect of safety as well as the prevention of water and air pollution;
- Satisfy any specific requirement contained in the statutory codes and legislation, and;
- Suitably designed for operation 365 days per year, 24 hours per day under specified design conditions.
- Contractor to determine and allow for the Hazardous Area Classification for the equipment to be supplied.

PTD 3.2 Specific Design Parameters

The objective for anaerobic sludge digestion shall be the destruction of biological solids using bacteria which function in the absence of oxygen. For heated digesters the Contract shall require the Tenderer to incorporate a heat exchanger system utilizing the methane gases produced as the source of energy for the heating of the boiler water for the sludge heat exchanger system proposed by the Tenderer.

The mixing of the digester content shall be designed to operate independently from that of the heat exchanger system for heated mixed digesters.

The heated anaerobic digesters shall be designed to achieve an active volatile solids destruction for Waste Activated Sludge (WAS) for digestion only of $\geq 30\%$ X Solids destruction and for WAS/primary sludge digestion of $\geq 40\%$ Volatile Solids destruction.

The two types of anaerobic sludge digestion shall be specified namely, unheated, mixed digesters for the smaller works and heated, mixed digesters for the larger wastewater treatment works.

The dimensional parameters of the digester shall be given on the civil tender/construction drawings. Tenderers shall design all equipment for the following sludge design loads and parameters :-

- A minimum of two digesters shall be equipped,
- The primary sludge shall be thickened to between 1 - 3% before being placed onto the digester unit process,
- The thickened consistency of WAS shall be between 2 - 4% prior to being discharged to the digester units,
- The unheated digestion process shall be designed and operated to include for the lowest winter 30 days rolling average of the wastewater temperature. This average temperature shall

be specified in the Project Specification,

- Unheated mixed digester volatile solids loading rates for, all digesters on line, shall be 0.5 - 0.7 kg VS/m³/day, and
- Heated, mixed digester volatile solids loading rates with one digester off line 2 kg VS/m³/day and 1.4 - 1.6 kg VS/m³/day with all digesters on line.

All digesters shall be designed and sized in accordance with listed factors below. The Tenderer shall not be responsible for the sizing of the site specific digester unit processes however cognisance shall be taken of the listed requirements for the design of associated mechanical equipment. Tenderers shall be responsible for the design and selection of associated mechanical equipment offered.

- Digesters shall be sized based on the lowest 15 days rolling average of the thickened sludge consistency (%TS) specified in the Project Specification, and or
- On the highest 15 days rolling average solids load (%TS) as specified in the Project Specification.

The operational requirements of the digester units shall be as specified by the Engineer.

- (a) Regular sludge feeding of the digester units shall be employed to limit and prevent any shock loads or spikes in the production of biogas mass. Regular preferably hourly feed is envisaged and pipe work shall be arranged such to allow an even distribution of the feed organic/solids loading. The operation of the sludge feed shall be timer controlled incorporating a variable time between activation and variable operation duration. An override for continuous sludge feed shall be incorporated for based on a maximum water level within the digester units. These automatic controls shall be supported by a manual override. The timing devices shall be supplied and installed by others,
- (b) Hydraulic mixing of the digester content shall be required. The pumps shall be capable and suitably designed to recycle processed sludge that shall contain encrusted balls and turnover the entire digested sludge content within 2 - 4 hours at an energy input of 8-16 W/m³ for reliable gas production. The mixing of the digester content shall be intermittent and the operation thereof shall be timer controlled incorporating a variable time between activation and variable operational duration for reliable gas production. A computerised fluid dynamic (CFD) analysis illustrating the mixing pattern within the digester tanks shall accompany the Tender,
- (c) The digester content shall be heated by means of a separate and independent system from that of the digester mixing capable and suitably designed to recycle processed sludge that shall contain encrusted balls. The sludge heating shall consist of an external pumping system incorporating a heat exchanger unit appropriately designed ensuring the optimal use of the energy source available. The energy source for the heat exchanger system shall be primarily gained from the production of the biogas generated within the digester units. The heat exchanger shall be designed on and be based on the exchange of heat between

the circulating sludge and that of the hot water,

- (d) The Tenderer shall design for the storage of sufficient biogas to collect any peaks in biogas production, which shall depend on the frequency of sludge feeding and mixing. Biogas conveyance pipe work and storage shall capture carry-over solids, drain condensate and scrub H₂S in cases where the feed sludge has high sulphate content,
- (e) Provision shall be made within the design to safely flare off any excess biogas production shall be to the atmosphere,
- (f) Digesters shall be designed to facilitate the withdraw supernatants, and
- (g) pH level shall be kept as close to 7.0, with a range of 6.6 to 7.4 considered acceptable

The mechanical equipment to be supplied under this Contract shall be installed, tested and commissioned on or in concrete structures constructed by others, to the dimensions indicated on the detail construction drawings.

PTD 4 ANAEROBIC SLUDGE DIGESTERS

PTD 4.1 Anaerobic Sludge Digester Parameters

Although not the responsibility of the Tenderer the following guidelines shall apply to the sizing and shape of the digester. These parameters are included for information purposes.

The tank shall be circular with a conical top and bottom and a side water depth (SWD) of a minimum of 0.7 times that of the diameter, unless indicated differently on the tender/construction drawings. The floor of the tank shall be sloped, vertical to the horizontal 1:5, to assist the sludge being scraped to a central collection hopper for withdrawal. The diameter of the tank shall be as shown on the tender/construction drawings.

The scum and freeboard allowance of 1.5 m below the biogas off-takes.

The digester roof or cover shall be a fixed digester cover which shall provide constant volume containment of digester gas and sludge during digestion as well as constant pressure storage of the digester gas which shall be used to heat the digesters via heat exchangers detailed hereunder.

Two access manholes shall be provided at the top of the tank. The access holes shall have stairways for easy access to the inside of the digester and shall be provided with gas tight and watertight covers.

The tank capacity shall be determined based upon the volume of the sludge to be treated, the total solids concentration and the volatile solids concentration. The digestion tanks shall be sufficiently insulated to minimise heat loss.

PTD 4.2 Sludge Inlet Pipe

The inlet pipe shall have a minimum nominal diameter of 150 mm and shall be manufactured from Ductile iron or 304 L stainless steel, supplied and installed by the Civil Contractor. The entry of the sludge pipe work shall be as detailed on the civil construction drawings.

PTD 4.3 Access Parameters

A 3CR12 ladder with the necessary handrails shall be rigidly fixed by means of expanding bolts to the outer end of the digester wall for access purposes. This shall be supplied and installed by the Civil Contractor.

PTD 5 DIGESTER MIXING EQUIPMENT

PTD 5.1 General

A computerised fluid dynamic (CFD) analysis illustrating the mixing pattern within the digester tanks shall accompany the Tender. Failure in submitting the resultant analyses to the Engineer at time of Tender, shall render the submission invalid and shall be liable to rejection.

PTD 5.2 Jet mixer pumps

PTD 5.2.1 General

The pump shall be specifically designed to pump high concentrations of waste solids. The pump assembly shall be mounted horizontally outside the tank with a standard inlet flange, cleanout, suction and delivery, pressure taps, drain connection and mounting base plate.

A combination of vacuum/pressure gauge shall be installed on the suction side of the pump along with a discharge pressure gauge on the discharge side of the pump in order to monitor the system performance from initial start-up and system operation shall be installed.

The design of the pumping equipment shall include for standby capacity. Duty rotation shall be based on the operational hours of each pump. The pipe work shall be arranged such that any one pump can be operated. The specific requirements shall be specified in the Project Specification. A suitably designed enclosure for the mixing pump installation shall be provided for. The enclosure shall protect the installation from the natural elements.

The pump shall carry the manufacturer's identification details together with the rated shaft speeds, output power and maximum ambient operating temperature.

PTD 5.2.2 Pumps

Self-priming chopper type pumps shall be used for mixing the sludge within the digesters.

Chopper pumps shall be centrifugal pumps that incorporate sharpened impeller blades to cut against a stationery bar, cutting through any solids too large to pass through the impeller into the pump and the nozzle system. The pump casing shall be of a semi-concentric back pull-out type design.

Refer to Particular Specification PT: Pumps

PTD 5.2.3 Impeller

The impeller shall have a semi-open impeller blade which shall cut across a stationery cutter bar the full diameter of the inlet. The impeller shall have pump out vanes to reduce the seal area pressure. Incoming solids too large to pass through the impeller are chopped prior to entry into the pump, thereby eliminating any blockages in the pump. The maximum clearance between the cutter bar and the impellers shall be limited to 0.51-0.76 mm.

The impellers and cutter bars shall be manufactured from cast alloy steel and shall be statically and dynamically balanced. The impeller shall be threaded to the shaft and shall have no axial adjustments.

PTD 5.2.4 Upper Cutter

The upper cutter shall be threaded into the back pull-out adapter plate above the impeller, designed to cut against the pump-out vanes and the impeller hub, reducing and removing stringy materials from the mechanical seal area. The upper cutter shall be manufactured from alloy steel.

PTD 5.2.5 Valves

A non-return valve shall be located after the chopper pump. These NRV's shall be renowned and suitable to handle raw and digested sewage without clogging and subsequent malfunctioning.

Resilient seal gate valves shall be considered acceptable for the mixer system. Should the Tenderer propose the use of knife gates valves the responsibility shall lie proving operational acceptance.

Gate valves shall be located before and after the chopper pump. The wetted parts of the valves shall be manufactured from 316 SS.

Refer to Particular Specification PLK for the detailed design and manufacture of valves.

PTD 5.2.6 Venting Gas

To avoid any gas or air build up in the pumping volute, a gas release valve shall be installed at the highest point in order to vent the gas before starting the pump. A suitable safety vent and flame arrestor shall be installed to prevent methane from causing any problems to the operators or with surrounding equipment.

PTD 5.2.7 Pressure Taps

Pressure taps shall be installed on the tops of the suction and discharge manifold. They shall be used for pump start-up and during troubleshooting.

PTD 5.2.8 Flow

Uniform fields of flow rotate the entire sludge content as a solid unit with the highest velocity near the perimeter of the tank while vertical fields of flow provide the greatest field velocities at the centre of the tank. In order to obtain an even mixture of sludge, a dual mixer is desirable, thereby incorporating both uniform and vertical flow.

The dual mixer prevents solids from settling in the centre of the tank as the average velocities are higher and steadier throughout the tank.

PTD 5.2.9 Nozzles

High velocity nozzles inducing flow over a long distance, thereby ensuring that the entire volume of the tank shall be mixed shall be required. To prevent clogging of the nozzle, tapered nozzles shall be used.

The nozzles shall have a minimum wall thickness of 25 mm and a long straight tapered length of at least 300 mm. The nozzles shall be manufactured from a corrosive, durable material such as cast iron or alloy steel.

The nozzle position, number and injection angles shall be determined by the Tenderer based upon the CFD analysis.

Nozzle Assembly

Multiple or single nozzle assemblies shall be acceptable. The nozzle assembly shall be bolted to the structural concrete by means of a levelling grout pad.

The number of assemblies, the number of nozzles required per assembly and the placement of the nozzle assembly shall be dependent upon the tank size and sludge concentration and shall be confirmed by the Tenderer, based on the CFD analysis in consultation with the Engineer.

Nozzle Base

The base of the nozzle shall be manufactured in a corrosive, durable metal with mountings for the bolts.

Fasteners

The nozzle assembly shall be secured within the tank by means of anchor bolts. The anchor bolts

shall be of sufficient length to support thrust loads imposed by the nozzles.

All submerged fasteners shall be 316 SS and mating flanges shall be sealed against ingress of any crevice corrosion by means of a sealant suitable for underwater conditions and approved by the Engineer.

PTD 5.2.10 System Piping

The 304 L stainless steel or ductile iron piping shall be designed for minimum friction losses. The piping system shall comprise of a suction line extracting sludge from the bottom of the conical floor section and a discharge header from the pump back through the tank wall and into the tank. Isolation valves shall be provided for on both the suction and delivery line for maintenance purposes. Appropriately selected and sized RSV or knife gate type valves shall be acceptable. Provision shall be made for the venting of gas and/or air from the delivery manifold immediately after the pumping equipment.

The Nozzle-feed laterals shall be extended outside of the tank from the discharge header and enter the digester tank wall at each nozzle assembly.

PTD 5.3 Draft tube mixer

PTD 5.3.1 General

The contractor shall design, manufacture, install, test and commission a hydraulic mixing system based on externally mounted recirculation pump and pipework with internally mounted.

The Tenderer is required to submit a computerised fluid dynamic (CFD) analysis illustrating the expected mixing pattern with his tender.

PTD 5.3.2 Mixer assembly

The mixer assembly shall consist of a drive unit, vertical propeller, shaft, propeller shaft housing with lubricated bearings, motor, seals, mounting flange, propeller shaft cover. The mixer assembly shall be removable as a unit without disturbing the sludge mixer draft tube, without varying the normal water level and without removing the motor drive assembly.

The motor drive assembly shall consist of an explosion-proof reversible motor driving the vertical impeller shaft through belts and sheaves adequately sized for the start-up and operating torques.

The propeller shaft shall be steel with a wear sleeve located at the lower bearing. There shall be a mechanical oil seal located at the lower end of the wear sleeve. Shaft bearings shall consist for an upper anti-friction, grease lubricated roller bearing and lower oil lubricated bearing.

The upper bearing shall include labyrinth seals at both ends, the lower shaft bearings shall be protected by a mechanical seal designed to prevent entry of any foreign material. A positive head

of oil must be maintained upon the lower bearing at all times. Design employing grease lubrication at the lower bearing shall not be acceptable. An oil level dip stick accessible from above the baseplate shall be provided to allow for monitoring of the lower bearing oil level.

A positive means of centring the mixing assembly shall be provided incorporating an adjustable centring guide assembly which is permanently mounted to the mixer shaft housing and is adjustable from above the mixer mounting base plate. The adjustable centring device shall also act as a flow deflector when pumping in the upward direction.

There shall be provided an estimated 915mm diameter propeller mounted at the end of the vertical drive shaft. The design shall allow for periodic reversing of rotation. The mixing propeller shall be constructed of cast iron and shall be of a "ragless" design, capable of pumping either upward or downward with equal efficiency. A "ragless" design shall be designed as one in which the angle of the leading edge of the propeller is such that any stringy or fibrous material striking the propeller blades will be directed outward, away from the hub of the propeller. This "ragless" condition must occur when pumping in both the upward and downward directions.

The drive assembly flange shall be fabricated of steel plate. It shall be provided with suitable gas-tight connections for mounting the drive assembly to the draft tube extension.

PTD 5.3.3 Upper draft tube

The draft tube shall be fabricated of 6mm thick 304 stainless steel and shall be approximately 950mm. It shall extend downward to fit the draft tube.

PTD 5.3.4 Lower draft tube

There will be furnished as part of the sludge mixer mechanism approximately 1000mm diameter draft tube extension fabricated from 6mm thick stainless steel with support legs and anchor bolts.

The draft tube extension will be arranged to fit the upper draft tube of the sludge mixer. The lower stationary and upper removable sections of the draft tube will be arranged to allow removal of the sludge mixer drive assembly from the digester without requiring the dewatering of the tank.

PTD 5.3.5 Shaft deflector

A 304 stainless steel flow deflector shall be mounted on the impeller shaft and be designed to shield the lower bearing by laterally deflecting the flow when pumping in the upward direction. The top outer edge of the deflector shall be located immediately above normal operation liquid level.

PTD 5.3.6 Electrical requirements

The mixer drive motors will be designed for operation on 380 Volt, 50 Hz, 3 Phase current. The motor will be explosion-proof and reversible with Class F insulation.

PTD 5.3.7 Tension rods

Three (3) tension rods (when applicable) will be furnished at 120° fixing the draft tube onto the tank walls at different heights levels. The material of construction shall be stainless steel AISI-316.

PTD 5.3.8 Materials

Mixer assembly	: Carbon Steel S275JR (epoxy coated)
Propeller	: Machined cast iron
Draft tube	: 304 stainless steel
Draft tube extension	: 304 stainless steel
Fixings	: Stainless Steel AISI-304 (A2)
Tension rods	: Stainless Steel AISI-316

PTD 6 PIPEWORK

The following supply items shall be supplied and installed by the contractor:

- (1) The sludge inlet pipes – ductile iron
- (2) The sludge removal and the scum draw-off pipes- ductile iron
- (3) The mixer pipework –stainless steel or ductile iron
- (4) The heat exchanger pipework – stainless steel
- (5) The boiler/burner pipework – ductile iron/stainless steel
- (6) The gas pipework – stainless steel
- (7) The hot water supply pipework – stainless steel
- (8) Potable water supply pipework - Galvanised mild steel

All elevated pipework exposed to the natural elements as well as pipework transporting hot water shall be designed to accommodate for all thermal expansion.

PTD 7 *Spares and Tools*

The Tenderer must submit on the appropriate schedule a priced list of spare parts which is recommended and should be kept by the Employer for maintenance of the plant. Spares which the Employer decides to order must be manufactured simultaneously with the rest of the equipment and be subject to the same tests for dimensions, tolerances, strength, etc.

All spares shall be packed separately and the cases appropriately marked. All spares shall be new and unused.

A full range of spares shall be kept locally for not less than 15 years.

Tenderers shall submit a provisional price (where applicable) for a complete set of spanners, keys and tools required for the operation, adjustment and overhaul of the plant supplied. All spanners, keys and tools shall be new and unused and housed in a lockable tool case.

PTD 8 METAL PREPARATION and Corrosion protection

Refer to Particular Specification PTV: Corrosion Protection

PTD 9 Colour codes

The standard final colour codes for equipment supplied under this Contract shall be in accordance with Particular Specification PLV.

PTD 10 Measurement and Payment

Measurement and payment will distinguish between system design, supply/delivery, installation and commission as well as per installation point.

END OF SECTION

PTJ VERTICAL SHAFT AERATORS

PTJ 1 SCOPE

This section of the specification includes the manufacture, delivery, transport, handling, protection, storage, installation, successful commissioning and upholding during the Defects Notification period of vertical shaft mechanical aerators.

PTJ 2 MATERIALS

All materials shall possess qualities adequate for the purpose for which they are to be used. All materials and properties claimed for these materials shall, unless specified otherwise in this document comply with the requirements of the most recent edition of the appropriate South African or other internationally recognised standard specification.

For each type of equipment, the Manufacturer shall indicate the materials used for each of the proposed sub-assemblies.

The equipment shall be manufactured using new prime quality materials taking into account the latest technical innovations.

All components shall have a surface finish in relation to their importance, their position and their intended purpose.

Rolled steels and all castings shall be clean and free of blisters, porosity, shrinkage, holes, cracks or other flaws that may be detrimental to their use.

PTJ 3 EQUIPMENT REQUIRED

PTJ 3.1 Aerators

Vertical shaft aerators shall be designed not only to act as surface aerators but also as an efficient circulator capable of drawing mixed liquor from the base of a cell and distributing it over the surface ensuring continuous and complete mixing.

The aerator shall be capable of operating efficiently at various depths of flow through the aeration tank and the Tenderer shall submit full details of the variation in oxygen input of the aerators offered over the full range of immersion depths for which the particular aerators were designed to operate. At maximum stated immersion depth, the motors shall draw 100% of the rated power.

Due to the variation in expected oxygen demand the aerators shall be required to operate over immersion depths that vary by at least 200 mm. A hand-operated overflow weir shall be

supplied to regulate the water level in the aeration tank in order to ensure efficient oxygenation of the mixed liquor in the tank.

The Contractor shall be responsible for the design (size and configuration) of the aerator impeller, spindle shaft, gearbox and associated mechanical components required to achieve the specified oxygen transfer and mixing requirements at site conditions. Unless otherwise specified in the Project Specification, the aerator impeller and spindle shaft shall be mild steel coated with an appropriate epoxy in terms of the Specification (refer to Particular Specifications PLQ and PTV).

The aerators must be installed on the platforms as shown on the drawings. Any additions or modifications required shall be stated in the tender.

Preference will be given to aerators having a good pumping action when operating at a low rotational velocity. The tip speed of the aerator blades shall not exceed 5 m/s and any offers exceeding this shall be deemed as not complying with the specification.

After assembly of the finished aerator cone, shaft and mounting flange, but before being dispatched to Site, the assembled unit shall be dynamically balanced at twice the maximum operating speed of rotation and in addition shall be tested for centricity and correct angular attachment of cone and flange to shaft. These tests shall be done in the presence of the Engineer or his representative and at least two weeks notice shall be given to the Engineer prior to the tests. Should any offer deviate from this requirement, full details of tests to be performed shall be submitted with the tender.

The Tenderer shall supply all relevant information for the proper adjudication of the units, giving information regarding the motor rating, impeller size and shape, the blade pitch, the tip speed, the pattern of flow in the basin, shaft length and diameter as well as construction taking into full account the specified medium, the ambient temperature, the height above sea level, tank geometry and the water depth in the tank.

PTJ 3.2 Gearboxes

Gearboxes shall be designed specifically for use with vertical shaft aerators and shall be capable of withstanding bending moments, thrusts and other tensions that could result due to the long shaft between the aerator and the gearbox. All gears shall be cut, hardened and ground. Semi-hardened and subsequently machined gears will not be acceptable. The gearbox shall be provided with a removable cover in the housing to facilitate the changing of gears.

This shall be accomplished without disturbing the motor alignment or draining the lubricating oil.

The casing and support stand shall be manufactured from close-grained cast-iron and so designed that the housing assures complete protection against moisture entering of all working parts and life-long alignment of shafts, bearings and seals.

Lubrication of upper gears and bearings shall be either by splash type lubrication or through feed lines from an oil pump driven directly by one of the gear shafts and fitted with an external pressure gauge. The oil will then flow downwards to lubricate the final reduction gearing and bearings. The lubricating oil shall be retained in the housing by means of a dry well which shall encircle the output shaft to avoid complete drainage of oil in the box in the event of an oil seal failure. The lower output shaft bearing situated in the dry well shall be grease-lubricated with the grease-nipple located in a readily accessible position.

Gearboxes shall be designed for continuous operation 24 hours per day. Mechanical power ratings (AGMA) shall be not less than 2 x installed power, and the efficiency not less than 96% when the aerator is running at peak power consumption.

Worm gears will not be considered. Gearboxes shall be provided with hot dipped galvanised steel jacking bolts allowing at least 100 mm adjustment up and down.

PTJ 3.3 Shafts and Bearings

The aerator and gearbox output shafts shall be manufactured from mild steel or other similar and approved material, coated with an appropriate epoxy resistant to the corrosivity of sewage. The gearbox output shaft shall be designed so that it is of sufficient size and rigidity to positively guarantee complete isolation of gearing from the aerator shaft loads and thrust conditions.

All bearings shall be designed for a life of at least 100000 hours at a B10 rating. Proof of such rating shall accompany the tender. In addition, the bearings on the output shaft shall be capable of withstanding the resultant forces caused by the combination of radial and axial loads (imposed by the aerator) acting simultaneously, and shall be selected such that the following condition is complied with:

$$\frac{\text{actual radial load}}{\text{permissible radial load}} + \frac{\text{actual axial load}}{\text{permissible axial load}}$$

is equal or less than one (where the "permissible" loads are the manufacturer's figures for 5000 hours at a B10 rating) Tenderers shall indicate what these forces are and how they are accommodated.

The output shaft shall be fitted with a standard mechanical seal closely positioned to the lower bearing, reducing shaft run-out and deflection to a minimum. The seal shall be balanced and sleeve-mounted.

The aerator shaft shall be coupled to the output shaft by means of a rigid coupling. This type of coupling shall be designed to drive by friction between the coupling faces in order to avoid the necessity to place the bolts in shear for the required coupling capacity.

Tenderers shall submit a detailed description and a clearly labelled cross sectional drawing of the aerators with their tenders as well as all other details of the aerator, motor, couplings, bearings, a catalogue of the make of gearbox and how the gearbox selection was made. **Failure to submit the above information will render the tender incomplete and as such liable to rejection.**

PTJ 3.4 Motors

The general requirements for low voltage electrical motors are included in Specification for electrical and electronic works.

PTJ 4 INSTALLATION

PTJ 4.1 Bridge Mounted Aerators

The aerators shall be mounted in such a way as to facilitate ease of maintenance. An access opening will be provided through the mounting platform adjacent to the gearbox installation for access to the aerator impeller.

PTJ 5 TESTING AND COMMISSIONING

Tenderers shall provide proof or sufficient evidence of oxygenation capacities and oxygenation efficiencies (for instance by submitting a report on performance by some recognised testing organisation) and must state clearly how aerator performance was assessed. Failure to submit this information will lead to the rejection of the tender on the grounds of incompleteness.

On completion of installation, the aerators shall be thoroughly tested at minimum and maximum water level for speed of rotation, energy input, resistance to bending of shaft and overall efficient operation of the complete mechanical and electrical system. The Contractor shall provide free of charge for testing purposes a kW meter to measure the energy absorbed by each aerator.

Oxygenation efficiency where called for in the Technical Schedules shall be expressed as kilograms oxygenation capacity per kilowatt-hour i.e., as the mass of oxygen measured in kilograms which the aerator can introduce over a period into a body of completely de-oxygenated water divided by the power input to the motor over the same period, measured in kilowatt-hours at Standard Conditions of 760 mm Hg and 20°C.

In situ oxygenation efficiency tests may be conducted once the plant is operating effectively and Tenderers shall price the Provisional Item in the Schedule of Quantities for conducting such tests.

The tests shall utilise the steady state method as follows:

In the aeration of activated sludge mixed liquor, at a temperature of T°C, the following relationship holds:

$$\frac{dC}{dt} = K_{(T)} (C_{s(T)} - C) - r$$

where $\frac{dC}{dt}$ = rate of change of oxygen concentration (mg/l/hr)

$K_{(T)}$ = oxygen transfer co-efficient in mixed liquor at T°C (hr⁻¹)

$C_{s(T)}$ = saturation concentration of oxygen in mixed liquor at T°C and at the ambient barometric pressure (mg/l)

r = oxygen uptake rate of the mixed liquor (mg/l/hr)

If it is assumed that, under normal operating conditions, a state of equilibrium exists in the system then

$$\frac{dC}{dt} = 0,$$

$$\text{and } K_{(T)} (C_{s(T)} - C) = r$$

$$\text{i.e. } K_{(T)} = \frac{r}{(C_{s(T)} - C)} \dots\dots\dots(1)$$

The value of $C_{s(T)}$ to be used in equation (1) is calculated from the following relationship:

$$C_{s(T)} = \frac{468 - 2,65S}{31,6 + T} \times \frac{(P - p_w)}{(760 - p_w)} \dots\dots\dots(2)$$

where $C_{s(T)}$ = saturation concentration of oxygen in mixed liquor at T°C and P mm pressure (mg/l)

S = dissolved solids in mixed liquor (parts per 1 000)

T = temperature of mixed liquor (°C)

P = barometric pressure (mm Hg)

p_w = saturation vapour pressure of water at T°C (mm Hg)

In equation (1), r and C can be determined, and $C_{s(T)}$ can be obtained from equation (2) above, so that the value of $K_{(T)}$ can be calculated. It's value of 20°C can then be obtained by the use of the following relationship:

$$K_{(T)} = K_{(20)} \times 1,02^{(T-20)}$$

i.e. $K_{(20)} = K_{(T)} \times 1,02^{(20-T)}$

From the value of $K_{(20)}$, the in situ oxygenation capacity of the aeration system in a particular basin, as defined above, is calculated as follows.

$$OC = K_{(20)} \cdot C_{s(20)} \cdot V \times 10^{-3} \text{ kg/hr}$$

where $C_{s(20)}$ = saturation concentration of oxygen in mixed liquor containing 1000 mg/l dissolved solids, at 20°C and 760 mm pressure (mg/l)

$$= 9,02 \text{ mg/l}$$

V = volume of mixed liquor in basin under consideration (m³)

The actual test procedure shall be proposed by the Contractor and must meet with approval from the Engineer before it is implemented.

Nevertheless, the following points shall be incorporated in the test procedure:

- the Contractor shall provide four dissolved oxygen meters, of approved make, all standardised and calibrated in accordance with the instructions supplied by the manufacturers.
- the Contractor shall provide all equipment required for conducting the oxygen uptake rate tests.
- the positions of the D.O. probes shall be to the satisfaction of the Engineer.
- the Contractor shall provide all equipment required to assess the power consumption of the aerators during the steady state oxygenation capacity test.
- at least three consecutive tests shall be conducted.
- the Contractor shall provide all test equipment required for assessing the constants to enable the in situ oxygenation efficiencies to be related to Standard Conditions.

Should doubts exist regarding the efficiency of the aerators after installation, the SABS will be instructed to carry out the necessary efficiency tests at the cost of the Contractor. If the oxygenation capacity at the aerators should prove to be less than specified, the Contractor shall, entirely at his own cost, improve the oxygenation capacity to the capacity specified. If these improvements result in larger aerators with greater electricity demand, the Employer will recover once-only from the Contractor, a sum of money which shall be determined by the cost of the additional electricity required by the aerators and will be calculated as a capitalised sum, taking into account the present cost of electricity, inflation, price rises, interest rates for state loans and redemption period of the loan.

PTJ 6 MEASUREMENT AND PAYMENT

Measurement and payment will be done in accordance with the methods stated below:

PTJ 6.1 Design, Drawings and General

<i>Pay Item</i>	<i>Unit</i>

PTJ 6.1.1	Provide design drawings and design information as specified.	Sum

PTJ 6.2 Supply and Delivery to Site

<i>Pay Item</i>	<i>Unit</i>

PTJ 6.2.1	Bridge mounted fixed speed vertical shaft mechanical aerator complete with motor, gearbox, fasteners etc.	No

PTJ 6.3 Installation Work

<i>Pay Item</i>	<i>Unit</i>

PTJ 6.3.1	Bridge mounted vertical aerator and motor set complete on base plate	No

The item shall include taking delivery of materials on site, handling safeguarding, installing, painting, fixing, grouting and aligning

PTJ 6.4 Commissioning

<i>Pay Item</i>	<i>Unit</i>

PTJ 6.4.1	Testing and commissioning of mechanical aerator	No

PTJ 6.5 In situ oxygenation efficiency tests

<i>Pay Item</i>	<i>Unit</i>

PTJ 6.5.1	Execution of in situ performance test if instructed by Engineer	Rate only

END OF SECTION

PTM VERTICAL SHAFT STIRRERS

PTM 1 SCOPE

This section of the specification includes the manufacture, delivery, transport, handling, protection, storage, installation, successful commissioning and upholding during the Defects Notification Period of mechanical vertical shaft stirrers.

PTM 2 MATERIALS

Construction materials shall be either steel protected against corrosion as specified or else inert corrosion proof materials.

All materials shall possess qualities adequate for the purpose for which they are to be used. All materials and properties claimed for these materials shall, unless specified otherwise in this document, comply with the requirements of the most recent edition of the appropriate South African or other internationally recognised standard specification.

For each type of equipment, the Manufacturer shall indicate the materials used for each of the proposed sub-assemblies.

The equipment shall be manufactured using new prime quality materials taking into account the latest technical innovations.

All components shall have a surface finish in relation to their importance, their position and their intended purpose.

Rolled steels and all castings shall be clean and free of blisters, porosity, shrinkage, holes, cracks or other flaws that may be detrimental to their use.

PTM 3 EQUIPMENT REQUIRED

PTM 3.1 Stirrers

Vertical shaft mechanical stirrers are required to mix the contents of the anaerobic (if applicable) and anoxic sections of the reactor. The stirrers are required to keep the organic solids, with a concentration which could vary between 2000 and 10000 mg/l in suspension as homogeneously as possible.

The introduction of oxygen through surface agitation shall be minimised while gently mixing the contents of the tanks. Should any baffles or other appurtenances be required, tendered prices shall make provision for this. The horizontal zones of maximum turbulence should preferably be as close to the floor of the tank as possible.

The Contractor shall be responsible for the design (size and configuration) of the stirrer impeller, spindle shaft, gearbox and associated mechanical components needed to achieve the mixing requirements at site conditions. Unless otherwise specified in the Project Specification, the stirrer impeller and spindle shaft shall be mild steel coated with an appropriate epoxy in terms of the Specification (refer to Particular Specifications PLQ and PTV).

The impeller shall be selected such that good pumping action is obtained without any vortex action and Tenderers shall state what pumping action is expected from his equipment at all speeds.

No visible sludge build-up in any section of the tanks will be allowed.

Six random samples will be taken in a specific tank and the individual samples shall have a solid content within 20% of the mean of the six samples.

PTM 3.2 Gearboxes and Bearings

Gearboxes shall be selected for continuous operation with a power service factor of not less than 2,0 based on installed power. Tenderers shall provide a catalogue of the make of gearbox offered and provide calculations to indicate how the selection of gearbox was made.

Worm gears will not be considered.

All gears and pinions shall be hardened and ground after cutting.

Gearboxes shall be of a type specifically designed to accommodate bending caused by long overhang of the shaft of the stirrer. Bending of the shaft shall not damage the driving gears or the bearings.

All bearings shall be designed for a life of 100000 hours at a B10 rating. Proof of such rating shall accompany the tender. In addition, the bearings on the output shaft shall be capable of withstanding the resultant forces caused by the combination of radial and axial loads (imposed by the stirrer) acting simultaneously, and shall be selected such that the following condition is complied with:

$$\frac{\text{Actual radial load}}{\text{permissible radial load}} \quad \text{plus} \quad \frac{\text{Actual axial load}}{\text{permissible axial load}}$$

is equal or less than 1 (where the "permissible" loads are the manufacturer's figures for 5000 hours at a B10 rating). Tenderers shall indicate what these forces are and how they are accommodated.

The gearbox casings shall be designed to prevent moisture from entering. A dry well for the output shaft lower bearing shall be provided to avoid complete drainage of oil in the box in the event of an oil seal failure. The gearbox casings shall be made of close grained cast iron.

Installed motor sizes shall make allowance for gearbox efficiencies and a 10% margin on motor power. Impellers shall be selected to operate preferably in the range of 20 - 25 rpm with a tip speed not exceeding 2 m/s.

Where belt drives are used in the drive train, allowance shall be made for the additional power loss when calculating the minimum size of motor required.

The Tenderer shall supply all relevant information for the proper adjudication of the units, giving information regarding the impeller size and shape, the blade pitch, the tip speed, the pattern of flow in the basin, shaft length and diameter as well as construction taking into full account the specified medium, the ambient temperature, the height above sea level, tank geometry and the water depth in the tank.

PTM 3.3 Motors

The general requirements for low voltage electrical motors are included in the portion Specification (different volume in some cases) for the supply and installation of electrical and electronic equipment.

PTM 4 INSTALLATION

PTM 4.1 Bridge Mounted Stirrers

The stirrer shall be mounted in such a way as to facilitate ease of maintenance.

Stainless steel anchor bolts shall be used to fix the mixer to the mounting platform.

PTM 5 TESTING AND COMMISSIONING

On completion of installation, the stirrers shall be thoroughly tested at minimum and maximum water level for speed of rotation, energy input, resistance to bending of shaft and overall efficient operation of the complete mechanical and electrical system. The Contractor shall provide free of charge for testing purposes a kW meter to measure the energy absorbed by each mixer.

If the mixers are unable to satisfy the above-mentioned criteria, the Contractor shall alter the mixers or add more mixers to satisfy the criteria at his own expense.

PTM 6 MEASUREMENT AND PAYMENT

Measurement and payment will be done in accordance with the methods stated below:

PTM 6.1 Design, Drawings and General

<i>Pay Item</i>	<i>Unit</i>

PTM 6.1.1 Provide design drawings and design information as specified.	Sum

PTM 6.2 Supply and Delivery to Site

<i>Pay Item</i>	<i>Unit</i>

PTM 6.2.1 Bridge mounted fixed speed vertical shaft mechanical stirrer complete with motor, gearbox, fasteners etc.	No

PTM 6.3 Installation Work

<i>Pay Item</i>	<i>Unit</i>

PTM 6.3.1 Bridge mounted vertical stirrer and motor set complete on base plate	No

The item shall include taking delivery of materials on site, handling safeguarding, installing, painting, fixing, grouting and aligning

PTM 6.4 Commissioning

<i>Pay Item</i>	<i>Unit</i>

PTM 6.4.1 Testing and commissioning of mechanical stirrer	No

END OF SECTION

PTU CHLORINE DOSING EQUIPMENT

PTU 1 SCOPE

This section of the Specification includes the supply, delivery, installation, commissioning and upholding during the Defects Notification Period of chlorination equipment.

PTU 2 MATERIALS

The chlorinator equipment, all associated chlorine dosing pipework and accessories that may come in contact with chlorine gas or solution shall be constructed of materials resistant to corrosion from the effects of chlorine.

PTU 3 EQUIPMENT REQUIRED

A vacuum operated chlorinator system containing two vacuum regulators suitable for fitting onto 1 ton containers are required. The chlorinator system shall operate in the change-over configuration.

Each vacuum regulator shall have an integral electrical heating system. The vacuum shall be created by an ejector in the chlorine dosing system. The ejector will be driven by a clear or process water supply as specified in the Project Specification. The pressure required in the water supply system to the ejector shall be stated in the tender. Each chlorinator shall be provided with the necessary drainage and ventilation pipes.

Chlorinators shall be adjusted manually by the plant Operator to achieve a prescribed dosage. Flow/residual pacing or automatic rate controlled chlorination shall not be required, unless stated in the Project Specification.

Each system to be supplied and installed under this portion of the Contract must include the following:

- regulators, heaters, rate valves, rotameters, ejectors, in-line strainers, etc.
- for automatic rate control system (if specified): regulators, heaters, actuated gas controller with automatic proportional to flow/residual control facility, appropriate Signal Conditioning Unit (SCU), rotameters, ejectors, in-line strainers etc. The facility to operate the system manually shall be provided.
- the complete gas piping including valves and fittings to the ejectors and the uPVC piping to the diffuser.
- the diffuser shall be designed to match the equipment accepted and shall be readily removable.
- complete piping from the clear/process water supply pipework including valves, fittings and an appropriate pressure gauge to the chlorine room.

The following ancillary equipment will be required:

- The complete electrical installation, cables, etc.
- Electrically driven extractor fan(s) with a capacity of 1 000 l/min.

- A sturdy weatherproof cupboard, 750 x 750 x 300 deep with a 50 mm minimum roof overhang and with two glass doors in front must be mounted on the wall just outside the chlorine room. A hardwood-framed fibre glass covered construction is required. The Tenderer to submit details of his offer with his tender. This cupboard will be used to house a resuscitator and two gas masks, completely self contained with oxygen cylinders, etc. "Siebe Gorman" ref. 01457708 or equal. Design of the cupboard must be approved by the Engineer before manufacturing.
- One chlorine detector with alarm unit.
- One lifting beam with hooks suitable to lift the containers with a 2 ton chain block and trolley.
- Emergency repair kit for the containers.
- The change-over device between the containers shall be provided with a potential-free contact for monitoring purposes.
- Emergency shut-off system for containers (refer to PTU 5)

PTU 4 LOAD CELLS

To determine the chlorine available in a container, load cells with a capacity from 0 to 2 000 kg with associated LCD display unit shall be provided. The LCD display unit shall be mounted in the chlorine dosing room. The accuracy of the load cells shall be within 0,25% of scale deflection.

The tare weight of the container must be back balanced to give a net reading of the weight of liquid chlorine available in the container. The platform of the scale must have four trunnions mounted thereon for easy positioning of the chlorine containers. The scale must be sturdy and dependable and of high quality, suitable to operate under extreme condition of dust, moisture, corrosion and impact. The gross weight of a chlorine container is approximately 1 600 kg.

PTU 5 EMERGENCY SHUT-OFF SYSTEM

An emergency shut-off mechanism of the outlet valve of the active containers shall be provided under this portion of the Contract. The system shall operate either electrically or pneumatically. In the case of pneumatic operation, compressor(s) and air storage vessel shall be provided.

The shut-off system shall be activated by a high chlorine level (typically 5 ppm) detected in the chlorine storage area. Once the detection level remains for say 30 seconds, a signal shall be generated initiating the closure of the outlet valves. If the mechanism is operated electrically, the valves shall be closed in the event of a power failure.

PTU 6 MEASUREMENT AND PAYMENT

The tendered prices shall include for the supply, delivery, installation, testing and commissioning of the equipment required as specified:

Pay item

Unit

PTU 6.1 Chlorine dosing equipment

Chlorinators as specified shall be supplied complete with ejectors, multiple flow meter assembly, rate control valves, isolating and solenoid valves, rotameters, in-line strainers,

	pressure gauges, by-pass connection, heaters, vacuum regulators and automatic change-over devices (automatic rate control devices if specified)	Sum
PTU 6.2	<u>Load cells</u>	
	Load cells for weighing 80 kg chlorine containers complete with trunnions and LCD displays in dosing room	No.
PTU 6.3	<u>Pipework</u>	
PTU 6.3.1	Cadmium plated copper flexible connectors and seamless steel header piping to BS 1485 from the containers to the regulators including brass plug valves and suitably sized catch pots	Sum
PTU 6.3.2	The complete uPVC piping with the necessary isolating valves, bends, flanges, etc. from the ejectors to the diffuser	Sum
PTU 6.3.3	The complete uPVC piping with the necessary isolating valves, bends, flanges, pressure gauge etc. from the site water installation to the ejectors	Sum
PTU 6.4	<u>Chlorine diffuser</u>	
PTU 6.4.1	Chlorine diffuser complete with the necessary fixing brackets, bends flanges, etc. to complete the installation	Sum
PTU 6.5	<u>Low level fans</u>	
PTU 6.5.1	Low level extractor fans with vent pipes for controlled release	No
PTU 6.6	<u>Ancillary items</u>	
PTU 6.6.1	Wall mounted cupboard with glass front complete with resuscitator and two gas masks	Sum
PTU 6.6.2	Chlorine detector	Sum
PTU 6.6.3	Lifting beam with hooks and 2 ton chain hoist & trolley	Sum
PTU 6.6.4	Emergency repair kit for the containers	Sum
PTU 6.6.5	Emergency shut-off system	Sum

END OF SECTION

EMVS MEDIUM VOLTAGE SWITCHGEAR

EMVS 1 SCOPE

As specified in the Project Specifications.

EMVS 2 STANDARDS

The medium voltage switchgear shall conform to and be in accordance with the latest applicable South African Bureau of Standards Codes and Standards:

The following Standard Specifications and drawings shall apply:

Standard No.	Description
SANS 10142	Code of Practice for the wiring of Premises
SANS 10142-2	Code of Practice for the wiring of Premises (Medium voltage)
NRS 006	Switchgear metal enclosed
NRS 008	Enclosure for cable terminations in air
NRS 029	Current Transformers
BS 142	Electrical Protection relays
BS 162	Switchgear
BS 2631	Switchgear
BS 3938	Current Transformers
BS 3941	Potential Transformers
SANS 556	Switchgear
SANS 1371	Bushings
SANS 1433-1	Terminal blocks having screw and screwless terminals
SANS 1433-2	Flat push-on connectors
SANS 1411-1	Materials of insulated electric cables and flexible cords: conductors
SANS 1091	National colour standards for paint
SANS 1186	Symbolic safety signs
SANS 1195	Busbars
SANS 1371	Bushings
IEC 62271-200	Internal Arcing test
IEC 62271-100	Pressure withstand test for gas-filled compartments
IEC 62271	Making and breaking capability of switching devices
IEC 62271-1	High-Voltage switchgear and control gear – Common specification
IEC 60529	Verification of IP coding
IEC 62262	Verification of IK coding
ANSI / IEEE	American National Standards Institute ANSI / IEEE
C37.04	Standard Rating Structure for AC HV Circuit Breakers
C37.06	Preferred Ratings for AC HV Circuit Breakers
C37.09	Standard Test Procedure for AC HV Circuit Breakers
C37.010	Application Guideline for AC HV Circuit Breakers

Standard No.	Description
C37.011	Application Guide for TRV for AC HV Circuit Breakers
C37.012	Application Guide for Capacitance Switching
C37.11	Requirements for Electrical Control
C37.20.2	Standard for Metal-Clad and Station-Type Cubicle Switchgear
C37.55	Conformance Testing Procedure of Metal-Clad Switchgear
C57.10	Requirements for Instrument Transformers
C57.13 Requirements for Instrument Transformers	Requirements for Instrument Transformers
47	Guide for Surge Withstand Capability Tests
NEMA	National Electrical Manufacturers Association (NEMA)
CC1	Electrical Power Connectors
SG-4	Standards for Power Circuit Breakers
SG-5	Power Switchgear Assemblies
IEC 60051-1	Direct Acting Indicating Analogue Electrical Measuring Instruments and Their Accessories Part 2: Special Requirements for Ammeters and Voltmeters

EMVS 3 STANDARDS AND DRAWINGS

All materials used shall satisfy the relevant SANS specification and may only deviate from it upon a definite instruction in this specification. The successful Tenderer shall ensure that he possesses the latest edition of the relevant SANS specifications as listed in this specification.

EMVS 4 PRE-MANUFACTURER

EMVS 4.1 Structural Drawings, with critical dimensions

- Arrangement;
- Plan, front view, and elevation section views;
- Required clearances for opening doors and for removing breakers;
- Conduit or cable trays entrance locations and dimensions for both top and bottom entrance;
- Bus bar locations and configurations;
- Incoming and outgoing power cable terminator positions;
- Anchor bolt locations;
- Grounding connections;
- Weight of equipment;
- Elementary Three-Line Diagrams.

EMVS 4.2 Three line diagrams, with function numbers used throughout

- Instrument transformers;

- Relays;
- Meters and meter switches;
- Breakers and other pertinent devices;
- Schematic Diagrams;
- Schematic diagrams shall be furnished for the electrically-operated breaker / relay control scheme;
- Each schematic diagram shall show device and terminal block terminal numbers for customer connections;
- Provide control switch development tables.

EMVS 4.3 Detailed Connection (Wiring) Diagrams

- Approximate physical location of all items in each unit;
- All wiring within each unit;
- All interconnecting wiring between units;
- Identification of all terminals, terminal blocks, and wires;
- Provide one set of drawings shipped with the switchgear for start-up use.

EMVS 4.4 Material List

- An electrical bill of material list shall be furnished listing the quantity, rating, type, and manufacturer's catalogue number of all equipment on each unit.

EMVS 4.5 Installation, Operating, and Maintenance Instructions

- Installation, operating, and maintenance instructions shall cover switchgear, breakers, relays, meters and devices requiring installation, programming and / or maintenance;
- The breaker operating mechanism shall be front-accessible, and all routine maintenance shall be performed with the breaker in an upright position. The interrupters shall be completely sealed requiring no interphase barriers. Breakers shall be designed for easy insertion, removal and transport on flat indoor surfaces;
- A breaker lift truck shall be supplied with the switchgear.

EMVS 5 BASIC CONSTRUCTION

The switchgear assembly shall consist of metal-clad, free-standing, vertical, dead-front steel structures containing circuit breaker compartments and circuit breakers, primary bus system, ground bus system, auxiliary compartments and transformers, protection and control devices, control bus (as required) and connection provisions for primary, ground, and control circuits.

The basic structure will be of modular construction and fabricated from steel specified in the project specification.

All the parts of the switchboard shall be able to withstand any mechanical stresses, which may develop out of normal duty or during maximum short circuit conditions without any damage or distortion to any part.

The switchboard shall be equipped with arc venting off venting system and front doors and panels shall be reinforced with special door locks to withstand explosion forces associated with maximum short circuit conditions.

The instrument and relay panel shall form an integral part of the switchboard with all the instruments and protection relays flush mounted.

The switchgear shall be designed so that future units can be added to each end (unless coupled to other equipment). A removable plate will cover any unused openings in the side of the gear.

Panels shall be manufactured from steel as specified in the Project Specification with a minimum thickness of 2 mm.

All the bolts used to bolt the different parts of the panel together shall be provided with jack nuts or another approved method to secure the nuts. No Self-Tapping Screws Shall Be Allowed. All the bolts and nuts visible from the outside shall be chromed and of the dome type.

EMVS 5.1 Compartments

The switchgear system shall be comprised of the following discrete modules, arranged for each vertical section:

- Circuit breaker compartments;
- Low voltage instrument compartments;
- Bus and cable compartments;
- Draw-out Auxiliary compartments (PT, CPT, Fuse, etc.)

EMVS 5.2 Circuit Breaker Enclosure

The circuit breaker enclosure shall include stationary support bushings and primary contacts for engagement with the circuit breaker or ground and test (G&T) device. Standard bushings shall be made of porcelain capable of supporting the weight of the current transformers. Primary contacts will be made of copper and designed to accept round, tulip style connectors.

EMVS 5.3 Ground Bus

Copper ground bus shall be provided for the entire length of the switchgear. It shall be equipped with a solderless connector for copper cable at each end. The ground bus shall be accessible in the cable compartment, and shall have connection points in each switchgear section for workmen's grounds. The ground bus will be connected to the breaker frames and will ground the draw-out circuit breaker in and when traveling in between the connected and test positions.

EMVS 5.4 Bus Bars

The main bus compartment shall be separated from the other compartments by an steel barrier and shall fully enclose the main bus. The main bus compartment shall be accessible from the rear through the cable compartment. Main bus ratings shall match the highest rated circuit breaker continuous current ratings and comply with ANSI / IEEE temperature rise requirements.

Bus bars shall be copper and shall be completely isolated and coated with an epoxy insulation that is flame retardant, non-hygroscopic and high-dielectric, except at bolted joints. The bus shall be mechanically braced for the close and latch rating of the breaker having the highest interrupting rating within each assembly. All bolted bus joints shall be Standard – silver-plated with. The bus connections to the circuit breakers shall match the breaker rating. Bus supports shall be flame retardant, track resistant Standard - porcelain.

Bus joint cover boots shall be manufactured from moulded PVC and shall be removable and reusable for field inspection and maintenance. Taping of bus joints is not acceptable.

The shape of the bus bar shall be full round edge. The main bus shall not be tapered.

Bus bar connections shall be mechanically secured with reusable fastening devices that shall maintain adequate pressures at the joints within the operating temperature range of the switchgear.

The bus bars and support systems shall be designed to withstand the forces created during short circuit conditions at the rated momentary and short-time (conditions of the highest rated circuit breaker and as specified in the Project Specifications. Supports shall be made of Standard - porcelain.

An insulated, rigid, copper riser bus shall be provided from the circuit breaker / switchgear primary disconnects to a cable compartment location to allow cable termination lug connections. Riser bus connections to bus duct shall be rigid. Cable termination bus arrangement shall allow for primary cable stress cones or potheads. Connections to roof entrance bushings shall include flexible straps from the rigid bus to the roof bushings.

The design shall be adaptable for top or bottom primary entrance arrangements which will be specified in the Project Specifications.

EMVS 5.5 Equipment

Bar type / zero-sequence current transformers, lighting arresters, surge capacitors, stationary control power transformers, ground sensors, or other auxiliary equipment shall be mounted in the cable compartments.

Rear extension shall be provided to accommodate additional equipment and power cable if required.

Control switches, instruments, meters, position indicating lights, protective relays, etc. shall be in a separate compartment from the circuit breaker unless specifically allowed by the Project Specifications. All other monitoring devices such as CT's and limit switches may be located within other compartments. Low voltage compartment door mounted devices shall be mounted on the front of the switchgear panels and arranged in an approved, logical, symmetrical manner. In those cases where there is not enough space on the door of the instrument compartment, the manufacturer shall advise for either increasing the size or extension shall be installed to mount metering, protection, and control devices.

EMVS 6 CURRENT AND FAULT RATINGS AND TEMPERATURE LIMITATIONS

All current carrying parts shall have normal, fault make, withstand and break ratings, as specified in the Project Specifications.

EMVS 7 INSULATION

All the Medium Voltage current-carrying parts shall be fully insulated or otherwise screened off and spaced in such a way that the basic insulation level shall be maintained under all working conditions.

Allowance shall be made for the easy dismantling of the bus bar connections when the switchboard is extended.

EMVS 8 ISOLATING CONTACTS

Isolating contacts shall be provided for circuit breakers and potential transformers. They shall be of the self-aligning type and must not transfer mechanical stresses. All accesses to the isolating contacts shall be equipped with mechanical shutters being operated by plugging-in or withdrawal of the circuit breaker or potential transformer. Facilities shall be provided to lock the shutters in the closed position.

Shutters for bus bar contacts shall be painted red while those for cable contacts shall be painted yellow. Shutters for double bus bars shall be marked according to the bus bar position.

EMVS 9 POWER CIRCUIT BREAKER

EMVS 9.1 Type

The power circuit breakers shall be electrically operated, 3-pole, draw-out type, with vacuum interrupters and a magnetic actuator operating mechanism with capacitor stored energy. The power circuit breaker shall be provided with self-aligning line-side and load-side disconnecting devices.

The circuit breaker mechanism shall have a life of 100,000 no-load operations.

Wheels shall be provided on the bottom of the circuit breaker for easy floor rolling after the breaker is removed from the frame. Circuit breakers that require a separately purchased floor rolling truck assembly are not acceptable.

EMVS 9.2 Rating

The rating of the circuit breaker shall be not less than the rating as specified in the Project Specification.

Test certificates issued by an independent test laboratory shall be submitted to prove the fault rating of the circuit breaker. Failure to submit these certificates may lead to the disqualification of a Tender.

EMVS 9.3 Draw-out Mechanism

The circuit breaker will be provided with an integral racking mechanism. Circuit breakers utilizing switchgear mounted racking mechanisms separate from the circuit breaker are not acceptable.

The draw-out mechanism shall hold the breakers rigidly in the **CONNECTED** (primaries and secondary's engaged), **TEST** (primary contacts disconnected and shutter closed, but control contacts engaged) and **DISCONNECTED** (both primary and secondary contacts disengaged) positions, with the door closed.

The secondary contact plug shall automatically disconnect when the breaker is moved from the **TEST** to the **DISCONNECTED** position. A fully automatic, self-aligning, secondary disconnecting device shall be provided to act as a disconnect for the secondary connections between the circuit breaker and the switchgear.

The disconnecting device shall be positioned and constructed as to not expose the operator to live parts. The secondary disconnect shall connect automatically when the circuit breaker is racked into the test and connected positions

The female portion of the disconnect system shall reside in the breaker compartment, so that energized contacts are recessed and remain "touch safe". To guarantee the integrity of operating personnel, it shall not be required to open or keep opened the door of the circuit breaker compartment after the breaker has been locked in the disconnected position to be able to rack the breaker or connect the secondary contacts, Circuit breakers that require manual connecting or disconnecting of the secondary contacts are unacceptable.

The breakers in the upper compartment and lower compartment shall be held captive in the cubicle by means of a latching mechanism, even in the disconnected position. Removal of the circuit breaker shall be by means of unlatching the mechanism and pulling the circuit breaker onto a lift truck. Cell must have a lip for proper sealing of the door and to prevent ingress of dirt and other contaminants. Circuit breakers that require rail extensions for circuit breaker removal are not acceptable.

EMVS 9.4 Interlocks and Safety Mechanisms

Interlocks shall be provided which will prevent connecting the breaker to, or disconnecting it from the bus stabs unless the breaker is OPEN (tripped), assuring proper sequencing and safe operation. The close springs of the circuit breaker will automatically discharge when the breaker is released from the cell by pulling in on the truck latch assembly. Provisions shall be made for the addition of optional KIRK KEY interlocks, as shown on project data sheets and the single line diagram.

Apart from any other interlocking or safety mechanism, the following mechanical interlocks shall be provided on every circuit breaker:

- a) Interlock to prevent the circuit breaker from being plugged in or isolated or to be inserted in the spouts when the circuit breaker is in the "closed" position.
- b) To prevent the circuit breakers from being closed unless it is properly in the "Service", "Isolated", "Test" or "Earthed" position or unless it is totally withdrawn from the fixed part of the panel.
- c) To prevent the circuit breaker from being closed in the "Service" position unless the secondary circuits on the circuit breaker and panel had been properly coupled.
- d) Interlock to prevent accidental contact with any live parts.
- e) Interlock to prevent access to the high voltage fuses of the potential transformer unless the transformer has been fully isolated.

EMVS 9.5 Electrical Interlocking

Electrical interlocking where necessary shall be specified in the Project Specifications.

EMVS 9.6 Control voltage and trip voltage

The breaker motor charging range shall be as specified in Project Specifications. The trip voltage shall be as specified in Project Specifications. The close voltage shall be (as specified in Project Specifications).

Close and trip circuits for each breaker shall be separately fused. Fuse blocks shall be dead front, pullout type, which provides the control power disconnecting means.

