DR. PIXLEY KA ISAKA SEME LOCAL MUNICIPALITY

TENDER DOCUMENT`

T15/2023: APPOINTMENT OF A CONTRACTOR FOR REFURBISHMENT OF VOLKSRUST WATER TREATMENT WORKS

ISSUED BY:
The Municipal Manager
DR. PIXLEY KA ISAKA
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PREPARED BY:
Mzolo Consulting Engineers

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Tel: +27 (0) 64 953 9233
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NAME OF TENDERER: ……...

SUPPLIER NO AS PER CSD:……

TENDER AMOUNT (INCL.VAT@15%):……..

CLOSING DATE: FRIDAY, 26 JANUARY 2023 AT 12:00

DR. PIXLEY KA ISAKA SEME LOCAL MUNICIPALITY

T15/2023: APPOINTMENT OF A CONTRACTOR FOR REFURBISHMENT OF VOLKSRUST WATER TREATMENT WORKS

CLOSING DATE AND TIME: FRIDAY, 26 JANUARY 2023 at 12:00

Tenders are hereby invited from Local SMME's, emerging contractors and co-operatives to submit bids for the **T15/2023: APPOINTMENT OF A CONTRACTOR FOR REFURBISHMENT OF VOLKSRUST WATER TREATMENT WORKS.**

Tenderers should have a CIDB contractor grading of 6ME or Higher.

Tender documents will be obtainable on **Tuesday, 16 January 2023** from 09H00am at the Finance Department (Volksrust Offices) upon payment of a non-refundable tender levy of R594.00 or may be downloadable free of charge from www.etenders.gov.za. Only bank guaranteed cheques or cash will be accepted. The compulsory briefing session will be held as per the abovementioned dates at the municipal offices in Volksrust and tenderers are expected to meet the Municipal representatives punctually as indicated. Failure to attend will result in a bidder not being considered.

Duly completed tenders must be sealed in an envelope clearly marked: **"MUNICIPAL MANAGER, DR PIXLEY KA ISAKA SEME LOCAL MUNICIPALITY, T15/2023: APPOINTMENT OF A CONTRACTOR FOR REFURBISHMENT OF VOLKSRUST WATER TREATMENT WORKS**
CLOSING DATE: **FRIDAY, 26 JANUARY 2023** AT 12H00 must be placed in the tender box at Dr Pixley Ka Seme Local Municipality offices, c/o Adelaide Tambo Street & Dr Nelson Mandela Drive in Volksrust not later than **FRIDAY, 26 JANUARY 2023** when tenders will be opened in public.

Late tenders, incomplete tender documents and tenders per email or fax will not be accepted and the Dr Pixley Ka Isaka Seme Local Municipality does not bind itself to accept the lowest or any tender. Dr Pixley Ka Isaka Seme Local Municipality reserves itself the right to accept a tender as a whole or in part.
All administrative enquiries can be directed to Ms. M.Ralinotsi at 017 734 6163 and the technical enquiries can be directed to Ms. M.Mabhengu.

MR. M A NGCOBO
MUNICIPAL MANAGER

NOTICE NO: T15/2023

TENDER NO.	PROJECT NAME	CIDB GRADING	ENQUIRIES	COMPULSORY BRIEFING SESSION DATE &TIME	CLOSING DATE
T15/2023	APPOINTMENT OF A CONTRACTOR FOR REFURBISHMENT OF VOLKRUST WATER TREATMENT WORKS IN WARD 4	6ME or higher	Ms.M. Ralinotsi Tel 017 734 6100 or M. M.Mabhengu for technical enquiries.	Friday, 19 January 2024 at 10:00	Friday, 26 January 2024 at 12:00

Contents

Number	Heading
The Bid	
Part T1: Bidding procedures	
	Bid Notice and Invitation to Bid (White)
T1.2	Bid Data (Pink)
Part T2: Returnable documents	
T2.1	List of Returnable Documents (Yellow)
	MBD Forms (Yellow)
The Contract	
Part C1: Agreement and Contract Data	
C1.1	Form of Offer and Acceptance (White)
C1.2	Contract Data (Yellow)
C1.3	Form of Guarantee (Yellow)
Part C2: Pricing data	
C2.1	Pricing Instructions (Yellow)
C2.2	Activity Schedule or Bills of Quantities(Yellow)
Part C3: Scope of Work	
C3	Scope of Work (Blue)
Part C4: Site information	
C4	Site Information (Green)
	Drawings (White)