EMVS 9.7 Closing of a circuit breaker

The circuit breaker shall be provided with a magnetically actuated mechanism which shall use a flux-shifting device with integral permanent magnets. It also shall incorporate an electronic controller and a capacitor for energy storage. The circuit breaker mechanism shall be capable of 100,000 no-load operations. The breaker shall be virtually maintenance free, except for minor lubrication. The circuit breaker shall be capable of operating in three cycles which means smaller power cables, lower construction costs, and improved system quality. The mechanism shall be completely front accessible and maintainable by removing the faceplate. Breakers that require lifting to access the mechanism under the carriage are unacceptable. It shall be possible to program the electronic controller to react in three different ways upon loss of control power: 1) trip

the circuit breaker immediately, 2) trip the circuit breaker with a delay, or 3) remain in the closed position, which will be specified in the Project Specifications.

The circuit breaker shall have the capability of accepting AC and DC as control power as specified in the Project Specifications.

The closing mechanism shall have a facility for local operation. Facilities for remote closing shall be provided for all Medium Voltage switchgear.

EMVS 9.8 Tripping of the circuit breaker

The circuit breaker shall be equipped with a D.C. shunt trip coil of the specified voltage as well as facilities for mechanical tripping by hand; the latter being suitably protected against accidental tripping and shall be clearly and indelibly marked.

The trip coils shall operate satisfactorily at 50 % under voltage.

EMVS 9.9 Indicator mechanisms

Positively driven mechanical indicators shall be supplied on the circuit breaker to indicate clearly whether the circuit breaker is in the "closed" or "open" positions. Springs charged and discharged indication shall also be given.

EMVS 9.10 Accessories and auxiliaries

The circuit breaker shall be complete and equipped with all the accessories and auxiliary contacts required for the successful operation as well as the specified indications and interlocking.

All the spare auxiliary contacts shall be wired to spare secondary plug contacts.

A fully automatic, self-aligning, secondary disconnecting device shall be provided to act as a disconnect for the secondary connections between the circuit breaker and the switchgear. The disconnecting device shall be positioned and constructed as to not expose the operator to live parts. The secondary disconnect shall connect automatically when the circuit breaker is racked into the test and connected positions. The female portion of the disconnect system shall reside in the breaker compartment, so that energized contacts are recessed and remain "touch safe". To guarantee the integrity of operating personnel, it shall not be required to open or keep opened the door of the circuit breaker compartment after the breaker has been locked in the disconnected position to be able to rack the breaker or connect the secondary contacts; Circuit breakers that require a manual secondary contact connecting plug are not acceptable.

The breaker shall have a mechanism device to indicate open or closed position, and spring charge status. Only the correct status flag for any single function shall be visible. Additionally, the breaker shall have a 5-digit, non-resettable operations counter.

EMVS 10 EARTHING FACILITIES AND EARTH BAR

The switchboard shall have integral facilities to earth cable circuits via the circuit breaker and the necessary auxiliary gear shall be provided to earth the busbars. The earthing of busbars shall preferably only be possible on the incoming supply panels.

Earth bars, earth blocks, cable boxes and glands shall be bonded with the panels by using brass bolts and nuts unless otherwise specified. Not more than two earth conductors will be permitted on a single connection point.

The earth bar shall be in an acceptable position to allow for earthing of cables and shall have sufficient connection points to take all earthwires.

All metal-clad instruments, meters, relays etc., mounted on hinged doors as well as the doors themselves shall be earthed.

Draw-out gear shall have an early-make-late break earthing arrangement which closes or breaks automatically when a circuit breaker truck is pushed-in or drawn-out.

EMVS 11 CURRENT TRANSFORMERS

Current transformers shall comply with BS 3938, 1973, and shall have a ratio and be suitable for the purpose as specified in the Project Specifications.

The primary windings of current transformers shall have the same short circuit rating as the associated circuit breaker unless special approval had been obtained. The primary windings may not have a cross-sectional area of less than 70 mm² copper.

Air insulated current transformers shall have a minimum audible corona discharge level of 8kV at 50 Hz to earth.

The secondary circuit of each set of current transformers shall be earthed at one point by means of a removable link.

Where specified summation current transformers shall be of the same accuracy class as the other current transformers in the same circuit.

Nameplates shall be located on the CT housing and information provided. The CT winding shall terminate on a screw type terminal on the CT housing and shall be wired to shorting terminal blocks.

Each current transformer shall have a 1-ampere secondary and a primary rating shall be specified in Project Specifications.

Each current transformer shall have a short-circuiting device (shorting type terminal blocks). The first termination of each current transformer shall be at the short-circuiting device terminal blocks where the ground connection is also made.

Low voltage ring type CT's will be bushing-mounted, located behind the shutters and accessible from the front. Bushing design will accommodate up to four standard accuracy CT's per phase (two on the bus side and two on the load side) for all ratings.

EMVS 12 POTENTIAL TRANSFORMERS

Potential transformers shall be of the 3-phase type and shall be coupled to either cable or the busbar side of circuit breaker panel as required. The transformers shall comply with all the relevant standards as specified in the document.

The potential transformers shall have a ratio of primary voltage to 110 V AC.

Both the primary and secondary windings shall be connected in star and such that with the exception of the inherent phase-angle-error, there shall be no phase displacement between the primary voltage and the induced secondary voltage.

Disconnection of potential transformers shall preferably be obtained by withdrawal of the transformers.

Suitable mechanical shutters shall be provided to shut off the access to all the fixed primary plugging contacts automatically when the transformer is withdrawn. Provision shall be made to lock the shutters in the close position with padlocks. Furthermore it shall be possible to lock the transformer in the "Service" position with padlocks.

The "Yellow" line of each transformer shall be earthed by means of a bolted link.

Potential transformer shall be designed to withstand the Basic Impulse Level (BIL) of the switchgear. Potential transformers shall always be fused. Potential transformers shall be mounted on a draw-out unit in an auxiliary enclosure, which disconnects them from the primary circuit safely. Potential transformers shall be supplied in accordance with Project Specifications.

Potential transformers shall be mounted in a separate draw-out compartment (truck assembly) and so arranged that the unit can be withdrawn from the operating position via a racking device with the door closed. In the withdrawn position, the fuses shall be completely disconnected from service and all exposed parts shall be visibly grounded.

The potential transformers compartment shall incorporate extension rails to allow changing fuses and general maintenance without the need to take the truck assembly completely out of its compartment.

Potential transformers shall be connected to the line or load via solid copper rod, bus or shielded cable.

An impact resistant glass-viewing window shall be on the front of the potential transformer door.

Each transformer shall be protected with current-limiting primary fuses, and shall be designed to withstand the basic impulse level of the switchgear.

Each transformer shall have a 110-volt AC secondary, accuracy classification shall be detailed in the Project Specification.

EMVS 13 POTENTIAL INDICATORS

Potential indicators consisting out of three neon-indicating lamps shall be provided. The neon lamps shall be energised via capacitor bushings on the cable side of the relevant circuit breaker.

One lamp shall be provided for each phase and they shall be marked clearly and indelibly "Cable Live".

The point where the indicating lamp is bonded to the bushing shall be permanently earthed via a resistor to avoid dangerous voltages

Threshold of indication of voltage presence below 45% of nominal three-phase system voltage is in line with IEC 61243-5 and IEC 61958.

Withstand voltages and withstand fault currents are in line with IEC 60694.

Resistance to moisture ingress tested according to IEC 60099-4.

EMVS 14 CABLE END BOXES

Cable boxes shall be suitable to accommodate the cable or cables for each circuit as specified. This applies not only to the number of cores, size and conductor material, but also to the type and construction of the cables.

Cable boxes shall be complete with the necessary clamps, tapes, glands, compound, terminating and other accessories. If heat shrink cable ends are specified then the end boxes shall be provided complete with the necessary wooden cable clamps and all accessories.

Mechanical cable glands for control and auxiliary cables shall be suitable for PVC/PVC/SWA/PVC type cables. The armouring shall be clamped firmly to ensure a reasonably good electrical connection and to prevent the cables from being pulled out easily. Each gland shall be complete with a neoprene shroud and one locknut.

3CR12 unpainted cable gland plates shall be provided for proper earthing of cable glands.

EMVS 15 CONTROL, INSTRUMENT AND RELAY PANELS

All protective relays, auxiliary relays, indicating instruments, recording instruments, indicating lights, transducers, etc. shall be housed in the low voltage compartment unless specifically specified in the Project Specifications. The low voltage compartment shall isolate the above equipment so that additional arc flash protection is available. Relays and instruments shall be provided and wired as specified in Project Specification.

Protective relays and test devices shall be semi-flush mounted. The relays shall be so arranged that they can be tested in position on the panel and readily withdrawn from the panel for inspection or replacement.

No relay or trip coil may be permanently connected to the positive pole of a D.C. supply. Protective relays shall be equipped with separate alarms and trip contacts.

Where auxiliary relays are required for alarm or indication facilities, these relays shall be of the series type.

The characteristic curves of overload and earth fault relays shall unless being specified to the contrary be of the inverse definite minimum time type with a three seconds time lag at 10 In and a time multiplier setting of 1,0. The time multiplier shall have a setting range between 0,05 and 1,0. The overload setting range shall preferably be between 50 % and 200 % while the earthfault range shall either be between 10 % and 40 % or 20 % and 80 %, all these ranges shall be obtained in 7 equal steps. Relays shall be dust proof and only external repair shall be possible.

Front panel mounted female socket for hard wired remote switching of circuit breakers shall be provided on each circuit breaker. The “chicken switch” shall be equipped with a matching male type plug top.

The relays shall support IEC 61850 Editions 1 and 2, including IEC 61850-9-2 LE for less wiring and supervised communication. IEEE 1588 V2 for high-accuracy time synchronization and maximum benefit of substation-level Ethernet communication. Shall also support Modbus, DNP3 and IEC 60870-5-103 communication protocols

All equipment, relays, etc., for protection systems shall comply with BS 142 and 3950 and their amendments.

All the relays and instruments shall be flush mounted with only the control handles, push buttons and the faceplates being visible.

Protection relays shall be provided as specified in Project Specification.

EMVS 15.1 Typical Incomers Equipment

- a) Large graphical display showing customizable single line diagram, accessible either locally or through an easy-to-use web-browser-based HMI 3-phase overcurrent protection (time and instantaneous);

- b) Ground overcurrent (time and instantaneous);
- c) Directional overcurrent as well as phase-voltage and frequency-based protection;
- d) Multi-shot reclosing (If specified);
- e) High set instantaneous;
- f) Ammeter per Phase, demand and peak demand ammeters;
- g) Event recording;
- h) Accumulation of breaker interrupting duty;
- i) Continuous self-checking;
- j) Cable Theft Monitor, Intelligent Vibration Sensor, CT Strap and all accessories.
- k) Minimum of RS-485 communications ports for remote terminal connection.

EMVS 15.2 Typical Transformer Equipment

- a) Large graphical display showing customizable single line diagram, accessible either locally or through an easy-to-use web-browser-based HMI 3-phase overcurrent protection (time and instantaneous);
- b) Ground overcurrent (time and instantaneous);
- c) Directional overcurrent as well as phase-voltage and frequency-based protection;
- d) Multi-shot reclosing (If specified);
- e) High set instantaneous;
- f) Ammeter per Phase, demand and peak demand ammeters;
- g) Event recording;
- h) Accumulation of breaker interrupting duty;
- i) Continuous self-checking;
- j) Cable Theft Monitor, Intelligent Vibration Sensor, CT Strap and all accessories.
- k) Temperature and Bucholz alarm / trip indication on HMI Display.
- l) Minimum of RS-485 communications ports for remote terminal connection.

EMVS 15.3 Typical Motor Protection Equipment

- a) Large graphical display showing customizable single line diagram, accessible either locally or through an easy-to-use web-browser-based HMI 3 Motor differential protection, thermal overload protection, motor start-up supervision and frequency protection (time and instantaneous);
- b) Ground overcurrent (time and instantaneous);
- c) Directional overcurrent as well as phase-voltage and frequency-based protection;
- d) Multi-shot reclosing (If specified);
- e) High set instantaneous;
- f) Ammeter per Phase, demand and peak demand ammeters;
- g) Event recording;
- h) Accumulation of breaker interrupting duty;
- i) Continuous self-checking;
- j) Cable Theft Monitor, Intelligent Vibration Sensor, CT Strap and all accessories.
- k) Shall be equipped with RTD/mA module to be used for various protection and monitoring purposes in motor applications;

- l) RTD/mA inputs and 4 mA outputs
- m) Minimum of RS-485 communications ports for remote terminal connection.

EMVS 16 TREATMENT AND PAINTING OF METAL PANELS

All metal parts shall be treated before painting in accordance with the requirements of standard corrosion protection specifications and the appropriate coating system shall be selected for the specific application.

Powder coating for Indoor Panels shall be done to the following standards:

Substrate	Steel
Pre-Treatment	Vapour Degrease & Immersion Zinc Phosphate
Type of Powder	Nylon Modified Polyester Powder
Film Thickness	70 microns

Type of Test	Test Standard	
Salt Spray	ASTM B-117 -73, BS 3900 Part F4	500hrs
Cross Hatch	2mm Crosshatch BSN ISO 2409	
Impact	ISO 6272, DIN 55669, BS 3900 E13	
Flexibility	ISO6860 (Conical Mandrel)	
Pencil Hardness	ISO 15184: 1998	3H

Powder coating for coastal region panels shall be done to the following standards:

Substrate	Steel
Pre-Treatment	Vapour Degrease
Type of Powder	1st Coat Zinc Rich Powder, 2nd Coat Polyester Powder
Film Thickness	120 microns

Type of Test	Test Standard	
Salt Spray	ASTM B-117 -73, BS 3900 Part F4	1000hrs
Cross Hatch	2mm Crosshatch BSN ISO 2409	
Impact	ISO 6272, DIN 55669, BS 3900 E13	
Flexibility	ISO6860 (Conical Mandrel)	
Pencil Hardness	ISO 15184: 1998	3H

EMVS 17 INSTRUMENTS

Indicating instruments shall comply with IEC 60051-1. Instruments shall be of the 2,5 accuracy class.

All instruments shall be flush mounted. Ammeters shall be equipped with suitably rated saturation current transformers.

EMVS 18 TEST BLOCKS

Test blocks shall be mounted on the front of the panels to enable the connection of external instruments in the potential and current transformer circuits complete with terminals and links for the short circuiting and bridging of circuits. Where more than one test block is installed on a panel, it must be clearly and indelibly labelled to indicate the relevant circuits.

EMVS 19 FUSES AND LINKS

Fuses and links of the withdrawable cartridge type shall be installed in the control and protection circuits as specified.

Cartridges for 15A fuses shall be green, for 5A and 1A fuses they shall be black while links shall be white. Fuses and links in closing circuits shall be subsidiary to those in trip circuits.

EMVS 20 TERMINALS

Terminals may be of the bolted type otherwise they shall be of rail mounted clamp type.

All types of terminals and their insulation shall have a minimum comparative creep index of 500 to BS 3781.

a) Bolt type terminals

The bolts shall be such that they cannot turn around in the insulation. The minimum diameter of bolts shall be 6mm.

Current may not be conducted by the bolts through the insulation.

A maximum of two connections per bolt shall be allowed. Locknuts or spring washers shall be used to prevent loosening of nuts by vibration.

Terminals having a potential higher than 50V shall be insulated.

a) Clamp type terminals

These terminals shall be not less than 8 mm wide.

Screws and connectors shall be electroplated to prevent corrosion. The connectors shall be such that the screws will not loosen due to vibration. Current carrying parts shall be of serrated silver plated copper or brass. Only one connection shall be allowed per connector. For more connections the number of terminals shall be increased and bridge pieces shall be used.

EMVS 21 MONITORING, CONTROL AND WIRING

Voltage free contacts shall be provided for circuit breaker spring charged indication and position indications

Control circuits shall be wired with 600/1000V grade PVC insulated cables complying with SANS 1507. These cables shall have at least 7 strands with a total cross-section of not less than 2,5mm².

Inter panel connection PVC covered conductors shall be protected by means of non-conducting grommets at panel through holes to prevent damage to conductor outer sheath.

EMVS 22 NUMBERING OF CONDUCTOR ENDS

Every conductor end whatsoever, with the exception of AC power cables at any terminal shall be numbered. The alpha numeric numbering and the colour of the wiring shall be in accordance with - BS 158 - 1961.

These numbers shall correspond with those on the circuit diagram and shall consist of ferrules situated behind the cable lug. It shall not be possible to remove the ferrule without damaging it or cutting off the lug.

EMVS 23 CONNECTION OF CONDUCTOR ENDS

All conductors whatsoever shall be connected at terminals by means of lugs and/or ferrules suitable for the specific conductor and terminal.

EMVS 24 LABELS AND INSCRIPTIONS

The standard labels on equipment regarding the manufacturer, type, class, rating etc.

Engraved laminated plastic labels shall however be provided to indicate the main circuits as well as the functions of relays, fuses, links, lights and selector and control switches. These labels shall be fixed with screws, bolts or rivets.

The proposed wording of labels as well as those for flagging or alarm relays in alarm panels shall be in English and submitted to the Engineer for approval.

EMVS 25 BATTERIES AND CHARGER

Battery cells shall be of the Lithium type with reserve requiring a minimum of maintenance.

The batteries shall be housed in a steel cubicle in such a way that the testing, maintenance and filling of the cells can be carried out conveniently. The centre point of the battery shall be earthed via a high resistance earth fault alarm relay.

The battery charger shall be of the constant voltage type with the charging current being limited by the battery characteristics. The minimum charging current shall be variable to allow for the battery requirements as well as any permanent load being connected to the battery.

The charger shall be suitable for use on a 230V plus/minus 10%, 50Hz. A.C. supply and equipped with an A.C. switch and fuse as well as a minimum charge current adjuster.

On the D.C. side the charger shall be equipped with a charge current meter, voltmeter, test button and a test load resistance.

A gland plate in such a position that access to the cables is obtained from the bottom shall be supplied for one supply and three outgoing cables and shall be manufactured from 3CR12 unpainted stainless steel.

Terminals shall be wired for monitoring of battery status, supply voltage and any trip condition on a remote monitoring system.

EMVS 26 MAINTENANCE TOOLS EQUIPMENT

a) Spare fuses and lamps

One spare fuse shall be provided for each fuse used on the switch gear.

Two spare lamps shall be provided for each lamp used on the switch gear.

The spare lamps and fuses shall not be used by the Contractor.

a) Tools, Tool boxes and brackets

At least two spring charging handles, operating handles and door keys as well as one remote operating chicken switch shall be provided for each substation.

Wall mounted brackets shall be provided for carrying the manual operating handles and test jumpers.

If special tools are required, a complete set of finished case-hardened spanners and special wrenches to fit every nut and bolt on the equipment supplied shall be provided under this contract. Any special tools or keys that may be required for effecting adjustments of parts as well as all standard earthing and test equipment, shall also be provided.

These tools shall be accommodated in a suitable, neat, and properly designed; wall constructed steel equipment cabinet with tool positions marked. The cabinet shall be capable of being locked by means of a padlock.

A fully detailed list of tools shall be supplied before delivery.

The tools shall not be used for the erection of the contract works.

All tool boxes and testing equipment brackets shall be properly fitted against substation walls in suitable positions.

EMVS 27 TEST EQUIPMENT

The following is understood under test equipment and shall be supplied as part of the contract for every switchboard.

- a) Plug-in contacts to establish a connection with the 11 kV isolating contacts on the switch gear for the purpose of pressure and injection testing as well as cable fault finding.
- b) An extension cable with plugging contacts and sockets to establish a connection between a circuit breaker and the secondary circuits on the fixed part of the switch gear for the checking of the secondary circuits.

EMVS 28 HANDBOOKS

Prior to the commissioning of any equipment, the contractor shall submit to the Engineer four sets of handbooks giving full particulars of all the gear. Under full particulars the following shall be understood:

- a) Switchgear technical descriptions and specifications.
- b) Erection and commissioning instructions.
- c) Operating instructions.
- d) Descriptions of the operation, setting, adjusting and maintenance of the gear.
- e) A parts list with illustrations for the correct identification and ordering of parts.

A draft handbook shall be submitted to the Engineer in advance for approval.

EMVS 29 INSTALLATION AND ERECTION OF SWITCHGEAR

The switchgear panels shall be properly aligned, erected, plumbed, bolted together and fixed onto the floor.

If the floor is not level, suitable packing shall be used to level the switchboard.

Each individual panel shall be levelled before the panels are bolted together.

The panels shall be assembled and erected strictly in accordance with the manufacturer's instructions, which shall be issued to the Installation Contractor by the manufacturer.

Switchgear trucks shall move freely and shall be properly aligned.

EMVS 30 EARTH RESISTANCE SURVEY

The Contractor will be responsible to have an earth resistance survey carried out on site by a specialist in this field, to be approved by the Engineer. The test shall be done on the undisturbed site, i.e. before earth works, trenching, building etc. commence.

The Engineer shall attend the survey. The Contractor shall inform the Engineer in good time when the test is scheduled to take place. If it is done without him or his representative being present, the test shall be repeated in the Engineer's presence at no additional cost.

The results of this survey will be used to adjust the earthing system as specified if necessary, on the basis of the quoted rates.

Payment for the services of the specialist shall be by the Contractor.

EMVS 31 INSPECTIONS AND TESTS

All equipment will be inspected by the Engineer and tested in his presence both in the factory during manufacturing and on site during installation. The Engineer will do all inspections accompanied by the Contractor and the Contractor will do all tests with the Engineer as witness.

The Engineer will require seven (7) days notification to avail himself for any test or inspection and the Contractor must arrange for the maximum number of inspections and tests to be done on the same day. The Contractor must provide all testing facilities and instruments, all equipment required for a test or inspection and all safety clothing prescribed by the Engineer.

The instruments must have valid test certificates issued by an accepted testing authority and the results of the test done must be recorded on a test certificate, of which the Engineer must receive two copies. The Engineer reserves the right to call for a calibration test on any instruments used during the test.

Following test will be minimum:

- The control circuits shall be operated at the normal voltage and current for proper operation of circuit breakers, circuit breaker simulators, switches, contactors, interlocks, etc.;
- Instruments shall be energized from the low voltage winding of the potential transformers and the low current winding of current transformers. Where practical, each instrument shall be operated through its range of voltage, current and/or phase angle and frequency to produce deflections over the entire scale;
- The ratio and interconnections of all potential transformers shall be functionally checked to verify conformance to the electrical drawings and electrical bills of material.
- Relays shall be tested by applying rated current and/or voltage as required to determine proper performance characteristics. Each relay shall be tested to determine its proper operation in itself and also in the total overall circuit performance;
- A static circuit check shall be performed for auxiliary switches, external circuit connections and parts of circuitry that have not been checked or cannot be checked functionally. The devices

shall be checked for mechanical function and for conformance to the schematic and wiring diagrams;

- After all electrical tests and mechanical checks have been completed and corrections have been signed off, the following dielectric tests shall be performed:
 - a) Each power bus shall be given a high voltage withstand test from phase to phase and phase to ground at the specified voltage, frequency and time duration indicated in the Standard C37.20.
 - b) Control wire shall be given a high voltage withstand test from wire to ground at the specified voltage, frequency and time duration with reference to the proper standard.

The cost of all tests must be included in the tender price.

EMVS 32 PERFORMANCE TESTS & TESTING

On completion of erection and installation the Contractor must carry out the following tests, where applicable, in addition to any other tests:

Before commissioning

- a) Cable Insulation test.
 - b) Earth continuity test.
 - c) Test for correct operation of control gear, setting of overload protection equipment, etc.
- On completion of installation and putting into proper operation all the plant and equipment, the Contractor will be required to make suitable arrangements for the testing of all plant and equipment supplied under this Contract and running the plant for at least one week, during which time he shall also train all the operators in the correct running of the plant. He shall also explain the maintenance manuals to the operator during this time.

The entire cost of testing, including supply of test equipment, must be borne by the Contractor and an adequate allowance for such tests must be made in the Tendered price.

EMVS 33 PROTECTION SETTINGS

The Contractor will be responsible to have protection setting calculation done by a specialist in this field, to be approved by the Engineer. The protection settings shall allow discrimination between protection settings of supply authority switchgear, plant incomer and distribution system medium voltage switchgear protection settings and protection settings shall be done by the specialist and demonstrated for correct operation by means of secondary injection test procedures.

The Engineer shall attend the test demonstration and the Contractor shall inform the Engineer in good time when the test is scheduled to take place. If it is done without him or his representative being present, the test shall be repeated in the Engineer's presence at no additional cost.

Short circuit analysis and coordination study "Short Circuit Analysis/Coordination Study" shall be completed and submitted with switchboard submittal to confirm interrupting rating of submitted equipment is adequate for the point of application in the electrical distribution.

Payment for the services of the specialist shall be by the Contractor.

EMVS 34 DEFECTS LIABILITY PERIOD

During this period the Contractor must visit the Site at least three times, say 1, 6 and 12 months respectively after the Commissioning Date, to inspect and check all the plant supplied and installed by him for proper operation and to adjust where necessary, and to satisfy himself that the regular maintenance of the plant is being carried out correctly and in accordance with the written instructions supplied by him. The Contractor shall make sufficient provision in the contract price for these visits.

EMVS 35 MEASUREMENT AND PAYMENT

Measurement and payment will be done in accordance with the methods stated below:

EMVS 35.1 Design, Drawing and General

The rate tendered shall include for the provision of the necessary design information for all items measured under the respective schedule. For medium voltage switchgear installation, design information shall include, but limited to, the following:

- Manufacturer's product data of metal enclosed switchgear and all related components.
- Dimensioned drawings of metal enclosed switchgear showing accurately scaled basic units including, but not necessarily limited to, auxiliary compartments, unit components and combination units.
- Schematics and wiring diagrams for metering and controls.
- Furnish, upon request, manufacturer's certification of rating of the basic breaker, switch and fusing components and the integrated metal-enclosed interrupter switchgear assembly.
- Short circuit analysis and coordination study "Short Circuit Analysis/Coordination Study" shall be completed and submitted with switchboard submittal to confirm interrupting rating of submitted equipment is adequate for the point of application in the electrical distribution.

<u>Pay Item</u>	<u>Unit</u>
(a) Provide design drawings and design information for medium voltage switchgear	Sum
(b) Provide operating all maintenance manuals and "as-built" drawings as specified	Sum
(c) Allowance for short circuit analysis and coordination study and protection setting calculations	Sum

EMVS 35.2 Supply and Delivery to Site

Rate tendered to include for all material, equipment, plant, testing apparatus, labour, manufacturing, factory applied corrosion protection, factory acceptance testing, transport, import duties, handling and possibly double handling, delivery to and off-loading at Site as well as temporary storage prior to installation. For medium voltage switchgear, the rate tendered shall be for the complete medium voltage switchgear and shall include, but not limited to, the detailed in this particular specification. Any special devices shall be listed separately in Variations and Additions to the Standard and Particular Specifications Section C3.4.2 .

<u>Pay Item</u>	<u>Unit</u>
(a) Supply and delivery to site of medium voltage switchgear	Sum
(b) Supply and delivery to site of charger and battery unit	Sum

EMVS 35.3 Installation

Rate tendered to include for all plant, tools, labour, rigging, handling, placing into position, aligning, fixing, grouting, but not limited to and getting ready for testing and commissioning

Install of switchgear shall be accordance with the manufacturer's written instructions and recognized industry practices, to ensure that the switchgear complies with the requirements and serves the intended purposes. Comply with the requirements of SABS and IEC standards and applicable portions of "Standard of Installation", for installation of switchgear but not limited to.

<u>Pay Item</u>	<u>Unit</u>
(a) Site installation of medium voltage switchgear	Sum
(b) Installation of charger and battery unit	Sum
(c) Earthing resistance survey	Sum
(d) Protection setting calculations and setting of protection relays	Sum

EMVS 35.4 Commissioning

Rate tendered to include for the drafting of the necessary testing and commissioning plans, attendance of required local and/or overseas specialists, testing apparatus, instruments and equipment, any/all equipment required for testing purposes and to prove performance, any/all temporary works, and compilation of final commissioning report.

Prior to energization, check switchgear for continuity of circuits and for short circuits. Each switchgear line up bus shall have its insulation resistance tested after the installation is complete except for line and load side connections. Tests shall be made using a Megger Earth Tester or equivalent test instrument at a voltage of not less than 1000 volts dc. Resistance shall be measured from phase to-phase and from phase to-ground.

Following completion of the construction work and prior to final acceptance testing, the overcurrent ground fault protection systems shall be field-tested with a test-set checking the

calibration of each relay and reset to the manufacturer's settings for both current and time. Contractor shall furnish a time current coordination study. Submit the results on log-log paper showing coordination with downstream devices. Contractor shall submit three copies to the Engineer. Contractor shall notify the Engineer one week in advance of the test so that the Engineer may be present. Coordinate final overcurrent and time setting with the supply authority switchgear, plant incomer and distribution system.

<u>Pay Item</u>	<u>Unit</u>
(a) Commissioning of medium voltage switchgear, inclusive of charger and battery unit	Sum

END OF SECTION

ERMU RING MAIN UNITS (RMU)

ERMU 1.1 Scope of Works

This specification includes the manufacturing, delivery, transport, handling, protection, storage, installation, successful commissioning and upholding during the Defects Liability Period.

The applicable scope of the works covered by this section shall be defined in the Variations and Additions to the Standard and Particular Specifications Section C3.4.2 and relevant Tender drawings.

This specification is for the supply and delivery of metering and non-metering type MV Ring Main Unit's (RMU) for the provision of MV (11kV) bulk electricity supplies and section switches. The Ring Main Unit's, with the exception of Item 3 is to be provided complete with weatherproof enclosure and plinth, suitable for installation in locations with public accessibility.

The following types are specified (the types required are listed in the Project Specifications):

a.	Item 1: of up to 4 MVA.	Metering type MV RMU for supplying transformer loads
b.	Item 2: loads of up to 500 kVA.	Non-metering type MV RMU for supplying transformer
c.	Item 3: loads of up to 2 MVA.	Non-metering type MV RMU for supplying transformer
d.	Item 4:	MV Three-way switch.
e.	Item 5:	MV Four-way switch.

ERMU 1.2 Service Conditions

Unless otherwise specified in the Technical Schedules in the following sections of this document, all equipment offered shall be suitable for use under the following service conditions. Installation shall be in normal indoor conditions in accordance with IEC 60694.

Ambient temperature	-10°C to 50°C
Altitude	1000 to 1600m
Average humidity	Not exceeding 95%
Lightning conditions	Moderate / Severe
Level of atmospheric pollution	High

ERMU 1.3 Standards

All equipment manufactured and supplied must comply with NRS 006, SABS and the following relevant international standards;

- 62271-1 HV Switchgear & Control gear – Part 1: Common Specifications
- IEC 62271-200 HV metal-enclosed switchgear
- IEC 62271-100 Circuit breakers

- IEC 62271-102 Earthing switches
- IEC 62271-105
- 60265-1 Switch disconnectors.
- 60044-1 Current transformer
- 60044-2 Voltage transformer
- 60125 Protection relays
- 60470 Contactors
- 60282-1 Protection fuse
- SABS 1874 – 2001: Metal-clad Ring Main Units for rated voltages above 1kV and up to and including 24kV.
- SABS 1885 – 2001: Metal-clad switchgear for rated a.c. voltages above 1kV and including 36kV-General Requirements and Method of test.
- SABS IEC 61330-1995: High-voltage/low-voltage prefabricated substations (enclosure design).

ERMU 1.4 Compliance to Statutory Regulations

- a. All units must comply with the Occupational Health and Safety Act, (Act 85 of 1993).
- b. The supplier shall be fully responsible for the design and satisfactory performance of the RMU's in service.

ERMU 1.5 Qualifying Tests

ERMU 1.5.1 Type Tests

Type tests are intended to establish design characteristics. They are normally only made once and repeated only when the design, components or the material of the unit are changed. The results of the type tests are recorded as evidence of compliance with design requirements.

- a. For the RMU, type tests as specified in SABS 1874 shall be carried out.
- b. For the VT, type tests as specified in SANS 60044 shall be carried out.
- c. For the enclosure, type tests as specified in SANS 61330 shall be carried out.

ERMU 1.5.2 Routine Tests

- a. Routine tests are intended to prove conformance of units to specific requirements and shall be made on every unit. These tests shall be non-destructive.

ERMU 1.5.3 Manufacture's Test Certificates

- a. The successful supplier shall submit Test Certificates carried out prior to despatch from the manufacturer's works. (Tests to be in accordance with standard requirements).

ERMU 2 GENERAL MECHANICAL AND STRUCTURAL CONSTRUCTION

All Ring main units with or without metering shall be supplied in an ARC Proof metal enclosed cubicle with Top Vent.

- a. The RMU unit shall be **fully arc proof metal enclosed (Top Vent)**, free standing, floor mounting, flush fronted type, consisting of modules assembled into one or more units. Each unit is to be made of a cubicle sealed for life with SF₆ gas and contains all medium voltage components sealed off from the environment. If a system requires use of several units a separate extension of the busbar shall form a system with a common busbar.
- b. The overall design of the switchgear shall be such that front access only is required. It shall be possible to erect the switchboard against a substation wall or mounted on a precast plinth, with MV cables being terminated and accessible from the front.
- c. The unit shall be constructed from at least 3 mm thick stainless steel sheets. The design of the units shall be such that no permanent or harmful distortion occurs either when being lifted by eyebolts or when moved into position by rollers.
- d. The cubicle shall have a pressure relief device. In the case of an internal arc, the high pressure caused by the arc shall be released by the device. The hot gases shall be exhausted from the top of the cubicle. A controlled direction of flow of the hot gas shall be achieved in order to avoid injury to the operator.
- e. The switchgear and control gear shall have the minimum degree of protection (in accordance with IEC 60529);
 - IP 67 for the tank with high voltage components
 - IP 2X for the front covers of the mechanism
 - IP 3X for the cable connection covers
- f. The switchgear shall have an optional possibility to be extendable in either direction.
- g. Each unit shall be supplied with an operating handle.

ERMU 2.1 Panel (Module) Description

Incoming cable module

- a. The incoming cable module shall consist of an SF₆ cubicle housing an on-load switch disconnector and an earth switch.
- b. The busbars and all electrical connections shall be located inside the tank.
- c. The operating shafts for the switches shall have rotary seals where they enter the SF₆ cubicle.
- d. The operating mechanisms shall be located outside on the front of the SF₆ tank.
- e. Cable bushings shall be located on the front of the SF₆ cubicle in a separate cable compartment.
- f. Access to the cable bushings shall be in the lower part of each module.
- g. Covers containing the mimic diagram and having a degree of protection IP2XC shall be used to close the front of the panels.

ERMU 2.2 The Circuit Breaker Module (Outgoing Feeder)

- a. The circuit breaker module shall consist of a Vacuum / SF₆ cubicle housing a circuit breaker unit and a disconnector earth switch.
- b. The circuit breaker shall be of the type and rating as indicated in the Project Specifications.
- c. An integrated (self-powered) relay and associated CT's shall be used for tripping of the circuit breaker during fault conditions.
- d. Busbars and all electrical connections shall be located inside the tank.

- e. The operating shafts for the switching devices shall have rotary seals where they enter the SF6 cubicle.
- f. The operating mechanisms shall be located outside on the front of the SF6 tank.
- g. Cable bushings shall be located on the front of the SF6 cubicle in a separate cable compartment.
- h. Access to the cable bushings shall be in the lower part of each module.
- i. Covers containing the minimum diagram and having a degree of protection IP2XC shall be used to close the front of the panels.

ERMU 2.3 Circuit Breakers

- a. Circuit breakers shall be of the vacuum/SF6 type.
- b. Circuit breaker ratings shall be as specified in the Project Specifications.
- c. The circuit breaker main circuit shall be connected in series with a three-position disconnectors-earth switch.
- d. The operation between circuit breaker and disconnectors earth switch shall be mechanically interlocked.

ERMU 2.4 Busbars

- a. The busbars shall comprise of 3 single phase copper busbars and the connections to the on-load cable modules and the circuit breaker module
- b. The busbar shall be fully integrated inside the SF₆ cubicle.
- c. The busbars and the circuit connections to the busbars shall have normal current ratings suitable to the application and shall be calculated by the Contractor.
- d. Busbars shall be rated to withstand all dynamic and thermal stresses for the full length of the switchgear.
- e. The use of cabled sections in busbar runs (e.g. to provide connections to bus-couplers) is not acceptable without the written approval of the Electrical Engineer.
- f. The temperature rise of busbars, busbar joints, busbar connections and breaker plug-in contact shall not exceed the figure laid down by BS 159 when carrying rated current, due account being taken of temperature rise correction for altitude.

ERMU 2.5 Rating of Switchgear

ERMU 2.5.1 Voltage Rating

- a. The MV switchgear shall be suitable for safe operation on the specified system for all operating conditions. The working voltage for the building substation shall be specified in the **Project Specification**.
- b. There shall be no audible corona discharge under working conditions. This requirement shall be taken to be complied with only if the audible corona extinction voltage, phase-to-

earth, or phase-to-phase, is not less than 125% of nominal system voltage. Compliance may be conceded if it can be shown that any discharge below the specified level takes place at points remote from all dielectric materials and cannot cause their deterioration.

ERMU 2.5.2 Fault Capacity

- a. The switchgear shall have the fault current ratings at nominal system voltage as specified in the **Project Specifications**.
- b. The contractor shall be required to verify the system fault level, and submit the details to the Electrical Engineer before commencing with manufacture.
- c. Testing shall be done on an entire switch unit, complete with circuit breaker, potential transformer and condenser bushings where applicable, current transformers, busbars, shutters, cable boxes and if necessary, such parts of adjacent panels as are required to support the busbars and present a complete unit for testing.

ERMU 2.5.3 Impulse Rating

- a. The switchgear shall have an assigned impulse rating as specified in the **Project Specifications**, supported by recent test certificates proving successful testing, using a standard 1/50 microsecond voltage wave, on identical units, manufactured in the factory from which an order would be executed.
- b. The complete RMU shall withstand a one minute power frequency voltage, of 2.2 times the rated voltage.
- c. Should reasonable doubt exist as to the validity of test certificates submitted, for example by virtue of modifications made to the switchgear, the Electrical Engineer may direct that a further certificate(s) be obtained on a sample unit(s) manufactured under the Contract at the expense of the Contractor. Such tests shall be carried out by a recognized testing institute and (at their discretion) in the presence of the Electrical Engineer.

ERMU 2.6 Electrical Requirements

ERMU 2.6.1 Basic Impulse Level (BIL)

- a. The rated impulse voltage withstands level (BIL) and the rated short duration power frequency withstand r.m.s. voltage (1 minute) of the RMU's 95kV and 28kV respectively as indicated in Table 1 of SANS 1874.

ERMU 2.6.2 Earthing

- a. The maximum earth fault current is 10kA for 1 second.
- b. The RMU shall have a copper earth bar with a cross sectional area of at least 70mm² that is accessible from all compartments. All earthing connections shall be provided with M12 bolts and nuts.

- c. The earth terminals of all equipment within the RMU, including the RMU shall be connected to the main earth bar of the RMU.
- d. The RMU enclosure shall be bonded to the earth bar. All RMU enclosure sections shall be bonded to one another.
- e. The RMU earth bar shall be accessible from the front. All shall be bonded to the RMU earth bar by 70mm² copper conductor.
- f. All earthing copper bars shall be enclosed with separate metal covers which shall be secured to the RMU with a bracket or earth braid, to prevent theft.

ERMU 2.7 On-Load Cable Disconnecter

- a. The on-load cable disconnecter shall be a combination of a switch-disconnector and an earth switch.
- b. The arc-quenching medium shall be SF₆ gas.
- c. The on-load cable disconnecter shall have three positions, namely:
 - Open
 - Closed
 - Earthed

ERMU 2.8 Earth Switch

- a. Earth switches shall be rated equal to the switchgear rating.
- b. Earth switches shall be of the quick-make type.
- c. Earth switches shall be operated from the front of the cubicle by means of a removable handle.

ERMU 2.9 Circuit Breaker Module

- a. The circuit breaker module shall be a combination of a circuit breaker and an earth switch.
- b. The circuit breaker and earth switches shall be mechanically interlocked.
- c. The arc-quenching medium shall be SF₆ gas.
- d. The circuit breaker shall have three positions, namely:
 - Open
 - Closed
 - Earthed

ERMU 2.10 Operating Mechanisms

- a. All operating mechanisms shall be situated in the mechanism compartment behind the front covers outside the SF₆ tank.
- b. The mechanism for the on-load cable disconnecter and the earth switch shall operate both devices via one common shaft.
- c. The mechanism shall provide independent manual operation for closing and opening of the disconnecter, independent closing of the earth switch and dependent opening of the earth switch.
- d. The mechanism for the vacuum circuit breaker (VCB) and disconnecter-earth switch shall operate the VCB and the disconnecter-earth switch via two separate shafts.

- e. The mechanism for the VCB shall have stored spring (kinetic) energy and shall provide independent manual operation for closing and opening of the VCB.
- f. The mechanism shall have a self-powered relay with associated CTs and/or remote tripping device.
- g. The mechanism for the disconnecter-earth switch shall provide independent manual operation for closing and opening of the disconnecter, independent closing of the earth switch and dependent opening of the earth switch.

ERMU 2.11 Electrical Bushings

- a. The bushings shall be made of cast resin with moulded electrical conductor in the centre.
- b. A screen shall be moulded into the bushing. This screen shall act as the main capacitor supplying voltage indicators.
- c. The bushings shall be sealed by O-rings and fixed to the cubicle by a common supporting bracket.

ERMU 2.12 Mechanical Bushings

- a. The mechanical bushings are the interface between the switches inside the cubicle and the mechanism outside.
- b. The mechanical bushing shall have a rotating shaft, which is connected to the shaft of the switch and to the corresponding shaft of the mechanism.
- c. The rotating shaft shall be sealed by a double set of radial simmering gas seals.
- d. O-rings shall provide the fixed sealing of the bushings.

ERMU 2.13 Front Covers

- a. The front cover shall contain the mimic diagram of the main circuit with the position indicators for the switching devices
- b. The voltage indicators shall be situated on the front covers.

ERMU 2.14 Position Indicators

- a. The position indication of the switching devices shall be visible through the front cover and be directly linked to the operating shaft of the respective switching devices.
- b. Mechanical position indicated shall be used.
- c. The following three positions shall be clearly visible for each of the different switching devices:
 - Open
 - Closed
 - Earthed

ERMU 2.15 Voltage Indication

ERMU 2.15.1 Neon Lights

- a. Where specified, three voltage-indicating neon lights - one for each phase - shall be provided to indicate whether the cable side of the circuit is energized.
- b. The neon lights shall be energized from condenser bushings on the cable side.
- c. It is the responsibility of the Contractor to ensure that the rating of the condenser bushings are sufficient to supply the imposed load on the bushings and to provide clear indication by the neon lights, even on the remote control boards, to the full approval of the Electrical Engineer.
- d. The Contractor shall state the make and type of condenser bushings used and the type of dielectric used for the manufacture of the bushings, and the certified 1/50 microsecond impulse strength of the bushings.
- e. Each neon light shall be shunted by a suitable resistor or non-linear resistor located immediately adjacent to the condenser bushings to prevent dangerous potentials appearing in the event of lamp failure and to protect the lamps against voltage surges.

ERMU 2.15.2 On-Load Cable Disconnect

- a. A separate set of voltage indicators (neon lights) shall be situated on the front cover of the respective modules.
- b. The voltage indicators shall be used to indicate the cable voltage of each incoming module.
- c. Identification of the phases shall be achieved by labels indicating L1, L2 and L3 on the front of the voltage indicators.
- d. The voltage indicator shall satisfy the requirements of IEC61243.

ERMU 2.15.3 Circuit Breaker Module

- a. A dedicated analogue voltmeter shall be situated on the front cover of the circuit breaker module to indicate the busbar voltage.
- b. Voltmeters shall be of the suppressed zero type and scaled to the approval of the Electrical Engineer with the normal operating voltage reading indicated in red.
- c. A voltage selector switch shall be provided having four positions marked "OFF", "R-B", "Y-B" and "R-Y" so that the voltage across any two lines may be indicated or the voltmeter may be disconnected from the circuit.
- d. The voltmeter shall be supplied via voltage transformers that shall be connected to the main busbars via primary fuses.
- e. All voltage transformers shall comply with IEC 60186.

- f. Voltage transformers shall be of dry type, with ratings and ratios as specified in the Technical Schedules.
- g. Voltage transformers in cubicles shall have dimensions according to DIN 42600, Narrow type.

ERMU 2.16 Cable Compartment

- a. It shall be possible to terminate a minimum of two single core MV cables per phase.
- b. The access to the compartment shall be possible by removing the cable cover, bolted to the main frame.
- c. Removable steel covers shall close the cable compartments.
- d. Arc proof cable covers shall be available as an option.
- e. Each module shall have a separate cable compartment that is segregated from each other by means of a partition wall. A partition wall shall be fitted to divide the cable compartment from the rear side of the switchgear.
- f. In case of an arc inside the tank, followed by the opening of pressure relief device, the partition wall shall prevent the hot gases flowing out from the pressure relief to enter the cable compartments.
- g. All covers shall be removable.

ERMU 2.16.1 Power Connection

- a. The cables shall be installed below the mimic front cover.
- b. The medium voltage cables shall be connected to the unit through electrical bushings
- c. The bushings shall be fitted with a capacitor of approximately 15 pF. This capacitor shall be the primary capacitor used in the capacitive voltage divider, which shall form part of the permanent cable voltage indicator.
- d. At the bottom of the cable compartment an earth bar system shall be fitted. This system shall be made of copper with a minimum cross-sectional area of 120 mm²
- e. In each compartment the earth bar shall be fitted
- f. The main SF6 tank shall be connected to the copper earth bar

ERMU 2.17 Interlocking

- a. The mechanism for the on-load cable disconnecter shall provide a built-in mechanical interlocking system to prevent the following operations:
 - Closing of disconnecter switch when the earth switch is close
 - Closing of the earth switch when the disconnecter switch is in the closed position.

- b. The mechanism for the circuit breaker unit shall provide a built-in mechanical interlocking system to prevent the following operations:
 - Closing of the circuit breaker when the earth switch is closed.
 - Closing of the earth switch when the circuit breaker is in the closed position.
- c. In addition, an interlocking device that allows access to the fuses only when the earth switch is in the earthed position and opening of the earth switch is only possible when the fuse cover is closed and secured.

ERMU 2.18 Auxiliary Equipment

ERMU 2.18.1 Current Transformers

- a. Current transformers shall be of dry type, with ratings and ratios as specified below.
- b. The low voltage metering current transformers shall be of the multi-ratio type, with ratios 100/200:5 for item 1 and 100/50:5 for item 2 and 3. The current transformers shall comply with SANS 60044-2
- c. All primary connections and all current transformers shall have a short time current rating corresponding to the rated breaking capacity of the switchboard.
- d. No CT wires shall be joined under any circumstances.
- e. The "Limits of Temperature Rise of Windings" specified in Table 1 of BS 3938 for the condition of rated current and burden, shall apply instead when the current transformer carries 150% of rated current and 225% of rated burden, continuously.
- f. Magnetisation characteristics (V_{kp} – 10 curves) and secondary winding resistance referred to 75°C shall be provided for all protection and metering current transformers. The following will specifically be required:
 - For Class TPS CT's, the excitation current shall be measured with V_k applied to the secondary winding.
 - For Class 5P and 10P CT's, the excitation current corresponding to the rated accuracy limit factor
 - The secondary winding resistance referred to 75°C
 - For all metering CT's, tests for accuracies as specified in BS 3938, Clause 9.1 are required.
- g. Current transformers used for metering purposes shall be of Class 0.5 accuracy and rated for a burden of 15 VA in accordance with BS 39378 (SABS IEC 60185)
- h. The metering CTs shall be designed for early saturation and the Contractor shall state the saturation factor applicable.
- i. Current transformers required for ammeter indication only, shall be Class 0.5 metering type for a burden of 15 VA.
- j. All current transformer secondary connections shall be brought out to fully accessible terminal blocks and shall be clearly marked.

- k. Duplicate rating plates to BS 3938 (SABS IEC 60185) for all CTs, shall be fitted in an accessible position on the relevant switchboard housing (e.g. where hinged doors are fitted to relay cubicles, the inside of such a door is an ideal position for mounting duplicate rating plates.)

ERMU 2.18.2 Voltage Transformers

- a. Where specified, three-phase voltage transformers shall be provided for connection to the main busbars.
- b. The voltage transformer shall be oil-immersed, or totally encapsulated in epoxy resin, using recognized vacuum filling techniques.
- c. The voltage transformer shall have an output of 50 VA per phase, be of Class 0.5 accuracy to BS 3941 (SABS IEC 60186) and shall be complete with fuses in the primary circuit and MCBs in the low-voltage circuit.
- d. The medium voltage fuses shall be accessible only when the voltage transformer is fully isolated from the primary plug-in contacts.
- e. The secondary voltage output shall be 110V between phases. The secondary wires of the VT outputs shall not be joined.
- f. The primary and secondary windings of the VTs shall be connected such that there shall be no phase displacement between corresponding primary voltages and secondary voltages, except for inherent phase angle errors.
- g. Isolation of a VT shall be achieved by complete withdrawal of the VT assembly from its primary isolating contacts.

ERMU 2.18.3 Low Voltage Compartment

- a. Necessary terminal blocks and wiring etc. shall be placed behind the front cover of each module.
- b. Further additional low voltage equipment shall normally be contained in the low voltage compartment. In particular:
 - Terminal blocks
 - Wiring for interconnections between units connecting the auxiliary cables
 - Instruments
 - Protection relay
 - Metering devices
 - LV fuses etc.

ERMU 2.19 Wiring

- a. Multi-stranded flexible copper conductor 600/ 1000 V grade solid dielectric insulated single core wiring shall be used for all wiring.
- b. All wiring shall be numbered at both ends of each conductor. The numbering method employed shall conform to the system laid down in Annexure A of NRS 003-1.

- c. All CT and VT circuit wiring shall have a cross sectional area of 2.5mm², with red, white, blue according to the relevant phases and black for the neutral.
- d. All internal signal wiring and control wiring shall have a cross sectional area of 1.5mm² with grey wire for DC wiring and black wire for AC wiring.
- e. All wires shall be provided with pre-insulated lugging, which shall be of the hooked flat blade (spade) type for terminal connections and ring ferrules for CT connections. For relay terminal connections ring type or hooked flat blade types shall be used, alternatively where space limitations are experienced, boot lace ferrules could be considered if approved in writing. Push-on lugs shall not be considered.
- f. All wiring shall be placed in adequately supported trunking or looms with 20% spare capacity per wire-way. Consideration shall be given during the design stage to temperature rise within trunkings or looms. The designed shall ensure that excessive temperature build-up does not occur within trunking or looms during normal operation of the system.

ERMU 2.20 Metering Compartment

- a. A metering compartment for electricity meter and thermal maximum demand indicator of 400mm wide and 200mm deep shall be supplied.
- b. The metering compartment shall be separate and independent from both the MV and consumer/equipment compartments and it shall open to the front of the enclosure. It shall not be possible to obtain access to any other compartment from the metering compartment.
- c. The metering compartment shall make provision for the installation of electricity or a maximum demand meter. The electricity meter shall be installed by the contractor.
- d. Two metering test blocks and associated fuse holders (with 2 A fuses fitted, item 1,) shall be fitted in the metering compartment.
- e. The metering unit shall incorporate the following equipment:
 - 1 x 11 000/110 Volt voltage transformer class B 200 VA, 2 x 100/50/5 Amp class 0,5 (As specified in Section RMU 2.18); 15 V A current transformers 1 x 5 amp; 3 phase; 110 V 3 Wire; kWh and kW maximum demand indicating meter with synchronous integral 30 minimum timing device. Scale length to be not less than 300 mm.
- f. The above equipment shall be mounted in a cubicle suitable for mounting on the ring main unit, so as to form an integral part of the switch unit.
- g. It shall be possible to gain access to the VT and CT by means of a door on the side of the enclosure.

ERMU 2.21 Cable Testing Facility

- a. Cable test facilities that are independent of the cable end boxes and are accessible from the front of the RMU are preferred.

- b. For operator safety, the cable testing procedures shall be displayed on the front and inside of the cable testing facility covers.
- c. Cable test facilities shall only be accessible when the isolator / switch are earthed.
- d. A substantial interlock must be fitted to prevent operation of the switch directly from the ON position to the Earth and Test positions. Provision to be made for padlocking in any position.
- e. Cable test terminals to be provided and these to be accessible only when the switch is in the Earth and Test position. Interlocks are to be provided to ensure that the switch cannot be moved from the Earth and Test position when the test terminal access cover is open.
- f. The test terminals to be suitable for cable testing voltages up to 30 kV D C for 15 minutes

ERMU 3 MEASUREMENT AND PAYMENT

Measurement and payment will be done in accordance with the methods stated below:

ERMU 3.1 Supply and Delivery to Site

Pay Item	Unit
a) Supply and delivery to site of RMU complete with concrete plinth.	Each

ERMU 3.2 Installation

Pay Item	Unit
a) Item installation of RMU complete with concrete plinth and floor screed.	Each

ERMU 3.3 Commissioning

Pay Item	Unit
a) Commissioning of RMU.	Each

END OF SECTION

EPPT POWER TRANSFORMERS

EPPT 1 SCOPE

This specification includes the manufacturing, delivery, transport, handling, protection, storage, installation, successful commissioning and upholding during the Defects Liability Period.

The applicable scope of the works covered by this section shall be defined in the Variations and Additions to the Standard and Particular Specifications Section C3.4.2 and relevant Tender drawings.

EPPT 2 CONDITIONS TO SERVICE

The power transformers will be installed indoors or outdoors as specified in the Variations and Additions to the Standard and Particular Specifications on an industrial plant.

EPPT 3 STANDARDS AND TESTS

The power transformers shall conform to and be in accordance with the latest applicable South African Bureau of Standards Codes and Standards:

The following Standard Specifications and drawings shall apply:

SANS 10142	- Code of Practice for the wiring of Premises
NRS 005	- Distribution Transformers
NRS 006	- Switchgear metal enclosed
NRS 008	- Enclosure for cable terminations in air
NRS 030	- Distribution Transformers
SANS 555	- Transformer oil
SANS 780	- Distribution Transformers
SANS 1433-1	- Terminal blocks having screw and screwless terminals
SANS 1433-2	- Flat push-on connectors
SANS 1091	- National colour standards for paint
SANS 1186	- Symbolic safety signs
SANS 1371	- Bushings

EPPT 4 STANDARDS AND DRAWINGS

All materials used shall satisfy the relevant SANS specification and may only deviate from it upon a definite instruction in this specification. The successful Tenderer shall ensure that he possesses the latest edition of the relevant SANS specifications as listed in this specification.

EPPT 5 INDOOR TYPE

The transformers shall be of the free breathing indoor, category 1, DYN 11, low loss type with copper windings and bushings suitable for indoor use, all in accordance with SANS 780. Transformers shall be supplied with all the necessary oil. Transformer oil shall comply with SANS 555. The transformer no load voltage shall be specified in the Variations and Additions to the Standard and Particular Specifications. A five position tap changer shall be supplied to ensure the designed secondary voltage at plus/minus 5 % of the primary voltage in steps of 2,5%.

The transformers shall be matched for parallel operation with percentage voltage impedance tolerance between parallel operated transformers not exceeding 2,5% of rated voltage impedances, same inherent phase angle difference between primary and secondary terminals, same voltage ratio, same polarity and same phase sequence.

Apart from the compulsory accessories listed in table 1 of SANS 780. The transformer shall be equipped with an Oil-level gauge, oil drain plug, bolted tank cover, two shafts and four rollers. A dial type instantaneous and maximum registering indicating thermometer, Bucholz relay (if specified in the Variations and Additions to the Standard and Particular Specifications), trip and alarm contacts on the thermometers and Bucholz relay. The alarm and trip contacts shall be wired to a separate transformer side mounted termination box equipped with rail mounted termination blocks and 3CR12 unpainted removable cable gland plate.

The transformer shall be supplied with a cable end box for termination of medium voltage cables by means of heat shrinkable terminations complete with wooden cable clamps and secondary cables by means of cable glands. Cable terminations shall be suitable to accommodate the cable or cables for each circuit as specified. This applies not only to the number of cores, size and conductor material, but also to the type and construction of the cables. Gland plates in the secondary cable end boxes shall be manufactured from unpainted 3CR12 steel with thickness to suit the cable sizes.

Cable end boxes and terminations shall be complete with the necessary clamps, glands, extension busbars if necessary and other accessories.

Before ordering the Contractor shall ensure that substation doors and transformer platforms are suitably sized for the transformers.

Before commissioning the transformer, the contractor shall ensure that the transformer is properly filled with oil. All the connection terminals shall be taped with insulation tape corresponding with the respective phase colours.

EPPT 7 OUTDOOR TYPE

The outdoor type transformers to be supplied and installed under this Contract shall have a normal no-load voltage ratio as specified with "off-load" tap changer with $\pm 2,5\%$ and 5% taps. The transformer no load voltage shall be specified in the Variations and Additions to the Standard and Particular Specifications.

The transformers shall be matched for parallel operation with percentage voltage impedance tolerance between parallel operated transformers not exceeding 2,5% of rated voltage impedances, same inherent phase angle difference between primary and secondary terminals, same voltage ratio, same polarity and same phase sequence. Gland plates in the secondary cable end boxes shall be manufactured from unpainted 3CR12 steel with thickness to suit the cable sizes

The transformer shall comply with the requirements of SANS 780 as amended to date for low loss transformers with copper windings and bushings suitable for indoor use and shall be of the free breathing outdoor type (or as specified in the Variations and Additions to the Standard and Particular Specifications) fitted with weatherproof MV and LV cable end boxes for termination of medium voltage cables by means of heat shrinkable terminations complete with wooden clamps and secondary cables by means of cable glands secured to a 3CR12 unpainted gland plate.

The transformer shall be supplied completely filled with oil to SANS 555.

In addition to the standard fittings to be provided in accordance with Table I of SANS Specification No. 780, the transformer shall be provided with a detail type instantaneous indicating and maximum registering thermometer, Bucholz Relays (if required), Trip and alarm contacts on the thermometers and Bucholz relay. The alarm and trip contacts shall be wired to a separate transformer side mounted weatherproof termination box equipped with rail mounted termination blocks and removable 3CR12 unpainted cable gland plate.

The transformer shall be provided complete with two axles and four rollers to facilitate rolling of the transformer in the longitudinal direction,

Before ordering the Contractor shall ensure that transformer platforms are suitably sized for the transformers.

Before commissioning the transformer, the contractor shall ensure that the transformer is properly filled with oil. All the connection terminals shall be taped with insulation tape corresponding with the respective phase colours.

EPPT 8 INFORMATION TO BE SUBMITTED WITH TENDERS

Three copies of each of the following drawings shall accompany each tender in respect of the transformers offered:

Outline drawings of the transformer complete with all its accessories, showing main overall dimensions; and

Drawings of the HT and LT bushings.

EPPT 9 INSTALLATION OF POWER TRANSFORMERS

The power transformers shall be installed in the indoor switch room in the positions indicated on the drawings in such a way that the LT bushings of the two adjacent transformers are facing each other.

Outdoor transformers shall be installed in a similar manner and as indicated on the drawings and can be either plinth or pole mounted.

The high-tension terminals on each transformer must be connected to the corresponding medium voltage circuit breaker by means of medium voltage cable via the cable ducts in the floor. At the transformer the cable must be terminated by means of the specified cable end boxes.

The neutral terminal on the LV side of each transformer as well as its earth terminal shall be connected to the substation earth as specified elsewhere in this document.

The connections between the low voltage terminals and the relevant board shall be done by means of the specified cable. The cable shall be terminated at the transformer by means of a heat shrinkable dry type crimped end kit.

After testing, the terminals must be insulated with busbar putty and taped with coloured PVC tape.

The necessary concrete plinths for the transformers will be provided by others under this contract.

On completion of the installation, but prior to commissioning the contractor shall do the following:

- a) Ensure that all stoppers have been removed from the breather pipe and oil conservator connection pipes on each transformer;
- b) Check the oil level of each transformer and top up if necessary;
- c) Check the tap positions on the transformer tap changers and ensure that both are in the same positions;
- d) Check the elements of the dehydrating breathers on the transformers in order to ensure that these are dry. Replace if necessary; and
- e) Check each transformer and dehydrating breather assembly for oil leaks and rectify if necessary.
- f) Remove all packings from relays and instruments.

EPPT 10 TESTING AND COMMISSIONING OF POWER TRANSFORMERS

On commissioning of the power transformers, the following shall be done;

- a) The contractor shall verify phase denomination on both HV and LV sides prior to terminating the cables.
- b) After energising the contractor shall proof phase rotation on the LV side of all transformers.
- c) After all testing had been carried out satisfactorily the transformer terminals and the terminals on the end boxes must be insulated with busbar putty and taped with coloured PVC tape. All arcing horns (if any) must be removed.
- d) All transformers shall be properly and permanently labelled in accordance with the feeder switchgear labelling system.

EPPT 11 EARTHING

All transformers shall be earthed to the common medium voltage earthing system by means of 70mm² bare copper conductors.

The contractor shall do all the bonding and earthing in accordance with the latest addition of the "Code of Practice for the Wiring of Premises" SABS 0142.

EPPT 11.1 Design and Approval

The Contractor shall allow for soil resistivity tests to be performed on site. A detailed report on the resistivity tests shall be submitted to the Engineer together with a preliminary earthing scheme showing how the Contractor envisages installing the earth mat before commencing installation of the earth mat. The Contractor shall employ a specialist to investigate, plan and install the earthing installation.

The earth mat installation shall incorporate earthing electrodes at the extreme corners of the station, in the vicinity of earthing switches and transformer neutrals. The substation fences shall also be earthed at regular intervals including all substation gates. The installed maximum earth

resistance shall be 1 Ω , or as agreed by the Engineer. The earth conductors shall generally be laid at a depth of more than 500 mm below the finished surface.

The complete earth mat design shall be submitted for written approval. The Engineer may then add or delete equipment and change the design of the earth system if he so requires. The installation of the earth mat shall be so arranged as not to cause delays in civil works.

EPPT 11.2 Earth Resistance Survey

If specified in the Variations and Additions to the Standard and Particular Specifications. The Contractor will be responsible to have an earth resistance survey carried out on site by a specialist in this field, to be approved by the Engineer. The test shall be done on the undisturbed site, i.e. before earth works, trenching, building etc. commence.

The Engineer shall attend the survey. The Contractor shall inform the Engineer in good time when the test is scheduled to take place. If it is done without his or his representative being present, the test shall be repeated in the Engineer's presence at no additional cost.

The results of this survey will be used to adjust the earthing system as specified herein, if necessary, on the basis of the quoted rates.

Payment for the services of the specialist shall be by the Contractor.

EPPT 12 MEASUREMENT AND PAYMENT

Measurement and payment will be done in accordance with the methods stated below:

EPPT 12.1 Supply and Delivery to Site

<u>Pay Item</u>	<u>Unit</u>
a) Supply and delivery to site of power transformers	Each
b) Supply and delivery to site of substation earthing system	Sum

EPPT 12.2 Installation

<u>Pay Item</u>	<u>Unit</u>
c) Site installation of power transformers	Each
d) Installation of substation earthing system	Sum

EPPT 12.3 Commissioning

<u>Pay Item</u>	<u>Unit</u>
e) Commissioning of power transformers	Each
f) Commissioning of substation earthing system	Sum

END OF SECTION

EMSS MINIATURE SUB STATIONS

EMSS 1 SCOPE OF WORKS

As specified in the Project Specifications.

EMSS 2 STANDARDS

The miniature substation shall conform to and be in accordance with the latest applicable South African Bureau of Standards Codes and Standards:

The following Standard Specifications and drawings shall apply:

Standard No.	Description
SANS 10142	Code of Practice for the wiring of Premises
SANS 10142-2	Code of Practice for the wiring of Premises (Medium voltage)
NRS 030	Distribution Transformers
NRS 004	Miniature substations
NRS 005	Distribution Transformers
NRS 006	Switchgear metal enclosed
NRS 008	Enclosure for cable terminations in air
SANS 152	Low voltage air break switches
SANS 156	Low voltage moulded case circuit breakers
SANS 172	Cartridge type fuse-links for low voltage electric fuses
SANS 064	Preparation of steel surfaces for coating
SANS 555	Transformer oil
SANS 780	Distribution Transformers
SANS 1029	Miniature substation
SANS 1091	National colour standards for paint
SANS 1186	Symbolic safety signs
SANS 1195	Bus bars
SANS 1371	Bushings
SANS 62271-202	Prefabricated Substation
NRS 012	Cable box's
SANS 62271-200	Switchgear general spec
SANS/IEC 60076	Transformer
ERMU	Bigen Africa Ring Main Unit Particular Specifications

EMSS 3 STANDARDS AND DRAWINGS

All materials used shall satisfy the relevant SANS specification and may only deviate from it upon a definite instruction in this specification. The successful Tenderer shall ensure that he possesses the latest edition of the relevant SANS specifications as listed in this specification.

EMSS 4 GENERAL REQUIREMENTS

The miniature substation shall consist of three / four separate compartments as specified in the Project Specifications, bolted together with common interlocked access doors to the Medium Voltage, Area Lighting, Transformer and Low Voltage compartments.

These doors shall be provided with latches for padlocks.

The transformer shall have a normal no-load voltage as specified in the Project Specifications. The miniature substation shall all be in accordance with the details of this specification and generally in accordance with SANS 1029 and NRS 004-1 complete with switchgear and other auxiliary equipment.

The miniature substation shall be completely tamper proof with tamperproof pad lock covers and supplied ready for mounting on a concrete plinth.

All units must comply with the Occupational Health and Safety Act, (Act 85 of 1993).

The units offered must provide Internal Arc Venting as per SANS 1029.

EMSS 5 PRE-MANUFACTURER

EMSS 5.1 Structural Drawings, with critical dimensions

- Arrangement;
- Plan, front view, and elevation section views;
- Required clearances for opening doors and for removing breakers;
- Conduit or cable trays entrance locations and dimensions for both top and bottom entrance;
- Bus bar locations and configurations;
- Incoming and outgoing power cable terminator positions;
- Anchor bolt locations;
- Grounding connections;
- Weight of equipment;
- Elementary Three-Line Diagrams.

EMSS 5.2 Three-line diagrams, with function numbers used throughout

- Instrument transformers;
- Relays;

- Meters and meter switches;
- Breakers and other pertinent devices;
- Schematic Diagrams;
- Schematic diagrams shall be furnished for the electrically-operated breaker / relay control scheme;
- Each schematic diagram shall show device and terminal block terminal numbers for customer connections;
- Provide control switch development tables.

EMSS 5.3 Detailed Connection (Wiring) Diagrams

- Approximate physical location of all items in each unit;
- All wiring within each unit;
- All interconnecting wiring between units;
- Identification of all terminals, terminal blocks, and wires;
- Provide one set of drawings shipped with the switchgear for start-up use.

EMSS 5.4 Material List

- An electrical bill of material list shall be furnished listing the quantity, rating, type, and manufacturer's catalogue number of all equipment on each unit.

EMSS 5.5 Installation, Operating, and Maintenance Instructions

- Installation, operating, and maintenance instructions shall cover switchgear, breakers, relays, meters and devices requiring installation, programming and / or maintenance;
- The breaker operating mechanism shall be front-accessible, and all routine maintenance shall be performed with the breaker in an upright position.

Notes:

- a) These drawings shall be submitted for approval before the manufacturing of the miniature sub for this particular service.
- b) The approval of drawings shall not relieve the Contractor of his responsibility to the Client to supply the miniature sub according to the requirements of the specification.
- c) The miniature sub must be inspected at the manufacturer's premises before dispatch on completion.

EMSS 6 CONSTRUCTION

The general arrangement of the Miniature Substation shall be in accordance with the Type B (lateral) layout, specified in SANS 1029.

The Miniature Substation enclosure shall be designed to comply with the internal arc testing requirements of SANS 1029, design details shall be submitted to the Engineer for approval.

A barrier shall separate the end of the Low Voltage compartment (located on the Low Voltage side of the transformer) from the front Low Voltage compartment.

The Miniature Substation earth busbar shall be accessible from the front of the ring main unit. The ring main unit shall be bonded to the miniature substation earth busbar by a 70 mm² copper conductor.

All unscreened connections used for the interconnections between the ring main unit and the transformer Medium Voltage bushings shall be barricaded (protected) to prevent inadvertent contact by persons requiring access to the Medium Voltage compartment.

Provision shall be made for the support (clamping) of two incoming (ring) cables in the Medium Voltage compartment. Two adjustable cable clamps, suitable for clamping one 240 mm² x 3 core copper shall be provided with the Miniature Substation. The minimum distance from the cable support point (clamp) to the ring main unit bushing centres shall be 650mm as per NRS 012.

EMSS 6.1 General Construction

The Miniature Substation shall be suitable for outdoor use which will be stipulated in Project Specifications, and shall be divided into three or four compartments:

- a) Medium Voltage compartment;
- b) Transformer compartment;
- c) Low Voltage compartment;
- d) Area Lighting.

The Miniature Substation enclosure (roof, compartments and doors) and transformer tank shall be suitable for non-corrosive environments.

For non-corrosive environments, the unit shall be 3mm mild steel or as specified in the Project Specification.

EMSS 6.2 Doors and Enclosures

The entire lock and door closing enclosure mechanism must be enclosed by means of a metal cover box. The metal box must be open on the bottom so as to enable the lock to be put in place.

The doors shall be fitted to all compartments and shall be constructed of steel as specified in the Project Specifications, minimum thickness of 3mm and shall be watertight and vermin proof.

The doors shall close against a drip proof door frame forming part of the relevant compartment.

All uni-strut channels, nuts, bolts and washers shall be stainless steel type.

EMSS 6.3 Hinges

Hinges shall be manufactured from stainless steel. Hinged doors shall exert uniform pressure at all points on the gasket when the door is closed to ensure proper closing and to prevent the penetration of water and vermin.

EMSS 6.4 Handles and Locks

All access doors shall be fitted with locking facilities for padlock type locks complete with tamper proof lock covers.

Handles shall be of the lockable 3 point steel lever type with locking catches and padlock facilities.

The Contractor shall supply padlocks to the client's specification, which shall be confirmed on site.

EMSS 6.5 Base Construction

The housing shall be erected on a U-section steel frame hot dipped galvanised in accordance with SANS 763 with measurements of not less than 75 x 50 x 5mm. It shall be rigid, robust and completely self-supporting.

EMSS 6.6 Signage

Danger signs on External Chromadek plates shall be supplied on each door and shall be in accordance with the Occupational Health and Safety Act, Act 85 of 1993.

Doors must be indelible marked MV/S and LV/S as applicable on the insides.

A sign depicting "Treatment and Full First Aid Instructions" shall be permanently attached to the inside of the Medium Voltage and Low Voltage compartment of the door that opens first.

External Chromadek electrical symbolic warning signs (warning-flash) with the words "No Unauthorized Entry Allowed" (in English, Afrikaans and Zulu) shall be permanently attached to all the doors, welded hinge which forms part of the door.

The barrier used to barricade the LV bushings of the transformer shall have a sticker applied to it depicting an electrical symbolic warning sign (warning against "Unauthorized entry").

EMSS 6.7 Labels

Phase labels shall be provided below all the bushings (primary and secondary) of the transformer and Ring Main Unit.

The Low Voltage busbars shall be color-coded in the colors of red, yellow, blue and black by a clearly visible painted-on spot at least 20 mm diameter.

The Medium Voltage and Low Voltage compartment doors shall be labelled with "MV" and "LV", respectively. The labels shall be clearly and indelibly stencilled on both the inside and outside of all the compartment doors.

The Low Voltage streetlight compartment door shall be labelled with "STREETLIGHT or AREA LIGHTING COMPARTMENT", which will be specified in the Project Specification. The labels shall be clearly and indelibly stencilled on outside of the streetlight compartment door.

The primary voltage, secondary voltage, 'kVA' rating and vector group shall be marked on the miniature substation, example "11kV/420V 500 kVA Dyn11". The markings shall be black and in characters larger than 50 mm high.

Miniature Substation roof and body shall be marked with stencilled marks that uniquely link the roof to the body.

EMSS 6.8 Paint and Colour

The metal shall be degreased and sand blasted to remove all dust and stains. It shall be painted with one coat of zinc chromate primer and two coats of scratchproof enamel of the colour "Avocado green" No. 12 in accordance with standard specification SANS 1091 on the outside and white on the inside.

The miniature substation steel base shall be hot dip galvanized in accordance with the relevant requirements of SANS ISO 1461 and, in addition, shall be coated with black epoxy tar paint.

EMSS 7 MEDIUM VOLTAGE COMPARTMENT

The Medium Voltage compartment of the miniature substation shall be equipped with an outdoor type non extensible ring main unit comprising of one isolator unit, busbars and one SF6 gas circuit breaker transformer feeder. The ring main unit shall comply with Bigen Africa Ring Main Unit Particular Specification.

The Voltage Detection System (VDS) shall comply with IEC 61243-5. Voltage Presence Indicating Systems (VPIS) shall comply with IEC 61958.

EMSS 7.1 General

The ring main unit (RMU) shall comply with the requirements of SABS 1874. Proof of compliance with the requirements to assess the effects of arcing due to an internal fault in accordance with Sub-clause 6.108 of IEC 60298 is required.

Medium Voltage compartment housing a metal-enclosed ring main unit will comply with the SABS 1874.

The RMU SF6 indicator(s) shall be clearly visible from the front of the mini-substation.

Where Type C bushings are offered, unscreened separable connectors (USC) shall be provided (4.8.4.4 (a) of SANS 1029).

The Voltage Detection System (VDS) shall comply with IEC 61243-5. Voltage Presence Indicating Systems (VPIS) shall comply with IEC 61958.

The Ring Main Unit configuration shall be two (2) x Isolators and One (1) x Breaker tee-off switch to the transformer with Protection.

The Medium Voltage compartment shall be ARC Proof metal enclosed with Top Vent chimney.

Busbar Insulation shall be used on all Medium Voltage Voltage Busbars.

3CR12 unpainted cable gland plates Shall be used in the Ring Main Unit.

EMSS 7.2 Incomer and Feeder Isolator

One (1) Metering Compartment Isolator and one Isolator as specified under Project Specification shall be supplied, strictly accordance to Bigen Africa Ring Main Unit Particular Specification.

EMSS 7.3 Transformer Feeder Circuit Breaker

The transformer feeder circuit breaker shall be equipped with a self-powered over current and earth fault relay complete with class X protection CT's and core balance CT. The switchgear shall be suitable for operation on a voltage system as specified in the Project Specifications, if not specified the fault capacity of 250MVA shall be used for calculations.

The over current earth fault protection settings shall be suitable for the transformer rating as specified Project Specifications and Bigen Africa Ring Main Unit Specification.

The circuit breaker shall be of the maintenance-free, low pressure SF6 gas type. The position of the power and earthing contacts shall be clearly visible on the front of the switchboard. The position indicator shall provide positive contact indication in accordance with IEC 60265-1 standard. In addition, manufacturer shall prove reliability of indication in accordance with IEC 60129 standard. The circuit breaker shall have 3 positions: open-disconnected, closed and earthed and shall be constructed in such a way that natural interlocks prevent all unauthorized operations. They shall be fully mounted and inspected in the factory.

An operating mechanism can be used to manually close the circuit breaker and charge the mechanism in a single movement. It shall be fitted with a local system for manual tripping by an integrated push button. There will be no automatic reclosing.

The circuit breaker shall be associated with an integrated protection unit that will operate without any auxiliary power supply and shall include:

EMSS 7.4 Electronic Protection Relay

The electronic protection relay shall be designed for use in distribution networks, mainly in MV/LV substations in which it shall provide protection upstream from the transformer.

The relay shall be self-powered and shall not require any auxiliary supply and shall be supplied by the current sensors.

The protection relay provides protection against phase-to-phase faults and earth faults.

Protection against earth faults shall operate by measurement of residual current based on the sum of the sensor secondary currents. Measurement shall be carried out by a core balance CT mounted on the back of the relay unit. Earth protection operates with definite time. The setting and time delay shall be adjustable.

The electronic protection relay shall be supplied complete with sensors to obtain the specified setting performances.

In the event of a short-circuit the cross-section of the core and the resistance of the winding shall be adapted to protect the protection relay.

The Relay will have the following capabilities:

- Buchholz Alarm indication;
- Buchholz Trip and Indication;
- Temperature Alarm indication;
- Temperature Trip and Indication;
- Transformer protection with Differential Protection Relay o/c and e/f plus o/c high sets relay equivalent to existing protection relays with settings between 15% and 200% for o/c and between 20% and 80% for e/f elements.

EMSS 7.5 Cable Testing and Earthing Facilities

Cable testing and earthing facilities are required. Interlocks shall be provided to prevent access to the test terminals or orifices until the circuit is earthed.

In event of a separate test unit being required, it shall be easily fitted without having to remove the canopy of the miniature substation and this unit shall also be provided and stored in a suitable receptacle in the HV compartment.

EMSS 7.6 Medium Voltage Unistrut

A suitable Unistrut for securing the Medium Voltage cables by means of "K"-clamps or wooden cleats shall be installed in the Medium Voltage compartment.

EMSS 7.7 Earthing

The earth of the fuse switch shall be connected to the miniature substation's earth with a flat copper earth bar with three (3) 12mm holes in the Medium Voltage compartment.

The under frame, neutral and transformer tank of the miniature substation shall be connected to the earth busbars with 70mm² copper conductors or equivalent earth copper bar.

The Medium Voltage and Low Voltage earth busbar shall be interconnected by means of a 70mm² copper conductor or equivalent earth copper bar.

The earth bar (referred to as Medium Voltage earth busbar), construction and earthing is to be performed in accordance with clause 4.7.4, SANS 1029.

EMSS 7.8 Cable End Boxes

Large size cable end boxes shall be provided on the Medium Voltage switchgear suitable for heat shrink terminations.

Cable boxes shall be complete with the necessary clamps, tapes, glands, terminating and other accessories.

Provision must be made for heat shrink type terminations in the end boxes.

EMSS 8 TRANSFORMER COMPARTMENT

The transformer compartment of the miniature substation shall be equipped with a transformer.

EMSS 8.1 General

The transformer shall be of the double wound, three phase, oil immersed, self-cooled type with copper windings and shall comply with SANS 780 where applicable. The transformer shall be of the low loss sealed type.

The rated impulse voltage withstand level (BIL) and the rated short-duration power frequency withstand r.m.s. voltage (1 min) of the transformer shall test at the factory acceptance test, please see example below of the minimum tests:

Rated voltage kV (r.m.s.)	Rated lightning impulse withstand voltage (BIL) kV (peak)	Rated short-duration power frequency withstand r.m.s. voltage kV (r.m.s.) – 1 min
11	95	28
0,420	30	1

EMSS 8.2 Rating

The transformer shall be rated as specified in the Project Specifications. The maximum temperature rise shall not exceed the limits as laid down in SANS 780.

EMSS 8.3 Internal Connections

The high voltage winding shall be connected in delta, and the low voltage winding in star, with the neutral brought out (Dyn 11).

The vector group of the transformer shall be Dyn11, refer SANS 1029.

The transformer Medium Voltage bushing required is the Type C bushing as specified in SANS 1029.

The transformer earth terminal shall be a 30 mm long boss, with an M12 thread throughout, welded to the transformer tank. The boss shall be fitted with a M12 ´ 25 mm self-locking setscrew. The boss and the setscrew shall be stainless steel of grades 304 and 316 respectively.

EMSS 8.4 External Connections

The connections on the Medium Voltage and Low Voltage side shall all be of the same size.

All Medium Voltage connections shall be properly insulated. An externally operated off-load tap changing switch shall be provided enabling the secondary voltage to be varied from 95% to 105% in five steps.

Open Low Voltage bushings shall be protected by means of a Perspex cover to prevent accidental contact with live equipment.

EMSS 8.5 Accessories

The transformer shall be equipped with the following accessories:

- Drain valve;
- Oil gauge;
- Lifting hooks;
- Earthing terminal.

EMSS 8.6 Tests

Certified copies of test certificates shall be forwarded to the Engineer as soon as possible after the tests have been carried out. Testing of the transformer shall be in accordance with SANS 780.

EMSS 9 LV COMPARTMENT

EMSS 9.1 Low Voltage Busbars

The following additional requirements for LV panel are required:

- The spacing between the lowest Low Voltage phase busbar and the Low Voltage neutral-earth busbar shall be 300 mm.
- The spacing between the Low Voltage neutral-earth busbar and the uni-strut channel shall be 200 mm.
- The Low Voltage busbars shall be rated as indicated in SANS 1029 and the current density shall not exceed 1.8 A/mm².
- Busbar Insulation shall be used on all Low Voltage Busbars.

EMSS 9.2 Low Voltage Unistrut

Uni-strut channel shall be provided for the outgoing Low Voltage feeder cables shall be at least 3 mm thick and shall be mounted on a steel support structure that is insulated from the Miniature Substation enclosure. The cross-sectional area of the individual steel support structures shall be at least 70 mm² which must be earthed in accordance SANS 1029.

EMSS 9.3 Area Lighting

A compartment for exclusive use of the street lighting or area lighting control panel shall be located in the in the Low Voltage end compartment of the Miniature Substation as shown SANS 1029 with its own door. The equipment shall be specified in the Project Specifications.

EMSS 9.4 Equipment

The Low Voltage compartment shall be equipped with the following:

- a) A single front panel mounted 400 Volt voltmeter with HRC fuses and 4-position selector switch to measure phase voltages.
- b) Three combined instantaneous and maximum demand ammeters, one for each phase and appropriately labelled.

These ammeters will be wired to indicate the total LV current of the transformer.

- a) The LV compartment is to be provided with tinned copper busbars complying with BS159 and of suitable dimensions to carry the full load current of the transformer at a current density of not more than 1.8 A/mm². The neutral bar shall have the same dimensions as the phase bars. An earth bar with dimensions of $\pm 31,5 \times 6,3$ mm shall be supplied along the full width of the LV compartment. The busbars shall be phase colour coded.

Connections to bus bars shall be effected by means of cable lugs and suitably sized cadmium-plated, high tensile steel bolts and nuts with cadmium-plated cup washers or lock washers. Spare connections shall be provided complete with bolts, nuts, washers and spring washers.

- a) Install in the low voltage compartment a suitably rated three pole circuit breaker as specified in the Project Specification.
- b) Feeder circuit breakers shall be supplied as specified in the Project Specifications. A removable cover shall be installed in front of the cable terminations on the feeder circuit breakers to prevent accidental contact with live conductors.
- c) **3CR12 unpainted cable gland plates** with suitable gland openings shall be provided at the bottom of the compartment for feeder cable terminations. The gland plates shall be secured to a DIN rail, supplied along the full width of the Low Voltage compartment, to allow positioning of the gland plates in any required position.

Note:

Circuit breakers, isolators, meters and maximum demand ammeters shall be flush mounted behind a sheet steel panel. In all other respects the panel shall comply with the requirements as specified for distribution board panels.

EMSS 9.5 Protection

A safety shield manufactured of either Perspex or Tuffnol shall be fitted to cover the bushings in the Low Voltage compartment.

EMSS 10 CONCRETE BASE FOR MINIATURE SUBSTATION

The miniature substation shall be mounted on a concrete plinth. The concrete of the plinth shall be of cement, sand and stone, in the ratio of 1:2:4.

The concrete plinth shall reach from at least 300mm below the natural surface at the lowest point to 200mm above the surface at the highest point. The plinth shall also be in accordance with the miniature sub manufacturer's details.

The onus rests on the Contractor to ensure that the concrete plinth is sufficiently reinforced and adequately braced so that it does not collapse.

The plinth must have an opening under the high- and low voltage compartments, so that all cables can easily be pulled in. The inside of the plinth must also be plastered.

EMSS 11 INSTALLATION OF MINIATURE SUBSTATIONS

Miniature substations shall be installed on concrete foundations, and secured to the foundation by means of Grade 304 Stainless Steel holding down bolts cast into the concrete. The foundation shall extend from 300 mm below the final ground level at the lowest point to 200mm above the highest point. The foundation shall be between 250 and 300mm wide and the area beneath the high tension, low tension and transformer compartment shall be left open to facilitate the installation of all the cables. It shall have neatly bevelled edges and shall be 75 mm wider than the miniature substation all round.

Cable entries underneath the foundations shall be well compacted after filling to prevent subsequent subsidence.

After the placing of substations the contractor shall undertake the necessary excavations in such a way that the soil underneath the foundation of the miniature substation will not give way.

The contractor shall then haul the cables in and terminate the cable ends onto the switchgear taking due cognisance of the phase rotation.

The low-voltage feeder cables shall be terminated by means of copper cable glands and lugs, which have been approved by the Engineer.

The contractor shall mount additional circuit breakers when required.

Where cables are terminated onto circuit breakers by means of short busbars the cable lugs shall be covered with shrouds in order to cover live open portions where the gap between phases and from phase to earth is less than 40 mm.

After the trenches around and underneath the miniature substation has been backfilled and compacted properly the contractor shall fill the inside volume of the concrete plinth and cast a 50mm cement screed on top of the filling soil 100mm underneath the base channel of the miniature substation. A sand/cement mixture of 5:1 shall be used.

The miniature substation shall be cleaned and tidied inside and shall be free from dust, oil or any foreign matter and shall be maintained until handing over.

The contractor shall be responsible to keep the miniature substation locked to prevent equipment from being stolen from it. The contractor shall provide his own padlocks for this purpose.

EMSS 12 EARTHING

The contractor shall do all the bonding and earthing in accordance with the latest addition of the "Code of Practice for the Wiring of Premises" SABS 0142.

The substation and Medium Voltage Miniature Substation room earthing shall consist of a 70mm² bare copper earth wire installed in the same trench as the Medium Voltage supply cables.

Earth resistivity measurements of less than 1 ohm will be acceptable

EMSS 13 TECHNICAL INFORMATION

Test certificates, technical details and brochures shall be submitted to the Engineer for approval before manufacture.

Suppliers who cannot produce satisfactory test evidence that their equipment has passed short-circuit tests at the specified fault levels, must include in their tender for those tests to be carried out at the SABS testing laboratories. These tests shall be witnessed by the Engineer.

EMSS 14 PROTECTION SETTINGS

The Contractor will be responsible to have protection setting calculation done by a specialist in this field, to be approved by the Engineer. The protection settings shall allow discrimination between protection settings of supply authority switchgear, plant incomer and distribution system medium voltage switchgear protection settings and protection settings shall be done by the specialist and demonstrated for correct operation by means of secondary injection test procedures.

The Engineer shall attend the test demonstration and the Contractor shall inform the Engineer in good time when the test is scheduled to take place. If it is done without him or his representative being present, the test shall be repeated in the Engineer's presence at no additional cost.

Short circuit analysis and coordination study "Short Circuit Analysis/Coordination Study" shall be completed and submitted with switchboard submittal to confirm interrupting rating of submitted equipment is adequate for the point of application in the electrical distribution.

Payment for the services of the specialist shall be by the Contractor.

EMSS 15 MEASUREMENT AND PAYMENT

Measurement and payment will be done in accordance with the methods stated below:

EMSS 15.1 Design, Drawings and General

The rate tendered shall include for the provision of the necessary design information for all items measured under the respective schedule. Miniature substation installation, design information shall include, but limited to, the following:

- Manufacturer's product data of miniature substation and all related components.
- Dimensioned drawings of miniature substation showing accurately scaled basic units including, but not necessarily limited to, auxiliary compartments, unit components and combination units.
- Schematics and wiring diagrams for metering and controls.
- Furnish, upon request, manufacturer's certification of rating of the basic breaker, switch and fusing components and the integrated metal-enclosed interrupter switchgear assembly.
- Short circuit analysis and coordination study "Short Circuit Analysis/Coordination Study" shall be completed and submitted with switchboard submittal to confirm interrupting rating of submitted equipment is adequate for the point of application in the electrical distribution.

<u>Pay Item</u>	<u>Unit</u>
(a) Provide design drawings and design information for medium voltage switchgear	Sum
(b) Allowance for short circuit analysis and coordination study and protection setting calculations	Sum

EMSS 15.2 Supply and Delivery to Site

Rate tendered to include for all material, equipment, plant, testing apparatus, labour, manufacturing, factory applied corrosion protection, factory acceptance testing, transport, import duties, handling and possibly double handling, delivery to and off-loading at Site as well as temporary storage prior to installation. For miniature substation, the rate tendered shall be for the

complete miniature substation and shall include, but not limited to, the detailed in this particular specification. Any special devices shall be listed separately in Variations and Additions to the Standard and Particular Specifications Section C3.4.2 .

<u>Pay Item</u>	Unit
(a) Supply and delivery to site of miniature substation complete with concrete plinth	Each

EMSS 15.3 Installation

Rate tendered to include for all plant, tools, labour, rigging, handling, placing into position, aligning, fixing, grouting, but not limited to and getting ready for testing and commissioning

Install of miniature substation shall be accordance with the manufacturer's written instructions and recognized industry practices, to ensure that the miniature substation complies with the requirements and serves the intended purposes. Comply with the requirements of SABS and IEC standards and applicable portions of "Standard of Installation", for installation of miniature substation but not limited to.

<u>Pay Item</u>	Unit
(a) Site installation of miniature substation complete with concrete plinth and floor screed	Each
(b) Earthing resistance survey	Sum
(c) Protection setting calculations and setting of protection relays	Sum

EMSS 15.4 Commissioning

Rate tendered to include for the drafting of the necessary testing and commissioning plans, attendance of required local and/or overseas specialists, testing apparatus, instruments and equipment, any/all equipment required for testing purposes and to prove performance, any/all temporary works, and compilation of final commissioning report.

Prior to energization, check miniature substation for continuity of circuits and for short circuits. Each miniature substation line up bus shall have its insulation resistance tested after the installation is complete except for line and load side connections. Tests shall be made using a Megger Earth Tester or equivalent test instrument at a voltage of not less than 1000 volts dc. Resistance shall be measured from phase to-phase and from phase to-ground.

Following completion of the construction work and prior to final acceptance testing, the overcurrent ground fault protection systems shall be field-tested with a test-set checking the calibration of each relay and reset to the manufacturer's settings for both current and time. Contractor shall furnish a time current coordination study. Submit the results on log-log paper showing coordination with downstream devices. Contractor shall submit three copies to the Engineer. Contractor shall notify the Engineer one week in advance of the test so that the

Engineer may be present. Coordinate final overcurrent and time setting with the supply authority switchgear, plant incomer and distribution system.

<u>Pay Item</u>	Unit
(c) Commissioning of miniature substation	Each

END OF SECTION

EMCC MOTOR CONTROL CENTERS AND DISTRIBUTION BOARDS

EMCC 1 SCOPE OF WORKS

As specified in the Project Specifications.

EMCC 2 STANDARDS AND TESTS

The motor control centres shall conform to and be in accordance with the latest applicable South African Bureau of Standards Codes and Standards:

The following Standard Specifications and drawings shall apply;

Standard No.	Description
SANS 10142	Code of Practice for the wiring of Premises
BS 159	Bus bars
SANS 1195	Bus bars
SANS 1091	Paint colour
BS 3938	Current Transformers
SANS 60044	Current Transformers
NRS 029	Current Transformers
BS 89	Ammeters
BS 638	Welding cables
SANS 1576	Welding cables
SANS 156	Moulded Case Circuit Breakers
SANS 767	Earth leakage protection units
SANS 1574	Electric cables and flexible cords
NRS 002	Graphical symbols for electrical power, telecommunications and electronic diagrams
SANS 1213	Mechanical cable glands
SANS 1433-1	Terminal blocks having screw and screw less terminals
SANS 1433-2	Flat push-on connectors
SANS 1473-1	Low-voltage switchgear and control gear assemblies: Type-tested and partially type-tested assemblies
SANS 1473-2	Low-voltage switchgear and control gear assemblies: Busbar trunking systems
SANS 1619	Small power distribution units (ready boards) for single-phase 230V service connections
SANS 1765	Safety of distribution boards
SANS 10292	Earthing of low-voltage distribution systems
SANS 60439-2	Low-voltage switchgear and control gear assemblies: Particular requirements for busbar trunking systems

Standard No.	Description
SANS 60439-4	Low-voltage switchgear and control gear assemblies: Particular requirements for assemblies for construction sites
SANS 60947-2	Low-voltage switchgear and control gear: Circuit breakers
SANS 60947-3	Low-voltage switchgear and control gear: Switches and disconnectors
SANS 60947-4-1	Low-voltage switchgear and control gear: Contactors and motor starters (Electromechanical)
SANS 60947-4-2	Low-voltage switchgear and control gear: Contactors and motor starters (semiconductor motor controllers)
SANS 60947-4-3	Low-voltage switchgear and control gear: Contactors and motor starters (For non-motor loads)
SANS 60947-5-1	Low-voltage switchgear and control gear: Electromechanical control circuit devices
SANS 60947-5-2	Low-voltage switchgear and control gear: Electrical emergency stop device with mechanical latching function
BS 89	Ammeters
NEMA ICS 18	Industrial Control and Systems: Motor Control Centres
UL 845	UL Standard for Safety for Motor Control Centres
IEEE C37.20.7	Arc-resistant or arc-containing low voltage MCCs shall be tested, rated, and labelled in accordance with the requirements of IEEE C37.20.7 'IEEE Guide for Testing Metal enclosed Switchgear Rated up to 38 kV for Internal Arcing Faults'

Table 6: Applicable Standards

EMCC 3 QUALITY ASSURANCE

The manufacturer of the MCC shall have a minimum of **25-years' experience** in the manufacturing and assembly of Low Voltage motor control centres and distribution boards.

Motor control centres and distribution boards shall be designed and manufactured in accordance with all the above mentioned standards.

EMCC 4 PRE – MANUFACTURE SUBMITTALS

EMCC 4.1 Manufacturer Drawings

MCC elevations showing dimensional information including details such as, but not limited to, the following:

1. MCC height (less any removable lifting angles or eyes);
2. MCC width;
3. MCC depth;
4. Location of shipping splits;

EMCC 4.2 Structure Descriptions Showing the Following

1. Bus ratings;

2. Enclosure ratings;
3. Short-circuit withstand ratings;
4. Cascaded systems;
5. Type 1, type 2 or full coordination system;
6. Other information as required for approval.

EMCC 4.3 Product Data

Data sheets and publications on all major components including, but not limited to, the following:

1. Motor starters
2. Overload relays
3. Circuit breaker and fuse information including time current characteristics
4. Control power transformers
5. Pilot devices
6. Relays
7. Timers

EMCC 4.4 Specifications Response

All clarifications and exceptions to the project specifications must be clearly identified and marked up on the drawing.

EMCC 4.5 Specifications Response

Provide a copy of the manufacturer's installation instructions that includes the following:

1. Receiving, handling, and storage instructions;
2. Nameplate data, serial numbers, UL markings, and short circuit ratings;
3. Installation procedures including splicing procedures, terminations and connections;
4. Conduit and cable installation;
5. Installing and removing plug-in units;
6. Operation of operator handles and unit interlocks;
7. Checklist before energizing;
8. Procedure for energizing equipment;
9. Maintenance procedures.

4.6 Final Submittals

1. The contractor shall provide certification that the all components or MCC has been installed in accordance with the manufacturer's instructions and with local codes and standards that govern MCC installations.
2. The contractor shall provide certification that all circuit breaker settings have been adjusted per field requirements.
3. The contractor shall provide certification that all power fuses have been selected and installed per field requirements.

4. The contractor shall provide certification that all solid-state motor overload settings have been adjusted per installed motor characteristics.
5. The contractor shall provide certification that all settings for solid state devices such as reduced voltage solid-state controllers and variable frequency drives have been adjusted per the specific application requirements.
6. The contractor shall provide certification that any timing devices have been properly adjusted.
7. Test reports indicating manufacturer's standard testing was performed.
8. MCC installation instructions
9. Installation/operation instructions for major components such as, automatic transfer switch and circuit breakers
10. MCC spare parts listing and pricing
11. Technical details and descriptive literature regarding all equipment and instruments offered;
12. Three paper prints of all of the above for final hand-over.

All settings as above detailed shall be indicated on the final drawings.

EMCC 5 DELIVERY, STORAGE AND HANDLING

The contractor shall coordinate with the Engineer manufacturer for entry into the building.

The contractor shall store the MCCs in a clean, dry, and heated space.

The contractor shall protect the units from dirt, water, construction debris, and traffic.

During storage the contractor shall connect internal space heaters (if specified) with temporary power.

EMCC 6 MANUFACTURER

EMCC 6.1 Ratings

The MCC shall be rated for the system voltage as indicated in the Project Specifications.

The MCC horizontal and vertical power bus bracing shall be rated to meet or exceed the available fault current as indicated in Project Specification.

All MCC units shall have a full rated short-circuit rating that meets or exceeds the available fault current as indicated in the Project Specification.

All circuit breakers used in the motor control centre shall have full-rated short-circuit interrupting ratings based on the applied MCC voltage.

The manufacturer shall be certified by South African Bureau of Standards or accredited testing facility which is to approval of the Engineer in manufacturing motor control centres

or distribution boards to the specified withstand fault current as detailed in the project specification. If the contractor does not have certification to build motor control centres or distribution boards to the rated withstand fault current as specified in the project specifications, it will be to the cost of the contractor to fully type test the assemblies at South African Bureau of Standards at the contractors cost.

The contractor shall have certificate from South African Bureau of Standards which is higher or is equal to the specified withstand fault current.

Motor control centre and distribution board shall be type tested as laid out South African Bureau of Standards to the rated withstand fault current as indicated in the Project Specification.

EMCC 6.2 Enclosure

The motor control centre or distribution board shall be suitable for the environmental conditions in which it operates. The motor control centre and distribution board shall be protected against corrosion.

Any point of a motor control centre or distribution board that has to be reached during normal operation shall not exceed a height of 2,2 m above floor (or walking) level. However, the board may be mounted higher if it can be disconnected from the supply by a switch-disconnector or circuit breaker that is less than 2,2 m above floor level.

The motor control centre board or distribution board shall be of the free standing floor mounted type with a minimum IP rating of 55 (insect proofed enclosure). The motor control centre or distribution board shall be constructed with a minimum of 2mm steel which will rest on a rigid channel iron or similar frame and for outdoor 3CR12 rigid channel shall be used, and shall be bolted down in position by means of M16 high tensile stainless steel bolts grouted into the concrete floor, the bolts shall be inside the board.

The panel door shall be provided with a locking system suitable for padlocking. The locking system shall consist of a 3-way locking mechanism locking the door at the top, middle and bottom. The unit doors shall be capable of being opened at least 110 degrees.

The motor control centre or distribution board shall be provided with removable covers on the sides and hinged panels on the front. All removable covers shall be suitably braced and reinforced to ensure rigidity.

The board shall be provided with readily removable, sectionalized, rigidly supported unpainted 3CR12 cable end support gland plates along the entire length of the board and at least 230 mm above floor level.

This compartment shall if necessary consist of an outer and inner shell with at least 10 mm insulation or polystyrene between the inner and outer shell all round to keep the temperature inside the compartment at least 5 Degree Celsius below the temperature surrounding the compartment in summer complete with ventilation fans.

The board shall be suitably sized to accommodate without cramping, all the switchgear and equipment specified. Motor starter panels shall be a segregated system with each motor starter housed in a separate panel complete with door interlocked main switch. Where motor starter panels are installed on top of each other cable access shall be provided from the side of each panel by means of a common cable marshalling panel. Provision shall be made for pre-wiring between the starter panel and cable connectors inside cable marshalling panel to facilitate site cable connections.

All switch gear, instruments and equipment for the control of any specific motor or other electrical device, shall be mounted flush behind a common hinged panel, with only operating handles, push buttons and instrument faces protruding through neatly machine punched holes in the panel.

Sufficient provision for ventilation and heat dissipation as per the equipment ratings and manufacturers requirements shall be allowed for. The contractor shall prove to the Engineer by means of Anemometer or Differential that the requirements and manufacturer's requirements are met.

Screwed-on engraved labels in English shall be provided below all switchgear and equipment on and in the panels, to facilitate identification.

All unpainted parts shall be plated for corrosion resistance.

The systems shall be designed to allow for **30%** for future extensions.

EMCC 6.2.1 Indoor

All hinged panels shall be reinforced to ensure rigidity and shall be provided with heavy duty rust proof hinges.

Each panel shall be supplied with concealed hinges, each fastened with not less than four (two on each side) brass bolts and nuts. In the case of double doors the first door shall be locked with two slides on the inside, onto the shell. The second panel door shall close over a drip proof gutter shaped lip on the first one.

All screws, studs, bolts, nuts and washers used for these boards shall be Cadmium plated. The use of self-tapping screws will not be permissible.

EMCC 6.2.2 Outdoor

All hinged panels shall be reinforced to ensure rigidity and shall be provided with heavy duty stainless steel hinges.

Each panel shall be supplied with concealed stainless steel hinges, each fastened with not less than four (two on each side) brass bolts and nuts. In the case of double doors the first door shall

be locked with two slides on the inside, onto the shell. The second panel door shall close over a drip proof gutter shaped lip on the first one.

All screws, studs, bolts, nuts and washers used for these boards shall be stainless steel plated. The use of self-tapping screws will not be permissible.

The outdoor motor control boards shall be constructed of at least 2mm powder coated 3CR12 steel. Vermin proofed IP 54 rated ventilation openings shall be provided in doors and side panels. A 3CR12 roof shall be added to all outdoor motor control centres and distribution boards with a minimum slope of 1/10.

EMCC 6.2.3 Busbars

The board shall be provided with one set of four solid, copper busbars in the top section and extending over the entire length of the board. Provision shall be made at the end of each busbar for future extensions. Bus bars shall comply with the requirements of BS 1433, SANS 1973-8 and SANS 1195. A solid copper earth bar shall be provided inside the board above the gland plate along the entire length of the board.

Busbars shall be rigidly supported at suitable intervals to prevent undue damage resulting under short circuit conditions. Ceramic or other approved busbar insulators shall be used. The busbars shall be arranged horizontally with the longer sides of the cross-sections in the vertical plane and one behind the other, in the horizontal plane, at 90mm centres.

Busbars shall be clearly and indelibly marked in the middle of the bus bar Red, White and Blue for the three phases and Black for Neutral.

The earth bars shall be drilled and provided with 6 mm diameter and 10 mm diameter cadmium plated, high tensile steel bolts and nuts, complete with cadmium-plated washers and cup washers or lock washers, for making the earth connections. The earthing positions shall be evenly spaced along the entire length of each busbar.

Connections to busbars shall be effected by means of cable lugs and suitably sized cadmium-plated, high tensile steel bolts and nuts with cadmium-plated cup washers or lock washers. Spare connections shall be provided complete with bolts, nuts, washers and spring washers.

EMCC 6.2.4 Electronic Equipment

Where electronic equipment such as transmitting I/O units are incorporated in an outdoor distribution or motor control board, this equipment shall be installed in a separate and special compartment and all wiring shall be terminated on rail mounted terminal strips for field connection of all monitoring and control cables.

The doors of this compartment must be labelled: "Electronic Equipment".

All the electronic equipment but not limited to HMI, power supply, PLC CPU, Ethernet switch, fibre switch, all I/O cards, UPS and telemetry and 30% additional space for the future. All equipment shall be mounted flush behind a common hinged panel, with laminated, shatterproof and tinted glass for viewing purposes.

Sufficient provision for ventilation and heat dissipation as per the equipment ratings and manufacturers requirements shall be allowed for. The contractor shall prove to the Engineer by means of Anemometer or Differential that the requirements and manufacturer's requirements are met.

The tier shall be designed to house all of the above equipment and the manufacturer shall coordinate with communication and instrumentation specialist.

EMCC 6.2.5 Treatment And Painting of Metal Parts

All metal parts shall be treated before powder coating in accordance with standard corrosion protection standards and the appropriate coating system shall be selected for the specific application. Motor control centre outer surfaces shall be powder coated colour B26, SANS 1091. (Electric orange)

An average of 2 mil thick electrostatic powder paint coat shall be applied, the contractor shall have a Rugged, fully electronic coating thickness gauges present for testing the thickness of the paint.

EMCC 7 GENERAL REQUIREMENTS

EMCC 7.1 Internal Wiring

The internal wiring of the boards shall consist of coloured PVC-insulated conductors of adequate copper cross-section, which shall be neatly installed horizontally and vertically in PVC trunking. Numbered ferrules of an approved type (clip on type not acceptable), shall be provided on each end of each wire, to facilitate the tracing of circuits.

Control circuits shall be colour coded as follows;

Three Phase	-	Red
Three Phase	-	Blue
Three Phase	-	White
Single Phase	-	Red
A.C. Neutral	-	Black
Earth	-	Green and yellow
110V D.C. Positive	-	Brown
110V D.C. Negative	-	Black
24V D.C. +ve	-	Grey
24V D.C. -ve	-	Purple
4-20mA +ve	-	White
4-20mA -ve	-	Black

All other voltages - To be confirmed with Engineer.

EMCC 7.2 Electronic Equipment

Where electronic equipment such as transmitting I/O units are incorporated in a distribution board and motor control centre, this equipment shall be installed in a separate and special compartment.

Sufficient room shall be provided for the rail mounted terminal strips and all wiring shall be terminated on these rail mounted terminal strips for field connection of all monitoring and control cables.

EMCC 7.3 Cable terminations

Low voltage cables shall be terminated with cable glands manufactured of bronze and comprising a barrel with sealing washer and bush nut screwed into one end and a compression nipple with wire clamping ring screwed onto the other end and shall bear the SABS mark of approval. The opposite end of the compression nipple must have a male electrical thread with locknut. The glands shall be suitably sized for the relevant cables, be of the adjustable type complete with armour clamps and with watertight neoprene shrouds.

Cable terminating glands for outdoor use shall be IP68 rated and provided with waterproofing double inner seals as well as waterproofing seals on nipples. Cable termination glands for high humidity and possible temporary water submerged conditions as for instance in filter lower gallery areas at water treatment plants shall also be IP68 rated with waterproofing double inner seals as well as waterproofing seals on nipples.

Cable armouring shall be earthed at each end but may not be used as earth continuity conductor. Flameproof glands for indoor and outdoor use shall be used where the hazardous area classification and explosion protection rating is supplied by the Engineer.

EMCC 7.4 Labelling of Switchboards and Motor Control Boards

A screwed on engraved label of the black on white "traffolyte" type shall be provided below each item of equipment on the front panel of each board as well as on the chassis in close proximity to the relevant equipment to identify such equipment in the English language in 6 mm high lettering.

Each board shall further be provided with a screwed on reverse engraved yellow Perspex nameplate with black 20mm high lettering to identify the board in the English language on the outside of the door at the top thereof.

EMCC 7.5 Motor starter panels

Motor starters shall be contained in its own separate compartment in the motor control board or distribution board.

EMCC 8 MOTOR STARTERS AND ACCESSORIES FOR SWITCHBOARDS

EMCC 8.1 Direct-on-Line starters (400V motors)

These starters shall be of the manually operated (locally and remotely) type and each starter shall be contained in its own separate compartment on the relevant motor control board.

Each of these units shall comprise amongst other the following components:

- a) 1 Only mains **Type 2 Coordinated** fused or circuit breaker switch/circuit breaker connected to the busbars of the board and interlocked with the door of the compartment to prevent opening of the door with the switch closed and to prevent closing of the switch with the door open
- b) 1 Set of HRC control fused links with carriers and basis where necessary;
- c) All necessary relays as required
- d) 1 Only mains **Type 2 Coordinated** contactor;
- e) 1 Set of START and STOP push buttons;
- f) 1 Only mains operated timing device to limit starts per hour; and
- g) 1 Only power factor correction capacitor unit for motors of 5 kW and more.

The following protective and indicating devices complete with the necessary suitably rated potential fuses, current transformers, test blocks and auxiliary relays;

- (a) 1 Only electronic type motor protection relay for motors > 7,5kW or more or as specified;
- (b) 1 Only motor under current relay (Where specified)
- (c) 1 Only instantaneous indicating ammeter for motor current;
- (d) 1 Only ammeter selector switch for motors >5 kW;
- (e) 3 Only Current transformers for motors > 5 kW;
- (f) 1 Only running hour meter;
- (g) 1 Only anti-cycle timer; and
- (h) 1 Only thermistor relay for motors > 22kW or more
- (i) 1 Only Start delay timer for motors >15kW and higher
- (j) 1 Only blue LED type indicator light to indicate the time delayed starting period
- (k) 4 Only LED type indicator lights as follows; Red – 'Motor Stopped'; Green - 'Motor Running'; Yellow – 'Motor Tripped'; and Red - "Emergency stop engaged". Optional: Yellow - 'Supply on'; Blue – 'Motor start delay'; and Green – 'Healthy'.

It shall further be possible to trip and lock out the starter by means of a remote stop button to be provided at the relevant motor.

Provision shall also be made for locking the mains fused switch handle in the OFF position.

EMCC 8.2 Star/Delta Starters (400V motors)

These starters shall be of the automatic star/delta type and each starter shall be contained in its own separate compartment on the relevant motor control board.

Each of these units shall comprise amongst others provided for direct-on-line starters the following components as:

- a) 1 Only Mains **Type 2 Coordinated** Contactor;
- b) 1 Only Star **Type 2 Coordinated** Contactor;
- c) 1 Only Delta **Type 2 Coordinated** Contactor;
- d) 1 Only Star to Delta timer of the clockwork or electromagnetic type;
- e) 1 Only Mains operated timing device to limit the starts per hour;
- f) 1 Set START and STOP pushbuttons
- g) 1 Only Three phase Power Factor Correction Capacitor unit for motors of 5kW or more
- h) All necessary relays

EMCC 8.3 Variable Speed Drives

These variable speed drives shall each be contained in its own separate panel, manufactured and equipped to the satisfaction of the variable speed drive manufacturer to suit their own requirements with regard to ventilation of the variable speed drive. Small drives below 1kW can be combined into one panel but sufficient ventilation by means of extractor fans must always be allowed for

The variable speed drive panel shall be equipped with ventilation fans and air filters. The ventilation fan shall be interlocked with the relevant motor and shall only be in operation when the motor is running. Failure of the ventilation fan shall stop the motor and a visible indication of the cause of the failure shall be provided on the panel.

The frequency converter shall make use of flux vector control without encoder or tacho generator feedback and shall incorporate direct torque control technology so that the overall effectiveness of the drive shall only be limited by the performance of the motor.

Semi-conductor switching shall be determined by the values of flux and torque and shall not have a predetermined pattern as in conventional pulse width modulation flux vector drives.

Each of these drives shall comprise amongst others the following components:

- a) 1 Only main isolator/circuit breaker that shall be interlocked with the door of the panel to prevent opening of the door with the switch closed and to prevent closing of the switch with the door open
- b) 3 Only ultra rapid fuses rigidly connected to the load side of the above mentioned mains isolator and the rating of which shall comply with the manufacturers specifications for the drive
- c) 1 Only direct torque control frequency converter
- d) 1 Only door mounted control panel complete with cable connections (also for small drives)
- e) 1 Set of START and STOP push buttons for manual control of small drives
- f) One dial type potentiometer for manual speed control.
- g) 1 Only manual/off/auto selector switch for manual control of small drives
- h) 1 Only Thermistor relay for motors of 22kW or more

- i) 1 Only external EMC line filter
- j) All equipment necessary for remote emergency stop device.
- k) All bus system interface equipment necessary for remote speed control via a monitoring and control SCADA system as well as PLC control.
- l) All equipment necessary for remote motor status and speed monitoring.
- m) 4 Only LED type indicator lights as follows; Red – 'Motor Stopped'; Green - 'Motor Running'; Yellow – 'Motor Tripped'; and Red - "Emergency stop engaged". Optional: Yellow - 'Supply on'; Blue – 'Motor start delay'; and Green – 'Healthy'.

A 3CR12 steel gland plate must be provided at least 250mm above floor level for cable connections.

The control panel shall be the user interface for monitoring, adjusting parameters and controlling the drive operation. It shall be possible to:

- a) Enter start-up data into the drive.
- b) Control the drive with start, stop and reference signals.
- c) Display actual values of motor performance.
- d) Display information on at least the five most recent faults.
- e) The drive shall satisfy the following technical requirements.
- f) The static speed control error shall not exceed $\pm 0,5\%$ of motor nominal speed.
- g) Fundamental power factor shall be at least 0,97 at nominal load.
- h) Efficiency shall be at least 98% at nominal power level.
- i) The drive shall operate satisfactorily under all ambient temperature conditions between - 5°C and + 40°C at an altitude of 1260m above sea level and humidity up to saturation point.
- j) The drive shall provide output protection for motor overload, over current, short circuit at start, earth fault, missing motor phase and over frequency.
- k) The drive shall satisfy the following minimum harmonic voltage limits: Total harmonic distortion of 6%, odd harmonic distortion of 4% and even harmonic distortion of 2%.
The Contractor shall measure these harmonic distortion parameters after commissioning of the system and if the equipment fails to comply with this requirement, the Contractor will have to rectify the same to the satisfaction of the Engineer.
- l) The drive shall be equipped with an AC choke for harmonic current reduction and shall be placed on the AC side of the rectifier bridge in order to protect the rectifier semiconductors against power line transients.
- m) Torque step rise time shall typically be less than 5ms.
- n) Stringent precautions must be taken in the design of the protection equipment to assure adequate lightning and surge protection.