T1.2 Bid Data

The conditions of Bid are the Standard Conditions of Bid as contained in Annex F of the CIDB Standard for Uniformity in Construction Procurement. (See www.cidb.org.za) which are reproduced without amendment or alteration for the convenience of Bidders as an Annex to this Bid Data

The Standard Conditions of Bid make several references to the Bid Data for details that apply specifically to this Bid. The Bid Data shall have precedence in the interpretation of any ambiguity or inconsistency between it and the standard conditions of Bid. Each item of data given below is cross-referenced to the clause in the Standard Conditions of Bid to which it mainly applies.

The additional conditions of Bid are:

Clause number	Bid Data
F.1.1	The employer is the DR. PIXLEY KA ISAKA SEME LOCAL MUNICIPALITY
F.1.2	The Bid documents issued by the employer comprise: T1.1 Bid notice and invitation to Bid T1.2 Bid data T2.1 List of returnable documents T2.2 Returnable schedules **Part 1: Agreements and contract data** C1.1 Form of offer and acceptance C1.2 Contract data C1.3 Form of Guarantee C1.4 Adjudicator's appointment **Part 2: Pricing data** C2.1 Pricing instructions C2.2 Activity schedules / Bills of Quantities **Part 3: Scope of work** C3 Scope of work **Part 4: Site information** C4 Site information
F.1.4	The employer's details are: Name: **Dr. Pixley Ka Isaka Seme Local Municipality** Address: **c/o Adelaide Tambo & Dr. Nelson Mandela Drive Volksrust, 2470** Tel: 017 734 6100 Fax: 086 630 2209 E-mail: records@pixleykaseme.gov.za
F.2.1	Only those Bidders who have in their employ management and supervisory staff satisfying the requirements of the Scope of Work for labour intensive competencies for supervisory and management staff are eligible to submit Bids.

Standard Conditions of Bid

(As contained in Annexure F of the CIDB Standard for Uniformity in Construction Procurement)

F.1 General

F.1.1 Actions

The employer and each Bidder submitting a Bid offer shall comply with these conditions of Bid. In their dealings with each other, they shall discharge their duties and obligations as set out in F.2 and F.3, timeously and with integrity, and behave equitably, honestly and transparently.

F.1.2 Bid Documents

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

F.1.3 Interpretation

F.1.3.1 The Bid data and additional requirements contained in the Bid schedules that are included in the returnable documents are deemed to be part of these conditions of Bid.

F.1.3.2 These conditions of Bid, the Bid data and Bid schedules which are only required for Bid evaluation purposes, shall not form part of any contract arising from the invitation to Bid.

F.1.3.3 For the purposes of these conditions for the calling for expressions of interest, the following definitions apply:

a) **comparative offer** means the Bidder's financial offer after the factors of non-firm prices, all unconditional discounts and any other Bided parameters that will affect the value of the financial offer have been taken into consideration
b) **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 Bid process; and
c) **fraudulent practice** means the misrepresentation of the facts in order to influence the Bid process or the award of a contract arising from a Bid offer to the detriment of the employer, including collusive practices intended to establish prices at artificial levels
d) **quality (functionality)** means the totality of features and characteristics of a product or service that bear on its ability to satisfy stated or implied needs

F.1.4 Communication and employer's agent

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

F.1.5 The employer's right to accept or reject any Bid offer

F.1.5.1 The employer may accept or reject any variation, deviation, Bid offer, or alternative Bid offer, and may cancel the Bid process and reject all Bid offers at any time before the formation of a contract. The employer shall not accept or incur any liability to a Bidder for such cancellation and rejection, but will give written reasons for such action upon written request to do so.

F.1.5.2 The employer may not subsequent to the cancellation or abandonment of a Bid process or the rejection of all responsive Bid offers re-issue a Bid covering substantially the same scope of work within a period of six months unless only one Bid was received and such Bid was returned unopened to the Bidder.