EMCC 8.4 Electronic Soft Starters

The soft starter shall be installed in the relevant motor starter panel but sufficient ventilation by means of extractor fans must always be allowed for and shall be interlocked with the relevant motor and shall only be in operation when the motor is running. A bypass contactor for motor

running conditions is a requirement and shall either form part of the soft starter or shall be a separate unit.

The soft starter shall have soft start and stop programmable capabilities with torque and current control. The normal motor protection facilities such as over/under-current, start limit, long start time, electronic overload, phase loss and phase sequence and load loss shall be available.

At least a 2 line 16 character LCD display unit with control function keys shall form part of the soft starter and shall preferably be separate motor starter front panel mountable. The LCD unit shall display all statistical data and trip conditions and shall allow functional key changes to programmable parameters.

The full motor protection capabilities shall be maintained when motor is operating in bypass contactor mode.

RS 485, MODBUS, PROFIBUS communication shall be possible.

EMCC 8.5 Induction Soft Starters

The induction type soft starter shall be installed in the relevant motor starter panel but sufficient ventilation by means of extractor fans must always be allowed for and shall be interlocked with the relevant motor and shall only be in operation when the motor is running. A bypass contactor shall be provided to bypass the soft starter.

The series impedance type starter shall incorporate reduced starting current and ensure gradual increase in the motor terminal voltage in smooth step-less manner.

The design of the induction soft starter shall allow the motor to generate adequate starting torque to overcome the load torque and friction to ensure smooth acceleration.

The soft starter shall allow five starts per hour.

EMCC 8.6 Mains surge arrestors

When a surge arrestor is installed in systems with a main breaker with 250Amps or 5kA fault current, the surge arrestor shall be pre-fused to prevent the units creating a danger when subjected to high fault currents. Surge arrestors shall be pre-fused to the manufactures requirements. All surge arrestors shall be **connection type 2** as per the latest addition of the SANS 10142.

EMCC 8.6.1 Building with External lightning protection

The main distribution board surge arrestors shall be combined type 1 & 2 and voltage compatible to the relevant installation and shall be able to withstand a lightning impulse current wave form 10/350µs at a maximum discharge current of 100kA.

Any distribution board feeding from the main distribution board shall have surge arrestors and shall be type 2 and voltage compatible to the relevant installation and shall be able to withstand a lightning impulse current wave form 8/20 μ s at a maximum discharge current of 40kA.

Each distribution board shall be equipped with mains surge arrestors.

EMCC 8.6.2 Building With NO lightning protection

The surge arrestors shall be type 2 and voltage compatible to the relevant installation and shall be able to withstand a lightning impulse current wave form 8/20 μ s at a maximum discharge current of 40kA.

Each distribution board shall be equipped with mains surge arrestors.

EMCC 8.7 Moulded case circuit breakers

All moulded case circuit breakers shall be as specified in the schedules of equipment for distribution boards and shall comply with the requirements of SANS Specification no. 156.

The required frame sizes or rupturing capacities required are specified in the schedules for each board.

Each circuit breaker shall be provided with non-adjustable time-delayed trips.

These circuit breakers shall be fitted with copper terminal collector bars where more than one cable tail has to be terminated on the same terminal.

EMCC 8.8 Fused switches

All fused switches shall be of the "load-breaking" and "fault-making" type complying with BS-5419 where applicable and fitted with HRC cartridge fused links to BSS-88. Auxiliary contacts shall be provided where relevant for signal purposes.

EMCC 8.9 Current limiting circuit breakers

The current limiting circuit breakers shall be capable of remaining in service and of carrying their normal rated current after having interrupted the maximum short circuit current of 200 kA rms at least three times.

The current limiting circuit breaker shall be equal and similar to the specified Merlin Gerin type.

EMCC 8.10 Current transformers

All current transformers shall be of the air insulated type complying in all respects with the requirements laid down in BS 3938: 1973.

The contractor shall carefully select the ratio, burden and accuracy class to suit its specific application in accordance with the recommendations and requirements of BS 3938.

EMCC 8.11 Indicating instruments

All indicating instruments shall comply with the requirements laid down in BS 89: Part I: 1970 for instruments of a 2,5 Accuracy Class. All indicating instruments shall have 96mm square dials.

The maximum demand ammeters shall be of the 6A combined maximum demand registering and instantaneous indicating type having MISC movement and thermal demand indication with an integrating time lag of 15 minutes. The ammeter scales shall be direct reading with a full-scale deflection corresponding to 120% of the rated primary current of the relevant current transformer. Each ammeter shall be clearly and indelibly marked to indicate the colour of the phase to which it is connected.

The ammeters for motor starters shall be 5A instantaneous indicating meters with MISC movement and direct reading scales. The meters shall be able to withstand over currents resulting under starting conditions and the full load current of the relevant motor shall be clearly marked in red on the face of the meter.

Voltmeters shall be of the direct reading moving iron suppressed zero type.

The power factor meters shall indicate from 0,7 lagging to 0,7 leading.

The running hour meters shall have cyclometer dials indicating up to 5 digits and two decimals. (12345,67)

EMCC 8.12 Instrument selector switch

A four-position rotary type instrument selector switch shall be mounted directly below the relevant instrument in such a way that only the selector knob and indicator plate are on the panel, and the switch itself is behind the panel.

The selector knob shall consist of Bakelite, and shall have an arrow engraved on it, indicating the switch position.

The switch shall have a positively driven switching mechanism.

The indicator plate shall consist of Bakelite and shall have the positions for the three phases and "OFF", engraved on it in 5mm high lettering.

EMCC 8.13 Contactors

All contactors shall be of the totally enclosed, three pole, double air break per pole, automatic magnetic type complying with the requirements of BS 775 for "CLASS UR" contactors of the

"CLASS II MECHANICAL DUTY CLASS / TYPE 2 COORDINATION" and "A3 Make and Break Category".

All contactors shall be provided with arc extinguishers, and readily replaceable silver or silver-alloy contacts rated for at least 2-million "on" and "off" switching operations at rated current.

Each contactor shall be provided with an AC, closing coil suitable for continuous operating and at least 15 closing operations per hour at system voltage. The contactor may not hum or chatter in service and the contacts may not bounce on closing.

EMCC 8.14 Time switches

The time switches shall be suitable for use on a 231 volt, 50 cycle per second AC supply and shall be of the microprocessor type.

The time switches shall be digital timers suitable for rail or surface mounting and shall be programmable with daily and weekly programs, switching intervals of 1 minute and switching accuracy precise to the second.

The time base shall be of the quartz type with LED display for time, weekday, holiday program, switching position and manual override and shall have a power reserve of 250 hours at full operation. The time switches shall have a switching capacity of 16 A at 231 V.

EMCC 8.15 Isolators

All isolators shall be of the "Load-breaking" and "fault making" type and shall comply with the requirements of BS 5419-1977 where applicable. Where relevant, isolators shall be provided with auxiliary contacts for signal purposes.

EMCC 8.16 400 Volt air-break contactors

All contactors shall be of the totally enclosed, three pole, double air break per pole, automatic magnetic type complying with the requirements of IEC 158-1 for Class AC 3 contactors of Intermittent Duty Class 0,3.

All contactors shall be provided with arc extinguisher and readily replaceable silver or silver-alloy contacts rated for at least 2-million "on" and "off" switching operations at rated current.

Each contactor shall be provided with a 240 Volt, 50 Hz closing coil suitable for continuous operation and at least 15 closing operations per hour. In rural areas contactor coils must be rated to operate satisfactorily between 75% and 130% of nominal voltage.

An adequate number of auxiliary contacts shall be fitted.

The contactor may not hum or chatter in service and the contacts may not bounce on closing.

EMCC 8.17 Earth leakage units

The earth leakage units shall consist of a combination of a earth leakage relay and a moulded case circuit breaker and shall have a sensitivity as specified, it shall conform to SANS 767.

EMCC 8.18 Terminals

Terminals may be of the bolted type otherwise they shall be of rail mounted clamp type.

All types of terminals and their insulation shall have a minimum comparative creep index of 500 to BS 3781.

EMCC 8.19 Clamp type terminals

These terminals shall be not less than 8 mm wide.

Screws and connectors shall be electroplated to prevent corrosion. The connectors shall be such that the screws will not loosen due to vibration. Current carrying parts shall be of serrated silver plated copper or brass. Only one connection shall be allowed per connector. For more connections the number of terminals shall be increased and bridge pieces shall be used.

EMCC 8.20 Surge Protection

EMCC 8.20.1 Surge Arrestors

Surge arrestors shall be supplied and installed under this contract where applicable.

EMCC 8.20.2 Main supply protection

Surge arrestors as specified shall be installed at the main incomer of each distribution board, motor control centre or any type of kiosk.

EMCC 8.21 Power factor correction capacitors for 400 Volt motors

Each of these capacitors shall be of the indoor switchboard mounting 400 Volt 50 cps three-phase self-contained type with a dead casing and shall fully comply with the requirements laid down in BS 1650-1971.

Each capacitor unit shall be of carefully selected rating to correct the power factor of its associated motor to 0,95 at full load and should not exceed a value which compensates for 85% of the no-load magnetizing current.

The dielectric shall consist of plastic film and low-loss paper situated between aluminium foil and impregnated with a synthetic liquid agent with scavenger additive.

The capacitor losses shall not exceed 1 Watt/kV.Ar.

The capacitor units shall have the following admissible overloads at an ambient temperature of 40°C and an altitude 260 m above sea level.

10% excess volts continuously;

50% excess current continuously; and

30% excess kV.Ar continuously.

Each of these capacitor units shall be provided with discharge resistors and a fuse in each winding element that will disconnect the affected element in event of a di-electric breakdown. A time controlled contactor shall connect and disconnect the capacitors to the starter control circuit.

EMCC 9 DANGER SIGNS

Danger signs on aluminium plates shall be supplied on each door of an outdoor motor control centre or distribution board and shall be in accordance with the Occupational Health and Safety Act, Act 85 of 1993.

EMCC 10 ELECTRONIC LEVEL CONTROL

The micro based electronic controllers which will be mounted in the starter panels shall be easy to calibrate and reliable in service.

The power units for all the pumps in a specific pump station shall be installed in a separate compartment of the starter panel and clearly labelled in accordance with the pumps it controls.

These level controls shall be designed to automatically select the pump sequence to ensure that all the pumps will at random be a duty pump.

Where a controller controls only two pumps and one pump is always a standby pump, the standby pump shall automatically become the next duty pump after each duty cycle, unless one pump is taken down for service. When that occurs, the duty pump shall remain on duty until the normal operation is restored.

When a pump selected for duty fails to respond to the start signal from the control, then the next duty pump shall automatically start-up after five minutes.

The level controller must also stop all the pumps, whether on manual or automatic selection, when the pump has reached a predetermined low level.

The transducers shall be designed to operate in air, been capsulated, of rugged construction and impervious to submergence. The transducer shall not form part of the MCC scope of supply

The coaxial cable between the transducer and power unit shall be of sufficient length to avoid any joints in this cable, as no joints will be permissible.

EMCC 11 EMERGENCY STOP PUSH BUTTONS AND WEATHERPROOF ISOLATORS

Each of these units shall consist of a totally enclosed outdoor type heavy duty "push and turn to lock" stop push button station with a cable gland entry at the bottom to accommodate a 4 core 2,5mm² LT PVC SWA PVC cable.

Where installed at motor positions the emergency stop push buttons shall not form part of the MCC scope of supply.

EMCC 12 EARTHING

The contractor shall do all the bonding and earthing in accordance with the latest addition of the "Code of Practice for the Wiring of Premises" SABS 10142.

Earth resistivity measurements of less than 1 ohm will be acceptable at motor control centres and distribution boards.

EMCC 13 INFORMATION TO BE SUBMITTED WITH TENDERS IN RESPECT OF THE 400 VOLT DISTRIBUTION BOARDS AND MOTOR CONTROL BOARDS.

The following information shall be submitted with each Tender in respect of all boards offered:

- a) Full technical details and descriptive literature regarding all equipment and instruments offered;
- b) Three paper prints of an outline drawing of each motor control centre and distribution board indicating the main overall dimensions and general lay-out of the boards; and
- c) Three paper prints of an outline drawing of the front end processor cabinet indicating the main overall dimensions, general layout and type of material employed on the face of the panel.

EMCC 14 INFORMATION TO BE SUBMITTED BY THE SUCCESSFUL TENDERER

The successful Tenderer shall submit three prints of the under mentioned drawings to the engineer for approval, before manufacturing.

- a) Wiring diagrams of all motor control centres and distribution boards.
- b) Schematic single line diagrams of all motor control centres and distribution boards.
- c) Elevations showing dimensional information including details such as, but not limited to, the following:
 - motor control centres and distribution boards height (less any removable lifting angles or eyes)
 - motor control centres and distribution boards width

- motor control centres and distribution boards depth
- Location of shipping splits
- a) Structure descriptions showing the following:
 - Bus ratings
 - Enclosure ratings
 - Short-circuit withstand ratings
 - Other information as required for approval
- a) Conduit locations
- b) Required bus splices
- c) Unit descriptions including information such as, starter sizes, circuit breaker frame sizes, circuit-breaker continuous ampere ratings, and pilot devices
- d) Nameplate information
- e) Manufacturer drawings shall be provided in PDF format
- f) Data sheets and publications on all major components including, but not limited to, the following:
 - Motor starters
 - Overload relays
 - Circuit breaker and fuse information including time current characteristics
 - Control power transformers
 - Pilot devices
 - Relays
 - All clarifications and exceptions must be clearly identified

After completion of the work, the contractor shall submit three final copies of each of the above-mentioned drawings showing the final layout and wiring diagram of the boards.

EMCC 15 INSPECTIONS AND TESTS

All equipment will be inspected by the Engineer and tested in his presence both in the factory during manufacturing and on site during installation. The Engineer will do all inspections accompanied by the Contractor and the Contractor will do all tests with the Engineer as witness.

The Engineer will require seven (7) days notification to avail himself for any test or inspection and the Contractor must arrange for the maximum number of inspections and tests to be done on the same day. The Contractor must provide all testing facilities and instruments, all equipment required for a test or inspection.

The instruments must have valid test certificates issued by an accepted testing authority and the results of the test done must be recorded on a test certificate, of which the Engineer must receive two copies. The Engineer reserves the right to call for a calibration test on any instruments used during the test.

The cost of all tests must be included in the tender price.

EMCC 16 TESTING OF DISTRIBUTION/MOTOR CONTROL BOARDS AT THE MANUFACTURER'S WORKS

Each distribution/motor control board shall be subjected to the following tests in the manufacturer's works after manufacture:

- a) A thorough inspection shall be carried out to ensure compliance with the specification and approved drawings and wiring diagrams and to ascertain that all connections are properly made.
- b) A high voltage test on all primary connections to check the insulation between phases mutually and between each phase and earth.
- c) The polarities and ratios of all potential and current transformers shall be checked.
- d) Primary and secondary injection tests shall be carried out on all switching, protection, metering interlocking and indication circuits.

The manufacturer shall submit three copies of test certificates giving details of conditions and results of tests carried out to the Engineer.

EMCC 17 CONCRETE PLINTH FOR OUTDOOR STARTER PANELS AND PEDESTALS

The plinth shall be cast 150mm below as well as 150mm above the ground level. It shall have neatly bevelled edges and shall be 75mm wider than the panels all round.

An opening of sufficient width to allow for cable entry shall be provided under the starter panels.

The grade 304 stainless steel foundation bolts for mounting of the panels shall be cast or grouted into the plinth. The plinth shall be in Class 20/19 concrete and shall be suitably reinforced if necessary.

It is recommended that the casting of these foundations must be carried out by the Civil Contractor at the cost of the Contractor under this Contract in accordance with his instructions and under his supervision.

EMCC 18 INSTALLATION OF DISTRIBUTION BOARDS AND MOTOR CONTROL BOARDS

Each of the relevant distribution boards and motor control boards shall be built into walls or securely bolted down on the floor or plinth, as may be required, by means of the requisite number of foundation bolts grouted into the floor in the positions indicated on the drawings.

These positions shall be confirmed with the Engineer on site, prior to installation.

- a) Contractor shall install MCC in accordance with manufacturer's instructions.
- b) Contractor shall tighten accessible bus connections and mechanical fasteners to the manufacturer's torque requirements.
- c) Contractor shall select and install fuses in fusible switches based upon field requirements.
- d) Contractor shall adjust circuit breaker settings based upon field requirements.
- e) Contractor shall adjust solid state overloads to match the installed motor characteristics.

EMCC 19 TESTING AND COMMISSIONING OF DB/MCC AFTER INSTALLATION ON SITE

After installation on site but prior to commissioning the following inspections and tests shall be performed on each distribution/motor control board.

- a) Check all components to ensure that they are free from dust and protective packing material;
- b) Check the operation of all components liable to damage in transit such as meter and protection measured;
- c) The insulation of all primary circuits between phases mutually and between each phase and earth shall be measured;
- d) All fused links shall be checked for electrical continuity; and
- e) All control supplies shall be checked.
- f) All adjustable protection devices shall then be set and the boards commissioned all in consultation with and to the instruction of the Engineer.

EMCC 20 OPERATING AND MAINTENANCE INSTRUCTIONS

Before completion of the testing of the plant, the Contractor shall provide the Employer with adequate and complete working, operating and maintenance instructions *in triplicate*, with the necessary drawings and diagrams clarifying the instructions. The Contractor will also provide *3 x "soft copies"* of the complete manual in PDF format on a Suitable sized USB Flash Drive (Memory Stick).

Instructions are to be made up in book form and particular reference is to be made to:

- Maintenance of equipment;
- Precautions to be taken in running the plant;
- All instruments and components must be fully described in data sheets supplied by the relevant suppliers;
- Wiring diagrams of the complete electrical installation.

The manual must be specific for the plant supplied and all extraneous material not connected with the relevant plant shall be deleted, leaving the manual as a comprehensive coherent document, bound in a professional way such that this may be used frequently without falling apart. Standard pamphlets may be supplied as addendums, bound separately in a good quality file to serve as reference but will not be allowed as part of the main manual.

EMCC 21 MEASUREMENT AND PAYMENT

Measurement and payment will be done in accordance with the methods stated below:

EMCC 21.1 Design, Drawing and General

The rate tendered shall include for the provision of the necessary design information for all items measured under the respective schedule. For motor control centres and distribution board's installation, design information shall include, but limited to as listed in this Particular Specifications.

<u>Pay Item</u>	<u>Unit</u>
(a) Provide MCC design drawings and wiring diagrams as specified	Sum
(b) Provide operating and maintenance manuals and "as built" drawings as specified	Sum

EMCC 21.2 SUPPLY AND DELIVERY TO SITE

Rate tendered to include for all material, equipment, plant, testing apparatus, labour, manufacturing, factory applied corrosion protection, factory acceptance testing, transport, import duties, handling and possibly double handling, delivery to and off-loading at Site as well as temporary storage prior to installation. For motor control centres and distribution boards, the rate tendered shall be for the complete motor control centres and distribution board's and shall include, but not limited to, as detailed in this Particular Specifications. Any special devices shall be listed separately in Variations and Additions to the Standard and Particular Specifications Section C3.4.2.

<u>Pay Item</u>	<u>Unit</u>
(a) Supply and delivery to site of a complete MCC	Each

EMCC 21.3 INSTALLATION

Rate tendered to include for all plant, tools, labour, rigging, handling, placing into position, aligning, fixing, grouting, but not limited to and getting ready for testing and commissioning

Install of motor control centre and switchgear shall be accordance with the manufacturer's written instructions and recognized industry practices, to ensure that the motor control centres and distribution board's installation switchgear complies with the requirements and serves the intended purposes.

Comply with the requirements of SABS and IEC standards and applicable portions of "Standard of Installation", for installation of motor control centres and distribution board's installation but not limited to.

<u>Pay Item</u>	<u>Unit</u>
(a) Site installation of MCC	Each

EMCC 21.4 COMMISSIONING

Rate tendered to include for the drafting of the necessary testing and commissioning plans, attendance of required local and/or overseas specialists, all testing apparatus, instruments and equipment, any/all consumables required for testing purposes and to prove performance, any/all

temporary works, any/all control checks, and compilation of final commissioning report. Comply with the requirements of SABS and IEC standards and applicable portions of "Standard of commissioning".

Pay Item

Unit

(a) Commissioning of MCC

Each

END OF SECTION

EPLC ELECTRICAL/ELECTRONIC: PROGRAMMABLE LOGIC CONTROLLERS

EPLC 1 SCOPE OF WORKS

As specified in the Project Specifications.

EPLC 2 CONDITIONS TO SERVICE

The PLC Units will be installed inside MCC (Motor Control Centres) Panels and/or in the PLC cabinets where required. The typical areas where PLC installation shall be required are the following:

- An industrial WTP (Water Treatment Plant)
- An industrial WWTP (Wastewater Treatment Plant)
- A Pipeline Project with Pump Stations/Reservoirs/Feeder Tanks, etc.
- Mining areas
- Power Plants
- Substations
- And all subsequent areas where Control Systems are required

EPLC 2.1 Abbreviations

PLC	-	Programmable Logic Controller
CPU	-	Central Processing Unit
HMI	-	Human Machine Interface
UPS	-	Uninterrupted Power Supply
SFC	-	Sequential Function Chart
SRS	-	Software Requirements Specification
I/O	-	Input and/or Output (Analog and/or digital)
CF	-	Control Function
CFS	-	Control Function Section
CSC	-	Computer Software Configuration item
CSC	-	Computer Software Component
CSU	-	Computer Software Unit

EPLC 3 STANDARDS AND TESTS

All materials and equipment to be supplied and installed under this contract shall be new and of the best quality available, as specified.

All materials and equipment shall comply with the requirements laid down in the latest editions of the BS, SANS and IEC specifications and their amendments (if any) as well as those laid down in this specification. All material and equipment shall bare the SABS mark, if material and equipment are offered not baring the mark, test certificates shall be submitted from independent testing agent, of the standard compliance of equipment.

The workmanship and finish of work shall be of a high standard throughout and to the satisfaction of the Engineer.

Similar equipment supplied under this contract must be identical in all respects and it shall be possible to interchange any of the same equipment under this contract.

a) Compliance with Laws and Regulations

The work shall be carried out strictly in accordance with and all material and equipment supplied shall comply with the following laws and regulations (the latest edition) of the where applicable:

- "Code of Practice for the Wiring of Premises", SANS 10142, as amended;
- The machinery and Occupational Safety Act (Act No 6 of 1983) as amended;
- The "Electrical Supply By laws and Regulations" of the Supply Authority;
- The local Fire Office Regulations;
- The Post Office Regulations;
- "Code of Practice for the Installations and Maintenance of Electrical Equipment used in Explosive Atmospheres" (SABS 086).

The Contractor shall be responsible for serving all notices and paying all fees due in terms of the above laws and regulations.

b) Standard Specifications

The work shall be carried out strictly in accordance with and all material and equipment supplied shall comply with The Occupational Health and Safety Act (Act No. 85 of 1993) as amended.

The following Standard Specifications and drawings shall apply:

SANS 156	-	Moulded Case Circuit Breakers
SANS 1574	-	Electric cables and flexible cords
NRS 002	-	Graphical symbols for electrical power, telecommunications and electronic diagrams
SANS 1433-1	-	Terminal blocks having screw and screw-less terminals
SANS 1433-2	-	Flat push-on connectors
IEC 68	-	Shock and vibration resistance
IEC 1000	-	Electrostatic discharge and electromagnetic interference
IEC 1131	-	Standard software

EPLC 4 RADIO AND TV INTERFERENCE

All equipment installed under this Contract shall comply with the Government Notice No R.2246 and any other applicable codes, rules and/or regulations in respect of radio and TV interference.

Any equipment found producing interference subsequent to commissioning, shall be suppressed or replaced to the satisfaction of the Engineer without any additional cost.

EPLC 5 PROGRAMMING AND CONFIGURATION

a) Programmable logic software

All PLC software shall be structured in a logical manner representing the key process units and control regimes required for plant control.

b) Programming

The contractor shall program the PLC including all functions and operations to comply with the plant and/or pump control philosophy and/or any other equipment as provided by the engineer. The contractor shall ensure that at tender stage they are familiar with the standards and protocols used by the client and shall allow for adaptability of the offered system. The client's standard IP addressing and network configuration shall be used to ensure smooth integration.

c) Execution of control regimes

Control programs shall be executed at PLC level always. Approval to execute any control functions at supervisory level shall be obtained from the Engineer before commencement of the development of the software.

d) Configuration

Where required, the contractor shall allow for the following scenario:

- i) Interface and configuration to an existing SCADA System, as per the existing Client's specification, and shall include all the relevant graphics required for integration to the new equipment.

A system specialist shall be required to complete this task and the contractor shall allow adequate time to complete, test (FAT), pre-commission and commission the complete integrated system, consisting of both the new and the old installations.

EPLC 6 PROGRAMMABLE LOGIC CONTROLLER HARDWARE

EPLC 6.1 Hardware Configuration

Normally the hardware configuration will be a single CPU with I/O modules as required mounted on a 19-inch rack back plane.

Where required, Remote I/O shall be installed within close proximity to a PLC unit. Based on the distance between the Remote I/O unit and PLC unit, this shall determine which physical media type is to be used (Multimode Fibre Optic or Ethernet CAT5e).

All designs shall be backed up with design calculations, compliance to network standards and compliance to international communication standards and protocols (ANSI, IEEE, IEC, etc.)

EPLC 6.2 Enclosures

PLC/Remote I/O equipment shall be mounted in an IP54 enclosure with a suitable viewing window in front of the modules. The enclosure will form part of the MCC (Motor Control Centre) and in the event that no MCC is available a separate enclosure shall be supplied.

EPLC 6.3 General

The unit shall comprise of a PLC with interface modules, a power supply, input and output modules, network modules and shall be suitable for 19 inch rack mounting, unless specified differently by the Engineer. All equipment shall be housed in a steel cabinet that will form part of that specific MCC unless the application requires a separate control cabinet installation.

The technical requirements for the different modules forming part of the overall PLC System are discussed below:

EPLC 6.4 Power Supply

The standalone single slot rack mounted power supplies shall operate from 24VAC/24VDC/230VAC and shall have sufficient capacity for the application. The Power Supply module shall be fed by a regulated UPS supply. The power supply shall provide all regulated DC back plane power necessary for all the installed modules. The power supply shall have over and under voltage protection for added security.

The stand-alone single slot rack mounted power supplies shall operate from UPS fed - 230 V-AC and be sufficiently sized based on the requirements of this project in terms of its power capacity.

The UPS backup shall provide power for a minimum duration period of one hour.

The power supply shall provide all regulated DC back plane power necessary for the installed modules.

The power supply shall have over and under voltage protection for added security.

Allowed interruptions of power supply should DC and AC power supplies should be less than 10mS and 0.5 seconds respectively.

EPLC 6.5 CPU

The CPU module shall be a back plane slot mounted controller containing on board executive memory, application memory and communication ports. It shall be possible to perform field upgrades through a field bus communications port. The front panel of the CPU shall be equipped with status and fault LED's to facilitate fault diagnostic procedures. The CPU shall have a multipoint interface for an external programming device as well as an Ethernet RJ45 port.

The technical specifications of the CPU Unit (unless specified differently by the Engineer) shall be as follows:

- The CPU should have the following minimum processing times for:
 - a. Bit operations : ≤ 50 nanoseconds
 - b. Word operations : ≤ 60 nanoseconds
 - c. Fixed point arithmetic operations : ≤ 80 nanoseconds
 - d. Floating point arithmetic operations : ≤ 300 nanoseconds
- The CPU should have minimum IP20 degree of protection
- The CPU shall have a real time clock for the generation of time related information
- The CPU shall have surge protection
- The CPU shall have diagnostics like alarms (including diagnostic alarm, hardware interrupts, wire break)
- The CPU shall have diagnostics indication LEDs (including run, stop, error, send, receive, etc.)
- The CPU shall have shock resistance according to IEC 60068-2-27.
- The CPU module shall be a back plane slot mounted controller containing the required integrated program memory and data memory.
- Sufficient programming memory and a processor with a very fast processing speed shall be made available.
- The programming memory shall have 30% spare capacity, after all the required design requirements have been met.
- The size of the processor selected shall be done such that the utilization factor will be at most 70% of its processing (CPU clock speed) capability. This then leaves at a minimum 30% available processing capability for future expansion
- **Note:** The proof of the CPU Utilization factor (based on the current I/O requirements), for each individual CPU Unit is required by the Engineer and shall form part of the overall Data Pack.
- Ethernet and engineering interface communication ports must be available on the CPU
- It shall be possible to perform field upgrades, as well as firmware upgrades, through the Field bus communications port/Ethernet port
- The CPU shall support at least the following **IEC 1131-3** programming languages:
 - Sequential Function Chart;

- Structured control language (SCL)
 - Function Block Diagram
 - Ladder Diagram
 - Structure Text
 - Instruction List
-
- The CPU shall be equipped with either a lithium battery or an internal energy storage element, for backing up the RAM holding application programs

EPLC 6.6 Communications Processor

- The communications processor shall provide communication links with other programmable controllers to other required network communication (i.e. PROFIBUS, Industrial Ethernet) connections apart from the PLC CPU communication interfaces.

EPLC 6.7 Software (General)

- All PLC software shall be structured in a logical manner representing the key process units and control regimes required for plant control.
- System diagnostics should provide all relevant information regarding errors present in the system; also, the software should allow automatic updating of the system diagnostics when modifying the hardware configuration and also fast fault localization.
- All PLC software shall be fully documented and the documentation shall consist of the following as a minimum:
 - Functional specification of the plant to be controlled
 - Process control logic diagrams
 - Sample report forms
 - Sample alarm report details (list and format of reports)
 - Fully annotated listing of the full software package
 - Full input/output listings
 - Full allocated register listing with functional description
 - Program software in electronic format
 - All documentation is subject to the approval of the Electrical Engineer.

EPLC 6.8 Software (Development)

- The Sequential Function Chart (SFC) language, used to structure the internal organization of a program, and four inter-operable programming languages: Instruction List (IL), Structured Control Language (SCL), Ladder Diagram (LD), Function Block Diagram (FBD) and Structured Text (ST) should correspond to the textual high-level language ST (Structured Text) defined in the standard IEC 61131-3 and fulfils base level and reusability level requirements according to PLC open standard.

EPLC 6.9 Digital I/O Modules

- The digital I/O modules shall accept inputs from plant controls and auxiliary multiple operations and provide control outputs to plant operations.
- The modules shall be complete with I/O connectors. 24VDC input and output modules will be preferred.
- These modules shall also be capable to accept floating alarms of duration of 20 milliseconds. as well as steady alarms from normally closed controls.
- A typical response time of 1ms for change of state shall be acceptable.
- All inputs and outputs shall be 2,5 kV isolated from the logic components.

EPLC 6.10 Analogue I/O Modules

- These modules shall accept analogue inputs from plant transducers and provide control analogue outputs to plant operations and shall be capable of converting 0-5V, 0-10V, 0-20mA or 4-20mA signals as may be required.
- All analogue inputs and outputs shall be galvanically isolated.
- The input modules shall have a typical accuracy of at least $\pm 0.05\%$ of full scale while the accuracy of the output modules shall not exceed $\pm 0.2\%$ of full scale.
- The input modules shall have broken wire fault detection capabilities, diagnostic functions, monitoring the supply voltage, should have an IP20 degree of protection, diagnostic functions, Diagnostic LEDs for status of inputs and maintenance

EPLC 6.11 Distributed (Remote) I/O Modules

- The distributed I/O module shall be a standalone unit with an integral 230V AC power supply and equipped with digital and analogue I/O as listed in the attached I/O list. The module shall, preferably, have an Ethernet port and the distributed I/O module should have minimum IP20 degree of protection
- The distributed I/O module shall be connected via Ethernet/IP to the main PLC unit
- The Engineer must firstly approve if the contractor offers an alternate communication protocol (for e.g. PROFIBUS, PROFINET, EtherNet/IP, Modbus TCP/IP, etc.)

EPLC 6.12 Optical Link Modules

The back plane mounted optical link modules for fibre optic cables shall allow networks to be configured in linear, ring and star structures and shall be supplied complete with the necessary cable connectors, interface cards and bus connectors.

EPLC 6.13 Fibre optic to RJ45 converters

Where specified fibre optic to RJ45 converters shall be installed. These units shall be secured in an acceptable manner.

EPLC 6.14 Distributed I/O

The distributed I/O module shall be a standalone unit with an integral 230V AC power supply and equipped with digital and analogue I/O as may be required. The module shall have an Ethernet port (unless specified differently by the Engineer)

EPLC 6.15 I/O Allocations for Plant Availability

The allocation of input and outputs shall be in a logical manner. The allocation shall be on the basis of process units or streams or drives such that the failure of a card will cause minimum loss of plant availability.

Specifically for any motor starter the inputs shall be grouped on one card. The number of inputs allocated to a motor starter is such that they can be grouped on a 16/32 way digital input card and/or 4/8 way analogue input card so that at most two motor starters are allocated to one card. The allocation of inputs and outputs for motor starters shall be such that a duty and standby motor starter are not together on the same I/O cards.

EPLC 6.16 Documentation

All PLC hardware and software shall be fully documented and the documentation shall consist of the following as a minimum:

- Functional specification of the plant to be controlled
- All proposed PID Loops including diagrams
- Process control logic diagrams
- All Loop diagrams
- Layout/images of Graphical Faceplates for proposed Plant Sites
- Sample report forms
- Layouts of proposed Trending Faceplates
- Sample Alarm report details (list and format of reports)
- Fully annotated listing of the full software packages
- Full input/output listings
- Full allocated register listing with functional description
- Program software in electronic format
- All documentation is subject to the approval of the Electrical Engineer.

EPLC 7 COMMUNICATION

EPLC 7.1 General

PLC communication shall utilize Ethernet as a standard, unless another standard is specifically mentioned by the Engineer.

The Contractor shall list three different protocols they intend using over the Ethernet physical standard. The Contractor shall ensure that the three different protocols they select, are not only compliant with their own equipment but with all the major Control System equipment suppliers (Siemens, Honeywell, Rockwell, Schneider, ABB, GE, Mitsubishi, etc.) as well.

The Contractor may give their preference for any of the three protocols selected, but must include valid reasons for their choice. The Engineer however reserves the right to decide which protocol shall be best suited to the installation requirements.

EPLC 8 INTERLOCKING CONTROL USING COMMUNICATION NETWORKS

Where it is necessary to execute process control on a PLC and/or supervisory network the following shall apply:-

Safety interlocks where human or equipment safety is a criterion may be communicated over a PLC to PLC network. The interlocks may not be communicated over a higher level supervisory network. This requirement does not negate the requirement to have hardwired safety stop controls on all drives and switchgear.

Non-essential interlocks, the failure of which will not cause harm to persons or equipment may be communicated with prior permission over a supervisory communications network. Preference, however, is to keep all interlocking at the field bus or Ethernet level unless rate of communication is compromised due to excessive traffic levels.

Data for the purpose of reporting and management information shall be channelled through the supervisory level network (Full duplex Ethernet Network). Such data shall preferably not be transmitted on the field bus or Ethernet sub-network level unless a supervisory level channel is not available for this purpose.

EPLC 9 HARDWARE CONFIGURATION UNIT BASIS

Hardware shall be configured on a per "unit" basis, which means each pump set shall be configured in a module with equipment dedicated to that pump set only. It shall be configured on a unit by unit basis only, thus ensuring that the failure of any one item will affect only a single pump set at any instant in time.

It may however, be necessary to serve a pump set PLC hardware with common services such as UPS (Uninterruptible Power Supplies) Units.

For this purpose the pump sets shall be provided with the following:

- A control console located on the operating floor in a position where the operator is able to overlook the pump sets, unless otherwise specified.

- A HMI (Human Machine Interface) terminal is required to display all process and fault information, unless otherwise specified. The normal control functions shall be executed by way of soft keys on the HMI Unit.
- An "Emergency Stop" push button for each pump set in the pump station mounted on the control console, unless otherwise specified. The emergency stop push button shall have a red mushroom operator and shall be of the latching, twist to release type.
- Stop circuits shall be hardwired in the main circuit breaker control circuit as the primary trip route and shall also be wired into the PLC control circuit.
- Emergency trip push buttons shall activate both the trip coil and no volt release coil of the main circuit breaker or contactor where used.

EPLC 10 HMI TERMINAL - PROCESS INFORMATION

The monitoring and control functions of each pump set shall be accessible on the HMI.

The device shall be programmed that the control soft keys of each pump set are the same. To ensure that this requirement is maintained, a standard software package shall be applied to each pump set. Variable speed pump sets shall have the facility for speed adjustment added.

The HMI shall have a minimum 10,4 inch colour screen and HD definition pixilation. Sufficient application memory shall be available to ensure at least 50% spare memory with the required applications loaded. The HMI shall be equipped with an Ethernet port for PLC communication.

As a minimum, the following basic process information shall be displayed for each pump set or pump stage as applicable:

Operating Parameters

- Suction pressure
- Delivery pressure
- Delivery flow rate
- Running hours - accumulated total and since last start
- Accumulated kWh
- Tank Levels
- Hour operational schedule

Valve Parameters

- Suction valve position indication
- Delivery valve position indication

Pump Parameters

- DE and NDE bearing temperatures
- Thrust bearing temperature
- Vibration measurement (vertical, horizontal and axial directions)
- Volute temperature

Motor Parameters

- DE and NDE bearing temperatures
- Phase stator temperatures
- Motor power
- Motor current
- Motor speed (variable speed drives only)
- Power factor (variable speed drives)
- Vibration measurement (vertical, horizontal and axial directions)

Auxiliary Devices

- Device run and stop indication
- Device fault indication
- Flood alarm

The following basic information Faceplate screens shall also be provided

- Faceplates showing process information for each individual pump
- Faceplate showing overview of pump sets
- Faceplates for each Area or Sub-area
- Faceplates for Auxiliary Systems (CP, AC Mitigation Systems, etc.)
- Faceplates for Auxiliary Systems (Fire Detection, Intruder Detection)
- Faceplates for Alarming
- Faceplates for trending
- Faceplate for all MV Protection settings and adjustments
- Faceplates for all interlocks (Hardwired & "Soft" wired)
- Faceplate showing a main Overview of entire process
- Faceplate for main 11kV electrical power supply system with status indication for all circuit breakers and associated equipment.

EPLC 11 SCADA INTERFACE

To facilitate an interface with a SCADA system the PLC's shall all have Ethernet communication ports as a minimum requirement, unless specified differently. Depending if sub-networks are required, field bus communication ports shall also be required.

The intention is that all main water pump sets be controlled from the relevant local control panel as well as from the SCADA system. However, process data will be collected utilizing the Ethernet standard for information, control, alarming, reporting and trending on the SCADA system.

Provision shall be made for control of the pump sets via the SCADA system by means of a selector switch panel on the motor starter panel located in the pump station which shall have the functions – **Remote Mode / Local Mode / Maintenance Mode**, unless otherwise specified. Switching of this selector switch while a pump is running shall not trip the relevant motor.

EPLC 12 TERMINAL STRIPS IN PLC PANELS.

Wiring directly to the PLC I/O cards is not permitted. All wiring shall be by way of two sets of terminals arranged such that one set of terminals are grouped on a cable by cable basis and the second set of terminals reflect the PLC I/O card slots. Patch wiring shall be provided between each of the terminal strips as required.

Terminals used in PLC cubicles shall be of the knife type, unless specified differently.

EPLC 13 PLC SOFTWARE DEVELOPMENT

EPLC 13.1 Software

IEC 1131 Standard software with up and down load capabilities programmable over the Ethernet network and complies with a standard Graphical User Interface 64/128 bit operating system for network applications, shall be used.

The software shall allow the reusability of function blocks as building blocks in future applications and shall have a built-in PLC simulator that will allow the running of the IEC program for debugging purposes.

EPLC 14 IDENTIFICATION

This specification describes the procedure for the development of PLC software. All PLC software developed shall conform to the conventions and standards described in this procedure. The documents described in this procedure shall be produced as outputs during the software development process, and together they will enable the maintenance and re-use of software, and they will simplify configuration management of software items.

EPLC 15 SOFTWARE ENGINEERING REQUIREMENTS

PLC software shall be designed for continuous reliable operation.

The software shall be designed for maintainability. This particular requirement enforces the following constraints on the software development:

It shall be possible to change the software in response to changing requirements by modifying only those sections of code that are directly related to the change in process requirements.

The code shall be written on the premise that it shall be possible to make changes to local code sections without affecting the functionality of other code.

The program style shall be direct and simple wherever possible. This will enable future modifications to be performed by programmers that may not have been involved in the development of the original system. Convolution programming techniques shall not be used.

Convolved programming techniques tend to mask the essential design of the program. Such techniques shall only be used when the programmer has no alternative, or when the benefit (efficiency, size, execution time etc.) significantly outweighs the cost.

All PLC programs shall be extensively documented to convey the intended function of the program. The intended function of the PLC programs shall therefore be very well described in the documentation, thus allowing for the total understanding of what the PLC programmer intended to achieve with the PLC program. Copies of the PLC programs (both soft copies & hard copies) shall be given to the Engineer.

EPLC 16 CSCI (COMPUTER SOFTWARE CONFIGURATION ITEMS)

High-level plant "classes" identified during the analysis phase shall be mapped to CSCI (Computer Software Configuration Items). Child classes shall be mapped to CSC (Computer Software Components) and CSU (Computer Software Units), in accordance with the class hierarchy of the system.

Each CSCI shall be comprehensively documented in a SRS (Software Requirements Specification).

A CSCI, CSC and CSU shall be characterized by one or more control function instances. These instances may be grouped into one or more control function types. Control function types include interlocks, trips, control algorithms and other functional and logical entities that are required for interaction with and control of a specific piece of plant equipment.

EPLC 17 SRS (SOFTWARE REQUIREMENTS SPECIFICATIONS)

Each CSCI must be specified by means of a SRS. The SRS shall meet the following minimum requirements:

Each plant component that has been subjected to object-oriented analysis shall be described by a set of overview class hierarchy diagrams that illustrates the inheritance relationships that are inherent in the system. The class hierarchy diagrams shall illustrate inheritance in:

- The PLC Input & Output points
- Discrete and batch control functions, e.g. interlocks, trips, start-up sequences
- Continuous process control functions, e.g. PID (Proportional - Integral - Derivative) Control
- The analog and digital values that are generated by the PLC software and/or communicated to the SCADA system, e.g. metering information

The SRS shall contain an introductory subsection that describes the purpose of the software system, and in particular, the role of the PLC software in the system.

The SRS shall specify the names and descriptions of all analog and digital plant inputs and outputs that are communicated to or from the PLC.

The SRS shall incorporate several subsections called Control Function Sections (CFS), each describing a number of instances of a specific control function. For example, a PLC program may implement several PID control loops. The software segment specification would then incorporate a "PID Control Loops" section, in which each PID control loop is described in detail, in keeping with a standard layout.

The SRS shall list and describe all digital or analog values that are generated by the PLC software (or that are scanned into the PLC) and then transmitted to the SCADA system.

The SRS shall include a detailed explanation of how the PLC driven systems operate in conjunction with the hard-wired systems.

EPLC 18 GENERIC LAYOUT

Each CFS shall conform to the following generic layout:

- Control Function (CF) type and instance number - this number shall be unique for each instance in a control function class hierarchy

Name	- A short text label that describes the control function.
Description	- Textual explanation of the behavior of the control function.
Software Algorithm	- Explanation of the PLC logic that is used to implement the control function. The names of all the PLC inputs and outputs that are used shall be given in the algorithm description

- SCADA indication - the SCADA indication details of the CF (Control Function) are given, including the location of the indicator, the colour of the indicator, and the message details.
- Notes and associated conditions - any settings that may be relevant to the CF, or any conditions such as alarms or pre-conditions that relate to the CF shall be documented.
- For example, the requirements section may incorporate a subsection describing the interlocks that pertain to the particular class. Each interlock description shall incorporate the following:

Interlock number	- This number shall be unique for each interlock in a class hierarchy
Name	- A short text label that is normally the same as the interlock message
Description	- Textual explanation of the function of the interlock
Software Algorithm	- Explanation of the PLC logic that is used to implement the interlock. The names of all the PLC inputs and outputs that are used shall be given in the algorithm description.
SCADA indication	- The SCADA indication details of the interlock are given, including the location of the indicator, the colour of the indicator, and the message details.
Pre-conditions	- These are any pre-conditions that must be satisfied before it can be confirmed that the interlock is unhealthy. In some cases it may be

necessary to explain the algorithm and PLC logic of the pre-conditions and any overrides that may be present.

EPLC 19 NAMING AND DOCUMENTATION OF SOFTWARE

Each PLC program shall be documented in a manner that allows the reader to understand the functionality of the program, and to locate the desired section of ladder logic.

A short "Program description" document shall be produced for each PLC program. The primary functions of the program shall be listed in this document. For example, the program might monitor and control electricity reticulation, provide water quality monitoring functions, and allow for the control of certain pump sets.

Each PLC program shall consist of several segments. Segments are used to divide the program in to logical sections. Segments are the basic schedulable entities within the PLC software. Each segment shall be documented by means of an SFC list. The SFC list gives some indication as to the purpose and structure of the program. Segment comments may be up to one page in length.

PLC segments consist of several SFCs. Each SFC shall be documented by means of a list of networks within the SFC. The list shall identify which of these networks are implemented as macros and which are specific and unique to the SFC. This list is intended to give some indication as to the purpose and structure of the SFC. SFC comments may be up to one page in length.

Each SFC consists of a number of networks. The logic employed in each network shall be described in the network comments that may be up to one page in length. Where a network is implemented by a macro, the macro comments may be copied to the network comments screen, or the network comments screen may simply reference the macro comments. Macro comments and network comments shall describe the PLC logic in terms of "power flow" that is regulated by the opening and closing of coils.

Each coil and register that is used in the PLC program shall be described in the comments field that may be 50 characters long (10+10+10+20).

Print outs of appropriate ladder logic shall be attached to all network comment documents.

EPLC 20 MACROS

Macros shall be used wherever possible in the implementation of PLC software in order to promote software re-use.

Common software elements shall be identified from the plant class hierarchy.

A set of macros shall be associated with a specific plant class hierarchy, although a direct mapping of macros to entities in the hierarchy may not result in optimal re-usability. In such instances, the macros shall rather be designed for optimal re-usability.

The PLC logic used in macros shall be described in the macro comments screen.

The design of macros shall not be explicitly documented. The software segment specification relating to each software segment identified in the plant class hierarchy shall describe the functional and behavioural aspects of the PLC software. If the software has been implemented in terms of macros, then the reader shall know this from the network comments that are associated with the relevant software.

EPLC 21 OPERATIONS MANUAL

An "Operations Manual" shall be delivered with the software. This manual shall contain the following information:

- Details of all instruments and devices that shall be connected to the PLC
- Details of PLC - network connections.
- A user document that describes how the PLC program shall operate in conjunction with new/existing SCADA systems, hard-wired systems and mimic panels
- This document shall inform the user of alternative control options, and give some idea of how the PLC system integrates with the plant and its hard-wired systems.

EPLC 22 TEST SPECIFICATION

A test plan shall be developed for each software segment whilst the software segment specification is being drawn up.

The test plan shall focus initially on verifying the architectural design of the program that is that the partitioning into segments, SFCs and networks has been performed in an intuitive and logical manner.

Each trip, interlock and data output shall be tested by varying all pre-conditions and overrides. The test scenario for each case shall be comprehensively described. Details of how to model a particular override or pre-condition by modifying the hard-wired configuration shall be given. Explicit criteria shall be given in terms of which the interlock or trip shall be deemed to have passed or failed the test.

EPLC 23 WALK-THROUGHS

Structured walk-throughs and code inspections shall be carried out during the development of each software segment.

Walk-throughs shall initially focus on verifying the architectural design of the program that is that the partitioning into segments, SFCs and networks has been performed in an intuitive and logical manner.

Ladder logic networks shall be tested individually. All possible coil status permutations shall be identified for each network. Factors that may cause coil statuses to change shall be identified and

the ramifications of changing coil statuses shall be investigated. Where registers are used in the networks, factors affecting register values shall be identified, and tests shall be devised to investigate the behaviour of the software when register values change to and from critical values.

A checklist shall be used to allow PLC programs to be checked for common PLC programming faults. The checklist shall be maintained on an on-going basis to ensure that the maximum number of common errors can be detected before testing and commissioning.

EPLC 24 TEST PROCEDURE

Software testing shall be carried out on site.

Before testing begins, the plant to be used in the on-site tests shall be de-commissioned and configured for testing.

Trips, interlocks and data outputs shall be tested individually. These tests shall follow the test specification that was produced in parallel with the software segment specification.

A test compliance document shall be completed during the test phase, and this document shall be included in the project documentation.

EPLC 25 CHANGE MANAGEMENT

Changes to the functionality of a program may be required if the system fails due to an identifiable fault in the program, if the requirements change such that the change in specification forces a change in the software, or if sub-optimal system behaviour can be improved through software modification.

Faults reports shall be generated by the plant operators, and they shall be passed on to the software configuration manager. Similarly, any change in requirements that leads to a change in specification shall be passed on to the software configuration manager.

Changes shall first be made to the software requirements specification. The ramifications of making the changes shall be investigated, and the software modules (segments, SFCs, networks) that are affected shall be identified and modified.

Before the software changes are effected, a test plan shall be produced that describes how the changes are to be approved. This test plan shall be incorporated in the project documentation in the "Change control" section.

A walk-through inspection shall be held once the changes are complete. The primary goal of this inspection shall be to determine that all possible side effects that may be produced by the changes have been anticipated and explicitly dealt with.

Minutes from this inspection shall be appended to the body of the main project documentation in the "Change control" section.

The modified software shall then be tested according to the test procedure that was produced when the specification was amended.

EPLC 26 MEASUREMENTS AND PAYMENT

Measurement and payment will be done in accordance with the methods stated below.

EPLC 26.1 Design, Drawing And General

The rate tendered shall include for the provision of the necessary design information for all items measured under the respective schedule. For programmable logic controller's, design information shall include, but limited to as listed in this Particular Specifications. A Control System integrator/specialist shall be required to complete this design and engineering tasks and the contractor shall allow adequate time for the complete design and engineering of the PLC Control System.

<u>Pay Item</u>	<u>Unit</u>
(a) The Contractor will provide the following design calculations, Drawings and wiring diagrams for approval by the Engineer:	Sum
a) Fibre loss design calculations in excel format which will include but limited to From, To, Distance losses and Tag numbers and total losses through the fibre network [fibre losses]	
b) Electrical Load lists in excel format of all PLC equipment.	
c) Engineer design drawings of network layout which contains all IP addresses, equipment and drawings.	
d) Report which will include antennae radio paths, drawings which have line of sight of all locations in AutoCad Format, Connection speeds with the radio or wireless communication, details of all Radio & Wireless Radio losses	
e) Input and Output schedules in excel format which contains all tag numbers, names, commands, and description of all I/O	
f) Loop diagrams in AutoCAD format	
g) Cable schedules in excel format which will include but limited to From, To, Distance and Tag numbers	
h) AutoCAD drawing of all equipment positions, equipment layouts, cable layouts, rack layouts, router / modems, switches connections and layouts.	
i) P&ID drawings of the entire system which is implemented and equipment in AutoCAD format which shall strictly accordance to ANSI/ISA-5.1 [American national Standard]	
j) Functional design specification which will include but not limited to all mimic diagrams, control procedures compared to control philosophy and a detail	

description how the PLC will control the entire system [broken down into each component].

(b)	Provide operating and maintenance manuals, data sheets of all equipment and “as built” drawings	Sum

EPLC 26.2 Supply and Delivery to Site

Rate tendered to include for all material, equipment, plant, testing apparatus, labour, manufacturing, factory acceptance testing, transport, import duties, handling and possibly double handling, delivery to and off-loading at Site as well as temporary storage prior to installation. For Programmable Logic Controllers System, the rate tendered shall be for the complete Programmable Logic Controllers System and shall include, but not limited to, as detailed in this Particular Specifications. Any special devices shall be listed separately in Variations and Additions to the Standard and Particular Specifications.

<u>Pay Item</u>	<u>Unit</u>
(a) Supply and delivery of a complete PLC and peripheral equipment installed in or other specified enclosures, all as specified	Each
(b) Supply and delivery of a complete UPS as specified	Each
(c) Supply and delivery of a complete HMI as specified	Each

EPLC 26.3 Installation

Rate tendered to include for all plant, tools, labour, rigging, handling, placing into position, aligning, fixing, grouting, but not limited to and getting ready for testing and commissioning. Install of Programmable Logic Controllers system shall be accordance with the manufacturer's written instructions and recognized industry practices, to ensure that the PLC system complies with the requirements and serves the intended purposes. Comply with the requirements of SABS and IEC standards and applicable portions of "Standard of Installation", for installation of Programmable Logic Controller System but not limited to.

<u>Pay Item</u>	<u>Unit</u>
(a) Site installation of a complete PLC and peripheral equipment installed in or other specified enclosures, all as specified	Each
(b) Site installation of a complete UPS as specified	Each
(c) Site installation of a complete HMI as specified	Each
(d) Site cable connections and programming of all PLC Systems	Sum

EPLC 26.4 Commissioning

Rate tendered to include for the drafting of the necessary testing and commissioning plans, attendance of required local and/or overseas specialists, all testing apparatus, instruments and

equipment, any/all consumables required for testing purposes and to prove performance, any/all temporary works, any/all control checks, and compilation of final commissioning report. Comply with the requirements of SABS and IEC standards and applicable portions of "Standard of commissioning".

<u>Pay Item</u>	<u>Unit</u>
(a) Commissioning of a complete PLC system and peripheral equipment installed in or other specified enclosures, all as specified	Each
(b) Commissioning of a complete UPS as specified	Each
(c) Commissioning of a complete PLC System HMI as specified	Each
(d) Commissioning of a PLC system programming and operation of plant in automatic and manual mode	Sum

END OF SECTION

ESCA SCADA - SUPERVISORY CONTROL AND DATA ACQUISITION

As specified in the Project Specifications.

ESCA 1 ABBREVIATIONS

SCADA	-	Supervisory Control and Data Acquisition
ECI	-	External network – control network Interconnection
IRA	-	Interactive Remote Access to a control network
ICC	-	Inter-Control Centre access to a shared control net
CNH	-	Control Network Host
AFD	-	Automation Field Host
FCN	-	Field Control Network within single control area
CCN	-	Control Centre Networks within single control area
SED	-	Standalone Embedded Device
ACI	-	Inter-Area Communication within hierarchical multi-area control network

ESCA 2 STANDARDS

The SCADA shall conform to and be in accordance with the latest applicable IEC, ISO, and IEEE Standards:

The following Standard Specifications and drawings shall apply:

Standard No.	Description
SCADA	Supervisory Control And Data Acquisition
ECI	External network – control network Interconnection
IRA	Interactive Remote Access to a control network
ICC	Inter-Control Centre access to a shared control net
CNH	Control Network Host
AFD	Automation Field Host
FCN	Field Control Network within single control area
CCN	Control Centre Networks within single control area
SED	Standalone Embedded Device
ACI	Inter-Area Communication within hierarchical multi-area control network

ESCA 3 HARDWARE CONFIGURATION

The SCADA system shall consist of multiple servers, work stations, engineering stations, Historian, off-site disaster recovery sites and software responsible for communicating with field equipment like PLC's, RTU's and smart sensors. Where required, the SCADA system shall comprise only of a master station for instances where the installation is small. Instances where dual-redundant or hot-standby formation SCADA systems are required, redundant servers, dual networks and redundant switches shall be installed for increased reliability.

ESCA 4 ALARMS

The effective management of all alarm signals received on the SCADA system is required to ensure the effective management of plant and equipment. The alarm management is required to prevent the following scenarios:

- a) Alarm flooding leading to the overwhelming of the operator's cognitive abilities.
- b) Alarming of insignificant criteria leading to unnecessary actions by the operator's.

The flooding of alarms with any proper form of alarm management shall lead to distractions on the part of the operator's, thus decreasing vigilance in the long run. The alarm management system shall provide all the requirements needed to ensure an efficient and stringent alarm management system.

Some of the alarm management capabilities shall include the following:

- a) Alarm grouping
- b) Alarm filtering
- c) Alarm inhibiting
- d) Alarm shelving
- e) Alarm suppressing

The alarm management system shall be able to do statistical analysis on alarms and also provide advanced alarm reporting. The system management of alarms shall be categorized according to groups and certain priorities.

These shall be assigned according to a hierarchical structure depicting priority importance (normally from top to bottom, with the top alarm having the highest priority).

ESCA 5 SCADA PROTOCOLS

Any previous legacy SCADA protocols proposed shall be ModBus RTU, ModBus TCP, Profibus and Profinet. However, the more recent and more secure SCADA protocols shall conform to the IEC 60870 Part 5 Standard. These are defined under the following sections:

- a) IEC 60870-5-1 Transmission Frame Formats
- b) IEC 60870-5-2 Data Link Transmission Services
- c) IEC 60870-5-3 General Structure of Application Data
- d) IEC 60870-5-4 Definition and Coding of Information Elements
- e) IEC 60870-5-5 Basic Application Functions
- f) IEC 60870-5-6 Guidelines for conformance testing for the IEC 60870-5 companion standards
- g) IEC 60870-5-101 Transmission Protocols, companion standards especially for basic tele control tasks
- h) IEC 60870-5-102 Companion standard for the transmission of integrated totals in electric power systems
- i) IEC 60870-5-103 Transmission Protocols, Companion standard for the informative interface of protection equipment

- j) IEC 60870-5-104 Transmission Protocols, Network access for IEC 60870-5-101 using standard transport profiles

The other approved SCADA Standard protocols shall be IEC 61850 and DNP3. The contractor shall confirm with the Engineer the list of proposed protocols they intend using, if different. The Engineer reserves the right to refuse certain protocols that do not comply with the requirements.

ESCA 6 DESIGN PHILOSOPHY

The SCADA system shall be designed to withstand temperature fluctuations, vibrations, and voltage fluctuations. Redundancy, where required shall be incorporated through redundant hardware and redundant communication paths. The contractor shall give through a proposal on how they intend achieving redundancy, if required on the SCADA system. The Engineer shall approve the proposal before the contractor can implement the design.

ESCA 7 SECURITY

SCADA systems shall be designed to be open, robust, and easily operated and repaired. The SCADA system shall however be designed utilizing the latest in security enhancements and features, thus ensuring data protection, integrity and privacy.

Any vendor, whose SCADA packages have been under recent attacks within the last 12 months, shall provide proof of the total eradication of any malware, worm and viruses infected in their subsequent software packages, wherever they were installed.

Furthermore, the specific vendor shall provide a root cause analysis why the infection/attacks were able to manifest itself in their software and what measures were taken to eradicate the infections.

The vendor shall also prove the commitment from their company to prevent further malware attacks on their software in the future by outlining their global security implementation strategy.

Failure to provide these requirements to the Engineer shall void their SCADA package from the selection process. The SCADA vendor shall ensure that the below mentioned security issues are encompassed and dealt with effectively in their SCADA packages.

The main reasons why security issues arise are the following:

- a) The general lack of concern about implementing security and authentication when doing the design, during installation and during operation of the SCADA networks. The contractor shall ensure all required security measures have been put in place during the design, installation and operation of the SCADA system, including the use of advanced encryption standards.

- b) The incorrect belief that SCADA systems have the required security by simply using specialized protocols and proprietary interfaces. The contractor shall ensure all required security measures has been implemented when interfacing to existing or legacy systems and third-party equipment.
- c) The incorrect belief that SCADA networks are secure just because they have been physically secured.
- d) The incorrect belief that SCADA networks are secure just because they have been disconnected from the Internet. The contractor shall ensure that where access to the SCADA system is required via a router, that stringent IT policy implementation has been effected over the entire OSI model, including the physical, data link and network layers.

SCADA systems face many threats to their data integrity and security. Some of the main security threats are the following:

- a) The unauthorized access to the control software through human access. This is when changes are done either intentionally or accidentally by virus infections and other software threats residing on the control host machine. The contractor shall ensure the risk unauthorized access is diminished by selecting a SCADA system that has lines of specialized industrial [firewalls](#) and [VPN](#) solutions for TCP/IP-based SCADA networks. The contractor shall further ensure that the hardware supplied have all their I/O ports blocked from people accessing the equipment using USB sticks, SD cards, CD's or DVD's.
- b) The unauthorized access to the control software through packet access to the network segments hosting SCADA devices. This can be through physical access to SCADA-related network jacks and switches. The contractor shall ensure IT security policies are implemented on all levels of the OSI model.

ESCA 8 GENERAL REQUIREMENTS

The SCADA system shall utilize client/server technology to support multiple users operating in a networked environment. A configuration server shall be required for managing and saving the configuration information.

The configuration server shall be able to support multiple simultaneous client connections, whilst providing users with shared access to a system's configuration information and real-time plant data. A communication server shall also be provided.

The configuration server shall store the data in a single database per each system. The storing of duplicated data shall not be allowed. Only common file formats that are widely used and accepted in the industry shall be accepted.

The system shall be so designed that all engineering tasks are not done in the runtime environment. This is to ensure very little process interruption.

The SCADA system shall have tools for seamless integration. The SCADA system shall have very good workflow automation and be able to do bulk import and export functions.

The SCADA system shall have a comprehensive range of engineering tools that can do easy configuration of control systems. The SCADA system shall consist of system libraries consisting of reusable software components.

The SCADA system shall be able to configure user information for the Windows and Engineering databases. It shall further allow for creation of user profiles along with their roles and certain project access permissions.

ESCA 9 PROJECT ADMINISTRATION

The SCADA system shall be able to manage the inflow and outflow of information by multiple users on automation projects.

The SCADA system shall allow certain designated individual with project administration privileges to perform various activities including but not limited to user assignments to projects, offline and online back-up of projects, project database maintenance and upgrade of projects from previous versions

The SCADA system shall allow a multi-user engineering environment providing high flexibility and efficiency for system configuration, documentation, commissioning and maintenance tasks.

Note - The SCADA system shall provide an Audit trail to enable effective management of changes. All changes to information within the automation system shall be carefully controlled to ensure all modifications are traceable and accountable.

The audit trail shall consist of any user actions which include system changes made at any engineering workstation onto a central database. These events shall be recorded onto an Historian for future audit purposes.

Users, with the applicable project administration privileges shall be capable of performing the following activities:

- Creation of System design projects
- Offline and online back-up of projects
- Project database maintenance

Upgrade of projects from previous versions

A multi-user accessible engineering platform shall be provided to attain a high level of flexibility and efficiency when doing system configuration, documentation, commissioning and maintenance. Engineering tasks shall be accessible by multiple users at any given time.

The option shall be available for an Engineer/s to reserve a complete application or some part of it for their exclusive access. This shall enable multiple users to be able to work on the same project at the same time without interfering with each other's work.

The SCADA system shall have an effective audit trail to provide effective change management. Changes within the automation system configuration shall be carefully controlled via the audit trail to ensure all modifications are traceable and accountable.

The audit trail functions shall include the tracking of user's actions, the archiving of user actions including any system changes made at any engineering workstation onto a central database. The SCADA shall have graphical user interfaces, object-related context menus, navigation windows, help functionality and a host of other features to provide sufficient guidance to the user.

Within the engineering environment, users shall be able to navigate from a specific tag to its associated control logic diagrams/P&ID/Loop Diagram. Links to 3rd party documentation like PDF user manuals, excel reports, etc. shall also be possible.

The engineering builder tool shall allow users to build projects through a simple drag and drop application. The engineering builder tool shall make the drawing of any logical and detailed network architecture easy. It shall allow for the easy configuration of communication ports.

The engineering builder tool shall be able to do the following:

- Design and draw logical and detailed network architectures
- Do the automatic configuration of the communication ports of a project
- Publish network addresses to all reachable PC nodes
- Have access to updated design information available for the updating of the main project design
- Provide easy generation of reports and any documentation required

The SCADA system shall have a central data base for all tag information. There shall not be any replication of changes in multiple databases. The SCADA system shall allow for easy database filtering via a user friendly menu for easier and faster configuration work.

The SCADA system should be so designed to allow Engineers to be able to import and export any amount of tag data, perform automatic searches and replace operations using any type of complex query commands. The SCADA system shall allow users to navigate directly from any tag to its related configuration document.

The SCADA system shall have the functionality to save multiple macros for future use. The SCADA system shall also have a standard library wherein function blocks (objects) can be used by simple "drag and drop" functionality for projects.

The standard library shall contain components, general layouts, loop diagrams, hook-up layouts, devices, P&I diagrams, equipment & instrumentation symbols, operation and control processing function blocks, I/O configuration, I/O lists, coding and any dimensions, etc.

The library shall also have the functionality of saving any macros, symbols, shapes, control logic templates, etc. that have been designed on previous projects.

The standard library shall also have the functionality of allowing the regular updating to this library of new function blocks, macros and code. This shall be at no extra cost to the SCADA system, but as a “self-learning” function of the library.

The SCADA system shall have standard Control Logic Templates, thus allowing for the reduction in time and costs normally associated with the implementation of a control project. The SCADA system shall allow for the functionality of designing, editing or maintaining Control Logic Templates.

The SCADA system shall have the functionality of handling large amounts of data by being able to:

Allow the import of process points and/or I/O spread sheets from which configuration can be done

- Allow the import of signal lists and their properties
- Allow the control of hardware
- Allow the assignment of I/O and the instantiation of I/O templates
- Allow the instantiation of Control Logic Templates

The SCADA system shall allow for the automatic updating to of all the above mentioned lists, using a central engineering database. SCADA systems that require the re-importing of revisions to the lists mentioned above for any changes made shall not be considered.

The SCADA system shall have the functionality of mapping. Furthermore the mapping shall be saveable for future work. The SCADA system shall have the further functionality of importing specific I/O signals for specific tasks like during the testing and commissioning phases of a project, thus not affecting the main engineering database.

The SCADA system shall have the functionality of fully supporting the configuration, testing, commissioning, maintenance and management of intelligent field and electrical devices like flow transmitters, pressure transmitters, temperature transmitters, level transmitters, turbidity transmitters, pH transmitters, analytical transmitters, actuators, motor control centres, etc. by using Profibus, ModBus, Ethernet TCP/IP, Hart, etc. communication protocols.

The SCADA system shall have the engineering tools required for the configuration and management of intelligent devices in a graphical environment. Additional tools shall include a batch data manager for the creation, editing, managing, downloading and debugging of function code, whether batch, user-defined or in sequential configuration.

ESCA 10 SCADA HARDWARE CONFIGURATION

The server setup for the SCADA system shall encompass front and back end server/s arrangements. When clients request information (via the client access portal) to a specific folder, the front end server/s shall check the Active Directory to find a list of all the back end server/s having the information the client is searching for.

The setup for the front end and back end server/s topology shall ensure the following:

- a) The Client access to requested information/folders is done on the front end server/s.
- b) The front end server shall authenticate the user on an active directory.
- c) The front end server shall determine firstly (without any client intervention required), in which location/folder the requested information resides and secondly on which back end server (if there are more than one back end server/s) the requested information is residing.
- d) The front end server shall "learn" from each previously processed request for information, so that instead of searching the entire data base again for previously requested information, the front end server/s can go directly to the correct data base holding the required information, thus minimizing search time.
- e) An algorithm shall manage the search for information on the back end server/s, whilst balancing the work load to each back end server/s.
- f) If one of the back end servers is off-line, the algorithm shall divert the search request to another/other back-end server/s that also has the exact same information.
- g) The algorithm shall divert all requests for information towards the remaining available back end server/s equally, thereby ensuring correct load balancing.
- h) Whenever a back end server is again on-line, the algorithm shall redistribute the traffic flow evenly (load balancing) over all the available back end server/s (those holding the requested files).

The algorithm shall also regulate the workflow such that one particular back end server is not "overworked", whilst another is hardly ever accessed.

Note: Project administrators shall inform all users if any folders/files have been removed from the back end server/s.

Dual authentication shall be required on both the front end and back end server/s.

Between the Client station and front end server, authentication is required. Authentication shall also be required between the front end and back end server/s. Basic authentication and forms-based authentication shall be acceptable, provided the contractor has reviewed the hardware/software firewall requirements

Basic authentication shall encompass the requirements for a user name and password of the user requesting folder/file access to the server, via a client access terminal. This shall be done in the following format: domain\username.

When using forms-based authentication, SSL encryption shall be required between the client access and front end server/s as well, especially where the front end server/s and back end server/s have separate subnets or use external networks. SSL shall protect user passwords from any network packet sniffing software.

Note: SSL shall be always configured on the front end server only in a front end/back end server configuration. For situations where there are only back-end servers (no front end/back end server configuration) and clients are directly accessing them, SSL configuration shall be a requirement

If there is a considerable decrease in performance due to SSL connections, a SSL accelerator shall be required to the front end and back end topology.

The type of SSL accelerator selected shall depend on the number of front end servers in your topology. If the quantities of front end servers are minimal, then the option of using SSL accelerator cards shall be acceptable due to its lower cost, effectivity to handle SSL tasks and simple installation.

For each accelerator card required, the SSL certificate of each accelerator card requires configuration and there are administrative costs as well.

If the quantities of front end servers are many, then a separate SSL accelerator device shall be required. The setup in this case shall be simpler as it only requires configuring once, no matter how many front end servers are in your setup.

Internet Protocol Security (IPSec) shall be a requirement for all communication between the front end and back end server/s setup.

The type of IPSec protocols allowed shall be Authentication Header (AH) and Encapsulating Security Payload (ESP). IP Packets of information that uses AH are not encrypted, but work by adding a checksum to the IP packet. If the checksum is identical between what was sent and what was received, then the message was delivered successfully.

ESP on the other hand works by encrypting the entire contents of the IP packet. The encryption affects the performance on both the front and back end servers, Therefore, the design to the front and back end topologies shall take due cognizance of any degradation to performance when implementing either ESP or AH.

The perimeter network shall have a firewall server between the front end and back end servers. The firewall server shall have the latest service packs and have extremely stringent security methodologies.

The front-end server/s shall have sufficient memory and very fast CPU clock speeds. The recommended ratio of front end server to back end servers shall be 1:3. The contractor shall indicate any reasons for diverting from this ratio.

Software and/or hardware firewall solutions shall be required. The various methods of firewalls shall be through the use of port filtering, IP filtering and application filtering.

Port filtering shall be the absolute minimum Firewall requirement. Port filtering shall be used to restrict network traffic coming through the firewall and allow access to information sent via specific ports only.

IP filtering shall also be required as a Firewall requirement. This shall restrict traffic through the firewall to specific servers only.

Application Filtering shall also be used as well as a firewall to provide advanced inspection at the application protocol level. This type of firewall shall perform functions such as the filtering of Remote Procedure Call (RPC) interfaces and the validating of any HTTP request syntax applications.

ESCA 11 HISTORIAN

The function of the Historian shall be to analyse and display information in a usable, understandable and meaningful manner so that real-time business decisions can be made.

The requirements of the Historian server shall be as follows:

- a) The Historian package shall be complete and already pre-configured. No additional engineering shall be allowed or required.
- b) The Historian package shall be able to provide detailed statistical reports for any and every desired time frame.
- c) The resolution shall be of a very high quality.
- d) Historical data from all the plant equipment shall be seamlessly integrated
- e) Data collection shall be event based and in real time with millisecond resolution.
- f) Memory and storage requirements shall be well managed when accessing historical data
- g) Statistical reports and Trend displays shall be generated on demand and within one second.
- h) The Historian package shall have unlimited historical data collection
- i) The Historical data reports shall be according to the following requirements:
 - I. Shall have access to all historical information and real-time data quickly and efficiently
 - II. Shall have a clearly arranged event historical display with integrated trend data graphics package
 - III. Shall enable complex graphics to be read and understood easily
 - IV. Shall enable Report configuration to be done easily by utilizing simple drag and drop interfaces
 - V. Shall have OPC server and client to enable easy data exchange with foreign systems
 - VI. Shall have life cycle management services available.

ESCA 12 MEASUREMENT AND PAYMENT

Measurement and payment will be done in accordance with the methods stated below:

ESCA 12.1 Supply and Delivery to Site

<u>Pay Item</u>	<u>Unit</u>
a) Supply and delivery to site of SCADA system associated hardware, installed as per design requirements and best practice, all as specified.	Sum
b) Supply and delivery to site of SCADA system associated software, installed as per design requirements and best practice, all as specified.	
c) Supply and delivery to site of SCADA UPS	Sum

ESCA 12.2 Installation

<u>Pay Item</u>	<u>Unit</u>
a) Installation of SCADA system associated hardware and software, installed as per design requirements and best practice, all as specified	Sum
b) Engineering and configuration of SCADA system associated hardware and software.	Sum
c) Installation of SCADA UPS	Sum

ESCA 12.3 Commissioning

<u>Pay Item</u>	<u>Unit</u>
a) Commissioning of SCADA system associated hardware and software, installed as per design requirements and best practice, all as specified	Sum
b) Commissioning of SCADA system associated hardware and software, installed as per design requirements and best practice, all as specified	Sum
c) Commissioning of engineering and configuration of SCADA system associated hardware and software.	Sum
d) Commissioning of SCADA UPS	

END OF SECTION

ECIS CONTROL AND INSTRUMENTATION SYSTEMS

ECIS 1 SCOPE OF WORKS

As specified in the Project Specifications.

ECIS 2 PRESSURE TRANSMITTERS

The pressure transmitters shall be pipe socket mounted and shall constantly display the relevant pressure and shall be easy to calibrate and reliable in service.

The pressure sensor shall have a ceramic diaphragm with electrodes in the ceramic substrate and diaphragm. A pressure proportional change in the capacitance shall be measured by the electrodes and displayed as the measuring pressure value.

The pressure sensor shall comply with the following technical requirements

Application	-	Measuring of absolute and gauge pressure in liquids
Measuring technique	-	Deflection of diaphragm
Measuring range	-	As specified in Variations and Additions to General and Particular Specifications
Construction	-	304 Stainless Steel housing
Mounting	-	½" pipe socket mounted
Pressure		16 bar or as required for application
Voltage	—	0 – 30VDC
Output	-	4 – 20mA
Accuracy	-	+/_ 0.2%
Reproducibility	-	+/_ 0,3%
Long term drift	-	+/_ 0,1% per year
Protection	-	IP 68
Display	-	Plug in display unit
Sensor cable	-	Screened transposed two-wire cabling

ECIS 3 FLOW METER EQUIPMENT

Flow meters will be supplied and installed by the mechanical contractor if not otherwise indicated. The flow meter controllers as free issue items will have to be installed under this contract in flow meter kiosks complete with a supply of electricity, surge protection and earthing system.

ECIS 4 ELECTRONIC LEVEL CONTROL

The micro based electronic controllers which will be mounted in the motor control centres or as specified and shall be easy to calibrate and reliable in service.

The transducers shall be designed to operate in air, been capsulated, of rugged construction and impervious to submergence.

The transducers shall, where possible, be installed at a point 500mm away from a wall or pipe, which may cause a false signal, and at least 500mm above maximum water level.

The coaxial cable between the transducer and power unit shall be of sufficient length to avoid any joints in this cable, as no joints will be permissible.

The grade 304 stainless steel brackets for mounting of level transducer must be provided and installed under this contract.

ECIS 5 NO-FLOW SWITCHES

The electromagnetic flow monitor shall be pipe socket mounted and shall be easy to calibrate for specific no-flow conditions and shall be reliable in service.

The no-flow sensor shall be steel pipe mounted and shall be supplied complete with a weld stub to ensure correct immersion into the measuring liquid. The weld stub shall be adapted according to the flow measuring pipe diameter.

The no-flow sensor shall comply with the following technical requirements:

Application	-	Measuring of no-flow condition in water pipe lines for pump set protection
Measuring technique	-	The flow sensor shall adopted the electro-magnetic principle of flow velocity measurement at the tip of the no-flow sensor
Measuring range	-	As specified in Variations and Additions to General and Particular Specifications
Construction	-	Die-cast aluminium housing, epoxy coated
Mounting	-	Weld stub mounted

Voltage	-	0 – 30VDC
Output	-	4 – 20mA
Accuracy	-	+/_ 2%
Reproducibility	-	+/_ 2%
Conductivity	-	³ 20mS/cm
Protection	-	IP 66 / NEMA 4X / Type 4X
Settings	-	Potentiometer adjustment

ECIS 6 FREE CHLORINE ANALYZER

The free chlorine analyser shall be an enclosed unit with front door mounted free chlorine content display unit with storage space for reagent. The unit shall be wall mountable.

The analyser shall sample every 2,5 minutes and shall use less than 475mL each of indicator and buffer over a 30 day period. A linear peristaltic pump, seal-free mixer, easy-to-clean cell and compact colorimeter shall provide a reliable low maintenance operation.

The analyser shall be equipped with a programmable 4-20mA recorder output and two user selectable alarms and shall be installed on a 230 Volt supply system.

The mixing system shall operate with no moving parts and a self-cleaning stir bar in the sample chamber shall generate a vigorous mixing action for accurate sample analysis. A transparent gasket shall occupy the space between the light source, sample chamber and detector. The optically clear RTV silicon light pipes shall transmit the colorimetric beam and minimize the risk of interference caused by high levels of humidity.

The measuring range shall be 0 to 5 mg/L free or residual chlorine.

Accuracy shall be +/- 5% or +/- 0.035mg/L, whichever is the greater.

The analyser shall be supplied with a three months' supply of reagent

ECIS 7 PH SENSOR

The ph sensor shall be of the pipe insertion mounted type with an LCP body glass electrode and titanium ground rod.

The instrument shall have a pH measuring range of 0 – 14 and temperature range of -5 to 95°C. The sensor shall be rated to withstand a pressure of 6 bar.

The sensor shall have a sensitivity of less than 0.005pH and shall have three measuring electrodes, a standard and process electrode as well as a ground electrode. If necessary, a digital gateway shall be provided with the pH sensor for communication with the same controller as the turbidity sensor.

ECIS 8 TURBIDITY SENSOR FOR LOW TO MEDIUM RANGE TURBIDITY MEASUREMENTS

ECIS 8.1 Turbidity sensor

The Turbidity sensor shall have a pulsed infrared source in conjunction with an automatic cleaning process and shall be a precision bypass sensor suitable for ultra-clear media to media with medium turbidity due to the particular low level of light interference.

The sensor enclosure shall have an IP 65 rating and shall be separately mountable from the controller up to a distance of 50m. Sensor to controller connection cable shall be provided with the sensor unit. The sensor shall be reconcilable with the existing turbidity and pH controllers installed on the plant.

The turbidity sensor shall comply with the following technical specifications:

Measuring technique	- 90° scattered infrared light in accordance with DIN EN ISO 7027
Measuring range	- 0.0001 – 1000 NTU
Precision	- +/- 1%
Reproducibility	- +/- 0,5%
Air bubble compensation	- Physical-mathematical
Sample size required	- Min. 0,2l/min, max. 1l/min. max. 6 bar
Ambient temperature	- Max. 40° C
Automatic cleaning	- Wiper cleaning
Materials	- Quartz measuring window, silicone wiper profile, Noryl GFN2 measuring chamber, ASA housing and stainless steel wiper axle.
Sensor cable	- +/- 5m length

ECIS 8.2 Turbidity controllers

The turbidity controller shall be a product from the same manufacturer as the turbidity sensor and shall be capable of receiving data from two sensor units and shall communicate with a PLC by means of RS485/MODBUS protocol. The controller shall be microprocessor-based and housed in a ½ DIN, NEMA 4X enclosure with an IP rating of IP66.

Multiple control functions shall include built-in PID, control contacts and alarm functions.

The turbidity sensor shall comply with the following technical specifications:

Ambient conditions	-	-20°C to 40°C, 0 – 95% relative humidity and non-condensing
Power requirements	-	230V AC
Display	-	Graphic dot matrix LCD, 128 x 64 pixels with LED backlighting
Relays	-	Three SPDT user configurable contacts rated 230V AC 5Amp.
Outputs	-	Two analog 4-20mA
Control	-	PID, high/low phasing, set point, dead band, overfeed timer, off and on delay
Communication	-	RS485 MODBUS
Memory	-	Non-volatile setting memory
Mounting	-	Wall mounting
Certifications	-	ETL to UL 6101A-1 and CSA C22.2 No. 1010.1

ECIS 9 ROTATING BRIDGE BRUSH GEAR

The brush gear to be installed on the kingpost on the bridge at the centre of the tank to facilitate connections between the incoming supply cable and the cable from the kingpost to the motor starter via the rotating arm shall consist of the following:

- A set of four 20 mm wide and three 8 mm wide brass slip rings on an ebonite or equivalent insulating sleeve (i.e. three slip rings or phase connections, one for the earth connection, three slip rings for the control circuit, namely, start, common and stop connections). Connections to these slip rings shall be affected via an approved heavy duty terminal block with stud type brass terminals onto which the lugs on the cable tails shall be bolted. This terminal arrangement shall be completely independent of fixing screws for the slip rings.
- A set of four main circuits and three control circuit "Morganite" carbon brushes, or equivalent. Each of these brushes shall be spring-loaded to ensure high contact pressure and the springs shall be rust-proofed.

The abovementioned brush gear shall be installed in a weatherproof IP55 grade UV protected and impact proof synthetic housing with removable cover, on the kingpost of the bridge. This brush gear-housing shall be suitably sized to accommodate the relevant equipment without cramping, and shall be insect proofed.

The brush gear housing shall be designed and constructed to prevent the accumulation of gas and the condensation of moisture inside the housing and the pressure of the brushes on the slip rings shall be high enough to obtain a self-cleaning effect during operation.

The driving motor must be provided with a weatherproof emergency stop push button station mounted on the bridge in close proximity to the bridge access ladder. The supply and installation of cables between the motor, emergency push button station, brush gear and kingpost, shall form part of this Contract. The cable shall be installed in a grade 304 stainless steel conduit mounted on the underside of the bridge and secured to the bridge by means of stainless steel conduit saddles.

ECIS 10 SURGE PROTECTION – ELECTRONIC DEVICES

The section is to be read in conjunction with the Particular Specifications of Electrical distribution systems.

Electronic equipment shall be adequately protected on both the incoming and outgoing terminals by means of suitable arrestors compatible with the relevant equipment. 4-20mA signal cables shall be protected on both sides of the cable against surges.

Surge protection shall be provided as specified at flow meters, level sensors and other electronic instruments.

The following surge arrestors shall be supplied and installed for surge protection complete with base element.

ECIS 10.1 Flow meters, level sensors and electronic instruments (4-20ma)

A combined lightning current and surge arrester module with Din rail mounted base and removable surge arrester module. The surge arrestors shall be of sufficient voltage rating and shall withstand a total discharge current of 8/20 magnitude and 20kA rating and a total impulse current of 10/350 magnitude.

At flow meter and level sensor position as well as at the termination point in the MCC/DB)

ECIS 10.2 Earthing at flow meters and level sensors

Apart from earthing already specified the following earthing system shall form part of the installations.

ECIS 10.2.1 At flow meter and level sensor

The earth connection and surge arrester earth at the flow meters/level sensors shall be connected to an earth mat comprising of 70mm² bare copper conductors installed in a cross configuration with the earth mat centre Cad welded to the 16mm² earth connection at the flow meter. The cross radial shall be at least 2m long with the radial ends connected to a 1,5m long earth spike driven into the ground at each end.

ECIS 10.2.2 Outdoor connection boxes at level sensors and flow meters

The outdoor type connection boxes required at flow meters and level sensors positions for cable connections to surge arrestors shall be equal and similar to the following:

Raised lid type with IP65 rating and equipped with mounting rail for surge arrestors and Teflon compression glands for unarmoured cables and brass compression glands for armoured cables.

All cables in manholes and valve chambers shall be mounted on heavy-duty cable racks.

ECIS 11 OPERATING AND MAINTENANCE INSTRUCTIONS

Before completion of the testing of the plant, the Contractor shall provide the Employer with adequate and complete working, operating and maintenance instructions *in triplicate*, with the necessary drawings and diagrams clarifying the instructions. The Contractor will also provide *3 x "soft copies"* of the complete manual in PDF format on a Suitable sized USB Flash Drive (Memory Stick)

Instructions are to be made up in book form and particular reference is to be made to:

- Maintenance of equipment;
- Precautions to be taken in running the plant;
- All instruments and components must be fully described in data sheets supplied by the relevant suppliers;
- Wiring diagrams of the complete electrical installation.

The manual must be specific for the plant supplied and all extraneous material not connected with the relevant plant shall be deleted, leaving the manual as a comprehensive coherent document, bound in a professional way such that this may be used frequently without falling apart. Standard pamphlets may be supplied as addendums, bound separately in a good quality file to serve as reference but will not be allowed as part of the main manual.

ECIS 12 INFORMATION TO BE SUBMITTED BY THE SUCCESSFUL TENDERER

The successful Tenderer shall submit three prints of the under mentioned drawings to the engineer for approval, before manufacturing.

- a) Wiring diagrams.
- b) General layouts and Schematic single line diagrams.
- c) Elevations showing dimensional information including details such as, but not limited to, the following:
 - height (less any removable lifting angles or eyes)
 - widths
 - depth
- a) Structure descriptions showing the following:

- Other information as required for approval.
- b) Conduit locations
- c) Unit descriptions
- d) Nameplate information
- e) Manufacturer drawings shall be provided in PDF format
- f) Data sheets and publications on all major components including, but not limited to, the following:
 - Instrumentation
 - Pipe connections
 - Instrumentation
 - Additional comments required
 - All clarifications and exceptions must be clearly identified

After completion of the work, the contractor shall submit three final copies of each of the above-mentioned drawings showing the final layout and wiring diagram of the boards.

ECIS 13 MEASUREMENTS AND PAYMENT

Measurement and payment will be done in accordance with the methods stated below.

ECIS 13.1 Design, Drawing And General

The rate tendered shall include for the provision of the necessary design information for all items measured under the respective schedule. For control and instrumentation, design information shall include, but limited to as listed in this Particular Specifications.

<u>Pay Item</u>	<u>Unit</u>
(a) The Contractor will provide the general layout drawings and wiring diagrams of the enclosure and instrumentation for approval to the Engineer.	Sum
(b) Provide operating and maintenance manuals, data sheets of all equipment and "as built" drawings	Sum

ECIS 13.2 Supply and Delivery To Site

Rate tendered to include for all material, equipment, plant, testing apparatus, labour, manufacturing, factory acceptance testing, transport, import duties, handling and possibly double handling, delivery to and off-loading at Site as well as temporary storage prior to installation. For control and instrumentation, the rate tendered shall be for the complete control and instrumentation and shall include, but not limited to, as detailed in this Particular Specifications. Any special devices shall be listed separately in Variations and Additions to the Standard and Particular Specifications.

<u>Pay Item</u>	<u>Unit</u>
(a) Supply and delivery to site respectively one of the following instruments: a) pressure transmitter, b) differential pressure transducers, c) temperature transmitters, d) no flow sensors, e) pH sensors, f) chlorine analyzers, g) turbidity analyzers and, kiosk, controller [if required] and electrical equipment complete as specified	Each
(b) Supply and delivery to site of a level transducers, controller [if required] and electrical equipment complete with mounting brackets as specified	Each
(c) Supply and delivery to site respectively one of the following flow meter instruments: a) ultra-sonic flow meter, b) turbine flow meter, c) magnetic flow meter and d) Thermal flow meter with kiosk, controller [if required] and electrical equipment as specified	Each

ECIS 13.3 Installation

Rate tendered to include for all plant, tools, labour, rigging, handling, placing into position, aligning, fixing, grouting, but not limited to and getting ready for testing and commissioning. Install of Programmable Logic Controllers system shall be accordance with the manufacturer's written instructions and recognized industry practices, to ensure that the PLC system complies with the requirements and serves the intended purposes. Comply with the requirements of SABS and IEC standards and applicable portions of "Standard of Installation", for installation of Programmable Logic Controller System but not limited to.

<u>Pay Item</u>	<u>Unit</u>
(a) Site installation of respectively one of the following instruments: a) pressure transmitter, b) differential pressure transducers, c) temperature transmitters, d) no flow sensors, e) pH sensors, f) chlorine analyzers, g) turbidity analyzers and, kiosk, controller [if required] and electrical equipment complete as specified	Each
(b) Site installation of a complete level transducers, controller [if required] and electrical equipment complete with mounting brackets as specified	Each
(c) Site installation of respectively one of the following flow meter instruments: a) ultra-sonic flow meter, b) turbine flow meter, c) magnetic flow meter and d) Thermal flow meter with kiosk, controller [if required] and electrical equipment as specified	Each

ECIS 13.4 Commissioning

Rate tendered to include for the drafting of the necessary testing and commissioning plans, attendance of required local and/or overseas specialists, all testing apparatus, instruments and equipment, any/all consumables required for testing purposes and to prove performance, any/all temporary works, any/all control checks, and compilation of final commissioning report. Comply

with the requirements of SABS and IEC standards and applicable portions of "Standards of commissioning".

<u>Pay Item</u>	<u>Unit</u>
(a) Commissioning of respectively one of the following instruments: a) pressure transmitter, b) differential pressure transducers, c) temperature transmitters, d) no flow sensors, e) pH sensors, f) chlorine analyzers, g) turbidity analyzers and, kiosk, controller [if required] and electrical equipment complete as specified	Each
(b) Commissioning of a complete level transducers, controller [if required] and electrical equipment complete with mounting brackets as specified	Each
(c) Commissioning of respectively one of the following flow meter instruments: a) ultra-sonic flow meter, b) turbine flow meter, c) magnetic flow meter and d) Thermal flow meter with kiosk, controller [if required] and electrical equipment as specified	Each

END OF SECTION

EG&M GENERAL AND MISCELLANEOUS

EG&M 1 STANDARDS

The following standards, regulation and drawings, etc. shall be applicable to the electrical installations related to this particular specification, whereas the latest applicable South African Bureau of Standards Codes and Standards should be used;

Standard No.	Description
SANS 1507	Electrical cables with extruded solid dielectric insulation for fixed installations (300/500 V to 1900/3300V)
SANS 1063	Earth rods and couplers
SANS 1213	Mechanical cable glands
SANS 1433-1	Electrical terminals and connectors Part 1: Terminal blocks having screw and screwless terminals
SANS 1433-2	Electrical terminals and connectors Part 2: Flat push-on connectors
SANS 10142	Code of Practice for the wiring of Premises
SANS 10199	The design and installation of an earth electrode
SANS 10292	Earthing of low-voltage distribution systems
SANS 10313	Protection against lightning - Physical damage to structures and life hazard
SANS 60947-5-2	Low-voltage switchgear and control gear Part 5-2: Control circuit devices and switching elements - Proximity switches

EG&M 2 GENERAL REQUIREMENTS

EG&M 2.1 Laws, Regulations and Codes of Practice to be Observed

The work shall be carried out strictly in accordance with the following laws and regulations where applicable;

- a) The latest edition of "Code of Practice for the Wiring of Premises", SANS 10142, as amended;
- b) Occupational Health and Safety Act (Act No. 85 of 1993);
- c) The "Electricity Supply By-Laws and Regulations" of the Local Supply Authority;
- d) The local Fire-Office Regulations;
- e) The Requirements of the Department of Communications;
- f) The Acts and Regulations applicable to the use of explosives;
- g) "The Code of Practice for the Installation and Maintenance of Electrical Equipment used in Explosive Atmospheres"

The Contractor will be responsible for serving all notices and paying all fees due in terms of the above laws and regulations.

EG&M 2.2 Radio and TV Interference

All equipment installed under this Contract shall comply with the Government Notice No. R.2246 and any other applicable rules and regulations in respect of radio and TV interference. Any

equipment found producing interference subsequent to commissioning, shall be suppressed or replaced to the satisfaction of the Engineer without any additional cost.

EG&M 2.3 Interchangeability

All equipment must be manufactured to such close tolerances that all similar components and spares must be fully interchangeable without any further alterations or adjustment being necessary.

EG&M 2.4 Water and Debris Accumulation

All outdoor equipment shall be designed so that water and debris will not readily accumulate to cause deterioration of equipment or an electrical discharge hazard. Where this cannot be avoided, such places shall be easily accessible for cleaning.

EG&M 2.5 Colour and Finishing

All metal parts of equipment shall either be finished in baked enamel or powder coating or galvanized (depending on the circumstances) after manufacture and treatment to SANS 064.

Colours of paint to be used shall be confirmed with the Engineer prior to application.

All steel areas subjected to corrosive atmospheres must be hot dip galvanized. The galvanizing must be clean, smooth, of uniform thickness and unblemished. The galvanizing must not affect the mechanical properties of the covered metal.

All drilling, welding, cutting and bending must be complete and the metal must be cleaned of any machining blemishes, mill scale, rust and lubricants before galvanizing. If site trimming, drilling and cutting cannot be avoided then all such denuded surfaces must be dressed with a cold galvanizing paint.

The Engineer must approve any other proposed corrosion protection before it is applied.

Galvanized areas must be kept free of lubricants.

Wire must be galvanized.

EG&M 2.6 Inspections and Tests

All equipment will be inspected by the Engineer and tested in his presence both in the factory during manufacturing and on site during installation. The Engineer will do all inspections accompanied by the Contractor and the Contractor will do all tests with the Engineer as witness.

The Engineer will require seven (7) days notification to avail himself for any test or inspection and the Contractor must arrange for the maximum number of inspections and tests to be done on the

same day. The Contractor must provide all testing facilities and instruments, all equipment required for a test or inspection and all safety clothing prescribed by the Engineer.

The instruments must have valid test certificates issued by an accepted testing authority and the results of the test done must be recorded on a test certificate, of which the Engineer must receive two copies. The Engineer reserves the right to call for a calibration test on any instruments used during the test.

The cost of all tests must be included in the tender price.

EG&M 2.7 Performance Tests

On completion of erection and installation the Contractor must carry out the following tests, where applicable, in addition to any other tests, which may be specified elsewhere:

Before commissioning:

- Cable Insulation test.
- Earth continuity test.
- Tests for correct direction of rotation of motors and reverse if necessary.
- Test for correct operation of control gear, setting of overload protection equipment, etc.
- The Contractor must obtain SABS test certificates for samples of insulating oil in HT switchgear and transformers. These certificates must be submitted to the Engineer.

On completion of installation and putting into proper operation all the plant and equipment, the Contractor will be required to make suitable arrangements for the testing of all plant and equipment supplied under this Contract and running the plant for at least one week, during which time he shall also train all the operators in the correct running of the plant. He shall also explain the maintenance manuals to the operator during this time.

The entire cost of testing, including supply of test equipment, must be borne by the Contractor and an adequate allowance for such tests must be made in the Tendered price.

EG&M 2.8 Operating And Maintenance Instructions

Before completion of the testing of the plant, the Contractor shall provide the Employer with adequate and complete working, operating and maintenance instructions in triplicate, with the necessary drawings and diagrams clarifying the instructions.

Instructions are to be made up in book form and particular reference is to be made to:

- Maintenance of equipment;
- Precautions to be taken in running the plant;
- All instruments and components must be fully described in data sheets supplied by the relevant suppliers;
- Wiring diagrams of the complete electrical installation.

The manual must be specific for the plant supplied and all extraneous material not connected with the relevant plant shall be deleted, leaving the manual as a comprehensive coherent document, bound in a professional way such that this may be used frequently without falling apart. Standard pamphlets may be supplied as addendums, bound separately in a good quality file to serve as reference but will not be allowed as part of the main manual.

The format for the operating and maintenance manual is described in detail elsewhere in this document.

N.B. The prices Tendered in the Schedule of Prices will be held to include for the supply of these operating and maintenance instructions.

EG&M 2.9 Spares

Tenderers shall submit on the appropriate Schedule in this document a list of spare parts and special tools, which is recommended and should be kept by the Employer for maintenance of the plant. Spares, which the Employer decides to order, must be manufactured simultaneously with the rest of the equipment and be subjected to the same tests for dimensions, tolerances, strength, etc. All spares and special tools must be packed separately and the cases appropriately marked. All spares and special tools must be new and unused and where possible should be standard to all sections of the plant.

EG&M 2.10 Labels And Inscriptions

The standard labels on equipment regarding the manufacturer, type, class, rating etc., shall be accepted unchanged.

Engraved laminated plastic labels shall however be provided to indicate a numbering system for relays, fuses, links, lights and selector and control switches and shall correspond to the wiring diagram numbering system. These labels shall be fixed with screws, bolts or rivets.

EG&M 2.11 Name Tags

Identification tags shall be attached to all equipment, sub-assemblies, components such as instruments, fuses etc., cable ends etc. The tags shall be screwed on with brass or plated steel screws (no self-tapping screws will be permitted). Where it is not possible to use screws such as on the cables, other means of attachment must be submitted for approval to the Engineer.

Cables shall be tagged at either end, whether the end terminates in a distribution board or an end box.

All cable cores and internal panel wiring shall be identified at both ends by means of durable colour coded wire marking ferrules in accordance with numbering systems in cable and wiring diagrams. Only closed ring interlocking type identification ferrules shall be used.

Outdoor tags shall be of stainless steel or brass type.

Tags mounted indoors or protected by an enclosure shall be made of Ivorene or similar sandwich material with black letters on a white background.

All lettering and text shall be approved by the Engineer.

Letter sizes must be compatible with the application, e.g.

For fuses, terminals, relays etc	3 to 5 mm
For panels or cubicles	12 to 20 mm
For switchboard or MCC board names	about 50 mm
For building or structure names	about 80 mm

EG&M 3 EMERGENCY STOP PUSH BUTTONS AND WEATHERPROOF ISOLATORS

Each of these units shall consist of a totally enclosed outdoor type heavy duty "push and turn to lock" stop push button station with a cable gland entry at the bottom to accommodate a 4 core 2,5mm² LT PVC SWA PVC cable.

This push button station and weatherproof isolator shall be mounted on a rigid 1meter high grade 304 stainless steel pedestal with 2mm radius rounded edges, designed to be bolted to a concrete floor. (Refer to the relevant drawing.)

An emergency stop push button station shall be installed near the coupling between each motor and its associated pump and shall be connected to the relevant starter panel via the specified cable to stop the motor.

The pedestal shall be securely bolted to the floor by means of stainless steel foundation bolts grouted into the concrete and care shall be taken to ensure that it is installed plumb.

Emergency stop pedestals for submersible pump sets shall be large enough to accommodate a motor cable termination box to facilitate submersible motor cables on DIN rail mounted termination blocks

EG&M 4 CONDUCTOR ENDS

EG&M 4.1 Numbering Of Conductor Ends

Every conductor end whatsoever, with the exception of AC power cables at any terminal shall be numbered.

These numbers shall correspond with those on the circuit diagram and shall consist of the slip on type numbering system (clipped on numbering system will not be accepted). It shall not be possible to remove the number holder without damaging it or cutting off the lug.

EG&M 4.2 Connection Of Conductor Ends

All conductors whatsoever shall be connected at terminals by means of lugs and/or ferrules suitable for the specific conductor and terminal.

EG&M 5 EARTHING

The contractor shall do all the bonding and earthing in accordance with the latest addition of the "Code of Practice for the Wiring of Premises" SABS 10142.

EG&M 6 LIGHTNING PROTECTION

EG&M 6.1 Plant

The lightning protection of the lighting structures, poles and plant of the works, including all the buildings and handrails on the new plant, form part of this contract.

The lightning protection must be a SABS approved scheme and SABS approved drawings of the scheme must be submitted to the Engineer.

EG&M 7 SURGE PROTECTION

Tenderers shall allow in their Tender prices for adequate protection of the equipment supplied and installed under this contract against direct as well as induced voltage surges and spikes which may be experienced on the system.

Surge arrestors shall be provided on each phase as well as neutral on the incoming power supply terminals of each board.

All arrestors shall be connected directly to earth along the shortest possible route and only conductors of adequate rating for the discharge currents catered for shall be used for connections to arrestors.

Tenderers shall submit full particulars of the arrestors offered as well as written confirmation that it will provide adequate protection for the relevant equipment against possible voltage surges and spikes on the system.

EG&M 7.1 Surge Protection Units

The following surge arrestors shall be supplied and installed for surge protection complete with base element.

EG&M 7.1.1 Main Supply Protection

Single Din rail mounted mains surge arrestors shall be supplied and installed for each phase and neutral conductor of an electrical board. The surge arrestors shall be of sufficient voltage rating and shall withstand a max discharge current of 8/20 magnitude and 40kA rating.

EG&M 8 NOTICES AND DANGER PLATES

EG&M 8.1 Scope

This specification deals with the provision of Notices and Danger Plates as required in terms of the Occupational Health and Safety Act No. 85 of 1993, as well as any other notices that may be required by law or by the nature of the finished Works.

The following standard specifications are referred to in this specification: -

- SANS 10140; Parts I to IV: Identification colour marking.
- SANS 1186: Symbolic safety signs.
- Occupational Health and Safety Act No 85 of 1993

EG&M 8.2 Materials and Finish

Outdoor signs shall be either of vitreous enamelled type or of cast aluminium with raised or embossed letters.

Indoor notices shall be of non-deteriorating plastic, Perspex or fiberglass.

The colours and sizes of letters and colours of background shall be in accordance with requirements of SANS 0140 and as approved by the Engineer.

Symbolic signs shall conform to the requirements of SANS 1186.

Signs shall be pre-drilled for fixing.

All fixing accessories shall be of non-corrosive material.

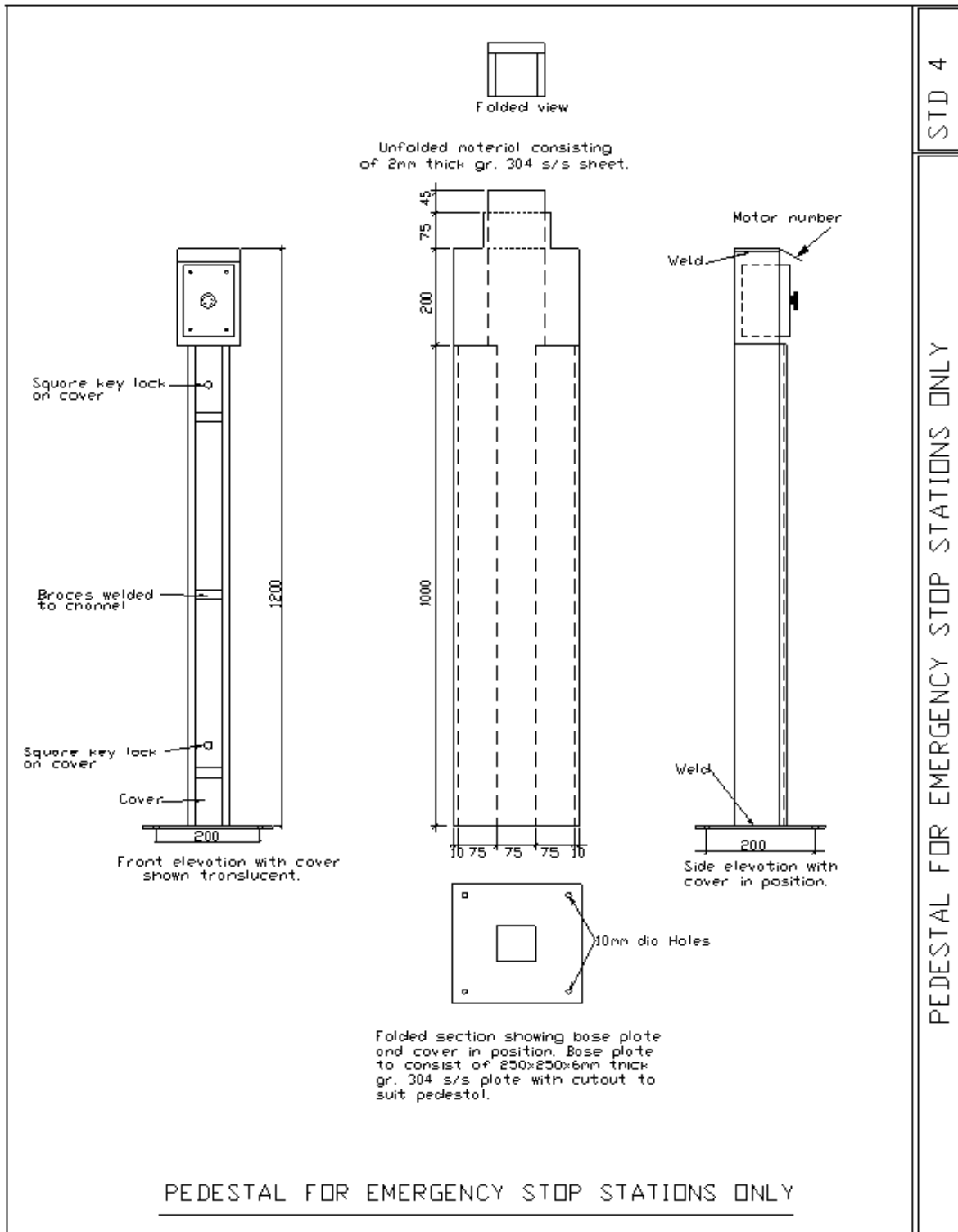
EG&M 8.3 Installation and Erection

The Contractor shall supply and fix permanently in position the signs and notices required by law for all the relevant working areas of the Works. The Engineer shall as prescribed by the relevant Regulations and as agree positions of signs.

EG&M 9 FIRE EXTINGUISHERS

5kg CO2 and powder fire extinguishers shall be supplied and installed in all pump stations and treatment plant buildings in accordance with the requirements of the Local Authority.

EG&M 10 PEDESTAL FOR EMERGENCY STOP AND START STATIONS ONLY



EG&M 11 OPERATING AND MAINTENANCE INSTRUCTIONS

Before completion of the testing of the plant, the Contractor shall provide the Employer with adequate and complete working, operating and maintenance instructions *in triplicate*, with the necessary drawings and diagrams clarifying the instructions. The Contractor will also provide 3 x "soft copies" of the complete manual in PDF format on a Suitable sized USB Flash Drive (Memory Stick)

Instructions are to be made up in book form and particular reference is to be made to:

- Maintenance of equipment;
- Precautions to be taken in running the plant;
- All instruments and components must be fully described in data sheets supplied by the relevant suppliers;
- Wiring diagrams of the complete electrical installation.

The manual must be specific for the plant supplied and all extraneous material not connected with the relevant plant shall be deleted, leaving the manual as a comprehensive coherent document, bound in a professional way such that this may be used frequently without falling apart. Standard pamphlets may be supplied as addendums, bound separately in a good quality file to serve as reference but will not be allowed as part of the main manual.

EG&M 12 INFORMATION TO BE SUBMITTED BY THE SUCCESSFUL TENDERER

The successful Tenderer shall submit three prints of the under mentioned drawings to the engineer for approval, before manufacturing.

- a) Wiring diagrams.
- b) Schematic single line diagrams.
- c) Elevations showing dimensional information including details such as, but not limited to, the following:
 - E-stop and notices height (less any removable lifting angles or eyes)
 - E-stop and notices height width
 - E-stop and notices height depth
- d) Structure descriptions showing the following:
 - Other information as required for approval
- e) Conduit locations
- f) Unit descriptions
- g) Nameplate information
- h) Manufacturer drawings shall be provided in PDF format
- i) Data sheets and publications on all major components including, but not limited to, the following:
 - Pilot devices
 - Relays
 - All clarifications and exceptions must be clearly identified

After completion of the work, the contractor shall submit three final copies of each of the above-mentioned drawings showing the final layout and wiring diagram of the boards.

EG&M 13 MEASUREMENT AND PAYMENT

Measurement and payment will be done in accordance with the methods stated below:

EG&M 13.1 Design, Drawing And General

The rate tendered shall include for the provision of the necessary design information for all items measured under the respective schedule. For general and miscellaneous, design information shall include, but limited to as listed in this Particular Specifications.

<u>Pay Item</u>	<u>Unit</u>
(a) Provide general layouts drawings, notice drawings and wiring diagrams of the for approval.	Sum
(b) Provide operating and maintenance manuals, data sheets of all equipment and "as built" drawings	Sum

EG&M 13.2 Supply And Delivery To Site

Rate tendered to include for all material, equipment, plant, testing apparatus, labour, manufacturing, factory acceptance testing, transport, import duties, handling and possibly double handling, delivery to and off-loading at Site as well as temporary storage prior to installation. For general and miscellaneous, the rate tendered shall be for the complete general and miscellaneous and shall include, but not limited to, as detailed in this Particular Specifications. Any special devices shall be listed separately in Variations and Additions to the Standard and Particular Specifications.

<u>Pay Item</u>	<u>Unit</u>
(a) Supply and delivery to site of emergency stop station [Refer to EG&M 10]	Each
(b) Supply and delivery to site of emergency stop station with built in motor cable termination box [Refer to EG&M 10]	Each
(c) Supply and delivery to site of fire extinguishers	Each
(d) Supply and delivery to site of all notices as may be required and specified	Sum
(e) Supply and delivery to site of all earthing requirements in terms of hand rails and building lightning protection as required and specified	Sum

EG&M 13.3 Installation

Rate tendered to include for all plant, tools, labour, rigging, handling, placing into position, aligning, fixing, grouting, but not limited to and getting ready for testing and commissioning. Install of general and miscellaneous equipment shall be accordance with the manufacturer's written instructions and recognized industry practices, to ensure that the general and miscellaneous complies with the requirements and serves the intended purposes. Comply with the requirements of OHSA, SABS and IEC standards and applicable portions of "Standard of Installation", for installation of general and miscellaneous but not limited to.

<u>Pay Item</u>	<u>Unit</u>
(a) Site installation of a complete emergency stop station [Refer to EG&M 10]	Each
(b) Site installation of a complete emergency stop station with built in motor cable termination box [Refer to EG&M 10]	Each
(c) Site installation of a complete fire extinguisher	Each
(d) Site installation of a complete all notices as may be required and specified	Sum
(e) Supply and delivery to site of all earthing requirements in terms of handrails and building lightning protection as required and specified	Sum

EG&M 13.4 Commissioning

Rate tendered to include for the drafting of the necessary testing and commissioning plans, attendance of required local and/or overseas specialists, all testing apparatus, instruments and equipment, any/all consumables required for testing purposes and to prove performance, any/all temporary works, any/all control checks, and compilation of final commissioning report. Comply with the requirements of SABS and IEC standards and applicable portions of "Standard of commissioning".

(a) Commissioning of a complete emergency stop station [Refer to EG&M 10]	Each
(b) Commissioning of a complete emergency stop station with built in motor cable termination box [Refer to EG&M 10]	Each
(c) Commissioning of a complete fire extinguisher	Each
(d) Commissioning of all notices as may be required and specified	Sum
(e) Commissioning of all earthing requirements in terms of handrails and building lightning protection as required and specified	Sum

END OF SECTION

EPTM TELEMETRY SYSTEM

EPTM 1 SCOPE OF WORKS

As specified in the Project Specifications.