F.2 Bidder's obligations

F.2.1 Eligibility

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

F.2.2 Cost of Biding

Accept that the employer will not compensate the Bidder for any costs incurred in the preparation and submission of a Bid offer, including the costs of any testing necessary to demonstrate that aspects of the offer satisfy requirements.

F.2.3 Check documents

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

F.2.4 Confidentiality and copyright of documents

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

F.2.5 Reference documents

Obtain, as necessary for submitting a Bid 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 Bid documents by reference.

F.2.6 Acknowledge addenda

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

F.2.7 Clarification meeting

Attend **compulsory a clarification meeting** at which Bidders may familiarize themselves with aspects of the proposed work, services or supply and raise questions. Details of the meeting(s) are stated in the Bid data.

F.2.8 Seek clarification

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

F.2.9 Insurance

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

F.2.10 Pricing the Bid offer

F.2.10.1 Include in the rates, prices, and the Bided total of the prices (if any) all duties, taxes (except Value Added Tax (VAT), and other levies payable by the successful Bidder, such duties, taxes and levies being those applicable 14 days before the closing time stated in the Bid data.

F2.10.2 Show VAT payable by the employer separately as an addition to the Bided total of the prices.

F.2.10.3 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.

F.2.10.4 State the rates and prices in Rand unless instructed otherwise in the Bid data. The conditions of contract identified in the contract data may provide for part payment in other currencies.

F.2.11 Alterations to documents

Not make any alterations or additions to the Bid documents, except to comply with instructions issued by the employer, or necessary to correct errors made by the Bidder. All signatories to the Bid offer shall initial all such alterations. Erasures and the use of masking fluid are prohibited.

F.2.12 Alternative Bid offers

F.2.12.1 Submit alternative Bid offers only if a main Bid offer, strictly in accordance with all the requirements of the Bid documents, is also submitted. The alternative Bid offer is to be submitted with the main Bid offer together with a schedule that compares the requirements of the Bid documents with the alternative requirements the Bidder proposes.

F.2.12.2 Accept that an alternative Bid offer may be based only on the criteria stated in the Bid data or criteria otherwise acceptable to the employer.

F.2.13 Submitting a Bid offer

F.2.13.1 Submit a Bid offer to provide the whole of the works, services or supply identified in the contract data and described in the scope of works, unless stated otherwise in the Bid data.

F.2.13.2 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 in black ink.

F.2.13.3 Submit the parts of the Bid offer communicated on paper as an original plus the number of copies stated in the Bid 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.

F.2.13.4 Sign the original and all copies of the Bid offer where required in terms of the Bid data. The employer will hold all authorized signatories liable on behalf of the Bidder. Signatories for Bidders 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 Bid offer.

F.2.13.5 Seal the original and each copy of the Bid 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 Bid data, as well as the Bidder’s name and contact address.

F.2.13.6 Where a two-envelope system is required in terms of the Bid data, place and seal the returnable documents listed in the Bid 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 Bid data, as well as the Bidder’s name and contact address.

F.2.13.7 Seal the original Bid 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 Bid data.

F.2.13.8 Accept that the employer shall not assume any responsibility for the misplacement or premature opening of the Bid offer if the outer package is not sealed and marked as stated.

F.2.14 Information and data to be completed in all respects

Accept that Bid 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.

F.2.15 Closing time

F.2.15.1 Ensure that the employer receives the Bid offer at the address specified in the Bid data not later than **12h00 on FRIDAY, 26 January 2023** when as stated in the Bid data. Proof of posting shall not be accepted as proof of delivery. The employer shall not accept Bid offers submitted by telegraph, telex, facsimile or e-mail, unless stated otherwise in the Bid data.

F.2.15.2 Accept that, if the employer extends the closing time stated in the Bid data for any reason, the requirements of these conditions of Bid apply equally to the extended deadline.

F.2.16 Bid offer validity

F.2.16.1 Hold the Bid offer(s) valid for acceptance by the employer at any time during the validity period stated in the Bid data after the closing time stated in the Bid data.

F.2.16.2 If requested by the employer, consider extending the validity period stated in the Bid data for an agreed additional period.

F.2.17 Clarification of Bid offer after submission

Provide clarification of a Bid offer in response to a request to do so from the employer during the evaluation of Bid 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 total of the prices or substance of the Bid offer is sought, offered, or permitted. The total of the prices stated by the Bidder shall be binding upon the Bidder.