EPTM 2 STANDARDS AND TESTS

The motor control centres shall conform to and be in accordance with the latest applicable South African Bureau of Standards Codes and Standards:

The following Standard Specifications and drawings shall apply;

Standard No.	Description
SANS 10142	Code of Practice for the wiring of Premises
EMCC	Particular Specifications for Motor Control Centres and Distribution Boards
EELP	Earthing and Lightning Protection
ETSI EN 301 489-4 V1.4.1	Electromagnetic compatibility and Radio spectrum Matters (ERM); Electro Magnetic Compatibility (EMC) standard for radio equipment and services; Part 4: Specific conditions for fixed radio links and ancillary equipment and services;
ETSI EN 300 019-1-1 V2.1.4	Classification of environmental conditions; Storage. Class 1.2, weather protected;
ETSI EN 300 019-1-2 V2.1.4	Classification of environmental conditions; Transportation. Class 2.3, public transportation;
ETSI EN 300 019-1-3 V2.1.2	Classification of environmental conditions; Stationary use at weather protected locations. Class 3.2, partly temperature controlled locations;
ETSI EN 300	Classification of environmental conditions; Stationary use at non-weather protected locations;
ETSI EN 300 132-2 V2.1.2	Equipment Engineering (EE); Power supply interface at the input to telecommunication equipment; Part 1: Interface operated by Direct Current (DC);
ETSI EN 302 217-1 V1.1.1	Overview and system-independent common characteristics;
ETSI EN 302 217-2-1 V1.1.1	System-dependent requirements for digital systems operating in frequency bands where frequency co-ordination is applied;
ETSI EN 302 217-2-2 V1.1.1	Harmonized EN covering essential requirements of Article 3.2 of R&TTE Directive for digital systems operating in frequency bands where frequency co-ordination is applied;

Standard No.	Description
CENELEC EN 60950	Safety of information technology equipment;
CENELEC EN 60215	Safety requirements for radio transmitting equipment;
CENELEC EN 60825-1	Safety of laser products, Part 1: Equipment classification, requirements and user's guide;
CENELEC EN 60825-2	Safety of laser products, Part 2: Safety of optical fibre communication systems;
ITU-R Rec. F.746-7	Radio-frequency channel arrangements for fixed service systems;
ITU-R Rec. F.1099-3	Radio-frequency channel arrangements for high capacity radio-relay systems operating in the 5 GHz (4 400-5 000 MHz) band;
ITU-R Rec. F.383-7	Radio-frequency channel arrangements for high capacity radio-relay systems operating in the lower 6 GHz band
ITU-R Rec	Radio-frequency channel arrangements for medium and high capacity analogue or digital radio-relay systems operating in the upper 6 GHz band
ITU-R Rec. F.385-8	Radio-frequency channel arrangements for radio-relay systems operating in the 7 GHz band
ITU-R Rec. F.386-6	Radio-frequency channel arrangements for medium and high capacity analogue or digital radio-relay systems operating in the 8 GHz band
ITU-R Rec. F.387-9	Radio-frequency channel arrangements for radio-relay systems operating in the 11 GHz band
ITU-R Rec. F.497-6	Radio-frequency channel arrangements for radio-relay systems operating in the 13 GHz frequency band;
ITU-R Rec. F.636-3	Radio-frequency channel arrangements for radio-relay systems operating in the 15 GHz band
ITU-R Rec. F.595-8	Radio-frequency channel arrangements for radio-relay systems operating in the 18 GHz band
ITU-R Rec. F.637-3	Radio-frequency channel arrangements for radio-relay systems operating in the 23 GHz band
ITU-R Rec. F.748-4	Radio-frequency channel arrangements for radio-relay systems operating in the 25, 26, and 28 GHz bands
ITU-R F.1520-2	Radio-frequency arrangements for systems in the fixed service operating in the band 31.8-33.4 GHz
ITU-R Rec. F.749-2	Radio-frequency channel arrangements for radio-relay systems +/- operating in the 38 GHz band

Standard No.	Description
ITU-R Rec. F.750-4	Architectures and functional aspects of radio-relay systems for synchronous digital hierarchy (SDH)-based network
ITU-T Rec. G.703	Physical/electrical characteristics of hierarchical digital interfaces
ITU-T Rec. G.823	The control of jitter and wander within digital networks which are based on the 2048 Kbit/s hierarchy
ITU-T Rec. G.825	The control of jitter and wander within digital networks which are based on the synchronous digital hierarchy (SDH)
ITU-T Rec. G.826	Error performance parameters and objectives for international, constant bit rate digital paths at or above the primary rate
ITU-T Rec. G.828	Error performance parameters and objectives for international, constant bit rate synchronous digital paths
ITU-T Rec. G.921	Digital Sections based on the 2048 Kbit/s hierarchy
ITU-T Rec. G.957	Optical interfaces for equipment and systems relating to the synchronous digital hierarchy
ITU-T Rec. G.958	Digital line systems based on the synchronous digital hierarchy for use on optical fibre cable
ETSI TR 101 036-1 V1.3.1	Fixed Radio Systems; Point-to-point equipment; Generic wordings for standards on digital radio systems characteristics; Part 1: General aspects and point-to-point equipment parameters
CEPT/ERC Rec. 74-01 E	Spurious Emissions
CEPT/ERC Rec 14-01 E	Radio-frequency channel arrangements for high capacity analogue and digital radio relay systems operating in the band 5925 MHz – 6425 MHz
CEPT/ERC Rec 14-02 E	Radio-frequency channel arrangements for medium and high capacity digital radio relay systems operating in the band 6425 MHz – 7125 MHz
CEPT/ECC Rec 02-06	Preferred channel arrangement for digital fixed service systems operating in the frequency range 7125-8500 MHz
CEPT/ERC Rec. 12-06 E	Harmonised radio frequency channel arrangements for digital terrestrial fixed systems operating in the band 10.7 – 11.7 GHz
CEPT /ERC/REC 12-02	Harmonised radio frequency channel arrangements for analogue and digital terrestrial fixed systems operating in the band 12.75 GHz to 13.25 GHz

Standard No.	Description
CEPT/ERC/REC 12-07 E	Harmonised radio frequency channel arrangements for digital terrestrial fixed systems operating in the bands 14.5 - 14.62 GHz paired with 15.23 - 15.35 GHz
CEPT/ERC/REC 12-03	Harmonised radio frequency channel arrangements for digital terrestrial fixed systems operating in the band 17.7 GHz to 19.7 GHz
CEPT T/R 13-02	Preferred channel arrangements for fixed services in the range 22.0-29.5 GHz
IEC 297-2	Dimensions of mechanical structures of the 486.6 mm (19 in) series: Cabinet and pitches of the rack structures
IEC 297-3	Dimensions of mechanical structures of the 486.6 mm (19 in) series: Sub-rack and associated plug in units"
IEC 60169-16	Radio-frequency connectors. Part 16: R.F. coaxial connectors with inner diameter of outer conductor 7 mm (0.276 in) with screw coupling - Characteristic impedance 50 ohms (75 ohms)
IEC 60169-29	Radio-frequency connectors - Part 29: Miniature R.F. coaxial connectors with screw-, push-pull and Snap-on coupling or slide-in rack and panel applications; Characteristic impedance 50 ohms
IEC 60603-7	Connectors for electronic equipment - Part 7-1: Detail specification for 8-way, shielded free and fixed connectors with common mating features, with assessed quality
IEC 60835-2-8	Methods of measurement for equipment used in digital microwave radio transmission systems - Measurements on terrestrial radio-relay systems - Adaptive equalizer
IEEE 802.3	Carrier Sense Multiple Access with Collision Detection
FCC 47 CFR Part 101	Fixed Microwave Services
SRSP – 305.9	Technical Requirements for Line-of-sight Radio Systems Operating in the Fixed Service in the Band 5915 – 6425 MHz
SRSP – 306.4	Technical Requirements for Line-of-sight Radio Systems Operating in the Fixed Service in the Band – 6425 – 6930 MHz
SRSP – 307.1	Technical Requirements for Fixed Line-of-Sight Radio Systems Operating in the Band 7125-7725 MHz
SRSP – 307.7	Technical Requirements for Fixed Line-of-sight Radio Systems Operating in the Band 7725-8275 MHz
SRSP – 310.7	Technical Requirements for Fixed Line-of-sight Radio Systems Operating in the Band 10.7-11.7 GHz
NRFP-18	ICASA National Radio Frequency Plan

EPTM 3 RADIO AND TV INTERFERENCE

All equipment installed under this Contract shall comply with the Government Notice No R.2246 and any other applicable codes, rules and/or regulations in respect of radio and TV interference.

Any equipment found producing interference subsequent to commissioning, shall be suppressed or replaced to the satisfaction of the Engineer without any additional cost

The National Radio Frequency Plan-208 allocates the Radio Frequency Spectrum to Radio Services in the Frequency Bands between 8.3 kHz and 3000 GHz. The Contractor will include his price all frequency assignments which shall be in accordance national radio frequency plan and shall be registered.

EPTM 4 PRE – MANUFACTURE SUBMITTALS

EPTM 4.1 Manufacturer Drawings

Telemetry outstations elevations showing dimensional information including details such as, but not limited to, the following:

1. Telemetry outstation height (less any removable lifting angles or eyes);
2. Telemetry outstation width;
3. Telemetry outstation depth;
4. Location of shipping splits;
5. Dimensions.

EPTM 4.2 Structure Descriptions Showing the Following

1. Rating of equipment;
2. Enclosure ratings;
3. Short-circuit withstand ratings;
4. Cascaded systems;
5. Type 1, type 2 or full coordination system;
6. IP Rating;
7. Radio
8. Other information as required for approval.

EPTM 4.3 Product Data

Data sheets and publications on all major components including, but not limited to, the following:

1. Motor starters;
2. Overload relays;
3. Circuit breaker and fuse information including time current characteristics;
4. Control power transformers;
5. Pilot devices;
6. Relays;
7. Timers;
8. Radios;
9. Antennas;
10. Programmable logic Controllers;
11. Digital Input, Digital Output, Analogue Input, Analogue Output, Voltage Free Contact

- and RTD's Devices;
- 12. Multicore cables and earth wires;
- 13. Glands;
- 14. Indication lights;
- 15. Terminal blocks.

EPTM 4.4 Specifications Response

All clarifications and exceptions to the project specifications must be clearly identified and marked up on the drawing.

EPTM 4.5 Specifications Response

Provide a copy of the manufacturer's installation instructions that includes but not limited to, the following:

1. Receiving, handling, and storage instructions;
2. Nameplate data, serial numbers, UL markings, and short circuit ratings;
3. Installation procedures including splicing procedures, terminations and connections;
4. Conduit and cable installation;
5. Installing and removing plug-in units;
6. Operation of operator handles and unit interlocks;
7. Checklist before energizing;
8. Procedure for energizing equipment;
9. Maintenance procedures.

EPTM 4.6 Final Submittals

1. The Contractor shall provide certification that the all components or Telemetry outstation has been installed in accordance with the manufacturer's instructions and with local codes and standards that govern South Africa and all listed standards.
2. Test reports indicating manufacturer's standard testing was performed.
3. Installation/operation instructions for major components.
4. Telemetry System spare parts listing and pricing
5. Technical details and descriptive literature regarding all equipment and instruments offered;
6. Three paper prints of all of the above for final hand-over.

All settings as above detailed shall be indicated on the final drawings.

EPTM 5 DELIVERY, STORAGE AND HANDLING

The contractor shall coordinate with the Engineer manufacturer for entry into the building.

The contractor shall store the telemetry system cubicles in a clean, dry, and heated space.

The contractor shall protect the units from dirt, water, construction debris, and traffic.

During storage the contractor shall connect internal space heaters (if specified) with temporary power.

EPTM 6 EQUIPMENT MANUFACTURER

EPTM 6.1 SABS Certifications

The manufacturer equipment shall be certified by South African Bureau of Standards or accredited testing facility which is to approval of the Engineer in manufacturing. If the contractor does not have certification, it will be to the cost of the contractor to test the telemetry system at South African Bureau of Standards at the Contractors cost.

The Contractor shall have certificates from South African Bureau of Standards which is higher or is equal to the specified equipment.

EPTM 6.2 Outstation Cabinets

All equipment shall be housed in epoxy coated 2,0mm thick 3CR12 steel dust and vermin proof cabinets. The cabinets shall have front access only. Cable entrance shall be possible from the bottom. The doors must be fitted with tamper proof locking catches with padlock facilities and shall be of the 3 point type. Concealed chromed steel hinges shall be used on the front door.

The systems shall be designed to allow for 30% for future extensions.

EPTM 6.2.1 Indoor

All hinged panels shall be reinforced to ensure rigidity and shall be provided with heavy duty rust proof hinges.

Each panel shall be supplied with concealed hinges, each fastened with not less than four (two on each side) brass bolts and nuts. In the case of double doors the first door shall be locked with two slides on the inside, onto the shell. The second panel door shall close over a drip proof gutter shaped lip on the first one.

All screws, studs, bolts, nuts and washers used for these boards shall be Cadmium plated. The use of self-tapping screws will not be permissible.

EPTM 6.2.2 Outdoor

All hinged panels shall be reinforced to ensure rigidity and shall be provided with heavy-duty stainless-steel hinges.

Each panel shall be supplied with concealed stainless-steel hinges, each fastened with not less than four (two on each side) brass bolts and nuts. In the case of double doors, the first door shall be locked with two slides on the inside, onto the shell. The second panel door shall close over a drip proof gutter shaped lip on the first one.

All screws, studs, bolts, nuts and washers used for these boards shall be stainless steel plated. The use of self-tapping screws will not be permissible.

The outdoor motor control boards shall be constructed of at least 2mm powder coated 3CR12 steel. Vermin proofed IP 55 rated ventilation openings shall be provided in doors and side panels. A 3CR12 roof shall be added to all outdoor motor control centres and distribution boards with a minimum slope of 1/10.

EPTM 6.2.3 Electronic Equipment

Where electronic equipment such as transmitting I/O units are incorporated in an outdoor distribution or motor control board, this equipment shall be installed in a separate and special compartment and all wiring shall be terminated on rail mounted terminal strips for field connection of all monitoring and control cables.

The doors of this compartment must be labelled: "Electronic Equipment".

All the electronic equipment but not limited to HMI, power supply, PLC CPU, Ethernet switch, fibre switch, all I/O cards, UPS and telemetry and 30% additional space for the future. All equipment shall be mounted flush behind a common hinged panel, with laminated, shatterproof and tinted glass for viewing purposes.

Sufficient provision for ventilation and heat dissipation as per the equipment ratings and manufacturers requirements shall be allowed for. The contractor shall prove to the Engineer by means of Anemometer or Differential that the requirements and manufacturer's requirements are met.

The tier shall be designed to house all of the above equipment, and the manufacturer shall coordinate with communication and instrumentation specialist.

EPTM 6.2.4 Treatment And Painting Of Metal Parts

All metal parts shall be treated before powder coating in accordance with standard corrosion protection standards and the appropriate coating system shall be selected for the specific application. Motor control centre outer surfaces shall be powder coated colour B26, SANS 1091. (Electric orange)

An average of 2 mil thick electrostatic powder paint coat shall be applied, the contractor shall have a Rugged, fully electronic coating thickness gauges present for testing the thickness of the paint.

EPTM 7 GENERAL REQUIREMENTS

EPTM 7.1 Internal wiring

The internal wiring of the boards shall consist of coloured PVC-insulated conductors of adequate copper cross-section, which shall be neatly installed horizontally and vertically in PVC trunking. Numbered ferrules of an approved type (clip on type not acceptable), shall be provided on each end of each wire, to facilitate the tracing of circuits.

Control circuits shall be colour coded as follows;

Three Phase	-	Red
Three Phase	-	Blue
Three Phase	-	White
Single Phase	-	Red
A.C. Neutral	-	Black
Earth	-	Green and yellow
110V D.C. Positive	-	Brown
110V D.C. Negative	-	Black
24V D.C. +ve	-	Grey
24V D.C. -ve	-	Purple
4-20mA +ve	-	White
4-20mA -ve	-	Black
All other voltages	-	To be confirmed with Engineer.

EPTM 7.2 Electronic Equipment

Where electronic equipment such as transmitting I/O units are incorporated in a distribution board and motor control centre, this equipment shall be installed in a separate and special compartment.

Sufficient room shall be provided for the rail mounted terminal strips and all wiring shall be terminated on this rail mounted terminal strips for field connection of all monitoring and control cables.

EPTM 7.3 Cable Terminations

Low voltage cables shall be terminated with cable glands manufactured of bronze and comprising a barrel with sealing washer and bush nut screwed into one end and a compression nipple with wire clamping ring screwed onto the other end and shall bear the SABS mark of approval. The opposite end of the compression nipple must have a male electrical thread with locknut. The glands shall be suitably sized for the relevant cables, be of the adjustable type complete with armour clamps and with watertight neoprene shrouds.

Cable terminating glands for outdoor use shall be IP68 rated and provided with waterproofing double inner seals as well as waterproofing seals on nipples. Cable termination glands for high humidity and possible temporary water submerged conditions as for instance in filter lower gallery areas at water treatment plants shall also be IP68 rated with waterproofing double inner seals as well as waterproofing seals on nipples.

Cable armouring shall be earthed at each end but may not be used as earth continuity conductor.

Flameproof glands for indoor and outdoor use shall be used where the hazardous area classification and explosion protection rating is supplied by the Engineer.

EPTM 7.4 Labelling

A screwed on engraved label of the black on white "traffolyte" type shall be provided below each item of equipment on the front panel of each board as well as on the chassis in close proximity to the relevant equipment to identify such equipment in the English language in 6 mm high lettering.

Each board shall further be provided with a screwed on reverse engraved yellow Perspex nameplate with black 20mm high lettering to identify the board in the English language on the outside of the door at the top thereof.

EPTM 7.5 Mains Surge Arrestors

When a surge arrestor is installed in systems with a main breaker with 250Amps or 5kA fault current, the surge arrestor shall be pre-fused to prevent the units creating a danger when subjected to high fault currents. Surge arrestors shall be pre-fused to the manufactures requirements. All surge arrestors shall be connection type 2 as per the latest addition of the SANS 10142.

EPTM 7.5.1 Building with External Lightning Protection

The main distribution board surge arrestors shall be combined type 1 & 2 and voltage compatible to the relevant installation and shall be able to withstand a lightning impulse current wave form 10/350µs at a maximum discharge current of 100kA.

Any distribution board feeding from the main distribution board shall have surge arrestors and shall be type 2 and voltage compatible to the relevant installation and shall be able to withstand a lightning impulse current wave form 8/20µs at a maximum discharge current of 40kA.

Each distribution board shall be equipped with mains surge arrestors.

EPTM 7.5.2 Building with NO Lightning Protection

The surge arrestors shall be type 2 and voltage compatible to the relevant installation and shall be able to withstand a lightning impulse current wave form 8/20µs at a maximum discharge current of 40kA.

Each distribution board shall be equipped with mains surge arrestors.

EPTM 7.5.3 Antennae Lightning Protection

The surge arrestors shall be suitable for multi frequency or for wireless applications and shall have excellent RF endurance performance or adapted to Wireless LAN and Wireless Local Loop applications for use according to the lightning protection zones concept at boundaries and higher and shall be able to withstand a lightning impulse current wave form 8/20µs at a nominal discharge current of 20kA. Shall be IEC 61643-21 complaint.

EPTM 7.6 Moulded Case Circuit Breakers

All moulded case circuit breakers shall be as specified in the schedules of equipment for distribution boards and shall comply with the requirements of SANS Specification no. 156.

The required frame sizes or rupturing capacities required are specified in the schedules for each board.

Each circuit breaker shall be provided with non-adjustable time-delayed trips.

These circuit breakers shall be fitted with copper terminal collector bars where more than one cable tail has to be terminated on the same terminal.

EPTM 7.7 Fused Switches

All fused switches shall be of the "load-breaking" and "fault-making" type complying with BS-5419 where applicable and fitted with HRC cartridge fused links to BSS-88. Auxiliary contacts shall be provided where relevant for signal purposes.

EPTM 7.8 Current Limiting Circuit Breakers

The current limiting circuit breakers shall be capable of remaining in service and of carrying their normal rated current after having interrupted the maximum short circuit current of 200kA rms at least three times.

EPTM 7.9 Current Transformers

All current transformers shall be of the air insulated type complying in all respects with the requirements laid down in BS 3938: 1973.

The contractor shall carefully select the ratio, burden and accuracy class to suit its specific application in accordance with the recommendations and requirements of BS 3938.

EPTM 7.10 Indicating Instruments

All indicating instruments shall comply with the requirements laid down in BS 89: Part I: 1970 for instruments of a 2,5 Accuracy Class. All indicating instruments shall have 96mm square dials.

The maximum demand ammeters shall be of the 6A combined maximum demand registering and instantaneous indicating type having MISC movement and thermal demand indication with an integrating time lag of 15 minutes. The ammeter scales shall be direct reading with a full-scale deflection corresponding to 120% of the rated primary current of the relevant current transformer. Each ammeter shall be clearly and indelibly marked to indicate the colour of the phase to which it is connected.

The ammeters for motor starters shall be 5A instantaneous indicating meters with MISC movement and direct reading scales. The meters shall be able to withstand over currents resulting under starting conditions and the full load current of the relevant motor shall be clearly marked in red on the face of the meter.

Voltmeters shall be of the direct reading moving iron suppressed zero type.

The power factor meters shall indicate from 0,7 lagging to 0,7 leading.

The running hour meters shall have cyclometer dials indicating up to 5 digits and two decimals. (12345,67).

EPTM 7.11 Instrument selector switch

A four-position rotary type instrument selector switch shall be mounted directly below the relevant instrument in such a way that only the selector knob and indicator plate are on the panel, and the switch itself is behind the panel.

The selector knob shall consist of Bakelite, and shall have an arrow engraved on it, indicating the switch position.

The switch shall have a positively driven switching mechanism.

The indicator plate shall consist of Bakelite and shall have the positions for the three phases and "OFF", engraved on it in 5mm high lettering.

EPTM 7.12 Contactors

All contactors shall be of the totally enclosed, three pole, double air break per pole, automatic magnetic type complying with the requirements of BS 775 for "CLASS UR" contactors of the "CLASS II MECHANICAL DUTY CLASS / TYPE 2 COORDINATION" and "A3 Make and Break Category".

All contactors shall be provided with arc extinguishers, and readily replaceable silver or silver-alloy contacts rated for at least 2-million "on" and "off" switching operations at rated current.

Each contactor shall be provided with an AC, closing coil suitable for continuous operating and at least 15 closing operations per hour at system voltage. The contactor may not hum or chatter in service and the contacts may not bounce on closing.

EPTM 7.13 Time Switches

The time switches shall be suitable for use on a 231 volt, 50 cycle per second AC supply and shall be of the microprocessor type.

The time switches shall be digital timers suitable for rail or surface mounting and shall be programmable with daily and weekly programs, switching intervals of 1 minute and switching accuracy precise to the second.

The time base shall be of the quartz type with LED display for time, weekday, holiday program, switching position and manual override and shall have a power reserve of 250 hours at full operation. The time switches shall have a switching capacity of 16 A at 231 V.

EPTM 7.14 Isolators

All isolators shall be of the "Load-breaking" and "fault making" type and shall comply with the requirements of BS 5419-1977 where applicable. Where relevant, isolators shall be provided with auxiliary contacts for signal purposes.

EPTM 7.15 400 Volt Air-Break Contactors

All contactors shall be of the totally enclosed, three pole, double air break per pole, automatic magnetic type complying with the requirements of IEC 158-1 for Class AC 3 contactors of Intermittent Duty Class 0,3.

All contactors shall be provided with arc extinguisher and readily replaceable silver or silver-alloy contacts rated for at least 2-million "on" and "off" switching operations at rated current.

Each contactor shall be provided with a 240 Volt, 50 Hz closing coil suitable for continuous operation and at least 15 closing operations per hour. In rural areas contactor coils must be rated to operate satisfactorily between 75% and 130% of nominal voltage.

An adequate number of auxiliary contacts shall be fitted.

The contactor may not hum or chatter in service and the contacts may not bounce on closing.

EPTM 7.16 Earth Leakage Units

The earth leakage units shall consist of a combination of a earth leakage relay and a moulded case circuit breaker and shall have a sensitivity as specified, it shall conform to SANS 767.

EPTM 7.17 Terminals

Terminals may be of the bolted type otherwise they shall be of rail mounted clamp type.

All types of terminals and their insulation shall have a minimum comparative creep index of 500 to BS 3781.

EPTM 7.18 Clamp Type Terminals

These terminals shall be not less than 8 mm wide.

Screws and connectors shall be electroplated to prevent corrosion. The connectors shall be such that the screws will not loosen due to vibration. Current carrying parts shall be of serrated silver-plated copper or brass. Only one connection shall be allowed per connector. For more connections the number of terminals shall be increased, and bridge pieces shall be used.

EPTM 8 RADIO SELECTION SLOW SPEED

The radio transceivers shall be of robust construction with Ethernet communication technology for increased data throughput. On an upgrade on an existing telemetry system similar radio communication systems shall be incorporated.

Ethernet communication technology shall be used.

EPTM 8.1 Radio Selection Medium Speed

Industrial protocols will be supported including Ethernet/IP, Modbus TCP/RTU, Profibus DP and Profinet CBA. The Wireless Ethernet Modem further simultaneously functions as a wireless

serial modem (RS232/485) providing secure, reliable short- and long-range communication solutions.

Capable of operating in Access Point/Client configuration, functioning as a network Bridge/Router, or serving as a Serial Server (RS232/485), the radio shall offer node to node deterministic mesh network repeatability for further range and multiple channel spacing options to increase network scalability. Radio Integrated Modbus server capability shall allow for all seamless I/O expansion modules.

Industrial applications requiring robust wireless Ethernet connectivity in process/automation applications connecting to PLC's, DCS/SCADA, or field instruments with Ethernet as well as RS232/485 interfaces. Powerful built-in diagnostics and universal industrial connectivity options in a highly configurable platform

2.4-GHz direct sequence spread spectrum (DSSS) wireless transceiver shall be used for medium speed radios. 20-MHz channel with 5-MHz channel spacing from the available 13 channels, starting with the first channel centered on 2.412 GHz.

5-GHz direct sequence spread spectrum (DSSS) wireless transceiver shall be used for High-speed radios. The permitted channel usage shall be confirmed in the country.

EPTM 8.2 Radio Selection High Speed

Industrial protocols will be supported including Ethernet/IP, Modbus TCP/RTU, Profibus DP and Profinet CBA. The Wireless Ethernet Modem further simultaneously functions as a wireless serial modem (RS232/485) providing secure, reliable short and long range communication solutions.

Capable of operating in Access Point/Client configuration, functioning as a network Bridge/Router, or serving as a Serial Server (RS232/485), the radio shall offer node to node deterministic mesh network repeatability for further range and multiple channel spacing options to increase network scalability. Radio Integrated Modbus server capability shall allow for all seamless I/O expansion modules.

Industrial applications requiring robust wireless Ethernet connectivity in process/automation applications connecting to PLC's, DCS/SCADA, or field instruments with Ethernet as well as RS232/485 interfaces. Powerful built-in diagnostics and universal industrial connectivity options in a highly configurable platform

5-GHz direct sequence spread spectrum (DSSS) wireless transceiver shall be used for High speed radios. The permitted channel usage shall be confirmed in the country.

EPTM 9 SOLAR PANEL AND BATTERIES

Where no electrical supply is available solar panels shall be used to charge batteries via a voltage regulator. A fully operational backup time of 96 hours (4 days) is required unless otherwise specified. Solar panels shall be installed at a radio communication.

The regulator shall be specifically designed for the telemetry use, where radio current draw varies for short durations of transmission. Allowance shall be made for at least 4 station interrogations per hour.

The regulator shall provide

- Over voltage cutout of load if battery voltage is greater than 16V.
- Cyclic charge to keep battery voltage falls below 10V for more than 30 seconds.
- Low voltage cutout of load if battery voltage falls below 10V for more than 60 seconds. Load is reinstated when battery is charged to more than 12V dc.

Batteries shall be selected for the purpose of the application. High peak discharge current during radio transmission shall be used for battery selection. Typically [Nickel Cadmium] batteries shall not be used.

Sealed lead-acid batteries shall be used for capacities up to 65Ampere Hour, and vented lead-acid (Plant) storage cells designed for standby applications shall be used for larger capacities. Liquid based storage cells shall be housed in a separate vented lockable enclosure.

EPTM 10 EARTHING AND LIGHTNING PROTECTION

Shall be done accordance to earthing and lightning protection particular specifications.

EPTM 11 SOLENOID VALVES

Solenoid valves complete with hydraulic pipe couplings shall be provided where indicated for telemetry control of hydraulic controlled valves at reservoir sites. These units shall operate from a 24V DC supply and shall be of the low energy consumption type. The open/close status of the hydraulic valve shall be monitored where possible by means of a limit switch mounted on the hydraulic valve casing. A weatherproof cable termination box must be supplied and installed next to the control valve and provision must be made for connection cables between the termination box, solenoid and limit switch. The control valve will be controlled by means of the level sensor at the relevant reservoir and must be a fail safe operation (valve must close in the event of a power failure).

EPTM 12 NUMBERING OF CONDUCTOR ENDS

Every conductor end whatsoever, with the exception of AC power cables at any terminal shall be numbered. The alphanumeric numbering shall be in accordance with - BS 158 - 1961.

These numbers shall correspond with those on the circuit diagram and shall consist of the slip-on type numbering system (clipped on numbering system will not be accepted). It shall not be possible to remove the number holder without damaging it or cutting off the lug.

EPTM 13 CONNECTION OF CONDUCTOR ENDS

All conductors whatsoever shall be connected at terminals by means of lugs and/or ferrules suitable for the specific conductor and terminal.

EPTM 14 MONITORING SYSTEM

EPTM 14.1 System Organisation

The system will consist of the following organisation which may in future increase in size. The system shall be suitable to be modified to a decentralised type of control with intelligent outstations.

EPTM 14.2 Monitoring

The system shall provide facilities for the monitoring of all status and analog values described as elsewhere.

EPTM 14.3 Status and Analog Indication and Alarms

The system shall provide plant information to the following display devices:

a) Mimic and SCADA Display units

Analog readings shall be in close proximity to related devices on the display screens showing flow rates and shall be continuously updated after outstation scans.

The following indications are catered for:

- Indication of status of all motors and pumps;
- Indication of which relay or any other device caused changes in the system;
- Alarms are indicated visually and audible. When the alarm is accepted the audible indication is cancelled;
- Indication of internal faults in the supervisory system;
- When selected, indication of analog signals at specific points in the system as specified in the relevant clause; and;
- When selected, indication of time, the control equipment and outstations shall give the same indications.

b) Data and Event Recording

The following information shall be recorded by the system:

- Automatic recording of events when a change of status takes place in the system and at the same time, recording time, date, outstation, item, alarm and identification;
- Automatically log all analogue values at preset intervals from a particular outstation;
- Automatically log any number of selected analogs at preset intervals;
- Record keeping of the real time operation of all motors; and
- Keep records of all controls transmitted.

The data logging will be such that it can also be done by manual selection at any time.

EPTM 14.4 Measuring Accuracies

Measuring accuracies of 2,5% full-scale value are required on all analog signals.

EPTM 15 TRANSDUCERS AND INTERFACES

Transducers shall be supplied and installed by the contractor and any other associated devices where it may be necessary in order that supervisory analog quantities can be measured by the telemetry. The monitoring and control system contractor will be responsible for all interfaces between his equipment and that of other contractors.

EPTM 16 FAULT FINDING AND TEST FACILITIES

The equipment shall be designed in such a manner that staff of the Employer with the minimum training in electronics, can do the maintenance on the equipment.

The contractor shall specify all standard and special test equipment required for normal maintenance and testing purposes.

The contractor shall supply a logical step-by-step system of fault location.

A rail mounted terminal strip equal or similar to Klippon Type SAKR shall be mounted in the supervisory panels for the connection between the plant equipment signals and electronic equipment.

EPTM 17 MODULAR DESIGN

The system shall be of modular design in order to facilitate expansion to the system by simple plug-in of additional modules and minimum wiring changes. All modules shall be DIN rail mounted and shall be interconnected by means of bus connectors.

EPTM 18 ANTENNAE

A list must be provided showing which mast is allowed for at each station.

These shall be either:

a) Wall mounted:

A 5mm tubular mast shall be fixed to the wall with a heavy-duty gauge galvanised offset bracket for 500mm roof overhang. The mast shall be either aluminum 50mm diameter, 5mm thick, or steel galvanised 50mm diameter, 2mm thick.

b) Self-supporting 9m:

A 9m flagpole type mast suitable for the size of antenna used, to withstand 140 km/h wind loading shall be provided.

c) Self-supporting 12 to 18m:

Mast above 12m should be lattice type construction. The mast plinth shall be supplied by the Contractor. The contractor shall provide the concrete base with plinth and wire way. A sketch of the civil works must be provided by the Contractor.

d) Self-supporting Above 18m:

Mast above 18m should be lattice type construction. The mast plinth shall be supplied by the Contractor. The contractor shall provide the concrete base with plinth and wire way. A sketch of the civil works must be provided by the Contractor.

EPTM 19 OUTSTATION HARDWARE

EPTM 19.1 Operational Requirements

a) General

The outstation shall comprise of a central processor unit with interface modules, a power supply, standby battery and plant input and output modules and a communication system. All equipment shall be housed in a steel cabinet as specified.

Apart from any other modules being necessary to operate and control the system satisfactorily, the following modules shall be made available on the outstations.

b) Power Supply

The stabilized power supply and battery charger unit shall be capable of re-charging a drained batteries and shall operate from 230 V-AC.

Battery backup for at least 24 hours of normal operation shall be provided for.

General purpose battery up to 5 years in standby service shall be supplied or more than 260 cycles at 100% discharge in cycle service shall be guaranteed.

c) Processor

The CPU module shall have a high-speed RAM for executable program sections with a RAM size that will match the requirements of the application.

Sufficient memory shall be made available to store data for a reasonable period of time in the event of a communication failure.

The CPU module shall be equipped with a CPU watchdog timer circuit that will automatically restart the system in case of severe electrical disturbance. The CPU shall be auto-configuring and shall determine automatically which I/O modules are connected, do data addressing and mode of operation to run. Use of programmer at outstation shall not be necessary.

d) Relay Interface Cards

Relay interface cards shall be available to connect control outputs to outside plant.

LED monitors shall be fitted to this card to aid with fault-finding.

e) Input/Output Modules

The digital I/O modules shall accept inputs from plant controls and auxiliary multiple operations and provide control outputs to plant operations.

These modules shall also be capable to accept floating alarms of duration of as well as steady alarms from normally closed controls.

All inputs and outputs shall be 2,5 kV isolated from the logic components. Inputs and outputs shall be protected against over voltage and over current.

These I/O's shall be isolated from field equipment by means of interface relays installed in the outstation.

f) Analog Modules

These modules shall accept analog inputs from plant transducers and provide control analog outputs to plant operations and shall be capable of converting 0-5 V DC, 4-20 mA or 0-5 V AC signals by using external converters. All analog inputs and outputs shall be galvanic isolated

Surge protection modules as specified shall be installed in the out station.
RS 232 Bus connectors

These modules shall accept data from an external source. The baud rate shall be adjustable from 300, 1200, 2400, 9600 or 19200-baud handshake protocol shall include XON/XOFF, CTS/RTS and direct.

g) Outstation General

The outstation shall be capable of scanning all inputs and storing data in memory for collection by the mother station.

It must also be possible to perform sequence control and interlocking of plant equipment.

h) Outstation Antennas

Antennas shall be installed at all outstations which will suite the application, speeds shall be detailed in Project Specification.

This high-gain shall band antenna shall be used for low speeds. The antenna shall cover virtually all of the international wireless, cellular and mobile data bands.

The minimum antenna shall operate in two frequency bands 2.4 GHz and 5 GHz.

This Antenna shall have a minimum 13dBi gain at 2.4GHz band and 18dBi gain at the 5GHz band. The housing shall be made of ABS which shall have cataristic for high impact resistant plastic and is also resistant to acids and other chemicals that may occur in industrial plants.

i) Time-Tagging

Events shall be time stamped at the outstations. Only a real time clock at the outstation will be acceptable which shall be hardware based with a crystal. Accuracy of time tagged events should be 20ms between events and 100ms between events at different outstations.

j) Digipeating

The telemetry system shall have the facility to repeat commands destined from or to a remote station, via another station (Digipeating, or Store-and-forward). The digipeat "map" shall be stored in E2PROM (non-volatile memory) at relevant stations, and be able to be programmed with local programmer (e.g. LAP-TOP) or remotely via the communications medium. The digipeat map shall allow for input/output data to be transferred from any remote site to any other remote site and/or Central Station.

k) Programmable Logic Controllers

Where logic control is required at an outstation for pump control programmable logic controllers shall be used. **Programmable Logic Controller Particular Specifications shall be followed.** These PLC's shall be of reputable brand name, to allow after sales programming support by specialist vendors. The telemetry interface to PLC will be serial communications.

EPTM 20 DANGER SIGNS

Danger signs on aluminium plates shall be supplied on each door of an outdoor motor control centre or distribution board and shall be in accordance with the Occupational Health and Safety Act, Act 85 of 1993.

EPTM 21 INSPECTIONS AND TESTS

All equipment will be inspected by the Engineer and tested in his presence both in the factory during manufacturing and on site during installation. The Engineer will do all inspections accompanied by the Contractor and the Contractor will do all tests with the Engineer as witness.

The Engineer will require seven (7) days notification to avail himself for any test or inspection and the Contractor must arrange for the maximum number of inspections and tests to be done on the same day. The Contractor must provide all testing facilities and instruments, all equipment required for a test or inspection.

The instruments must have valid test certificates issued by an accepted testing authority and the results of the test done must be recorded on a test certificate, of which the Engineer must receive two copies. The Engineer reserves the right to call for a calibration test on any instruments used during the test.

The cost of all tests must be included in the tender price.

EPTM 22 TESTING OF TELEMETRY SYSTEM AT THE MANUFACTURER'S WORKS

Each telemetry outstation shall be subjected to the following tests in the manufacturer's works after manufacture:

- a) A thorough inspection shall be carried out to ensure compliance with the specification and approved drawings and wiring diagrams and to ascertain that all connections are properly made.
- b) Primary and secondary injection tests shall be carried out on all switching, protection, metering interlocking and indication circuits.
- c) Load Mismatch Test, Output Open and Short Circuit Protection Test, Output Open and Short Circuit Protection Test, Linearity Test, Modulation Input Impedance Test, Modulation Sensitivity Test, Modulation Frequency Response Test, Ground Isolation Test, Turn-On and Turn-Off Characteristics Test, Occupied Bandwidth test, Transmitter Quality Test, Transmitter Phase Noise Test, Transmitter Bit Error Probability and Additive Noise at GPS Frequencies.

The manufacturer shall submit three copies of test certificates giving details of conditions and results of tests carried out to the Engineer.

EPTM 23 CONCRETE PLINTH FOR OUTDOOR TELEMETRY SYSTEM

The plinth shall be cast 150mm below as well as 150mm above the ground level. It shall have neatly bevelled edges and shall be 75mm wider than the panels all round.

An opening of sufficient width to allow for cable entry shall be provided under the starter panels.

The grade 304 stainless steel foundation bolts for mounting of the panels shall be cast or grouted into the plinth. The plinth shall be in Class 20/19 concrete and shall be suitably reinforced if necessary.

It is recommended that the casting of these foundations must be carried out by the Civil Contractor at the cost of the Contractor under this Contract in accordance with his instructions and under his supervision.

EPTM 24 OPERATING AND MAINTENANCE INSTRUCTIONS

Before completion of the testing of the plant, the Contractor shall provide the Employer with adequate and complete working, operating and maintenance instructions in triplicate, with the necessary drawings and diagrams clarifying the instructions. The Contractor will also provide 3 x "soft copies" of the complete manual in PDF format on a Suitable sized USB Flash Drive (Memory Stick)

Instructions are to be made up in book form and particular reference is to be made to:

- Maintenance of equipment;
- Precautions to be taken in running the plant;

- All instruments and components must be fully described in data sheets supplied by the relevant suppliers;
- Wiring diagrams of the complete electrical installation.

The manual must be specific for the plant supplied and all extraneous material not connected with the relevant plant shall be deleted, leaving the manual as a comprehensive coherent document, bound in a professional way such that this may be used frequently without falling apart. Standard pamphlets may be supplied as addendums, bound separately in a good quality file to serve as reference but will not be allowed as part of the main manual.

EPTM 25 MEASUREMENT AND PAYMENT

Measurement and payment will be done in accordance with the methods stated below:

EPTM 25.1 Design, Drawing and General

The rate tendered shall include for the provision of the necessary design information for all items measured under the respective schedule. Telemetry system design shall include but limited to as listed in this Particular Specifications.

<u>Pay Item</u>	<u>Unit</u>
(a) Provide a complete Telemetry System design, design drawings and wiring diagrams as specified	Sum
(b) Provide operating and maintenance manuals and "as built" drawings as specified	Sum

EPTM 25.2 Supply and Delivery to Site

Rate tendered to include for all material, equipment, plant, testing apparatus, labour, manufacturing, factory applied corrosion protection, factory acceptance testing, transport, import duties, handling and possibly double handling, delivery to and off-loading at Site as well as temporary storage prior to installation. For Telemetry System, the rate tendered shall be for the complete Telemetry System and shall include, but not limited to, as detailed in this Particular Specifications. Any special devices shall be listed separately in the Project Specifications.

<u>Pay Item</u>	<u>Unit</u>
(a) Supply and delivery to site a complete Telemetry System	Sum
(b) Supply and delivery to site a complete Solar Plant	Sum

EPTM 25.3 Installation

Rate tendered to include for all plant, tools, labour, rigging, handling, placing into position, aligning, fixing, grouting, but not limited to and getting ready for testing and commissioning

Install of switchgear shall be accordance with the manufacturer's written instructions and recognized industry practices, to ensure that the switchgear complies with the requirements and serves the intended purposes. Comply with the requirements of SABS and IEC standards and applicable portions of "Standard of Installation", for installation of switchgear but not limited to.

<u>Pay Item</u>	<u>Unit</u>
(a) Installation to site a complete Telemetry System	Sum

(b)	Installation to site a complete Solar Plant	Sum

EPTM 25.4 Commissioning

<u>Pay Item</u>	<u>Unit</u>
(a) Commissioning to site a complete Telemetry System	Sum
(b) Commissioning to site a complete Solar Plant	Sum

END OF SECTION

EELP EARTHING AND LIGHTNING PROTECTION

EELP 1 SCOPE OF WORKS

As specified in the project specifications.

EELP 2 STANDARDS AND TESTS

The earthing and lightning protection shall conform to and be in accordance with the latest applicable South African Bureau of Standards Codes and Standards:

The following Standard Specifications and drawings shall apply;

Standard No.	Description
OHSA	Occupational Health and Safety Act
SANS 10089-1	Electrical Code for Petroleum Industry
SANS 10121	Cathodic Protection of Buried and Submerged Structures
SANS 10123	The Control of Undesirable Static Electricity
SANS 10142	Code of Practice for the wiring of Premises
SANS 10198-12	Installation of Earthing System
SANS 10199	Design and installation of an Earth Electrode
SANS 10199	The Design and Installation of and Earth Electrode
SANS 10200	Neutral Earthing in Medium Voltage Industrial Power Systems
SANS 10292	Earthing of Low Voltage (LV) distribution systems
SANS 10313	The protection of structures against lightning
SANS 1063	Earth rods and Couplers
SANS 1063	Earth Rods and Couplers
SANS IEC 61000-5-2	Electromagnetic Compatibility (EMC) Part 5: Installation and mitigation guidelines Section 2: Earthing and Cabling
SANS IEC 61024-1	Protection of Structures against Lightning Part 1: General principles
SANS IEC 61024-2	Protection of Structures against Lightning Part 2: Risk Management
SANS IEC 61024-3	Protection of Structures against Lightning Part 3: Physical damage to structures and life hazard
SANS IEC 61024-4	Protection of Structures against Lightning Part 4: Electrical and electronic systems within structures
SANS IEC 61312-1	Protection against Lightning Electromagnetic Impulse Part 1: General principles
SANS IEC 61312-4	Protection against Lightning Electromagnetic Impulse Part 4: Protection of Equipment in existing structures
SANS IEC 61643-1	Surge Protective Devices Connected to Low Voltage Power Distribution Systems Part 1: Performance requirements and testing methods
SANS IEC TS 61312-2	Protection against Lightning Electromagnetic Impulse (LEMP) Part 2: Shielding of structures, bonding inside structures and earthing
SANS IEC TS 61312-2	Protection against Lightning Electromagnetic Impulse (LEMP) Part 2: Shielding of structures, bonding inside structures and earthing

The lightning protection system shall be designed to protect lives and property from the destructive effects of lightning. The lightning designer shall assess corrosion effects of the lightning protection system and design accordingly.

The installation shall satisfy the requirements of all relevant South African Statutory Regulations.

Where applicable, equipment items shall carry the SABS mark to demonstrate compliance with the regulations.

EELP 3 GENERAL REQUIREMENTS

Equipment and materials to be used, shall be of high quality, and shall comply with all relevant specifications, codes as mentioned in this particular specification as well as the Occupational Health and Safety Act of 1993(Act 85 of 1993).

Where equipment and material does not comply with the relevant particular specifications it shall be submitted to Engineer for approval before installation.

All materials used for the earthing and lightning protection system shall withstand the electric and electromagnetic effects of lightning current and predictable stresses without being damaged.

Materials and sizes shall be chosen bearing in mind the possibility of corrosion of either the earthing and lightning protection system or the structure to be protected.

The installation shall be in accordance with SANS 10313: Code of Practice for the protection of structures against lightning and the requirements of this specification.

All equipment and material shall comply with the relevant National and International standard standards as listed in the specification. Where equipment does not comply it shall be submitted to the Engineer for approval.

The system of protection will be finials/air terminals, down conductors and earth spike or roof conductors, down conductors and earth spike.

EELP 4 OPERATING CONDITIONS

All material and equipment supplied and fitted must be designed and manufactured for successful operation under the prevailing environmental conditions.

EELP 5 GENERAL PRINCIPLES

Evaluation of Risk: The risk of lightning strike shall be evaluated as described in SANS 10313 and SANS IEC 61024-2.

Effective height of a structure: The effective height of the highest point shall be determined by considering the average height of building, trees and structures and land profile of the surrounding area.

Ground flash density (Ng): The ground flash density (Ng) for general buildings, structures and installations shall be estimated from the average ground flash density given in Annexure C of SANS 10313 as a general guide.

EELP 6 AIR-TERMINATION SYSTEM

The air-termination system should be composed of any combination of the following elements:

- Rods;
- Stretched wires;
- Meshed conductors.

For the design of the air-termination system the following methods should be used:

- Protective angle method
- Rolling sphere method
- Mesh size method

The air-termination system shall be designed and installed in accordance with all the relevant SABS / SANS / IEC standards as mentioned in this document.

EELP 7 LIGHTING PROTECTION SYSTEM

The requirement of the SANS 62305-3 shall comply for the system. The lighting protection system earthing shall be bonded to the fixed electrical installation protective earthing in accordance with the requirements of SANS 10142-1.

EELP 8 EXTERNAL LIGHTNING PROTECTION SYSTEM

The requirement of the SANS 62305-3 and SANS 10313 shall comply for the system. Earth electrodes shall be designed in accordance with SANS 10199.

EELP 8.1 General

External down-conductors shall be installed between the air-termination system and the earth termination system.

The average distance between the down-conductors shall comply with SANS IEC 62305-3.

Down-conductors shall be uniformly placed along the perimeter of the structure and with a symmetric configuration. Down-conductors shall be arranged in such a way that from the point of strike to earth several parallel current paths exist and the length of the current paths is kept to a minimum. The formation of loops shall be avoided.

In order to reduce the probability of damage due to lightning current flowing in the lightning protection system, the down-conductors shall be arranged in such a way that from the point of strike to earth:

- a) several parallel current paths exist;
- b) the length of the current paths is kept to a minimum;
- c) equipotential bonding to conducting parts of the structure is performed according to the requirements

The down-conductor system shall be designed and installed in accordance with all the relevant SABS standards as mentioned in this document.

EELP 8.2 Construction

The down-conductors shall be installed so that, as far as practicable, they form a direct continuation of the air-termination conductors. Down-conductors shall be installed straight and vertical such that they provide the shortest and most direct path to earth.

Down-conductors shall not be installed in gutters or down-spouts even if they are covered by insulating material.

Down-conductors of a lightning protection system not isolated from the structure to be protected may be installed as follows:

- a) wall is made of non-combustible material, the down-conductors may be positioned on the surface or in the wall;
- b) wall is made of readily-combustible material the down-conductors may be positioned on the surface of the wall, provided that their temperature rise due to the passage of lightning current is not dangerous for the material of the wall;
- c) wall is made of readily-combustible material and the temperature rise of down conductors is dangerous, the down-conductors shall be placed in such a way that the distance between them and the wall is always greater than 0,1 m. Mounting brackets may be in contact with the wall.

When the distance from down-conductor to a combustible material cannot be assured, the cross-section of the conductor shall be not less than 100mm².

EELP 8.3 Natural components

The following parts of the structure should be considered as natural down-conductors:

- a) The metal installations provided that:

The electrical continuity between the various parts is made durable in accordance with SANS 62305-3.

Their dimensions are at least equal to that specified in SANS 62305-3 for standard down conductors.

- a) the metal of the electrically-continuous reinforced concrete framework of the structure;
- b) the interconnected steel framework of the structure;
- c) the facade elements, profile rails and metallic sub-constructions of facades, provided that

Dimensions conform to the requirements for down-conductors shall be as SANS 62305-3 and that for metal sheets or metal pipes thicknesses shall be not less than 0,5mm.

Electrical continuity in a vertical direction conforms to the requirements of the SANS 62305-3.

EELP 8.4 Test Joints

At the connection of the earth termination, a test joint should be fitted on each down conductor, except in the case of natural down-conductors combined with foundation earth electrodes. For measuring purposes, the joint shall be capable of being opened with the aid of a tool. In normal use it shall remain closed.

The joint should be capable of being opened with the aid of a tool for measuring purposes, but normally it should be closed.

EELP 9 INTERNAL & EXTERNAL LIGHTNING PROTECTION SYSTEM

The SANS 62305-3 shall apply. For the protection against over-voltages of internal systems, see SANS 62305-4.

EELP 10 EARTH-TERMINATION SYSTEM

The design shall cater for the dispersion of the lightning current into the ground, whilst minimizing any potentially dangerous over-voltages, the shape and dimensions of the earth-termination system are the important criteria.

The lightning protection system earthing shall be bonded to the fixed electrical installation protective earthing in accordance with the requirements of SANS 10142-1. **ALL EARTHING AND BONDING ABOVE GROUND SHALL BE DONE WITH KWENA-ANTI THEFT CABLE.**

The requirements of SANS 62305-3 apply with the additions given in 10.2 and 10.3. Earth rods shall comply with the requirements of SANS 1063, and earth electrodes shall be installed in accordance with the requirements of SANS 10199. Specific attention is drawn to the requirements for explosive manufacturing and storage areas.

ALL EARTHING AND BONDING ABOVE GROUND SHALL BE KWENA ANTI-All earthing and Bonding may it be above ground.

EELP 10.1 Earth Resistivity and Electrode

Necessary earth resistivity tests on site, and invite to the Engineer for inspections must be arranged. Tests will be in accordance with the requirements of BS 1013.

After all earth electrodes/trench earth's have been installed, an earth megger shall be used to test the earth resistance at the earth bar or connection point to the main station earth and the results

recorded. Note that all ECC connections, and any other bonding material shall be disconnected from the earth connection point whilst the earth is being tested.

The following are the maximum acceptable earth electrode resistances: Electrical Earth

- a) Main substation - 1 ohm
- b) Buildings Ring Earth - 1 ohm
- c) Transformer Yard - - 1 ohm
- d) Miniature substations and kiosks - 1 ohm
- e) High masts - 5 ohms
- f) Instrument Earth - < 1 ohm

EELP 10.2 Type B Arrangement

Type B arrangement as per SANS IEC 62305-3 shall be used.

Ring conductor external to the structure which will be in contact with the soil for at least 100% of its total length, or a foundation earth electrode. Earth electrodes may also be meshed.

The number of electrodes shall not less than the number of the down-conductors, with a minimum of two.

EELP 10.3 Installation of earth electrodes

The embedded depth and the type of earth electrodes shall be such as to minimize the effects of corrosion, soil drying and freezing and thereby stabilize the conventional earth resistance.

The requirements of SANS 62305-3 apply with the additions given in 10.2 and 10.3.

Earth rods shall comply with the requirements of SANS 1063, and earth electrodes shall be installed in accordance with the requirements of SANS 10199.

EELP 11 COMPONENTS

Components of a lighting protection system shall be manufactured from the materials listed in SANS IEC 62305-3 or from other materials with equivalent mechanical, electrical and chemical (corrosion) performance characteristics.

Earth electrodes shall be designed in accordance with SANS 10199.

EELP 11.1 Fixing

Air-terminations and down-conductors shall be firmly fixed so that the electrodynamic or accidental mechanical forces will not cause conductors to break or loosen as per SANS IEC 62305-1.

EELP 11.2 Connections

The number of connections along the conductors shall be kept to a minimum. Connections shall be made secure by such means as brazing, welding, clamping, crimping, seaming, screwing or bolting. Connections of steelwork within reinforced concrete structures shall conform to SANS IEC 62305-3.

EELP 12 EQUIPOTENTIAL BONDING

Equipotentialization shall be achieved by interconnecting the lightning protection with all structural metal parts, all below indicated but limited to the following:

- a) metal installations,
- b) internal systems,
- c) external conductive parts and lines connected to the structure.

Have a nominal cross-sectional area of at least 2,5 mm² copper or equivalent for indoor, and outdoor shall be aluminium, the conductors will be either cast in to the concrete or shall be so arranged that it cannot be tampered with.

EELP 12.1 Lightning equipotential bonding for external conductive parts

For external conductive parts, lightning equipotential bonding shall be established as near as possible to the point of entry into the structure to be protected.

Bonding conductors shall be capable of withstanding the lightning current flowing through them evaluated in accordance SANS IEC 62305-1 and SANS 10142.

The requirements of SANS 62305-3 and SANS 10142 shall apply. For the protection against over-voltages of internal systems, see SANS 62305-4.

EELP 12.2 Lightning equipotential bonding for internal systems

Lightning equipotential bonding shall be installed strictly according to SANS 10313, SANS 10142 and SANS IEC 62305-3.

EELP 12.3 Lightning equipotential bonding for lines connected to the structure to be protected

Lightning equipotential bonding for electrical and telecommunication lines shall be installed in accordance with 6.2.3 of SANS IEC 62305-3.

EELP 13 TOUCH AND STEP VOLTAGES

The requirements of SANS 62305-3 apply.

EELP 14 RISK MANAGEMENT

The requirements of SANS 62305-2 apply. The Contractor shall allow for the purchase of the spreadsheet-based risk calculator which has been developed by IEC TC 81 (see annex E in SANS 62305-2:2011). The software program can be purchased directly from the IEC and shall be submitted as proof of design.

EELP 15 MAST PROTECTION FOR THATCHED ROOFS

The requirements of SANS 62305-3 shall apply with the additions given in 11.2 to 11.7. Metals used in the construction of a thatched roof shall be bonded and earthed. Water pipes, vent pipes, tanks, gas pipes, antennas, telephone and bell wires, burglar alarms and electrical wiring and conduit within 1 000 mm of the thatch shall be shielded, bonded and earthed as per SANS 10142-1.

EELP 15.1 Dangerous Sparking

Dangerous sparking between an lightning protection system and a metal, an electrical or a telecommunication installation can be mitigated which is detailed SANS 62305-3.

EELP 15.2 Ageing of thatch

Ageing of the thatch, flammable gases could evolve within the thatch and the thatch could ignite.

EELP 15.3 Metals in or on the thatch

The requirements of SANS 62305-3 shall apply.

EELP 15.4 Protection by masts

At least lightning protection level III (see SANS 62305-3) shall apply in the case of thatched structures.

EELP 15.5 Earthing of masts

All free-standing masts shall be earthed in accordance SANS 10199, and shall comply with SANS 62305-3.

EELP 16 STRUCTURES WITH EXPLOSIVE OR FLAMMABLE SUBSTANCES

The requirements of SANS 62305-3 apply with the additions given in 12.2 and 12.3.

EELP 17 DESIGN REQUIREMENTS

The requirements of SANS 62305-3 and SANS 10313 shall apply.

EELP 18 INSPECTION OF LIGHTING PROTECTION SYSTEM

The requirements of SANS 62305-3 apply and all required forms shall be in place for Engineers inspection. An Installation safety report see annex A of SANS 10313 shall be issued in respect of an inspected and compliant lighting protection system by the lighting protection system designer and installer.

EELP 19 DANGER SIGNS

Danger signs on aluminium plates shall be supplied on each door and shall be in accordance with the Occupational Health and Safety Act, Act 85 of 1993.

EELP 20 EARTH BAR

A copper earth bar shall be provided and mounted not less than 40mm from the wall or fixed structure approximately 1000mm above the final floor level and final position will be confirmed with Engineer in the position as indicated on the drawings and agreed on site. The mounting shall be electrically insulated from the wall.

A solid 200 mm x 30 mm x 5mm copper earth bar shall be provided. The earth bar shall be provided with 6 x 6mm holes evenly spaced along the entire length. 6 mm f cadmium plated high tensile steel bolts complete with nuts and lock-washers shall be provided for each hole. Serrated washers shall not be used between the copper earth bar and the lug.

The earth bar shall be connected with a 70mm² Kwena Anti-Theft conductor to the building earth-termination system (system earth mat) and the tenderer shall allow for 100m of Kwena Conductor to the earth bar for tender purpose.

EELP 21 INFORMATION TO BE SUBMITTED BY THE SUCCESSFUL TENDERER

The successful Tenderer/Contractor shall submit three prints of the under mentioned drawings to the engineer for approval, before manufacturing.

- a) Earthing and Lightning Protection drawings.
- b) Multiview Projections including elevations showing dimensional information including details such as, but not limited to, the following:
 - Front views
 - Side views
 - Rear view
 - Floor plan view
 - Roof view

All drawings will be obtainable from the Engineer.

- a) Structure descriptions which will be indicated on Multiview projections and elevations showing the following:
 - All Bonding
 - All Earthing and Lightning Protection equipment.
 - Earth Mat locations
 - Conductor Network
 - Fixings
 - Air terminals
 - Conductor Joint clamps
 - Earth Electrode Positions
 - Earth Inspection Pits
 - Other information as required for approval

- b) Conduit locations
- c) Unit descriptions including information such as, clamps, conductor sizes, earth electrode depth, earth inspection pits all as mentioned above (item c).
- d) Design and manufacturer Engineers approved drawings shall be provided to the Engineer in PDF format.
- e) Data sheets and publications on all major components including, but not limited to, the following:
 - Aluminium Conductor
 - KWENA Bonding Conductors
 - Clamps
 - Control power transformers
 - Pilot devices
 - Relays
 - All clarifications and exceptions must be clearly identified

After completion of the work, the contractor shall submit three final copies of each of the above-mentioned drawings showing the final layout / as built.

EELP 22 MEASUREMENT AND PAYMENT

Measurement and payment will be done in accordance with the methods stated below:

EELP 22.1 Design, Drawings and General

The rate tendered shall include for the provision of the necessary design information for all items measured under the respective schedule. Earthing and Lightning Protection System installation, design information shall include, but limited to, the following:

- Manufacturer's product data of lightning protection and earthing and all related components.
- Dimensioned and Professional Engineer signed drawings of lightning and earthing system showing accurately scaled basic units including, but not necessarily limited to, auxiliary compartments, unit components and combination units all as specified under this specification.

<u>Pay Item</u>	<u>Unit</u>
(a) Provide design drawings and design information for Earthing and Lightning Protection System	Sum
(b) Provide operating and maintenance manuals and "as built" drawings as specified	Sum
(c) Provide risk management calculations and IEC Program as specified	Sum

EELP 22.2 Supply and Delivery to Site

Rate tendered to include for all material, equipment, plant, testing apparatus, labour, manufacturing, factory applied corrosion protection, factory acceptance testing, transport, import duties, handling and possibly double handling, delivery to and off-loading at Site as well as temporary storage prior to installation. For miniature substation, the rate tendered shall be for the complete miniature substation and shall include, but not limited to, the detailed in this particular specification. Any special devices shall be listed separately in Variations and Additions to the Standard and Particular Specifications Section C3.4.2 .

<u>Pay Item</u>	Unit
(a) Supply and delivery to site of lightning protection system complete as specified	Each
(b) Supply and delivery suitable earth-termination system, earthing and earth mat as specified	Sum
(c) Supply and delivery suitable earth bar as specified	Each
(d) Supply and delivery all connection points, terminals, interconnections, bonding points and test joints for the entire system including for "natural" components;	Sum

EELP 22.3 Installation

Rate tendered to include for all plant, tools, labour, rigging, handling, placing into position, aligning, fixing, grouting, but not limited to and getting ready for testing and commissioning.

Install of earthing and lightning protection system shall be accordance with the manufacturer's written instructions and recognized industry practices, to ensure that the earthing and lightning protection system complies with the requirements and serves the intended purposes. Comply with the requirements of SABS and IEC standards and applicable portions of "Standard of Installation", for installation of earthing and lightning protection system but not limited to.

<u>Pay Item</u>	Unit
(a) Site installation of lightning protection system complete as specified	Each
(b) Site installation of suitable earth-termination system (system earth mat) and earth mat as specified	Sum
(c) Site installation of suitable earth bar as specified	Each
(d) Site installation of all connection Points, terminals, interconnections, bonding points and test joints for the entire system including for "natural" components;	Sum
(e) Earthing resistance survey upon completion of the excavations and test report	Sum

EELP 22.4 Commissioning

Rate tendered to include for the drafting of the necessary testing and commissioning plans, attendance of required local and/or overseas specialists, testing apparatus, instruments and equipment, any/all equipment required for testing purposes and to prove performance, any/all temporary works, and compilation of final commissioning report.

Contractor shall submit three copies to the Engineer. Contractor shall notify the Engineer one week in advance of the test so that the Engineer may be present.

<u>Pay Item</u>	Unit
(a) Commissioning of complete lightning protection system, inclusive of down conductor, earth-mat and earth spikes, etc.	Sum
(b) Certificate of compliance of lightning protection system	Sum

END OF SECTION

ESPL SMALL POWER AND LIGHTING INSTALLATIONS ON BUILDINGS AND STRUCTURES

ESPL 1 SCOPE OF WORKS

As specified in the Project Specifications.

ESPL 2 STANDARDS

The following standards, regulation and drawings, etc. shall be applicable to the electrical installations related to this particular specification, whereas the latest applicable South African Bureau of Standards Codes and Standards should be used;

Standard No.	Description
BS 3676	Switches for household and similar fixed electrical installations. Specification for general requirements
SANS 156	Moulded-Case Circuit Breakers
SANS 164	Plug and socket-outlet systems for household and similar purposes for use in South Africa
SANS 201	Energy Efficiency in Buildings
SANS 474	Code of practice for electricity metering
SANS 475	Luminaires for interior lighting, street lighting and floodlighting - Performance requirements
SANS 890	Ballasts for fluorescent lamps
SANS 950	Un-plasticized polyvinyl chloride rigid conduit and fittings for use in electrical installations
SANS 1012	Electric light dimmers
SANS 1085	Wall boxes for the enclosure of electrical accessories
SANS 1091	National colour standard
SANS 1195	Bus bars
SANS 1213	Mechanical cable glands
SANS 1239	Plugs, socket-outlets and couplers for industrial purposes
SANS 1411	Materials of insulated electric cables and flexible cords
SANS 1619	Small power distribution units (ready boards) for single-phase 230V service connections
SANS 1765	Machine-made textile floor coverings - Determination of thickness
SANS 1777	Photoelectric control units for lighting (PECUs)
SANS 10142	Code of Practice for the wiring of Premises
SANS 10114-1	Interior lighting Part 1: Artificial lighting of interiors
SANS 10114-2	Interior lighting Part 2: Emergency lighting
SANS 60309-1	Plugs, socket-outlets and couplers for industrial purposes Part 1: General requirements
SANS 60309-2	Plugs, socket-outlets and couplers for industrial purposes Part 2: Dimensional interchangeability requirements for pin and contact-tube accessories
SANS 60570	Electrical supply track systems for luminaires
SANS 60669-1	Switches for household and similar fixed-electrical installations Part 1: General requirements
SANS 60669-2-1	Switches for household and similar fixed electrical installations Part 2-1: Particular requirements - Electronic switches
SANS 60669-2-2	Switches for household and similar fixed electrical installations Part 2-2: Particular requirements - Electromagnetic remote-control switches (RCS)
SANS 60669-2-3	Switches for household and similar fixed electrical installations Part 2-3: Particular requirements - Time-delay switches (TDS)

Standard No.	Description
SANS 60669-2-4	Switches for household and similar fixed electrical installations Part 2-4: Requirements - Isolating switches
SANS 60669-2-5	Switches for household and similar fixed electrical installations Part 2-5: Particular requirements - Switches and related accessories for use in home and building electronic systems (HBES)
SANS 60906-3	IEC system of plugs and socket-outlets for household and similar purposes Part 3: SELV plugs and socket-outlets, 16 A 6 V, 12 V, 24 V, 48 V, a.c and d.c
SANS 60921	Ballasts for tubular fluorescent lamps - Performance requirements
SANS 60947-1	Low-voltage switchgear and control gear Part 1: General rules
SANS 60947-2	Low-voltage switchgear and control gear Part 2: Circuit-breakers
SANS 60947-3	Low-voltage switchgear and control gear Part 3: Switches, disconnectors, switch-disconnectors and fuse-combination units
SANS 61084-All	Cable trunking and ducting for electrical installations
SANS 61347-All	Lamp control gear Part
SANS 10292	Earthing of low-voltage (LV) distribution systems

ESPL 3 SPL CABLING AND ACCESSORIES

ESPL 3.1 PVC Insulated Conductors

PVC insulated conductors shall be of high conductivity, stranded copper with Polyvinyl Chloride insulation of 600/1 000 volt grade.

The wiring of circuits shall be carried out on the "loop-in" system and no jointing of conductors in conduit runs or cutting away of wire strands will be permissible.

Connectors for use in conduit boxes shall be of the heavy brass terminal type mounted in porcelain insulators.

All plug circuits shall consist of 2 x 4mm² PVC insulated conductors plus 1 x 2,5mm² bare copper earth wire in Ø20mm conduit.

All lighting circuits shall consist of 1,5mm² PVC insulated conductors in 20mm conduit. For fluorescent lights an additional 2,5mm² bare copper earth wire shall be provided and thoroughly bonded to each fitting.

Connections between lamp holders of incandescent fittings and the conduit boxes shall consist of asbestos insulated wire or other approved heat resistant conductors.

ESPL 3.2 Conduit And Conduit Accessories

Conduit, conduit accessories and conduit fittings shall be hot-dip galvanized both on the inside and outside

Only brass bushes and bush nuts will be acceptable.

The conduit installation shall be carried out on the "loop-in" system and no conduit shall have a diameter of less than 20 mm. All conduits shall be built into walls, concrete ceilings etc., and no conduit will be allowed on the surface.

All conduit ends shall be remerged and all joints securely screwed together. No inspection bends or elbows will be allowed in the installation. Running joints may only be used where unavoidable and shall be provided with lock nuts. All screwed joints shall be thoroughly painted with "Red Lead" in order to prevent corrosion.

No conductor may be drawn into any conduit, unless all foreign materials, moisture and sharp edges have been removed.

In event of a conduit terminating in any sheet metal box, two lock nuts and a brass bush or one lock nut and a bush-nut shall be used.

Standard round conduit boxes shall be used for light points and draw boxes. Draw boxes shall be provided with enamelled metal cover plates with brass screws.

Standard 100 x 50 x 50 mm hot dipped galvanised pressed steel boxes shall be used for all switch boxes.

Standard 100 x 100 x 50 mm hot-dipped galvanised pressed steel boxes shall be used for all plug boxes and telephone outlets.

Expansion boxes shall be provided at all expansion joints in the building. Such expansion box shall comprise a flush hot dipped galvanised sheet steel box with blank enamelled steel cover plate secured in position by means of brass screws. The conduit on the one side shall be securely fixed to the box, while the conduit on the other side shall be able to move freely in the box in order to provide for movement of the building. The conduit on the one side shall be bonded to that on the other side inside the box by means of flexible copper connections with clamps, bolts and nuts, in order to ensure earth continuity.

The conduit shall be installed in the concrete ceilings along the shortest possible routes, with the cover plates of draw boxes on the final ceiling surface. Conduit shall be installed as near as possible to the neutral axis of concrete beams, slabs and columns and deep conduit boxes shall be used.

All unwired conduits should be equipped with hot dipped galvanised draw wires with at least 200 mm ends on each end of the conduit. The ends of the draw wire shall be neatly coiled in the draw boxes.

ESPL 3.3 Standard 100 X 100 X 50 mm And 100 X 50 X 50 mm Boxes

The above mentioned boxes shall be heavy gauge, hot-dip galvanized, pressed steel boxes.

ESPL 3.4 Cover Plates

All cover plates (switch boxes, plug boxes and draw boxes) should be of baked enamelled steel.
The colour to be approval by the Engineer, with input for the Architect and Client.

ESPL 4 LIGHTING INSTALLATIONS

ESPL 4.1 Light Switches

Light switches shall comply with SANS 10142 and BS 3676.

Standard mounting box for all light switches: 100 x 50 x 50mm, hot dip galvanized and neat rounded corners

Light switches current rating: >16Amp and suitable for the load it is connected to.

Flush mounted switches: micro type with white rocking lever

Watertight switches to be installed in cast iron boxes, inclusive of watertight cover plates and clearly marked with "ON" and "OFF" positions.

The switch lever shall be protected where it protrudes through the cover plate.

ESPL 4.2 Light Fittings

Light fittings shall be of the latest technology lamps and control equipment as prescribed. LED lights shall be installed as specified.

Fluorescent light fittings shall be equipped with electronic ballasts.

Fluorescent lamps colour temperature: 3 000°K unless otherwise specified.

Light fittings with filament lamps installations: wiring between the terminal box and the lamp holder shall have heat resisting insulation.

ESPL 4.3 Insect Killers

As specified in the project specifications.

ESPL 5 SMALL POWER INSTALLATIONS

ESPL 5.1 Power Outlets

Plug outlets shall be of the combined 3 pin, 13Amp or 16Amp socket and switch combination.

Type: flush mounted units, with a white rocking lever.

Mounting box: 100 mm x 100 mm x 50 mm and neat rounded corners.

The switch lever shall be protected where it protrudes through the cover plate.

ESPL 5.2 Three Phase And Multi-Pin Plug Outlets

Three phase plug outlets shall be either;

- 63A, 400V, 5 pin units complete with plug and interlocked isolating switch; or
- 32A, 400V, 7 pin units complete with plug and interlocked isolating switch.

ESPL 5.2.1 Isolator Installation

Isolation installation: 100x50x50mm, IP 65 weatherproof wall box as indicated on the drawings, as required.

Isolators shall be one of the following and as specified;

- 20A double pole;
- 30A double pole;
- 60A double pole;
- 30A triple pole; or
- 60A triple pole.

Mounting height (kitchens and other areas where cupboards are fitted): 1050 mm AFFL

Mounting height (gate motors): 500mm AFFL

Isolator units to be installed in an accessible location and in close proximity to the particular equipment (ex. air-conditioning units, geysers, extractor fans, gate motors, etc.) and as indicated on the drawings.

ESPL 6 DISTRIBUTION BOARDS

Each of the relevant distribution boards shall be built into walls or securely bolted down on the floor or plinth by means of the requisite number of foundation bolts grouted into the floor in the positions indicated on the drawings.

These positions shall be confirmed with the Engineer on site prior to installation as follows;

- a. Contractor shall install distribution board in accordance with manufacturer's instructions.
- b. Contractor shall tighten accessible bus connections and mechanical fasteners to the manufacturer's torque requirements.
- c. Contractor shall select and install fuses in fusible switches based upon field requirements.
- d. Contractor shall adjust circuit breaker settings based upon field requirements.
- e. Contractor shall adjust solid state overloads to match the installed motor characteristics.

ESPL 6.1 Wall Surface Mounted Type Mounted Lv Db Specifications

DB board type:

- Surface mounted with doors, 1,6 mm sheet steel, with a bonding tray, chassis and removable panel.

Bonding trays:

- Adequately sized in order that all the relevant equipment is installed without cramping and adequately braced with suitable gaskets.

DB Doors:

- Secured with robust and rust proofed hinges. A single door shall not be wider than 600 mm.
- Rust proofed handles and latches. Ball type batches will not be acceptable.

DB chassis:

- Rigid and facilities shall be provided on the chassis for mounting all the relevant equipment.

Mounted:

- Panels shall be mounted in order that all equipment are flush behind the panel with only operating handles and push buttons projecting through neat machine punched slots in the panel.
- Panels shall be provided with chromium plated brass handles to facilitate removal.
- The panel shall be rigid and readily removable without necessitating the disturbance of any of the equipment on the board.

Colouring:

- Interior surfaces of the board shall be powder coated white .
- Exterior surfaces (including panels) in colour B26, SANS 1091 (Electric orange).
- Powder coating shall be of the best quality with high shock and scratch resistance.
- Before powder coating, metal parts shall be thoroughly degreased and cleaned by shot blasting to be free of rust, mill-scale and other foreign materials.

Gland Plate:

- A 3CR12 steel gland
- Fitted to the bottom section of the board to facilitate termination of cables by means of cable glands.

Busbars:

- Shall consist of tinned solid high conductivity copper mounted on suitable busbar insulators.
- Connections to busbars shall be done with suitable lugs sweated or crimped to the conductor ends, and cadmium plated high tensile steel bolts, nuts and washers.

Copper multiway neutral and earth bars:

- Shall be equipped with cadmium plated high tensile steel bolts, nuts and washers for connection of the various conductors.
- The neutral bar shall be mounted on busbar insulators, but the earth bar shall be thoroughly bonded to the metalwork of the board.

The internal wiring of the boards:

- Done with PVC insulated conductors arranged neatly horizontally, vertically and at right angles in front of the chassis.

- The conductors shall be neatly bunched by means of cable ties. (String will not be acceptable.)

Labelling:

- An engraved plastic label of the black on white sandwich type shall be screwed to the panel below each item of equipment.
- For single pole equipment a number system shall be used.
- A neatly typed legend card behind clear "Perspex" in a metal frame should be provided. The frame shall be mounted on the inside of the switchboard doors.

Sundries:

- All bolts, nuts, washers and screws used on should be rustproof.
- The use of self-tapping screws will not be allowed.

ESPL 6.2 Wall Flush or Semi-flush mounted DB Specifications

Flush and semi-flush mounted distribution boards shall be manufactured as follows:

- Constructed of 1,2mm sheet steel (minimum) and shall comply with SANS 1180 Part 1.
- Including rust hot dipped galvanised wall tray.
- Braced with of suitable gussets.
- Suitable sized to accommodate equipment without cramping as specified in the schedules.
- Expanded metal to be spot-welded at the rear of all wall trays for 110mm walls.
- Formed with bevelled or flat edges and neatly mitred and shall accommodate the panel chassis and door/s.
- The lip for the mounting of the circuit breaker carriers, and front panels shall form part of the architrave frame.

Panels Door specifications:

- Rigid and manufactured with a smooth flat finish.
- Suitably braced to ensure stiffness,
- Recessed flush in the architrave.
- Door catches shall be equal and similar to "Union" manufacture, as follows;
 - Cat No. 51741 (solid, no lock), or
 - Cat No. 5174 (with built-in lock),
- Single doors to be constructed of sheet steel and shall open at least 150 degrees.
- The distance between panel and inside of door(s) shall be not less than 40mm.
- Circuit breaker carriers specifications;
- Rigid construction for mounting of equipment.
- Fixed to the architrave frame and provided with the necessary means for fixing of circuit breakers, isolators, etc.
- Width of carriers for compact circuit breakers shall be such that a distance of 10mm is maintained between the carriers.

Mounted:

- Panels shall be mounted in order that all equipment are flush behind the panel with only operating handles and push buttons projecting through neat machine punched slots in the panel.
- Panels shall be provided with chromium plated brass handles to facilitate removal.
- The panel shall be rigid and readily removable without necessitating the disturbance of any of the equipment on the board.
- Panels shall be attached to architrave by means of captive fasteners (with screw driver slots).
- Self-tapping screws are not acceptable.
- Panels can also be fitted by means of two guiding pins at the bottom or on the hinge side of the door.

Slots for equipment:

- Slots for equipment installed separately shall have the exact dimensions to accommodate only the specific equipment, as per example main switches, earth leakage relays, etc.
- A maximum tolerance of approximately + 1mm shall be maintained on all sides between slots and equipment.
- Power meters:
- Where required, power meters shall also be flush mounted behind the panels and Contractors are required to co-operate with the supply Authorities in this respect.

Busbars specifications:

- Consist of solid drawn high conductivity copper with a rectangular cross-section in accordance with SANS 1195 for each phase and neutral and are to be installed in a group in the top section of all distribution boards.
- Busbars to be installed either horizontally or vertically.
- Busbars must be so arranged that horizontal bars are placed one above the other and vertical bars placed side-by-side, with the flat surface facing front wards to facilitate connections and clear of all equipment.
- Where necessary, busbars shall either be twisted to a 45° angle or shall be stepped in the horizontal plane.
- 50mm spacing between bars to be provided.
- A set of busbars should be installed in each section of a distribution board feeding more than two three phase connections including future equipment.
- These busbars shall not be mounted directly onto the terminals of any triple pole circuit breakers, fuse-switches or isolators.
- Busbars shall be mounted on coloured "ceramic" or "paxalene" or similar insulators. Colour of insulators shall be in phase colours, red, white, blue and black for neutral.
- Busbars for single pole circuit breakers shall consist of solid copper with a minimum cross-section of 1,5mm x 19mm and shall be fixed directly to the terminals of the circuit breakers. Single pole circuit breakers should be grouped distinctly separate for the three phases, in horizontal rows (one above the other) in the following sequence, red, white and blue, starting with red on top.

- Connections to busbars shall be done with lugs, sweated or crimped to cable ends and bolted to busbars with cadmium plated 6mm diameter steel bolts (machined bolts) and nuts. Bolts shall be of the hexagonal head type, with 6mm thread and must be provided with washers, spring washers and hexagonal nuts.
- Busbars are to be drilled and tapped and bolts must be screwed into the busbars from the rear. Connection facilities to busbars shall make provision for the number of three phase connections as well as spare connections specified.
- Spare bolts, complete with washers and nuts, are to be screwed into each busbar, to allow for future extensions.
- Busbars shall be mounted on a rigid chassis and the use of two chassis for the mounting of a busbar will not be permitted. Only similar metals shall be used for busbars and connections thereto.
- Each busbar shall be provided with one large terminal for the main conductor. All busbars must be accessible from the front.

Wiring specifications:

- Wiring is to be carried out from the sides and in front of the chassis with conductors neatly arranged in horizontal, vertical and at right angles rows and bound together by means of perforated plastic tape (string will not be acceptable).
- Each conductor within the harness shall be kept parallel to the others without twisting or spiralling and shall be free of links.
- Only one conductor per connection point will be permitted
- All wiring is to be kept free and away from any exposed terminals, or other non-insulated current carrying parts.
- Looping from terminals of main switch, circuit breakers, or isolators will be limited to a maximum of only two outgoing circuits per DB, more than two circuits shall be connected to the busbars.
- Only copper conductors will be permitted.
- Internal wiring in the DBs, shall consist of stranded conductors and shall be in the colours of the relevant phases being red, white, blue and black for neutral.
- Colour taped conductors will not be permitted
- Switch boards shall be supplied completely wired and ready for connection.

DB powder coated finish specifications:

- All metal parts shall be degreased, rinsed, pickled, rinsed, phosphate, neutralized and then to be thoroughly dried.
- The above process is to be followed by the following powder coating process, before distribution boards are delivered for installation.
- Powder coating finishing shall be colour B26, SANS 1091 (Electric orange) or a colour as described by the Architect. Care to be taken that all edges are properly covered with powder coating.

Labelling:

- Screwed-on, engraved labels, of the white-on-black type, shall be provided on the front of the DB to identify the equipment and instruments as indicated on the proposed layout.

- Inscriptions shall be 6mm high lettering on Ivorene labels. Fixing screws shall be chrome or brass 6BA roundhead.
- **Note:** All grouped SP circuit-breakers on distribution boards and cubicles must be numbered with suitable engraved printed plastic or Ivorene plates indicating numbers of circuit controlled.
- A neatly typed legend card behind clear "Perspex in a metal frame shall be provided for this purpose.
- The frame shall be spot welded on the inside of the switchboards doors.

ESPL 7 ACCESSORIES FOR SWITCHBOARDS

ESPL 7.1 Mains Surge Arrestors

When a surge arrestor is installed in systems with a main breaker with 250Amps or 5kA fault current, the surge arrestor shall be pre-fused to prevent the units creating a danger when subjected to high fault currents. Surge arrestors shall be pre-fused to the manufactures requirements. All surge arrestors shall be **connection type 2** as per the latest addition of the SANS 10142.

ESPL 7.2 Building with External Lightning Protection

The main distribution board surge arrestors shall be combined type 1 & 2 and voltage compatible to the relevant installation and shall be able to withstand a lightning impulse current wave form 10/350µs at a maximum discharge current of 100kA.

Any distribution board feeding from the main distribution board shall have surge arrestors and shall be type 2 and voltage compatible to the relevant installation and shall be able to withstand a lightning impulse current wave form 8/20µs at a maximum discharge current of 40kA.

Each distribution board shall be equipped with mains surge arrestors.

ESPL 7.3 Building With No Lightning Protection

The surge arrestors shall be type 2 and voltage compatible to the relevant installation and shall be able to withstand a lightning impulse current wave form 8/20µs at a maximum discharge current of 40kA.

Each distribution board shall be equipped with mains surge arrestors.

ESPL 7.4 Moulded Case Circuit Breakers

All moulded case circuit breakers shall be as specified in the schedules of equipment for distribution boards and shall comply with SANS 156.

The required frame sizes or rupturing capacities required are specified in the schedules for each board.

Each circuit breaker shall be provided with non-adjustable time-delayed trips.

ESPL 7.5 Current Limiting Circuit Breakers

The current limiting circuit breakers shall be capable of remaining in service and of carrying their normal rated current after having interrupted the maximum short circuit current of 200 kA RMS at least three times.

ESPL 7.6 Contactors

All contactors shall be of the totally enclosed, three pole, double air break per pole, automatic magnetic type complying with the requirements of BS 775 for "CLASS UR" contactors of the **"CLASS II MECHANICAL DUTY CLASS"** and **"A3 Make and Break Category"**.

All contactors shall be provided with arc extinguishers, and readily replaceable silver or silver-alloy contacts rated for at least 2-million "on" and "off" switching operations at rated current.

Each contactor shall be provided with an AC, closing coil suitable for continuous operating and at least 15 closing operations per hour at system voltage. The contactor may not hum or chatter in service and the contacts may not bounce on closing.

ESPL 7.7 Time Switches

The time switches shall be suitable for use on a 230 volt, 50 cycle per second AC supply and shall be of the microprocessor type.

The time switches shall be digital timers suitable for rail or surface mounting and shall be programmable with daily and weekly programs, switching intervals of 1 minute and switching accuracy precise to the second.

The time base shall be of the quartz type with LED display for time, weekday, holiday program, switching position and manual override and shall have a power reserve of 250 hours at full operation. The time switches shall have a switching capacity of 16 A at 230V.

ESPL 7.8 Earth Leakage Units

The earth leakage units shall consist of a combination of a earth leakage relay and a moulded case circuit breaker and shall have a sensitivity as specified, it shall conform to SANS 767.

ESPL 8 EARTHING

The contractor shall do all the bonding and earthing in accordance with the latest addition of the "Code of Practice for the Wiring of Premises" SABS 10142.

Earth resistivity measurements of **less than 1 ohm** will be acceptable at motor control centers and distribution boards.

ESPL 9 DANGER SIGNS

Danger signs on aluminum plates shall be supplied on each door of an outdoor motor control center or distribution board and shall be in accordance with the Occupational Health and Safety Act, Act 85 of 1993.

ESPL 10 INSPECTIONS AND TESTS

All equipment will be inspected by the Engineer and tested in his presence both in the factory during manufacturing and on site during installation. The Engineer will do all inspections accompanied by the Contractor and the Contractor will do all tests with the Engineer as witness. The Engineer will require seven (7) days notification to avail himself for any test or inspection and the Contractor must arrange for the maximum number of inspections and tests to be done on the same day. The Contractor must provide all testing facilities and instruments, all equipment required for a test or inspection.

The cost of all tests must be included in the tender price.

ESPL 10.1 Testing of Distribution/Motor Control Boards

Each distribution/motor control board shall be subjected to the following tests in the manufacturer's works after manufacture:

- a. A thorough inspection shall be carried out to ensure compliance with the specification and approved drawings and wiring diagrams and to ascertain that all connections are properly made.
- b. A high voltage test on all primary connections to check the insulation between phases mutually and between each phase and earth.
- c. The polarities and ratios of all potential and current transformers shall be checked.
- d. Primary and secondary injection tests shall be carried out on all switching, protection, metering interlocking and indication circuits.

The manufacturer shall submit three copies of test certificates giving details of conditions and results of tests carried out to the Engineer.

ESPL 10.2 Operating And Maintenance Instructions

Before completion of the testing of the plant, the Contractor shall provide the Employer with adequate and complete working, operating and maintenance instructions *in triplicate*, with the necessary drawings and diagrams clarifying the instructions. The Contractor will also provide *3 x "soft copies"* of the complete manual in PDF format on a Suitable sized USB Flash Drive (Memory Stick)

Instructions are to be made up in book form and particular reference is to be made to:

- Maintenance of equipment;
- Precautions to be taken in running the plant;

- All instruments and components must be fully described in data sheets supplied by the relevant suppliers;
- Wiring diagrams of the complete electrical installation.

The manual must be specific for the plant supplied and all extraneous material not connected with the relevant plant shall be deleted, leaving the manual as a comprehensive coherent document, bound in a professional way such that this may be used frequently without falling apart. Standard pamphlets may be supplied as addendums, bound separately in a good quality file to serve as reference but will not be allowed as part of the main manual.

ESPL 11 SUPPORTING DOCUMENTATION

ESPL 11.1 Information to Be Submitted With Tenders: 400v Db

Before manufacturing, the following information shall be submitted with each Tender in respect of all boards offered;

- a. Full technical details and descriptive literature regarding all equipment and instruments offered;
- b. Three paper prints of an outline drawing of each motor control centre and distribution board indicating the main overall dimensions and general lay-out of the boards; and
- c. Three paper prints of an outline drawing of the front end processor cabinet indicating the main overall dimensions, general layout and type of material employed on the face of the panel.

ESPL 11.2 Information Required With Tender Submission

The following information regarding the switch- and distribution boards shall be submitted with each tender.

- a. The name and address of the switchboard manufacture.
- b. Descriptive literature and technical information of all equipment and instruments offered with the boards.
- c. Wiring diagrams of all distribution boards.
- d. Schematic single line diagrams of all distribution boards.
- e. Elevations showing dimensional information including details such as, but not limited to, the following:
 - Distribution boards height (less any removable lifting angles or eyes)
 - Distribution boards width
 - Distribution boards depth
 - Location of shipping splits
- a. Structure descriptions showing the following:
 - Bus ratings
 - Enclosure ratings
 - Short-circuit withstand ratings
 - Other information as required for approval
- b. Conduit locations
- c. Required bus splices

- a. Unit descriptions including information such as, starter sizes, circuit breaker frame sizes, circuit-breaker continuous ampere ratings, and pilot devices
- b. Nameplate information
- c. Manufacturer drawings shall be provided in PDF format
- d. Data sheets and publications on all major components including, but not limited to, the following:
 - Motor starters
 - Overload relays
 - Circuit breaker and fuse information including time current characteristics
 - Control power transformers
 - Pilot devices
 - Relays
 - All clarifications and exceptions must be clearly identified

After completion of the work, the contractor shall submit three final copies of each of the above-mentioned drawings showing the final layout and wiring diagram of the boards.

ESPL 11.3 As Built Information

On completion of the works, but before the certificate of completion will be issued, the contractor shall submit to the Engineer, as built information in electronic format indicating in a satisfactory manner:

- a) The exact position of all electrical installation equipment in the buildings
- b) Distribution board as built wiring diagrams
- c) Certificate of Compliance for all building installations

Electronic copies of the various plans for the marking up of the information required will be supplied to the contractor on request.

ESPL 12 MEASUREMENT AND PAYMENT

Measurement and payment will be done in accordance with the methods stated below:

ESPL 12.1 Design, Drawing And General

The rate tendered shall include for the provision of the necessary design information for all items measured under the respective schedule. For distribution board's installation, design information shall include, but limited to as listed in this Particular Specifications.

<u>Pay Item</u>	<u>Unit</u>
(a) Provide design drawings and wiring diagrams as specified	Sum

(b)	Provide operating and maintenance manuals and “as built” drawings as specified	Sum
(c)	Allowance for short circuit analysis and coordination study and protection setting calculations	Sum

ESPL 12.2 Supply And Delivery To Site

<u>Pay Item</u>	<u>Unit</u>
(a) Supply and delivery to site of complete electrical installation equipment as specified	Sum

ESPL 12.3 Installation

<u>Pay Item</u>	<u>Unit</u>
(a) Installation of complete electrical installation as specified	Sum

ESPL 12.4 Commissioning

<u>Pay Item</u>	<u>Unit</u>
(a) Commissioning of complete electrical installation as specified	Sum

END OF SECTION

EMCA MULTICORE CABLES AND EARTHWIRES

EMCA 1 SCOPE OF WORKS

As specified in project specifications

EMCA 2 STANDARDS AND TESTS

Cables shall conform to and be in accordance with the latest applicable South African Bureau of Standards Codes and Standards:

The following Standard Specifications and drawings shall apply:

Standard No.	Description
SANS 97	Electric cables - Impregnated paper-insulated metal-sheathed cables for rated voltages 3,3/3,3 kV to 19/33 kV
SANS 1339	Electric cables - Cross-linked polyethylene (XLPE) insulated cables for rated voltages 3,8/6,6 kV to 19/33 kV
SANS 1507	Electrical cables with extruded solid dielectric insulation for fixed installations (300/500 V to 1900/3300V)
SANS 1713	Electric cables - Medium-voltage aerial bundled conductors for voltages from 3,8/6,6 kV to 19/33 kV
SANS 10142	Code of Practice for the wiring of Premises
ITU-T G.651.1	Design of the multimode Fibre Optic network

EMCA 3 CONSTRUCTION DETAILS

EMCA 3.1 Low Voltage Cables

All multi core cables shall be stranded metal annealed copper conductor, PVC insulated, PVC bedded, single wire armoured and PVC sheathed in accordance with SANS 1507 as amended to date for cables with copper conductors and insulated for 500/3300 volt grade.

Cables for status and analogue signals shall consist of the requisite size and number of copper twisted pairs, individually and overall screened, PVC sheathed, steel wire armoured and PVC covered, complying with the requirements of SANS 1507 where applicable.

Cables and earth wires for a specific application shall be selected strictly in accordance with the requirements laid down in SANS 10142 in respect of current rating and voltage drop. Where practicable the earth continuity conductor shall form an integral part of the cable.

EMCA 3.2 Medium Voltage Cables

These cables shall be manufactured in accordance with NRS. 013-1991 and comply with SANS 97 - 1991. All the 11 kV cables shall have copper conductors and shall be suitable for use on an unearthed system.

Three core cables shall be of the fully impregnated belted type. The cable shall have a helical fibrous bedding, lead alloy E sheath, single wire armour and a PVC serving as laid down in the Variations and Additions to the Standard and Particular Specifications, all in accordance with SANS 97 - Table 18. Single core cable shall be fully impregnated, screened general purpose cable with copper conductors suitable for an earthed system. The cables shall be in accordance with Table 11 of SANS 97, shall have a lead alloy E sheath and a PVC anti-electrolytic over sheath. (Type PEC)

EMCA 3.3 Fibre Optic Cables

EMCA 3.3.1 Communication Network (Fibre Optic Cable - Multimode)

The multimode Fibre Optic communication network shall have both uplink and downlink connections available.

EMCA 3.3.2 Technical Design Requirements

The design of the multimode Fibre Optic network shall include, amongst others the following minimum design requirements:

- a) Detailed optical power budget calculations
- b) Transceiver SFP details
- c) Fibre link lengths
- d) dB losses per each patch cord/lead used
- e) Any Mid-couplers used
- f) Type of Patch panels installed (8-way, 16-way, etc.)
- g) Type of connectors used (LC, ST, etc.)
- h) Amount of splicing joints made

The design of the multimode Fibre Optic network shall conform, amongst other international standards to the following international standard: **ITU-T G.651.1** specification.

The distances between the sites that will be interconnected will be indicated on the specific drawings and/or project specifications. The contractor shall however confirm these distances as part of their final design.

No splicing of Fibre Optic cable joints shall be allowed, except for termination of the Fibre Optic cables in the patch panels at all the respective sites. The design of the entire multimode Fibre Optic network shall be based on international standards, including but not withstanding the **ITU-T G.651.1** specification. The design shall include, amongst others the technical details specified below:

- a) **Type of SFP transceivers selected** - Shall include the following design details:
 - o Optical Power Budget (PB)
 - o Minimum Optical Power transmission values (dBm)
 - o Minimum Receiver sensitivity values (dBm)
- b) 76
 - o dB losses from connectors;

- dB losses from patch cords;
- dB losses from patch panels;
- dB losses from mid-couplers;
- dB losses from pig-tails;
- dB loss/km for each specific Fibre Optic link (@ 850nm wavelength)

EMCA 3.3.3 Express/Emergency Joints

Each Fibre Optic link shall be installed without the need for any splicing joints in-between sites. Only splicing at the patch panels on either side (at both sites) is expected. Express or Emergency splicing joints shall only be done when a Fibre Optic cable has been damaged and needs to be temporarily repaired to restore service.

Before commencing with any such endeavours, the Contractor shall firstly request permission from the Engineer if the need to make an Express or Emergency splicing joint arises. The Engineer reserves the right to decline such a request from the Contractor. An express joint shall always be a temporary measure only and the repaired cable shall be replaced as soon as possible (The Contractor shall communicate the time frame on the replacement of the affecting Fibre Optic link to the Engineer).

For Information: The overall design of the Fibre Optic network shall ensure the optimal Optical Power Budget (**PB**) shall remain after installation, to cater for any such temporary Express or Emergency splicing joints, without affecting the overall Quality of Service (QoS) relevant to the Fibre Optic Link affected.

EMCA 3.3.4 Optic Fibre Optical Characteristics

The multimode Fibre Optic cable shall conform to the following **Optical** properties and characteristics:

- a) 8 cores
- b) Typical Core Diameter - 50 μm ;
- c) Cladding Diameter - 125.0 $\pm$ 1 μm ;
- d) Primary Buffer >250 μm ;
- e) Secondary Buffer >900 μm ;
- f) Bandwidth at 850nm – 1000 MHz/km;
- g) Cable Fibre Attenuation – <5dB/km @ 850nm, <3dB/km @ 1300nm;
- h) Each Optical Fibre shall consist of a doped silica core surrounded by a concentric silica cladding;
- i) The Fibre shall be a matched clad design; and
- j) The coating shall be dual layered and UV-cured acrylate.

EMCA 3.3.5 Optic Fibre Mechanical Properties

The multimode Fibre Optic cable shall conform to the following **Mechanical** properties and characteristics:

- a) The cable shall consist of a dielectric, glass reinforced plastic (GRP) rod to prevent bucking of the cable;

- b) Water-blocking technology shall be used to impede migration of water through the cable core;
- c) Fillers shall be included in the cable core to aid in symmetry of the cable cross-section if needed;
- d) A water blocking tape shall be applied longitudinally around the outside of the stranded tubes or fillers;
- e) The water blocking tape shall be non-nutritive to fungus, electrically non-conductive and homogenous. It shall also be free from dirt and any foreign matter;
- f) High tensile strength dielectric yarns shall be helically stranded evenly around the cable core to improve tensile strength;
- g) Ripcords shall be provided in the cables for easy sheath removal;
- h) The armoured cables shall contain two ripcords under the steel armour;
- i) The armoured cable shall contain corrugated steel tape/steel wire, plastic coated on both sides for corrosion resistance;
- j) It shall be applied around the outside of the water blocking tape over the dielectric tensile strength members;
- k) This shall be done with an overlapping seam with all the corrugations in line;
- l) The outer jacket shall be applied over the corrugated steel tape/steel wire armour;
- m) The outer jacket / sheath shall be HDPE;
- n) The minimal outer jacket thickness shall be 2.0 mm;
- o) The cable jacket on the armoured cables shall contain no metal elements and shall be of a consistent thickness;
- p) The shipping, storage, and operating temperature range of the cable shall be -40°C to +70°C;
- q) The installation temperature range of the cable shall be -30°C to +70°C;
- r) Cable Sheath Marking - All cables shall have sequential length markings along the cable sheath;
- s) The height of the marking shall be approximately 2.5 mm; and
- t) As required by Section 350 G of the NESC, ANSI C2-1993, all cables shall have a visual identifier to identify them as telecommunications / data-communications cables.

EMCA 3.3.6 Fibre Optic Cable Installation Requirements

The Fibre Optic cable shall be installed in 50mm cable ducts. The requirements for the cable duct shall be as follows:

- a) Direct burial type of duct
- b) 50mm outside diameter
- c) UV rated
- d) Pre-installed pull tape
- e) Silicone lined for reduction in friction
- f) Manufactured according to SABS ISO 9001
- g) Jointing of duct only via high compression couplings
- h) Ducts shall have a pressure rating > 9 Bar

Where the cable route changes direction (termination of fibre links into buildings, change of direction due to services and infrastructure, etc.), manholes/handholes shall be constructed or installed if of the pre-cast/polyethylene type.

The Contractor shall be required to survey the route prior to the commencement of the installation of the multimode Fibre Optic cables to determine the following:

- a) The length of the route that requires the Fibre Optic cable;
- b) The terrain conditions and terrain accessibility;
- c) Crossings including existing services, streams, rivers, pipelines, etc.;
- d) Location and condition of existing manholes (where applicable);
- e) Distances between existing manholes (where applicable);
- f) Distances between planned new manholes;
- g) Accessibility of the terrain, if the use of mechanical hauling equipment is preferred;
- h) However, the pulling in of multimode Fibre Optic cables by hand is preferred;
- i) Identification and allocation of correct spare pipe to be utilised if available;
- j) Once the above has been verified, a proper hauling schedule shall be compiled;
- k) Cables are normally available in full drum lengths from the cable supplier and it is essential to make optimum use of the available lengths;
- l) Confirm the available lengths from cable supplier before the hauling schedule is compiled;
- m) Ensure that the cables are drummed correctly to suit the direction of pull; and
- n) Drums shall be unloaded from its transport vehicle using a JCB or fork-lift truck.

EMCA 4 JOINTING OF CABLES

EMCA 4.1 Low Voltage Cables

Joints will only be allowed where more than one full drum length of cable is necessary to complete a specific circuit and must be restricted to the absolute minimum. All joints shall be made to the best practice by competent cable jointers using first class material. The contractor shall maintain the electrical continuity of the armouring in an approved manner at all straight through joints.

Heat shrinkable cable joint kits that will suit the relevant cable size shall be used for all low voltage cable joints

EMCA 4.2 Medium Voltage Cables

On 11 kV cables, straight joints shall be made by means of heat-shrinkable straight through joints for unearthed paper insulated cables up to 11 kV. All cable joint kits shall comply with NRS 053 Specifications

The joints shall be made to the manufacturer's instructions and with materials stipulated in such instructions.

The cores of the cable shall be joined colour to colour or number to number.

EMCA 4.3 Fibre Optic Cables

Joints in fibre optic cable must be avoided as far as possible due to losses in signal strength when jointed.

The joints shall be made to the manufacturer's instructions and with materials stipulated in such instructions.

EMCA 5 TERMINATION OF CABLES

EMCA 5.1 Low Voltage Cables

Low voltage cables shall be terminated with cable glands manufactured of bronze and comprising a barrel with sealing washer and bush nut screwed into one end and a compression nipple with wire clamping ring screwed onto the other end. The opposite end of the compression nipple must have a male electrical thread with locknut. The glands shall be suitably sized for the relevant cables, be of the adjustable type complete with armour clamps and with watertight neoprene shrouds.

Cable terminating glands for outdoor use shall be IP68 rated and provided with waterproofing double inner seals as well as waterproofing seals on nipples. Cable termination glands for high humidity and possible temporary water submerged conditions as for instance in filter lower gallery areas at water treatment plants shall also be IP68 rated with waterproofing double inner seals as well as waterproofing seals on nipples.

Cable armouring shall be earthed at each end but may not be used as earth continuity conductor.

EMCA 5.2 Medium Voltage Cables

Medium voltage cable terminations shall be heat shrinkable termination kits and shall comply with NRS 053 Specifications.

The cable terminations shall be made to the manufacturer's instructions and with materials stipulated in such instructions.

EMCA 5.3 Fibre Optic Cables

Fibre optic cables shall be terminated by means of suitable glands, ST connections and bus terminals capable of direct connection to the bus interfaces on the bus stations. These bus stations will be housed in separate panels of various motor control centres.

EMCA 6 CONCRETE CABLE SLABS

The cable slabs supplied and installed under this Contract shall be formed solidly out of concrete with steel reinforcing and shall have dimensions of 1 000 x 350 x 100 mm. Alternative block sizes will be considered. The following concrete mixture is desired:

1. Portland cement (dry) - 1 part per volume

2. Clean dry river sand - 3 parts per volume
3. Crushed stone (size 10 mm) - 6 parts per volume

EMCA 7 CABLE TRAYS AND CABLE LADDERS

Heavy duty cable trays and cable ladders manufactured from hot dipped galvanised steel or grade 304 stainless steel, as specified in the Variations and Additions to the Standard and Particular Specifications, shall be supplied and installed as indicated on the drawings. The height of the cable ladder sides shall be 76 mm with the width to suit the number and size of cables to be installed.

EMCA 8 INSTALLATION OF CABLES

EMCA 8.1 Cable Handling

NOTE - Under no circumstances shall the drums be dropped from the transport vehicle onto the ground.

Small drums can be rolled carefully to the installation point. Drums shall never be allowed to roll freely down a slope. In most instances a drum trailer or similar arrangement shall be used. Battens shall only be removed when ready for installation. When deploying cable from a rotating drum into a trench or duct, it shall be ensured that the drum stand or trailer is firmly located and that rotation of the drum during installation shall not cause any problem.

The Contractor shall ensure that the drum does not lie flat during installation and that coils are pulled off thus causing corkscrew twists. This shall be avoided at all cost as this will cause cable damage and installation problems, the replacement costs for the cable of which shall be for the contractor's account. No bends, kinks, damaged cable shall be accepted.

To minimize problems which may arise due to water/moisture contamination, the following guidelines shall be adhered to:

- a) Do not cut or break into cables until it is absolutely necessary;
- b) Before cutting into or breaking, pump out any standing water in the manhole or trench if applicable;
- c) Before cutting or breaking cable, check weather conditions and if applicable cover the manhole/trench with a tent or waterproof covering (Rain, Thundershowers, Hail, etc.);
- d) When terminating or splicing always arrange the cable working position 'above ground' so as not to allow the cables to lie on the ground or in water;
- e) If a cable end has to be created by cutting through a continuous cable, fit a waterproof sealing end cap until such time is required to open the end of the cable for termination or splicing; and
- f) If cut cables have to be left for a considerable period of time like overnight or longer, then the cable shall have to be sealed to prevent water ingress.
- g) Where patch panel are installed, the patch panels shall be earth bonded to earthing bars.

- h) The Contractor shall strictly comply to all the manufacturers recommendations, and everything shall be accordance to Aberdare Cable Facts and figures booklet. Extreme care shall be used not to damage cables as cable replacement shall be at the contractor's expense.
- i) The Contractor shall use the Aberdare Cable Facts and figures booklet to submit a detailed quality control plan and submit to Engineer for approval.

EMCA 8.2 Cable Trenches

The contractor will be responsible for the excavation, bedding, back-filling, consolidating and making good of all cable trenches along the routes indicated on the drawings, with the exception of those sections of the cable routes where it is specifically indicated on the accompanying drawings that open cable ducts will be provided by others. The Contractor however will be responsible for the bedding and filling soil in cable ducts where necessary. A sealing screed to cover the cable duct shall be provided by others unless otherwise stated in the Variations and Additions to the Standard and Particular Specifications and relevant drawings.

The Contractor may need to adjust trench depths to accommodate bedding where required. The padding and bedding materials shall be sieved to a maximum allowable of 4mm size, approved by the Engineer. Large objects shall not be dumped into the trench. Removal of rubble shall be the responsibility of the Contractor.

All ducts and pipes shall be well sealed at entry/ exit points of manholes/handholes. General Backfill shall consist of the material excavated from the trench, provided that:

- a) The material is easily workable and compactable;
- b) The material is free from organic material (roots, grass etc.) rubbish, clay lumps and aggregates stuck on the 4mm sieve shall be disposed of; and
- c) The material has suitable moisture content and is not too dry.

If the site materials cannot meet these requirements, then suitable material shall be imported. Compaction of suitable bedding material of thickness 100 mm shall be achieved by passes over the whole trench bed, preferably using a Power Vibrating Rammer or a 5 kg hand rammer as an alternative. The cable/duct/sleeve shall then be laid on the prepared bed. For any variations to this procedure, approval shall firstly be required from the Engineer.

An appropriate amount of slack shall be looped and retained where splices are to be made (at all designated sites). Self-expanding polystyrene type foam shall be injected into the communication tube openings after the cable has been pulled in to seal the ends of the tubes and to stop the ingress of sand, rodents, etc. at these manholes.

All trenches shall be backfilled with suitable material that is easily workable and compactable. The backfill material shall be free from grass and roots. If the backfill material is too dry, it shall be moistened prior to placing and compacting.

Each layer of 150 mm thick compacted backfill shall be tested to the following requirements using the standard 5 kg DCP test method or an appropriately SABS recognised Density Test Method:

Road Trenches: Minimum of 5 blows per 100 mm penetration

Sidewalk, driveways and median trenches: minimum of 3 blows per 100 mm penetration

Verge trenches: minimum of 2 blows per 100 mm penetration

Trenches in the verge (unhardened areas) may be backfilled and compacted in 300 mm loose layers. All test results shall be recorded and handed to the Engineer. The Engineer reserves the right to carry out their own DCP testing and should minimum requirements not be achieved on completed work, the Contractor shall be required to remove and redo the operation to ensure compliance.

The procedure to deal with existing services shall be as follows:

- a) Where required trenches have been identified in areas by the Contractor, and where infrastructure are/may be prevalent, pilot holes shall be dug at intervals along that run.
- b) These pilot holes shall be dug either as per one or a combination of the following:
 - ≤ 20 m for trenches less than equal to 200m
 - ≤ 25 m for trenches greater than 200m
 - Or as per the site requirements and/or site instruction.
- c) Pilot holes shall be dug at points where the new trench crosses known existing services, according to way leave plans and/or other drawings and including verbal communication from the client's site personnel.
- d) The pilot holes shall be at least 150 mm deeper and wider than the proposed excavation so as to reveal the presence of any services belonging to other administrations.
- e) These Pilot holes shall be dug by hand, and with the utmost of care.
- f) All excavation work shall be performed under the supervision of a responsible and competent person who shall be competent to exercise such supervision.
- g) Failure to abide by any of the above instructions, may/can lead to damages to existing services. The contractor shall be liable for all damages to existing services, and the subsequent repairs shall be carried out by the contractor without any delay.

The trench shall be laid out in such a position that the cables/ducts/sleeves shall be laid at least 300 mm from power cables. Where this is not possible with services that are in the way of the cable/duct/sleeve and if there is insufficient space for the 300 mm separation, then the cable/duct/sleeve shall be tunnelled 300 mm underneath the other services. Storm-water gutters and drains shall not be obstructed.

Where it is not possible to get the minimum required depth, the cables/ducts/sleeves must be boxed in concrete to a required thickness of 50 mm and strength of 20 MPa. Trenching for cables shall be excavated in straight lines in accordance with the servitude/way leave plan, except where

obstruction or other conditions occur. These areas shall be pointed out to the Engineer for his approval on any route diversions.

Before commencing with cable/duct/sleeve-laying operations in an excavated trench the Contractor shall suitably prepare the trench floor to provide firm support for the cable/duct/sleeve over their full length. To this end he must ensure that the trench floor is free from all loose and or unsuitable material, including soil saturated with water, evenly levelled and at the proper depth required for the cable/duct/sleeve.

The Contractor shall exercise due care in trimming and/or undercutting trench floors to ensure that only the necessary amount of ground is removed. Should the Contractor remove, either by neglect or bad workmanship more ground than is necessary, he shall at his own cost fill such excess excavation with compacted bedding material.

The Contractor shall pay particular attention to the proper compaction of bedding, padding and backfilling material. The approved type of marker tape, orange in colour and a minimum width of 150mm (warning tape with inscription: "**Warning - Fibre Optic Cable Below**" for Fibre and **Electric Cable Below**) shall be laid 300 mm above the cable/duct/sleeve over the entire length of the cable/duct/sleeve run. A high standard of compaction effort shall be incited upon in all cases where fine materials are approved as bedding and padding.

The Contractor shall supply tamping tools for the manual compaction of padding material immediately adjacent to and between the cable/duct/sleeve. A suitable tamping tool shall be provided similar to the following:

- a) A tamping foot made up of a 37 mm diameter steel rod 300 mm long securely attached to a vertical handle made up of 20 mm steel rod 1.35 meters long.

During the compaction of padding and backfill material the Contractor must exercise due care to ensure that cable/ducts/sleeves are not disturbed or damaged in any way. The use of non-cohesive, single size, graded sand or crusher sand for bedding, surround blankets and backfilling of trenches shall not be permitted.

NOTE: Tenderers shall acquaint themselves fully with the nature and formation of the ground in which the cables are to be laid, before submitting a Tender. No subsequent claim for extras due to lack of knowledge in this respect will be entertained by the Employer.

Cable trenches for low Voltage power and lighting cables shall be deep enough to facilitate the laying of these cables at a depth of minimum of **750mm** below final ground level.

Trenches for Medium Voltage power cables shall be deep enough to facilitate the laying of these cables at a depth of **1000mm** below ground level. The floors of all cable trenches shall be smooth and free from boulders and sharp rock projections.

Each cable shall be laid in a bedding of river sand or sifted soil [4mm sieve – the soil shall first be approved by the Engineer] 75 mm over and 75 mm below the cable. Clayey soil will not be accepted as bedding.

o cable trench shall be back-filled before the cable(s) in the trench has been inspected and approved by the Engineer.

EMCA 8.3 Under Ground Cable Pipes

Cable pipes will be supplied and installed by others unless indicated otherwise on the drawings. Each cable pipe shall be sealed by the Contractor under this Contract at both ends by means of bitumen impregnated jute bags or similar material, after the cable has been installed.

EMCA 8.4 Cable Slabs

Where electrical cables cross above other services such as water pipes, sewerage pipes, other electrical cables, pilot cables and telephone cables or where danger exists that cables may be damaged due to excavations by others cables shall be protected by means of reinforced concrete slabs. The concrete slabs shall protect the cable for at least 0,5 m in both directions of the crossing.

Where electrical cables cross underneath other services such as water pipes, sewerage pipes, post office cables etc. a concrete slab shall be placed above and axial with the other service and should the free space between the two services be less than 300 mm an additional slab shall be placed axial with the electrical cable between the two services.

Where cables are laid down a grading and a possibility exist that the cables might be washed open due to rain, then cable slabs shall be placed on top of the cables for the entire length of the grading.

The concrete slabs shall be supplied and installed under this Contract.

EMCA 8.5 Cable Crossing With Other Services

EMCA 8.5.1 General

Where a cable is laid above another service it shall not be less than 750 mm below ground level, and if this is not possible, the cable shall be laid underneath the other service and shall be protected by means of concrete slabs in the manner prescribed. The deeper or shallower positions of the cable shall only apply for a distance of 1 m on both directions of the crossing.

If not possible to cross underneath the other service the matter shall be referred to the Engineer for a decision.

EMCA 8.5.2 Clearances

The following minimum clearances shall be maintained between electrical cables and other services:

DESCRIPTION	VERTICAL	HORIZONTAL
Telkom cables	0,3m	0,3m

Other water pipes	0,3m	0,3m
Sewerage pipes	0,3m	0,8m
Storm water pipes	0,3m	0,6m
Other Electrical cables	150mm	150mm

EMCA 8.6 Cables must be Laid without Delay

The cables shall be laid with the minimum of delay in order to backfill the trenches as soon as possible.

The Contractor shall, however not backfill the trench until each length of cable has been tested, inspected and approved by the Engineer.

Only one cable shall be laid at a time and the Contractor shall ensure that cables already laid are not damaged.

EMCA 8.7 Method

All cables shall be handled with the utmost care and shall be laid in accordance with the best methods observed in good modern practice. All cables shall be run out on rollers in order to prevent abrasion and no cable shall be dragged along the ground. No cable shall be bent to a radius of less than 12 times its overall diameter.

a) In Concrete Ducts

Cables shall be laid neat parallel with each other on the floor of the duct with the maximum spacing. Any other cables shall be installed on cable ladders secured to the vertical sections of the cable ducts.

b) On cable ladders

Cable shall be installed neat and parallel with each other with the maximum spacing. On Horizontal sections the cables shall be secured to the cable ladders with intervals of not more than 2m. On vertical sections or where the cable ladders are installed at an angle the cables shall be secured to the cable ladders with intervals of not less than 500mm with suitable strapping material approved by the Engineer.

Either stainless steel or hot dipped galvanized steel cable strapping material shall be used on outdoor cable installations depending on the cable rack or ladder material.

Sections of the cable ladders shall be electrically connected and provision shall be made for crimping and expansion of the racks.

c) In Trenches

Two or more L.T. cables in the same trench shall be laid in a straight line and in parallel and not less than 75mm apart between cable route turning points, except where otherwise approved. Cable routes shall always follow routes parallel to permanent structures to facilitate as built information.

H.T. cables in the same trench shall be laid parallel and not less than 150mm apart, except where otherwise approved.

All L.T. power cables shall be laid 750mm below final ground level and H.T. power cables shall be laid 1 m below final ground level.

The contractor shall provide 3m slack at each end in each run of power cable and its associated earth wire and bury the same in the ground as near to the relevant end as possible. Where the cables and earth wires are to be installed in open ducts outside buildings, the slack shall be coiled in the ducts.

The separation between any signal cable and the nearest parallel power cable shall not be less than 150mm.

d) Against Walls

Cables and earth wires to be installed on walls, where approved by the Engineer, shall be neatly installed on heavy-duty hot dipped galvanised steel cable racks. Cables and earth wires on outside walls shall be installed in a similar manner or in suitably sized hot dipped galvanised conduit from 300 mm below up to 2,4 m above final ground level or as required. These conduits shall be secured to the walls by means of hot dipped galvanised steel bat holders at intervals not exceeding 600 mm. (Hospital Saddles).