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

F.2.18 Provide other material

F.2.18.1 Provide, on request by the employer, any other material that has a bearing on the Bid offer, the Bidder'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 Bidder 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 Bid offer as non-responsive.

F.2.18.2 Dispose of samples of materials provided for evaluation by the employer, where required.

F.2.19 Inspections, tests and analysis

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

F.2.20 Submit securities, bonds, policies, etc.

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.

F.2.21 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.

F.2.22 Return of other Bid documents

If so, instructed by the employer, return all retained Bid documents within 28 days after the expiry of the validity period stated in the Bid data.

F.2.23 Certificates

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

F.3 The employer's undertakings

F.3.1 Respond to clarification

Respond to a request for clarification received up to five working days prior to the Bid closing time stated in the Bid Data and notify all Bidders who drew procurement documents.

F.3.2 Issue Addenda

If necessary, issue addenda that may amend or amplify the Bid documents to each Bidder during the period from the date of the Bid Notice until seven days before the Bid closing time stated in the Bid Data. If, as a result a Bidder applies for an extension to the closing time stated in the Bid Data, the Employer may grant such extension and, will then notify it to all Bidders who drew documents.

F.3.3 Return late Bid offers

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

F.3.4 Opening of Bid submissions

F.3.4.1 Unless the two-envelope system is to be followed, open valid Bid submissions in the presence of Bidders' agents who choose to attend at the time and place stated in the Bid data. Bid submissions for which acceptable reasons for withdrawal have been submitted will not be opened.

F.3.4.2 Announce at the opening held immediately after the opening of Bid submissions, at a venue indicated in the Bid data, the name of each Bidder whose Bid offer is opened, the total of his prices, preferences claimed and time for completion, if any, for the main Bid offer only.

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

F.3.5 Two-envelope system

F.3.5.1 Where stated in the Bid data that a two-envelope system is to be followed, open only the technical proposal of valid Bids in the presence of Bidders' agents who choose to attend at the time and place stated in the Bid data and announce the name of each Bidder whose technical proposal is opened.

F.3.5.2 Evaluate the quality of the technical proposals offered by Bidders, then advise Bidders 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 Bidders, who score in the quality evaluation above the minimum number of points for quality stated in the Bid data, and announce the score obtained for the technical proposals and the total price and any preferences claimed. Return unopened financial proposals to Bidders whose technical proposals failed to achieve the minimum number of points for quality.

F.3.6 Non-disclosure

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

F.3.7 Grounds for rejection and disqualification

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

F.3.8 Test for responsiveness

Determine, on opening and before detailed evaluation, whether each Bid offer properly received:

a) meets the requirements of these Conditions of Bid,
b) has been properly and fully completed and signed, and
c) is responsive to the other requirements of the Bid documents.

A responsive Bid is one that conforms to all the terms, conditions, and specifications of the Bid 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,
- change the Employer's or the Bidder's risks and responsibilities under the contract, or
- affect the competitive position of other Bidders presenting responsive Bids, if it were to be rectified.

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

F.3.9 Arithmetical errors

Check responsive Bid 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 rates) applies 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 will 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 Bidder's addition of prices, the total of the prices shall govern and the Bidder will be asked to revise selected item prices (and their rates if a bill of quantities applies) to achieve the Bided total of the prices.

Consider the rejection of a Bid offer if the Bidder does not correct or accept the correction of his arithmetical errors in the manner described above.

F.3.10 Clarification of a Bid offer

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

F.3.11 Evaluation of Bid offers

F3.11.1 General

Appoint an evaluation panel of not less than three persons. Reduce each responsive Bid offer to a comparative offer and evaluate it using the Bid evaluation method that is indicated in the Bid Data and described below:

Method 1: Financial offer	1) Rank Bid offers from the most favorable to the least favorable comparative offer. 2) Recommend highest ranked Bidder for the award of the contract unless there are compelling and justifiable reasons not to do so.
Method 2: Financial offer and preferences	1) Score Bid evaluation points for financial offer.
	2) Confirm that Bidders are eligible for the preferences claimed and if so, score Bid evaluation points for preferencing. 3) Calculate total Bid evaluation points. 4) Rank Bid offers from the highest number of Bid evaluation points to the lowest. 5) Recommend Bidder with the highest number of Bid evaluation points for the award of the contract, unless there are compelling and justifiable reasons not to do so.

Method 3: Financial offer and quality	1) Score quality, rejecting all Bid offers that fail to score the minimum number of points for quality stated in the Bid data. 2) Score Bid evaluation points for financial offer. 3) Calculate total Bid evaluation points. 4) Rank Bid offers from the highest number of Bid evaluation points to the lowest. 5) Recommend Bidder with the highest number of Bid evaluation points for the award of the contract, unless there are compelling and justifiable reasons not to do so.
Method 4: Financial offer, quality and preferences	1) Score quality, rejecting all Bid offers that fail to score the minimum number of points for quality stated in the Bid data. 2) Score Bid evaluation points for financial offer. 3) Confirm that Bidders are eligible for the preferences claimed, and if so, score Bid evaluation points for preferencing. 4) Calculate total Bid evaluation points. 5) Rank Bid offers from the highest number of Bid evaluation points to the lowest.

	6) Recommend Bidder with the highest number of Bid evaluation points for the award of the contract, unless there are compelling and justifiable reasons not to do so. .

EVALUATION CRITERIA

The following Stages of Evaluation will be carried out in the evaluating Tenders:

Stage 1: Administrative Compliance
Stage 2: Mandatory Requirements
Stage 3: Functionality Criteria
Stage 4: Preference Point System

ADMINISTRATIVE COMPLIANCE (STAGE 1)

All the bids will be evaluated against the administrative responsiveness requirements as set out in the list of returnable documents T2.1

MANDATOR REQUIREMENTS (STAGE 2)

The following are considered mandatory criteria and failure to submit the required documentation will render the tender non-complaint:

Mandatory criteria	**Supporting evidence**
CIDB Grading of 6ME OR HIGHER	Valid certified CIDB grading certificate
Lead Engineer with NQF level 7 or higher in Mechanical Engineering, Professionally Registered with ECSA Two years post-registration experience in water treatment	• Certified copy of Mechanical Engineering qualification • Certified copy of ECSA certificate indicating active Professional Registration with ECSA • CV indicating relevant experience in water treatment.
Electrical Engineer with a NQF Level 7 or higher and active Professional ECSA registration in Electrical Engineering	• Certified copy of Electrical Engineering qualification • Certified copy of ECSA certificate indicating active Professional Registration with ECSA • CV indicating relevant experience in water treatment.
Process Engineer with NQF level 7 or higher in Chemical Engineering, Professionally Registered with ECSA Two years post-registration experience in water treatment	• Certified copy of Chemical Engineering qualification • Certified copy of ECSA certificate indicating active Professional Registration with ECSA • CV indicating relevant experience in water treatment.
Civil Engineer with a NQF Level 7 or higher and active Professional ECSA registration in Civil Engineering	• Certified copy of Civil Engineering qualification • Certified copy of ECSA certificate indicating active Professional Registration with ECSA • CV indicating relevant experience in water treatment.
Safety Officer registered with SACPCMP as a Construction Health and Safety Officer	• Certified registration SACPCMP certificate
Company or JV or Sub-Contractor or Nominated Supplier Experience – Proof of relevant projects completed in the past 5, 3, and 2 years respectively of comparable scope and similar type - Refurbishment of water or wastewater treatment works exceeding a value of: • R 7 million Mechanical scope of work. • R 3 million; Electrical scope of works, • R1 million Civil scope of works;	Signed agreement/contract between bidder and subcontractor, Final Approval or Completion Certificate of the relevant projects completed within the last 5, 3, and 2 years respectively to be attached. (Certificate must display detailed scope, be signed by the Client, and contain the Client's contact details. If experience presented is for a Subcontractor, the Subcontractor's Company Profile and a signed)

FUNCTIONALITY EVALUATION (STAGE 3)
The functional evaluation will be done as outlined below. Should a Bidder not achieve the minimum specified points (70) for functionality, the Bidder will be regarded as non-responsive and not be considered for the next evaluation stages and will be disqualified.