Saddles shall only be secured by means of round-headed hot dipped galvanized screws and plugs of an approved type. (Wood will not be accepted as plugging material.) Plugs will not be allowed in joints between bricks.

e) On Poles

Cables and earth wires to be installed on poles shall be secured to the poles at intervals not exceeding 600 mm by means of 25 mm x 1,5 mm adjustable Grade 304 Stainless Steel straps. Each cable together with its associated earth wire shall be installed in a suitably sized stainless steel pipe or channel from 300 mm below up to 2,4 m above ground level. This pipe or channel shall be secured to the pole by means of 25 mm x 1,5 mm adjustable stainless steel straps at intervals not exceeding 600 mm. To avoid metallic action between different materials Neoprene rubber strip shall be installed between the pole and the strap.

f) Cable Channels on Structures and in Buildings

Where cable channels have been provided on structures and in buildings these must be backfilled with river sand by the contractor.

g) Cables connected to motors and other equipment

Cables and earth wires connected to motors and other equipment shall be secured between the cable channels, cable rack or cable tray to the point of termination by means of a heavy-duty hot dipped galvanised type of cable support. The cable shall be secured to the cable support by means of steel straps or other acceptable strapping material.

EMCA 8.8 Inspection of Cables and Cable Trenches

After the cables have been installed and spaced on top of the 75mm thick layer of sand in the trenches, the installation shall first be inspected and approved by the Engineer before the trenches may be refilled. Should the Contractor not meet with the requirement, or if he fails to give the Engineer sufficient notice of an inspection, portions of the trenches or the complete trench shall have to be re-excavated by the Contractor at his own expense for inspection by the Engineer.

A logbook with three copies per page shall be kept by the Contractor on the site, in which each part of the installation that has been inspected can be recorded after inspection and approval.

EMCA 8.9 Backfilling of Trenches

Once the cable has been laid, straightened, inspected, approved and covered with the top layer of bedding soil, the trenches shall be backfilled with soil which does not contain more than 40 % rock or shale and will pass through a sieve with 100 mm diameter holes that has been approved by the Engineer.

Back filling of cable trenches shall be done in layers of 150 mm and shall be compacted and consolidated to 95% modified AASHTO. Test shall be carried out to ensure the required compaction at the cost of Contractor.

The Contractor shall maintain the closed up sections of the cable trenches in a proper, safe condition for the duration of the contract. Where the soil in the trenches subsides it shall be refilled and compacted to the satisfaction of the Engineer.

Bedding: This shall refer to the material constituting the even floor of an excavated trench onto which a duct or a bank of ducts is laid (+/-100mm).

Padding: This shall refer to the material installed around and/or between ducts up to a level of at least 150 mm above the duct or bank of ducts.

Backfilling: This shall refer to the material installed above the padding material layer to complete the refilling of an excavated trench.

The 3 layers of material in the backfilled trench shall be classified as bedding, padding, and main backfill. The bedding and padding material shall not be too fine, and shall be free of large stones (it shall be evenly graded between 0,6 mm and 19 mm). Clay type material shall not be acceptable (the PI shall not exceed 12 and the compaction factor shall not exceed 0.4).

EMCA 9 INSTALLATION OF CABLE TRAYS AND CABLE LADDERS

The cable ladders shall be secured on suitable lengths which shall be suspended from the roof slab by means of suitable lengths 8 mm dia threaded hot dipped galvanized steel rods or secured to the walls with suitable sized hot dipped galvanized steel Rawl type bolts and shall be secured to the channel sections by means of two hot dipped galvanized nuts and washers.

The different parts of the trays and ladders must be thoroughly bonded electrically and mechanically to each other.

The cable trays and ladders shall be installed neatly, level and square/parallel to walls.

Cable straps suitable for the specific cable shall be employed to secure the cable onto the tray. Outdoor cable straps shall be stainless steel and cables shall be secured on intervals not exceeding 600mm. Cables on cable trays or ladders in outdoor environments shall be covered with removable cable tray or ladder covers of similar material.

EMCA 10 CABLE SUPPORTS TO MOTORS AND OTHER EQUIPMENT

Cables to motors and other electrical equipment shall be supported by means of hot dipped galvanized cantilever brackets and cable supports. Cables shall be strapped to these supports by means of acceptable strapping material.

EMCA 11 WIRE TRUNKING

Heavy duty hot dipped galvanised wire trunking of sufficient dimensions shall be installed against all large capacity pump set concrete plinths for installation of pump set protection sensor monitoring cables. The monitoring cables shall be installed in hot dipped galvanised conduit from the trunking to the sensor position.

EMCA 12 SENSOR TERMINATION CUBICLE

All large capacity pump set sensor cables shall be terminated in a powder coated mild steel frame mounted termination cubicle with lockable front door secured against the pump set plinth. DIN rail mounted cable conductor termination blocks shall be installed inside the termination cubicle for cable conductor termination.

EMCA 13 CABLE MARKERS

Cable ends shall be properly labelled with reference to equipment, section of plant and other requirements specified by the client at both cable ends.

Cable markers with lead labels cast into the top of the cable markers shall be supplied and installed along the cable routes under this Contract as follows:

Along straight runs of the route, not further than 25 m apart;

At turns - one on each side of the turning point, 900 mm from such turning points;
At each branch, 3 markers - i.e. one on each side of the branch, 900 mm from the branch.

The cable markers shall be installed deep enough to ensure that the top of the marker will protrude 50 mm above final ground level.

EMCA 13.1 Name Tags

Identification tags shall be attached to all cable ends. The tags shall be secured to cables by means of cable ties to the approval to the Engineer.

Cables shall be tagged at either end, whether the end terminates in a distribution board or an end box.

All cable cores and internal panel wiring shall be identified at both ends by means of durable colour coded wire marking ferrules in accordance with numbering systems in cable and wiring diagrams. Only closed ring interlocking type identification ferrules shall be used.

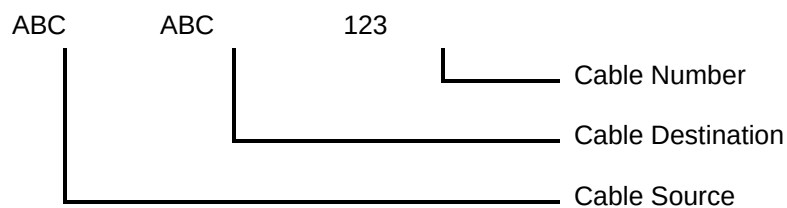
Outdoor tags shall be of stainless steel or brass type and shall be secured by means of similar strapping material.

Tags mounted indoors or protected by an enclosure shall be made of Ivorene or similar sandwich material with black letters on a white background.

All lettering and text shall be approved by the Engineer.

Letter sizes must be compatible with the application and shall not be smaller than 8mm.

a) Cable Naming Convention



b) Table of Areas

Example of area abbreviations:

ILW	-	Inlet works
IMC	-	Inlet motor control centre

c) Example of cable schedule;

Cable Number	From	To	Grade (V)	Size mm ²	No. of cores	Length (m)
ILW-IMC-001	Inlet works	Inlet motor control centre	400	185	4	55
IMC-SCR-001	Inlet works MCC	Screen 01	400	10	4	25

EMCA 14 WARNING TAPES

Warning tape shall be installed along all trench excavated cable routes 300mm above the cables.

Warning tape shall have a minimum width of 300mm and have a bright orange colour with the wording "Danger". The minimum thickness shall be 800 gauge.

EMCA 15 EARTH WIRES

Earth wires shall be installed with L.T. cables as and where indicated on the drawings or specified herein and shall consist of bare hard-drawn copper wire.

These earth wires shall be installed at the same depth as the relevant cables, with at least 75 mm clearance between any earth wire and the nearest cable, unless specifically approved otherwise.

No joint will be allowed in any run of earth wire.

Each earth wire shall be terminated at each end by means of a suitably sized bolted lug either sweated or crimped onto the wire. The lugs shall be bolted onto the relevant earth bars or earthing terminals.

EMCA 16 TESTING OF CABLES

EMCA 16.1 Low Voltage Cables

On each completed section of laid and jointed cable, the insulation shall be tested to approval with an approved "Megger"-type instrument of not less than 500 V.

EMCA 16.2 Medium Voltage Cables

On each completed section of laid and jointed high tension cable a high voltage test shall be carried out. The test shall be performed according to SABS 97 of 1991. Alternating or direct current may be used.

A certificate shall be submitted confirming the successful testing of the relevant cable.

EMCA 17 ROUTE PLANS TO BE SUBMITTED BY THE CONTRACTOR

On completion of the works, but before the certificate of completion will be issued, the contractor shall submit to the Engineer, route plans in electronic format indicating in a satisfactory manner:

- a) The exact cable routes with reference to fixed points (e.g. buildings);
 - b) The exact lengths of cable (HT and LT) installed between terminating points and between joints where relevant; and
 - c) With reference to fixed points the exact positions of cable joints (e.g. buildings).
- Electronic copies of the various plans for the marking up of the information required will be supplied to the contractor on request.

EMCA 18 MEASUREMENT AND PAYMENT

Measurement and payment will be done in accordance with the methods stated below:

EMCA 18.1 Design, Drawing And General

The rate tendered shall include for the provision of the necessary design information for all items measured under the respective schedule. For multicore cables and earthwires, design information shall include, but limited to as listed in this Particular Specifications.

The Contractor shall be required to complete this design and engineering tasks and the contractor shall allow adequate time for the complete design and engineering of the multicore cables and earthwires.

<u>Pay Item</u>	<u>Unit</u>
(a) The Contractor will provide the following design calculations, drawings, method statements, cable routes, cable schedules in excel format which will include but limited to From, To, Distance and Tag numbers all to the approval of the Engineer [Refer to particular specification EMCA 3.3.2, 8.7 & 17]	Sum
(b) Provide operating and maintenance manuals, all data sheets [a) cables, b) joint kits, c) ladders, d) glands, conduit, fasteners and all that are used and etc] and furthermore the Contractor to supply as built" drawings	Sum

EMCA 18.2 Supply And Delivery To Site

Rate tendered to include for all material, equipment, plant, testing apparatus, labour, manufacturing, factory acceptance testing, transport, import duties, handling and possibly double handling, delivery to and off-loading at Site as well as temporary storage prior to installation. For multicore cables and earthwires, the rate tendered shall be for the multicore cables and earthwires and shall include, but not limited to, as detailed in this Particular Specifications. Any special devices shall be listed separately in Variations and Additions to the Standard and Particular Specifications and schedule of quantities.

<u>Pay Item</u>	<u>Unit</u>

(a)	Supply and delivery to site of multicore cables and earthwires and cable name tags for the following cables as per the particular specification	Meter (m)
(b)	Supply and delivery to site of all multicore cables and earthwires termination materials [equal or similar to Enviro Glands, neoprene shrouds, lugs, insulating, materials, cable ties and corrosion proof bolts, washers, spring washers, nuts, etc] to terminate the following cables as per the particular specification	Each
(c)	Supply and delivery to site of cable route markers	Each
(d)	Supply and delivery to site of concrete cable slabs	Each
(e)	Supply and delivery to site of [Type] heavy-duty cable ladder, trunking, welded wire mesh and accessories including all necessary supports, clamps strapping, brackets, reducer splice, hangers, threaded rods, trunking, bolts, nuts and anchor bolts etc as per the particular specification	Meter (m)
(f)	Supply and delivery to site of [Type] heavy-duty cable ladder, trunking, welded wire mesh and accessories including all necessary supports, clamps strapping, brackets, reducer splice, hangers, threaded rods, trunking, bolts, nuts and anchor bolts etc as per the particular specification	Each
(g)	Supply and delivery to site of all [Type] heavy-duty cable ladder supports, bolts, holders and etc that is required as per the particular specification	Sum
(h)	Supply and delivery to site of pump set sensor termination cubicles	Each
(i)	Supply and delivery to site of HPDE heavy-duty cable sleeves, joints, sealing rings, couplings, end plugs, spacer modules, bell mounth, manderel, duct brush flexibend, stainless steel draw wire long bend as per the particular specification	Meter (m)
(j)	Supply and delivery to site of all Equal or similar Pratley EZEE-Fit with solid cover IP68 including non sparking connectors, insulating sleeves, identification tag, mounting screws, locknuts , lockout device with lock, lid securing chain and all accessories	Each
(k)	Supply and delivery to site of all 316 Stainless Steel Conduit with saddles, fasteners, surface mounted against brick or concrete every 500mm and all accessories	Meter (m)
(l)	Supply and delivery to site of all soil for the bedding of cables during excavations including cleaning of cable routes complete as per particular specification.	m ³

EMCA 18.3 Installation

Rate tendered to include for all plant, tools, labour, rigging, handling, placing into position, aligning, fixing, grouting, but not limited to and getting ready for testing and commissioning. Install of multicore cables and earthwires shall be accordance with the manufacturer's written instructions and recognized industry practices, the above particular specification, to ensure that the multicore cables and earthwires complies with the requirements and serves the intended

purposes. Comply with the requirements of SABS and IEC standards and applicable portions of "Standard of Installation" and particular specification, for installation of multicore cables and earthwires but not limited to.

<u>Pay Item</u>	<u>Unit</u>
(a) Installation of all multicore cables and earthwires and cable name tags for the following cables as per the particular specification	Meter (m)
(m) Installation of all multicore cables and earthwires termination materials [equal or similar to Enviro Glands, neoprene shrouds, lugs, insulating materials, cable ties and corrosion proof bolts, washers, spring washers, nuts, etc] to terminate the following cables as per the particular specification	Each
(n) Installation of cable route markers	Each
(o) Installation of concrete cable slabs	Each
(p) Installation of [Type] heavy-duty cable ladder, trunking, welded wire mesh and accessories including all necessary supports, clamps strapping, brackets, reducer splice, hangers, threaded rods, trunking, bolts, nuts and anchor bolts etc as per the particular specification	Meter (m)
(q) Installation of [Type] heavy-duty cable ladder, trunking, welded wire mesh and accessories including all necessary supports, clamps strapping, brackets, reducer splice, hangers, threaded rods, trunking, bolts, nuts and anchor bolts etc as per the particular specification	Each
(r) Installation of all [Type] heavy-duty cable ladder supports, bolts, holders and etc that is required as per the particular specification	Sum
(s) Installation of pump set sensor termination cubicles	Each
(t) Installation of HPDE heavy-duty cable sleeves, joints, sealing rings, couplings, end plugs, spacer modules, bell mounth, manderel, duct brush flexibend, stainless steel draw wire long bend as per the particular specification	Meter (m)
(u) Installation of Equal or similar Pratley EZEE-Fit with solid cover IP68 including non sparking connectors, insulating sleeves, identification tag, mounting screws, locknuts , lockout device with lock, lid securing chain and all accessories	Each
(v) Installation of 316 Stainless Steel Conduit with saddles, fasteners, surface mounted against brick or concrete every 500mm and all accessories	Meter (m)
(w) Installation of all soil for the bedding of cables during excavations including cleaning of cable routes complete as per particular specification.	m ³
(x) Excavating, back filling, consolidation, importation of soil and dumping of all rock and stone removed during excavations including cleaning of cable routes all according to particular specification (including hand	Sum

excavations where necessary along existing cable routes.

EMCA 18.4 Commissioning

Rate tendered to include for the drafting of the necessary testing and commissioning plans, attendance of required local and/or overseas specialists, all testing apparatus, instruments and equipment, any/all consumables required for testing purposes and to prove performance, any/all temporary works, any/all control checks, and compilation of final commissioning report. Comply with the requirements of SABS and IEC standards and applicable portions of "Standard of commissioning".

<u>Pay Item</u>	<u>Unit</u>
(a) Testing and commissioning of all cables	Sum
(b) Updating, verifying and submission of Electronic Cable schedules with Tag numbers and final agreed lengths	Sum
(c) Surveyor to mark-up as-built cable route plans and all mark-up must be on made on the AutoCAD format	Sum

END OF SECTION

ESLS SITE LIGHTING SYSTEM

ESLS 1 SCOPE

As specified in the Project Specifications.

ESLS 2 STANDARDS AND TESTS

The following standards, regulation and drawings, etc. shall be applicable to the electrical installations related to this particular specification, whereas the latest applicable South African Bureau of Standards Codes and Standards should be used;

Standard No.	Description
SANS 156	Moulded case circuit breakers
SANS 1777	Photoelectric control units for lighting
SANS 10142	Code of Practice for the wiring of Premises
SANS 1507	Electrical cables with extruded solid dielectric insulation for fixed installations (300/500 V to 1900/3300V)
SANS 1063	Earth rods and couplers
SANS 1213	Mechanical cable glands
SANS 1433-1	Terminal blocks having screw and screwless terminals
SANS 10199	The design and installation of an earth electrode
SANS 10292	Earthing of low-voltage distribution systems
SANS 10313	The protection of structures against lightning

ESLS 3 15M MAST SITE LIGHTING SYSTEM

The site lighting system will consist of a 15m mast, fitted with 160 W LED flood lights complete with control gear as specified in the project specifications.

Each scissor mast shall be equipped with three (3) floodlights and shall be balanced for easy and safe lowering of mast.

ESLS 3.1 Adjusting of Luminaires

The Tenderer must allow in his Tender for at least one visit to site after dark for adjusting of the luminaires in the presence of the Engineer.

ESLS 3.2 15m Scissor Type Masts

The hinged masts complete with the foundation, prescribed luminaires, circuit breakers inside the mast must be supplied and installed under this contract.

ESLS 3.3 Lighting Columns

The columns offered shall have an overall floodlight mounting height of 15 meters. The cross section and wall thickness of the columns offered shall be determined by the Tenderers on the basis of working loads. However, the manufacturer shall reinforce the column in those sections

which are stressed by the frame during raising and lowering to ensure that the metal in these sections shall not crack, tear, stretch or be damaged in any way. The top of the columns shall have suitable mounting brackets to suit the floodlights offered.

ESLS 3.4 Construction

The column shall be continuously tapered and shall be equipped with tamper-proof locking device for the raising and lowering action of the column.

ESLS 3.5 Protection and painting

All steel parts of the mast and head frame shall be heavy duty hot-dip galvanised.

ESLS 3.6 Electrical equipment and mounting plate

Each flexible multi core cable shall be 600/1000V rated, with a minimum 4 mm² diameter PVC/SWA/PVC copper cable with suitable number of cores. Each core shall be rubber insulated and the multi core cables shall be overall sheathed to give a circular form. The final sheath shall be of chloroprene.

The cable shall have numbered cores with one green/yellow earth core.

The cable shall be provided with an approved tension sock at the point of suspension.

In the event of the luminaire control gear being situated at the bottom of the mast, special cables shall have to be used to allow for the higher voltage, as required. Details of these cables have to be submitted to the Engineer for approval.

ESLS 3.7 Access door to electrical equipment

The access door shall be close fitting, vandal resistant and weatherproof.

ESLS 3.8 Transport

Special care must be taken in the handling of the galvanised mast during loading and off-loading to avoid any damage to galvanised surfaces. During transit, the mast must be supported on wooden blocks and secured in position to avoid surface damage.

ESLS 3.9 Guarantee

The manufacturer shall guarantee the column against faulty workmanship, incorrect design and material specification. Should the column be damaged due to any of the above, the manufacturer shall replace the damaged mast and fittings at own expense. All electrical equipment shall be guaranteed against faulty workmanship for a period of one year as described in the Conditions of Contract.

ESLS 3.10 Installation of masts

The masts shall be installed in accordance with the manufacturer's Specification.

ESLS 3.11 Earthing

Each mast shall be earthed by means of at least 4 x 1,2m earth spikes to allow an earth resistance of 1 ohm or less. Each spike shall be connected with a 70mm² bare copper conductor to the bolting-down assembly inside the concrete foundation. Approved clamps shall be used to ensure positive contact at the connection point between the copper and steel.

The earthing of the electrical installation of the mast is by means of the earthing supplied with the feeder cable. The earth bar in the distribution board shall be connected to the earth stud in the mast.

ESLS 3.12 Pole Lightning arrestor

The contractor shall install a pole lightning arrestor on the top of the high mast to protect the luminaires from direct lightning strikes.

A "Copper weld" copper steel bi-metallic rod with a spindle on top shall be used for the pole arrestor. The minimum length of the pole arrestor shall be equal to the radius of the luminaire cluster with the luminaires installed. The diameter of the "Copper weld" rod shall be submitted to the Engineer for his approval.

The pole arrestor shall be attached to the top column of the mast by means of two non-ferrous mechanical clamps and bolts. A 70mm² single core copper earth conductor shall be installed inside the mast. A cable lug shall be crimped on the two ends of the earth conductor for bolting to the earth bar and pole arrestor as appropriate. Any type of brazing will not be permitted.

ESLS 3.13 Delivery

Prices quoted shall make provision for supply, delivery and installation of material on site.

ESLS 4 STREET TYPE SITE LIGHTING SYSTEM

ESLS 4.1 Street Lighting System

A standard type streetlight mast for suburban routes with total length of 8,5m and single outreach arm of 0,5m complete with 36W LED light fitting and 36W LED lamp shall be supplied and installed as specified and indicated on drawings.

The mast shall be complete with base plate, bottom cable entry, switchgear compartment with removable cover, cable gland plate, 5A circuit breaker and mounting strip for clip on terminal blocks.

ESLS 4.2 Protection and Painting

All steel parts of the mast and head frame shall be heavy duty hot-dip galvanized.

ESLS 4.3 Electrical Equipment and Mounting Plate

Each mast shall be equipped with a hot dipped galvanized gland plate with provision for two number 2 PVC SWA PVC cable glands as well as Din rail mounted type connector blocks for conductor connection and 5 Amp circuit breaker.

ESLS 4.4 Flexible Multi Core Mast Cables

Each flexible multi core cable shall be 600/1000V rated, with a minimum 4 mm² diameter PVC/SWA/PVC copper cable with suitable number of cores. Each core shall be rubber insulated and the multi core cables shall be overall sheathed to give a circular form. The final sheath shall be of chloroprene.

The cable shall have numbered cores with one green/yellow earth core.

The cable shall be provided with an approved tension sock at the point of suspension.

ESLS 4.5 Access Door to Electrical Equipment

The access door shall be close fitting, vandal resistant and weatherproof.

ESLS 4.6 Transport

Special care must be taken in the handling of the galvanised mast during loading and off-loading to avoid any damage to galvanised surfaces. During transit, the mast must be supported on wooden blocks and secured in position to avoid surface damage.

ESLS 4.7 Installation Of Masts

The masts shall be installed in accordance with the manufacturer's Specification.

ESLS 4.8 Earthing

The earthing of the electrical installation of the mast is by means of the earthing supplied with the feeder cable. The earth bar in the distribution board shall be connected to the earth stud in the mast.

ESLS 5 MEASUREMENT AND PAYMENT

Measurement and payment will be done in accordance with the methods stated below:

ESLS 5.1 Supply and Delivery to Site

<u>Pay Item</u>	<u>Unit</u>
Supply and delivery to site of complete mast as specified	Sum
Supply and delivery to site of complete streetlight pole as specified	Sum

ESLS 5.2 Installation

<u>Pay Item</u>	<u>Unit</u>
(d) Installation of complete mast as specified	Sum
Installation of complete streetlight pole as specified	Sum

ESLS 5.3 Commissioning

<u>Pay Item</u>	<u>Unit</u>
(a) Commissioning of complete mast as specified	Sum
Commissioning of complete streetlight pole as specified	Sum

END OF SECTION

ESGS STANDBY GENERATORS

ESGS1 SCOPE

As specified in the Project Specifications

ESGS2 STANDARDS

Cables shall conform to and be in accordance with the latest applicable South African Bureau of Standards Codes and International Standards:

The following Standard Specifications and drawings shall apply:

Standard No.	Description
SANS 1507	Electrical cables with extruded solid dielectric insulation for fixed installations (300/500 V to 1900/3300V)
SANS 10142	Code of Practice for the wiring of Premises
NRS 016	Code of practice for earthing of low voltage distribution systems
NRS 053	Medium voltage cable joints and termination kits
BS 5000-3:2006	Rotating electrical machines of particular types or for particular applications. Generators to be driven by reciprocating internal combustion engines. Requirements for resistance to vibration
BS ISO 3046-1:2002	Reciprocating internal combustion engines. Performance. Declarations of power, fuel and lubricating oil consumptions, and test methods. Additional requirements for engines for general use
BS ISO 3046-3:2006	Reciprocating internal combustion engines. Performance. Test measurements
BS ISO 3046-4:2009	Reciprocating internal combustion engines. Performance. Speed governing.

ESGS3 GENERATOR DETAILS

This item shall comprise the supply and installation of a suitably rated fully automatic standby diesel-alternator set(s) in order to meet at least 120 % of the required maximum demand.

The set shall be operated as an automatic mains failure set with an automatic switch back to main supply system.

The supply and installation of fuel pipes, lubrication oil make-up tanks, oil pipes, starting batteries, inlet air louvers and screen, exhaust silencers and piping, engine protection panels, electrical protection, control panels, attenuation canopy and all the electrical cabling and connections necessary for the complete installation shall be included under this Contract. The set shall be installed on a suitable concrete plinth, provided by others, complete with cable entries.

ESGS4 COMPOSITION OF STANDBY GENERATOR SYSTEM

The installation shall comprise of the following items;

- Fuel piping,
- One or more engine-alternator unit/s
- Engine control/protection, automatic voltage regulator excitation panel,
- One set of engine starting batteries, and charging alternator on the engine/s,

- One set of engine exhaust piping and silencer per engine,
- All the interconnecting cables as well as all the cables to link up with the electricity distribution system on the electrical motor control centre in a separate control room.
- Day tank for the generator set/s,
- The generating set shall be a self-contained unit, installed in a suitable 3-CR-12 powder coated steel container with tamper free door lock mechanisms complete with attenuating louvers.
- All the necessary synchronizing, and load sharing equipment as well as the protection in this respect must be supplied and installed under this Contract. The equipment shall be of well-known and widely maintenance supported manufacture.
- Any other items and auxiliaries to complete the entire installation.

ESGS5 ENGINE ALTERNATOR SET MOUNTING AND COUPLING

The engine, cooling water radiator and generator shall be moulded on a common rigid sub-frame fabricated from rolled steel sections. The sub-frame shall be secured by means of anti-vibration mountings to another fabricated, skid-type steel base frame, suitable for rigid bolting to the foundation. The outer frame shall be equipped with lifting bars suitable for attaching slings to facilitate handling.

The alternator shall be flange-moulded to the engine and the drive to the generator shall be by means of a suitable flexible coupling.

An oil tray shall be provided over the full length of the engine. The sump drain shall extend to outside the base frame.

ESGS6 ENGINE

The engine shall be multi-cylinder, four stroke direct injection, compression ignition type in compliance with BS ISO 3046. The engine shall be de-rated for site conditions in accordance with BS ISO 3046. The engine shall be capable of delivering the output continuously with a 10% overload capacity for any 1-hour in any 12-hours continuous running. The engine must be suitably rated to take full load in one single step.

The engine shall have the following features or auxiliaries:

- Speed 1500 rpm maximum
- Turbo charging and after cooling affect not exceeding 20 % of the prime power output.
- Thermostatically controlled 220V jacket water heater to ensure positive starting at minimum ambient air temperature.
- Electric starter and manual starting buttons.
- Cyclonic type two stage air filters.
- Pressure lubrication.
- Full flow lubricating oil filters.
- Fail safe fuel cut-off solenoid.
- Lubricating oil pressure gauge.
- Cooling water temperature gauge.

ESGS6.1 Starting and Stopping

The starting period for either manual or automatic switching on until the taking over by the generating set, in one step of a load equal to the specified site electrical output, shall not exceed 15 seconds.

The engine shall be fitted with an electric starter motor and be easily started from cold, without the use of any special ignition devices under summer as well as winter conditions.

Tenderers must state what arrangements are provided to ensure easy starting in cold weather. Full details of this equipment must be submitted. In the case of water-cooled engines, any electrical heaters shall be thermostatically controlled. The electrical circuit for such heaters shall be taken from the control panel and must be protected by a suitable circuit breaker.

ESGS6.2 Starter Battery

The genset to be supplied with a fully charged lead acid type battery, complete with necessary electrolyte with capacity as specified below;

- Sufficient starting ampere in order to provide the starting torque stipulated by the engine makers.
- Capacity not less than 120 Ah
- Capable of providing six starts in quick succession. The last three attempts being manual and of 5 second duration.

The battery must be of the heavy duty "low maintenance" type, house in a suitable battery box.

ESGS6.2.1 Battery Charging

A trickle charger shall be incorporated to keep the starting battery in a fully charged state from the mains supply when the set is operated as a standby set. The charger shall be of the constant voltage type with current limiting. A voltage trimming adjustment shall be provided which is accessible by screwdriver from the inside only. The input to the charger shall be fuse protected.

The starting batteries shall be mounted on a stand and thereby kept off the floor.

ESGS6.3 Cooling

The engine may be either of the air or water cooled type.

In the case of water-cooling, a built-on heavy duty, tropical type pressurised radiator on engine alternator set base and engine driven fan and cooling water pump must be fitted. Only stand-by sets that are water cooled shall have electric heaters.

For either method of cooling, protection must be provided against running at excessive temperatures. The operation of this protective device must give a visual and audible indication on the switchboard. Water-cooled engines shall in addition be fitted with a low water cut-out switch, installed in the radiator, to switch the set off in the event of a loss of coolant. The protection shall operate in the same way as the other cut-outs (e.g. low oil pressure). All air ducts for the cooling of the engine are to be allowed for. The air shall be supplied from the cooling fan cowl/radiator face to air outlet louvers in the plant room wall.

ESGS6.3.1 Inlet And Outlet Air Openings And Ducting

The sizes of the building openings shall be designed by the contractor to ensure that inlet and outlet openings shall be sufficient to prevent overheating of the set/s.

The openings shall be flanged and framed by means of 6mm flat steel onto which the Contractor shall supply and mount by means of drilling and tapping screens and louvers to suit his plant.

Hot air ducting of galvanised sheet, with a flexible section shall also be supplied and installed between the engine cooling water radiator and the outlet opening.

ESGS6.4 LUBRICATION

Lubrication of the main bearings and other important moving parts shall be by forced feed system. An automatic low oil pressure cut-out must be fitted, operating the stop solenoid on the engine and giving a visible and audible indication on the switchboard.

ESGS6.5 FUEL SYSTEM

ESGS6.5.1 Fuel Pump

The fuel injection equipment is suitable for operation with the commercial brands of diesel fuel normally available in South Africa.

ESGS6.5.2 Fuel Tanks

A hot dipped galvanised frame mounted bulk fuel tank shall be supplied and installed. The capacity shall be enough to supply full load for at least 24 hours. The fuel tank should be installed on a concrete plinth with bunted walls as provided by the civil contractor. The exact location of the bulk diesel storage will be as indicated on the drawings.

A level control unit shall be installed in the day tank to activate a relay in the generator control panel.

The relay shall be supplied with an auxiliary contact for an "ON" signal to the remote fuel pump and to open the solenoid in the fuel line in the generator room.

The fuel pump, fuel lines from the bulk tank to the day tank and the solenoid in the fuel line shall be supplied and installed under this contract.

The tank shall be fitted with a suitable filter, a full height gauge glass, "low fuel level" alarm, giving an audible and visible signal on the switchboard as well as a low-low fuel level cut-out.

ESGS6.5.3 Fuel Lines

The fuel lines to and from the engine shall be done in black steel piping. A fusible link shall be supplied in each fuel line together with an automatic fuel shut-off valve.

ESGS6.5.4 Fuel Filter and Water Trap

Apart from the engine-moulded filter, a combined fuel filter and water trap shall be installed in every fuel line to the engine.

ESGS6.6 Governor

- Electronic governor to be equal and similar to the American Bosch Governor equipment and to meet the requirements of BS ISO 3046 for Class A2 electronic governors.
- The Governor shall make use of the engine starting battery as auxiliary power source.
- The permanent speed variation between no load and full load shall not exceed 4,5% of the normal engine speed and the temporary speed variation shall not exceed 10% External facilities must be provided on the engine, to adjust the normal speed setting by $\pm 5\%$ at all loads zero and rated load.

ESGS6.7 Flywheel

A suitable flywheel must be fitted, so that lights fed from the set will be free from any visible flicker. The cyclic irregularity of the set must be within the limits laid down in BS ISO 3046.

ESGS6.8 Exhaust Pipe and Silencer

It is essential to keep the noise level as low as possible. An effective exhaust silencing system of the residential type must be provided.

In a building environment the exhaust pipe shall exit through the wall, with the pipe being fixed in or to the wall. The exhaust pipe must be flexibly connected to the engine to take up vibrations transmitted from the engine, which may cause breakage. Any flexibility as may be required shall be provided near the engine.

The exhaust piping and silencer shall be lagged to reduce the heat and noise transmission into the plant room and shall be protected against the ingress of driving rain at 45° to the horizontal. The exhaust pipe must extend 0,5m above the roof gutters. It must be secured by flanges both sides of the wall at the point of exit. These flanges must be clamped to the wall with bolts through the wall.

The exhaust pipe shall be stainless steel.

All asbestos fibre lagging shall be over wrapped by metallic tape to prevent fibre loss.

All exhaust gas ducting and silencing shall be provided with the engine, to suit the layout shown on the drawings, with all passages through wall apertures neatly finished with architraves or flashing supplied and installed by the Contractor.

For air-cooled engines, the exhaust gas ducting shall preferably be inside the exhaust air ducting, which shall be of non-heat conductive material as far as possible and fully lagged. Exhaust air and gas ducting shall be sufficiently robust to preclude deterioration due to operating vibration.

ESGS6.9 Accessories

The engine must be supplied complete with all accessories, air and oil filters, 3 instruction manuals, spare parts lists, the first fill of all lubricating oils, fuel, etc.

ESGS7 ALTERNATOR

The alternator shall be of the type and construction having the following characteristics:

- Self-excited brush less type, with enclosed ventilated drip proof housing and must be capable of supplying the specified output continuously with a temperature rise not exceeding the limits laid down in BS 5000 for rotor and stator windings.

- 400/230V, 3 phase, 50 Hz, star connected with neutral brought out for solid earthing.
- Continuous running duty class S1.
- Full load plus 20% minimum continuous rating at a power factor of 0,8 and an one hour overload rating; the ratings to match the engine continuous and overload ratings at site.
- Protection class IP21 and cooling method ICO1.
- Self-exciting with automatic voltage regulation as specified separately.
- Anti-condensation heaters shall be provided in the generator windings.
- Class F rotor insulation.
- Class B or F stator insulation but temperature rise limits to 80°C by resistance method.
- Both ends of all three windings brought out to dry type terminal boxes which allow phase and neutral connections to be made by means of suitably sized 1000V cables/bus bars and also for a star point to be created within the box.
- Both windings must be fully impregnated for tropical climate and must have an oil resisting finishing varnish.

ESGS7.1 Regulation

The alternator must preferably be self-regulated without the utilisation of solid-state elements. The inherent voltage regulation must not exceed 5% of the nominal voltage specified, at all loads with the power factor between unity and 0,8 lagging and within the driving speed variations of 4,5% between no-load and full load.

ESGS7.2 Performance

The excitation system shall be designed to promote rapid voltage recovery following the sudden application of the load. The voltage shall recover to within 5% of the steady state within 300 milliseconds following the application of full load and the transient voltage dip shall not exceed 18%.

ESGS7.3 Coupling

The engine and alternator must be directly coupled by means of a high-quality flexible coupling, equal and similar to the "HOLSET" type.

ESGS7.4 Alternator Controls

The following alternator set controls shall be supplied and moulded together with the protection devices:

- Voltage setting device.
- Governor setting device to set frequency.
- Frequency meter.
- Combined instantaneous and thermal maximum demand kVA meter.
- Power factor meter.
- Running hour meter.

ESGS7.5 Diesel Alternator Set Protection

The diesel alternator set shall be provided with protection devices for the following conditions:

- Low water level.
- High temperature.
- Low oil pressure.

- Over-speed.
- Under-speed.
- Low fuel level (audible and visual alarm shall be provided when the day tank is half and shall stop the engine just before the day tank is empty).

These occurrences shall cause the engine to stop and in addition voltage free contacts shall be provided to trip the associated alternator circuit breaker.

The over-speed protection shall operate in such a way that the engine is stopped even though it may still be supplied with fuel.

An indication shall be retained by each of these fault conditions. The indication shall be cancelled by a reset pushbutton after the initiating device has reset.

The above protection devices shall preferably be of the solid state, plugged-in modular type.

In addition to the above protection devices for the engine the following protective relays shall be supplied and installed for the generator:

- 3 Phase over-current protection relay.
- An instantaneous restricted earth-fault relay. Suitably rated Current transformers must be supplied and installed in the phase and neutral conductors. If necessary, a timer must be installed to ensure stability under switching transients.
- An over-voltage relay with an additional 0,2-10 sec's timer if necessary.

Tenderers shall satisfy themselves of the suitability, stability and sensitivity of the required scheme. Tenderers shall furthermore supply any additional protection they consider necessary.

ESGS7.6 Excitation and Voltage Regulation

Tenderers must allow for auxiliary equipment and instruments for the complete A.V.R. and excitation system. Full details of the system must be submitted with every Tender.

ESGS8 CONTROL PANEL FOR STANDBY GENERATOR SET

ESGS8.1 General Details

A control cubicle shall be provided for the generator set and it shall house all the electrical equipment associated with starting and stopping of the set, protection of the set, indications and the circuit breakers, contactors and switches controlling the outgoing power circuit and starting battery charger.

ESGS8.2 Cubicle Construction

The control cubicle shall be a separate totally enclosed, floor-mounting unit of rigid sheet metal construction with hinged or removable panels on a rigid channel iron base frame. The cubicle shall be large enough for adequately housing the specified equipment with sufficient electrical clearances and space to make cable terminations and facilitate easy replacement of and maintenance to equipment.

The cubicle shall be constructed with neatly rounded corners and all equipment shall be mounted behind the front panel on sub panels in such a way that only operating handles and instrument faces protrude.

The cubicle steelwork shall be thoroughly cleaned after fabrication, primed with a high quality zinc chromate primer and finished with two coats of baked enamel. The final colour shall be admiralty grey, no. G35 to SANS 1091.

All exposed hinges, catch mechanisms, bolts, screws, etc., shall be chromed. Self-tapping screws shall not be used anywhere on the cubicle.

The cubicle of external cable terminations shall be of the rail mounted clamp type and not less than 8mm wide. All metal components of the terminals shall be of a type that will not allow screws to work loose with vibration.

The set shall be operated as an automatic standby set or as a manually operated pushbutton start standby set, as specified in the Project Specification.

ESGS8.3 Power Control Equipment

The following equipment shall be provided in the power circuit:

- a) One 3-pole main switch (SW1).
- b) One 3-pole generator contactor (C1).
- c) One 3-pole moulded case circuit breaker with shunt and over current trips generator protection (CB1).

The circuit breaker over current tripping curve shall have an inverse time characteristic to prevent spurious tripping on momentary overloads but shall be fast enough to disconnect the alternator before any damage is sustained in the events of short circuit or unallowable sustained overload.

A core balance relay embracing line and neutral connections to the alternator shall be provided and shall operate on the shunt trip coil of the circuit breaker. The core balance relay shall also have an inverse characteristic, and its sensitivity shall be such as to prevent serious lamination damage in the event of an internal winding to earth fault.

Only the coils of contactor C1 and the shunt trip coil of CB1 and their current paths shall operate on 220V AC. C1 shall be complete with auxiliary switches as may be required in the control circuits.

- a) One voltmeter with selector switch and three fuses.
- b) One frequency indicator.
- c) Three current transformer operated ampere meters with instantaneous, immediate past half hour maximum demand and resettable highest past half hour maximum demand indicators, transformers for meters and built-in saturating current transformers for meter protection.
- d) One 3-pole 15kA moulded case circuit breaker for feedback to the main distribution board (CB2).

All the power control equipment operating at 380/220 V including connections, except the contactor control relays, shall be housed in a compartment separate from the one housing the control equipment which will operate at starting battery voltage.

ESGS8.4 Communication Module

An Ethernet communication module shall be supplied for remote monitoring and control of the standby generator set. All available parameters of the standby generator set shall be displayed on the SCADA system.

ESGS8.5 Alarm Equipment

Three alarm lights are required to indicate the following:

- Start failure.
- Engine faults.
- Fuel shortage.

These lights are to be turned off when acknowledged on a push button or toggle switch on the panel. An alarm hooter shall also sound on any of these failures and shall be turned off by acknowledgement on a separate push button or toggle switch.

ESGS8.6 Instruments

Indicating instruments shall be as far as possible of the same size and appearance with a scale length of approximately 90 mm and Class 1.5 accuracy.

ESGS8.7 Generating Set Control Equipment

The generating set control and protection equipment shall operate on a supply derived from the starting battery except the control current paths for CB1 and C1.

The control circuitry for the generating set shall be designed to suit automatic standby duty and a three phase mains monitoring relay shall be provided for controlling the starting and stopping of the set and change-over of the mains and generator contactors.

The normal (automatic) operation of the set shall be as follows:

- SW1 and CB1 must be on and if this condition is not fulfilled then start-up must be inhibited.

On receipt of a mains failed signal, the starting cycle shall be initiated. The starting cycle shall be locked out after three failures to start, and an alarm sounded with the relevant alarm light lit.

ESGS8.8 Normal Start-Up

In case of start-up, contactor C1 shall be closed only if the following conditions have been fulfilled:

- a) The speed (frequency) is within acceptable limits.
- b) The voltage is within acceptable limits.
- c) A period of 10 seconds has elapsed after start-up.

ESGS8.9 Normal Shutdown

Normal shutdown of the set shall be initiated by removal of the start signal. C1 shall open if mains power becomes available.

The opening of C1 shall initiate a timer set to 5 min. after which period the engine shall be stopped, provided also that the starting battery is in fully charged condition. The time delay is to provide a cooling down period at no load as well as to prevent cycling during short power restorations.

ESGS8.10 Test running

For test running of the set a key operated switch shall be provided which when operated will simulate a power failure and cause the set to start. The key shall be trapped in this position.

When returned to normal the set shall be caused to stop in the normal manner. Whether the set is tested on load or off load shall depend on the position on SW1. Initially, testing the set this way will always result in an off load test.

ESGS9 CABLING TERMINATIONS AND DUCTING

All the necessary ducts for cabling and piping must be made available under this contract.

The Contractor shall supply and install all the control cabling and wiring necessary for the complete installation.

The power cables/bus bars between the alternator and the circuit breaker on the Control panel shall be suitably sized and shall all be supplied and installed under this Contract.

ESGS9.1 Small Wiring

Small wiring shall be done in P.V.C. insulated conductors of the following types:

- Flexible conductors of not less than 2,5 mm² of 300/500V grade to table M of SANS. 1507.
- Seven strand conductor of not less than 2,5 mm² or otherwise in compliance with SANS. 1507 for 600/1000V grade cores

ESGS9.2 Low Voltage and Multicore Cabling

The conductors shall be of high conductivity copper insulated with one layer of P.V.C.

The colour of the cores of 2, 3 and 4 core cables shall be as follows:

- Twin Core: One Red and One Black
- Three Core: One Red, One White and One Blue
- Three Core: (Single Phase): One Red, One Black and One Green/Yellow
- Four Core: One Red, One White, One Blue and One Black

The cores of cables with more than four cores may be coloured or numbered.

The cores are to be twisted together, bedded, and sheathed with P.V.C. (preferably black) armoured with a layer of galvanised steel wire, bedded and served with black P.V.C.

All insulation shall be for general service 1 000 volt grade.

The cable is to be in accordance with SANS 1507.

Cables with cores of less than 4 mm² area shall not be used.

ESGS9.3 Terminals

Terminals may be of the stud type otherwise of the rail moulded clamp type. All types together with their insulation shall have a minimum comparative creep index of 500.

Stud type terminals shall be of a type which cannot rotate in their insulation. Studs shall be of brass of not less than 6 mm dia. brass.

Studs shall not carry current through the insulation.

Not more than two connections per terminal shall be made. Locknuts or spring washers shall be used to prevent loosening of connections with vibration.

Terminals carrying voltages over 42 volts shall be protected by insulation.

Clamp type terminals shall be at least 8 mm wide.

Screws and clamps shall be plated against corrosion and screws shall be self-locking type unaffected by vibration.

Current carrying parts shall be of copper or brass, grooved and silver plated.

Only one connection per terminal entry may be made. For more connections more terminals with central bridge pieces shall be used.

ESGS9.4 Marking of Wiring and Cable Ends

All small wiring and cable ends shall be marked in accordance with the requirements of The Particular Specification for Cables. Marking ferrules shall be prevented from coming off the conductor ends by the terminal lugs.

ESGS9.5 Termination of Wiring and Cable Ends

All wiring and cable ends shall be terminated with proper cable lugs entirely suitable for the type of terminal.

ESGS9.6 Glands for PVC-SWA Cable

Glands shall be of the adjustable type, and shall be suitable for PVC SWA PVC general purpose 1 000 Volt cable.

The non-watertight glands must be easily converted to watertight glands by means of a waterproofing shroud.

The glands are to be made of copper plated and heavily tinned bronze or brass, and shall consist of a barrel, with a cone nut carrying a cone bush screwed into one end and a hot tinned steel nipple carrying a heavy galvanized steel lock nut screwed into the other end.

On the cable entrance side of the barrel, a round groove shall be provided, for taking the top rim of the waterproofing shroud.

The shrouds are to be made of non-deteriorating neoprene or synthetic rubber, and shall be resistant to water, oil and sunlight. The shrouds shall tightly fit around the glands and cable.

ESGS10 General

ESGS101 Painting and Corrosion Protection

The Contractor shall give full details in the TECHNICAL SCHEDULE of the painting system he proposes. The colour of finishing coats shall conform to SABS 0140: PART II.

EGS10.2 Markings and Labels

The standard nameplates of manufacturers giving information on manufacturer type, class, rating etc., will be accepted unaltered.

All controls related to the starting, stopping and running of the plant and all alarms shall be properly marked with plastic labels engraved with contrasting characters in both Afrikaans and English. Characters shall not be less than 4 mm high.

Labels shall be fixed with chrome-plated screws. The wording of all labels, nameplates excluded, shall be submitted for approval.

ESGS10.3 Identification

Engines are to be provided with a substantial information plate fastened securely to the engine in an easily visible position.

The plate must be clearly and indelibly marked (i.e. painted lettering is not adequate), showing at least the following data:

- a) Manufacturer's name, engine model and serial number.
- b) Contract number.
- c) Supply agency.
- d) Country of origin where not manufactured locally.
- e) Year of manufacture.
- f) Capacity of engine.
- g) Sea level rating at nominal ambient conditions.
- h) Site rating.
- i) Mass of engine complete.
- j) Type of lubricating oil to be used.

ESGS10.4 Spares

Tenderers must submit a priced list of recommended spares to be kept in stock by the Client.

ESGS10.5 Noise

The noise level of the complete unit, (engine and driven load) shall be kept to an intensity less than 84db(A) at 0,5 m, in the open.

The Contractor shall be responsible for achieving this sound level and shall give full details in the TECHNICAL SCHEDULE of any insulation he proposes to install in order to achieve this level.

ESGS11 HANDLING

Engines shall be closed crated for transporting to Site, with crating fully adequate for the protection of all parts from impact damage and from dust or grit ingress.

Where it is necessary for engines to be stored either at the place of manufacture or supply, or at the Site, they shall be stored under cover and guarded against excessive moisture or windblown dust or grit.

Engines shall be stored on timbers to raise them off the ground, and all inlets and outlets shall be adequately sealed.

ESGS12 INSTALLATION

Installation on Site shall only be carried out by competent workmen under experienced supervision. Site fabrication, if any, shall be done in a workmanlike manner without damage to other sections of the Works.

ESGS13 COMMISSIONING

Commissioning of the engines shall be done in the presence of the Engineer.
Commissioning shall comprise the checking of each function of each accessory to the engine as well as a 2-hour duration running of the engine, under load if feasible, to ensure consistent oil pressure and temperature.

ESGS13.1 Instruction of Attendant(s)

During commissioning of the set, and after, if necessary, the Contractor shall instruct an attendant or attendants in the operation of the plant until he/they is/are fully conversant with the operation and maintenance of the plant.

ESGS14 TESTS

The following tests shall be done by the Contractor in the presence of the engineer and the client.

- Factory test reports
- Field test reports and other documentation including a description of the test procedures and inspections with results listed for each test performed in a type-written format. Include results of tests, inspections and retests.

The following tests shall be done by the Contractor in the presence of the client.

ESGS14.1 Works Tests

Before delivery to site as many of the tests possible in accordance with BS ISO 3046 shall be done at the manufacturer's works. Tenderers shall state what load tests can be done at their works. If proper load tests and sudden application and rejection of loads cannot be done, to prove governor and A.V.R. responses, then these will have to be done after installation at site.

Stripping of engines after testing will not be required.

The Contractor shall supply the fuel required for works tests.

Sufficient notice shall be given to the client of the proposed testing date(s).

ESGS14.2 Site Tests

After completion of the installations site tests shall be done to prove the correct function of all controls and protection.

Generators shall be dried out by running the sets and circulating full load current on short circuit and taking insulation resistance/time curves.

Tests shall be done to prove correct functioning of all controls, protection and synchronising.

Fuel consumption tests shall be done. These tests shall be done at full, three quarter and half load. (A dummy load must be provided for full load tests by the Contractor).

If called for by the Client a twenty-four-hour test shall be carried out at full load with a 10% overload for 1 hour in every 12-hour period. Afterwards curves shall be drawn of all the variable parameters such as speed, temperature, oil pressure, fuel consumption, etc.

ESGS15 GUARANTEE AND MAINTENANCE

The Contractor shall guarantee and do the normal maintenance for the complete plant for a period of twelve months from the date it has been taken over by the Client in good running order.

Warranty and Service of the Unit

12 months – Defects - The Rates for the Generator shall include the Servicing of the Unit in the Defects Liability Period

Typical Service Tasks in the Defects Liability: Min 2 Services in 12 months

- **Oil and filter changes:** Oil and filter replacements
- **Fuel system maintenance:** Cleaning fuel filters, checking fuel lines, and inspecting injectors help ensure efficient operation.
- **Cooling system checks:** Inspecting coolant levels, radiator condition, and thermostat function is crucial for preventing overheating.
- **Battery testing:** Battery testing and replacement, if necessary, for reliable starting.
- **Electrical system inspection:** Checking wiring, connections, and control components helps prevent electrical failures

ESGS16 DOCUMENTATION

ESGS16.1 Drawings Accompanying Tenders

Drawings shall be submitted with all Tenders to show the general appearance of main equipment offered. Salient dimensions only are required on such drawings.

ESGS16.2 Contract Drawings

Within two months after the commencement date of the Contract, the Contractor shall submit duplicate paper prints of general arrangement drawings and circuit diagrams to the client for approval. Drawings to be revised shall be re-submitted until final approval is obtained.

After approval four further paper prints shall be supplied.

A transparent print of each approved drawing on film shall be supplied when so requested by the client.

Drawings shall only be done on A1 size of sheets with the long sides of the sheets orientated horizontally.

This will facilitate the eventual binding of Engineer's and Supplier's drawings in one volume.

Drawings shall be done in accordance with the requirements off the specifications.

General arrangement drawings shall show front and side elevations together with salient dimensions and the positions of fixing holes and external connections as well as clearances or space required for withdrawal or lifting of major pieces of equipment for servicing or maintenance purposes. The layout of instrument and control panels shall also be shown.

Diagrams, and the symbols used shall be in compliance with the requirements of B.S. 3939.

In circuit diagrams preference shall be given to showing a circuit element in its correct electrical position in the current path rather than attempting to keep all the elements of a device together. A current path shall be drawn as far as possible in a straight line and crossing of different current

paths shall be avoided as far as possible. In this connection refer to B.S. 3939: Introduction Page 11 and also B.S. 3939: Guiding Principles, Clause H3 and N3.
Wiring diagrams for switchgear are not required.
Diagrams showing cable connections between units of an installation shall be supplied.

ESGS16.3 Handbooks

Handbooks shall contain complete information on the following aspects of all units comprising a working installation:

- Technical descriptions and specifications of equipment.
- Erection and commissioning instructions.
- Operating instructions.
- Description of functioning, adjustment and maintenance of equipment.
- Parts lists, with illustrations where necessary, for ordering of replacements.

ESGS17 MEASUREMENT AND PAYMENT

Measurement and payment will be done in accordance with the methods stated below:

ESGS17.1 Supply and Delivery to Site

	Pay Item	Unit
a)	Supply and delivery to site of complete Standby generator set as specified	Sum
b)	Supply and delivery to site of complete automatic mains failure Start-up system as specified	Sum
c)	Supply and delivery to site of complete automatic change over system as specified	Sum
d)	Supply and delivery to site of complete sound attenuation enclosure as specified	Sum
e)	Supply and delivery to site of complete fuel tank complete with mounting frame	Sum

ESGS17.2 Installation

	Pay Item	Unit
a)	Installation of complete Standby generator set as specified	Sum
b)	Installation of complete automatic mains failure Start-up system as specified	Sum
c)	Installation of complete automatic change over system as specified	Sum
d)	Installation of complete sound attenuation enclosure as specified	Sum
e)	Installation of complete fuel tank complete with mounting frame	Sum

ESGS17.3 Commissioning

	Pay Item	Unit
a)	Commissioning of complete Standby generator set as specified	Sum
b)	Commissioning of complete automatic mains failure Start-up system as specified	Sum
c)	Commissioning of complete automatic change over system as specified	Sum
d)	Commissioning of complete sound attenuation enclosure as specified	Sum
e)	Commissioning of complete fuel tank complete with mounting frame	Sum

END OF SECTION

PORTION 5: DRAWING INDEX

<u>Drawing Register Umzinto WWTW Phase 2</u>	
<u>DWG. NO.</u>	<u>DRAWING DESCRIPTION</u>
	GENERAL:
1843.30.AAA.01.A001	DRAWING REGISTER
1843.30.AAA.01.A010	PROCESS FLOW DIAGRAM
1843.30.AAA.10.U001	LOCALITY PLAN
1843.30.AAA.10.U002	EXISTING WORKS AND BM POSITIONS
1843.30.AAA.10.U003	SITE LAYOUT
1843.30.AAA.01.L001	HYDRAULIC PROFILE
	INLET STRUCTURE
1843.30.WBA.14.D001	EXISTING INLET DIVISION STRUCTURE – PLAN, SECTION & DETAIL
	BIOLOGICAL REACTOR:
1843.30.WIA.14.A001	3D VIEWS
1843.30.WIA.14.U001	PLAN
1843.30.WIA.14.D001	DETAIL PLAN A,B & STAIR ELEVATION A
1843.30.WIA.14.X001	SECTIONS AND DETAIL A
1843.30.WIA.14.M001	PIPE ITEM SCHEDULE
	BIO-FILTER:
1843.30.WHA.14.D001	EXISTING BIO-FILTER - PLAN AND SECTION
	SETTLING TANKS:
1843.30.WDA.14.D001	PRIMARY DORTMUND TANKS - PLAN, SECTIONS AND DETAILS
1843.30.WDB.14.D001	SECONDARY SETTLING - PLAN
1843.30.WDB.14.D001	SECONDARY SETTLING - SECTIONS
1843.30.WDA.13.M001	PIPE ITEM SCHEDULE
	CHLORINE CONTACT TANK:
1843.30.WNA.14.A001	3D VIEWS
1843.30.WNA.14.D001	PLAN AND SECTIONS
1843.30.WNA.14.M001	PIPE ITEM SCHEDULE
	ANANEROBIC DIGESTER:
1843.30.WKA.14.D001	PLAN AND SECTIONS
	PUMP STATION:
1843.30.WPA.14.D001	EXISTING RECYCLE PUMP STATION - PLAN, SECTIONS AND DETAILS
1843.30.WPB.14.D001	RAS PUMP STATION - PLAN AND SECTION

	SITE PIPEWORK:
1843.30.AAA.10.U004	SITE LAYOUT: PIPEWORK
	BUILDING WORK:
1843.30.SUB.16.D001	MCC ROOM - PLAN, SECTIONS AND DESCRIPTIONS
	ROADS AND PAVING:
1843.30.GZA.03.U001	PLAN
1843.30.GZA.03.D001	TYPICAL DETAILS
	DETAILS:
1843.30.WAA.14.D001	NAMEBOARD
1843.30.WAA.14.D002	TYPICAL STEELWORKS ITEMS
1843.30.WAA.14.D003	TYPICAL STORMWATER DETAILS
	ELECTRICAL:
1843.30.AAA.12.U001	EXISTING ELECTRICAL - LAYOUT PLAN
1843.30.AAA.12.U002	NEW ELECTRICAL - LAYOUT PLAN

PORTION 6: ANNEXURES

- 6.1 Baseline Risk Assessment: (By L P . H& S Consultants)**
- 6.2 Health and Safety Specifications: (By L P . H& S Consultants)**
- 6.3 Environmental Management Specification (Baboloki Geohub)**
- 6.4 Geotechnical Investigation Final Report (By Bazi Dukhan Consulting Engineers)**