FUNCTIONALITY CRITERIA
The following criteria will be applied when bids are assessed for functionality:

1. Company Experience – 20 Points
2. Qualification and Experience of the site key personnel's – 25 Points
3. Labour Intensive Design and Construction Methods and SMME Development – 10 Points
4. Plant and equipment – 10 Points
5. Construction Method Statement – 10 Points
6. Proof of availability of Capital – 25 Points

No.1	Functional Requirements-Company Experience		Weight
1.1	**Company Experience - Mechanical**		
	Proof of relevant projects completed in the past 5 years of comparable scope of work and similar type - Refurbishment of water and wastewater treatment works exceeding a value of R 7 million (Mechanical Scope of Work). Comparable Scope of work includes the Mechanical design, supply, installation & automation, commissioning of one or more of the following: Mechanical: • Rapid Gravity Filters, Pumping Equipment; Mixing Equipment, Blowers, Sedimentation Tank Equipment, Lime storage and dosing in water treatment plants. Final Approval or Completion Certificate of the relevant Mechanical projects completed within the last 5 years to be attached. Certificate must display contract value, be signed by the Client, and contain the Client's contact details. **N.B:** In case of sub-contracting, also attach letter of appointment for the main Contractor from the client and a Completion Certificate, duly signed by the contracting party and the appointed Contractor on the project.		**10 points**
	• 5 projects completed	10 points	
	• 4 projects completed	8 points	
	• 3 projects completed	6 points	
	• 2 projects completed	4 points	
	• 1 project completed	2 points	
	• 0 project completed	0 points	
1.2	**Company Experience-Electrical**		
	Proof of relevant projects completed in the past 3 years of comparable scope and similar type - Refurbishment of water or wastewater treatment works exceeding a value of R 3 million (Electrical Scope of work). Comparable Scope of work includes the Electrical design, supply, installation & automation, commissioning of one or more of the following: Electrical: • Motor Control Centers and Distribution Boards for mechanical equipment listed below: o Rapid Gravity Filters, Pumping Equipment; Mixing Equipment, Blowers, Sedimentation Tank Equipment, Lime storage and dosing in water treatment plants. • Programmable Logic Controllers • Control and instrumentation, Network and Telemetry systems • Earthing and lightning protection; Small Power and Lighting Final Approval or Completion Certificate of the relevant Electrical projects completed within the last 3 years to be attached. Certificate must display contract value, be signed by the Client, and contain the Client's contact details. **N.B**: In case of sub-contracting, also attach letter of appointment for the main Contractor from the client and a Completion Certificate, duly signed by the contracting party and the appointed Contractor on the project.		**5 points**
	5 projects completed	5 points	
	4 projects completed	4 points	
	3 projects completed	3 points	
	2 projects completed	2 points	

	1 project completed	1 point	
	0 project completed	0 point	
1.3	**Company Experience-Civil**		
	Proof of relevant projects completed in the past 2 years of comparable scope and similar type - Refurbishment of water or wastewater treatment works exceeding a value of R 1 million (Civil scope of works). Final Approval or Completion Certificate of the relevant Civil projects completed within the last 2 years to be attached. Certificate must display contract value, be signed by the Client, and contain the Client's contact details. **N.B**: In case of sub-contracting, also attach letter of appointment for the main Contractor from the client and a Completion Certificate, duly signed by the contracting party and the appointed Contractor on the project.		**5 points**
	5 projects completed	5 points	
	4 projects completed	4 points	
	3 projects completed	3 points	
	2 projects completed	2 points	
	1 project completed	1 point	
	0 project completed	0 points	

No.2	**Functional Requirements-Key Staff**		**Weight**
2.1	**Key Staff: Lead Engineer (Mechanical Engineer)**		
	Key Staff's experience that is relevant to the scope of work, refurbishment or upgrade water works including the following: design, supply and installation of design, supply, installation & automation, commissioning of one or more of the following: Rapid Gravity Filter, Pumping Equipment; Mixing Equipment, Blowers, Sedimentation Tank Equipment, Lime storage and dosing in water treatment plant. Lead Engineer with NQF level 7 or higher in Mechanical Engineering, Professionally Registered with ECSA. Minimum of two years post-registration experience in water treatment. Attach copies of both, proof of qualifications, ECSA registration & detailed CV indicating years of experience & details of staff's experience of a similar nature are compulsory. **Evaluation of Lead Engineer's Experience**		**10 points**
	5 projects completed	10 points	
	4 projects completed	8 points	
	3 projects completed	6 points	
	2 projects completed	4 points	
	1 project completed	2 points	
	No Proof Qualifications & Detailed CV	0 points	
2.2	**Key Staff: Process Engineer**		
	Key Staff's experience that is relevant to the scope of work (Construction, refurbishment or upgrade of water treatment works including the following: design, supply and installation of design, supply, installation & automation, commissioning of one or more of the following: Rapid Gravity Filter, Pumping Equipment; Mixing Equipment, Blowers, Sedimentation Tank Equipment, Lime storage and dosing in water treatment plant. Process Engineer with NQF level 7 or higher in Chemical Engineering, Professionally Registered with ECSA. Minimum of two years post-registration experience in water treatment. Attach copies of both proof of qualifications, ECSA registration & detailed CV indicating years of experience & details of staff's experience of a similar nature are compulsory.		**5 points**

	Evaluation of Process Engineer's Experience		
	5 projects completed	5 points	
	4 projects completed	4 points	
	3 projects completed	3 points	
	2 projects completed	2 points	
	1 project completed	1 point	
	No Proof Qualifications & Detailed CV	0 points	

2.3	**Key Staff: - Electrical Engineer**		
	Key Staff's experience that is relevant to the scope of work: Construction, refurbishment or upgrade of waste treatment works including the following - • Motor Control Centers and Distribution Boards. The Panel builder shall be SABS 1973-3 Registered and have a certificate. • Programmable Logic Controllers • Control and instrumentation • Network and Telemetry systems • Earthing and lightning protection • Small Power and Lighting Electrical Engineer with NQF level 7 or higher in Electrical Engineering, Professionally Registered with ECSA. Minimum of two years post-registration experience in water treatment. Attach copies of both proof of qualifications, ECSA registration & detailed CV indicating years of experience & details of staff's experience of a similar nature are compulsory. **Evaluation of Electrical Engineer's Experience**		**5 points**
	5 projects completed	5 points	
	4 projects completed	4 points	
	3 projects completed	3 points	
	2 projects completed	2 points	
	1 project completed	1 point	
	No Proof Qualifications & Detailed CV	0 points	
2.4	**Key Staff: -Civil Engineer**		
	Key Staff's experience that is relevant to the scope of work (Construction, refurbishment or upgrade of treatment works and/or water retaining structures) Attach copies of both proof of Civil Engineering qualifications, ECSA registration & detailed CV indicating years of experience & details of staff's experience of a similar nature are compulsory. **Evaluation of Civil Engineer's Experience**		**5 points**
	5 projects completed	5 points	
	4 projects completed	4 points	
	3 projects completed	3 points	
	2 projects completed	2 points	
	1 project completed	1 point	
	No Proof Qualifications & Detailed CV	0 points	

No.3	Key Staff: - LIC Manager/Supervisor		10 Points
	Contractors shall employ in labour-enhanced works only those supervisory and management staff that have completed the required Skills Programme in terms of the "Guidelines for the implementation of labour-enhanced infrastructure projects under the Expanded Public Works Programme (EPWP) Third Edition 2015": ▪ Foremen / Supervisors at NQF level 4 "National Certificate: Supervision of Civil Engineering Construction Processes"; ▪ Site Agent / Construction Manager at NQF level 5 "Manage Labour-Intensive Construction Processes" or equivalent Quality Council for Trades and Occupations (QCTO) qualifications at NQF level 5 or 7. Tenderers' attention is drawn to the required minimum supervisor to worker ratio for this project stated in clause E2.3 of Part E of the Particular Specifications. The Tenderer must insert in the spaces provided below the relevant details of the personnel to be employed in the construction of the Works possessing the required qualifications in the supervision or management of LIC projects. **Evaluation of LIC Supervisor/Manager Experience**		
	5 projects completed	10 points	
	4 projects completed	8 points	
	3 projects completed	6 points	
	2 projects completed	4 points	
	1 project completed	2 points	
	No Proof Qualifications & Detailed CV	0 points	

No.4	Plant and Equipment		10 Points
	Contractors shall have a Proof of Plant and equipment ownership where owned by the Tender and/or where plant will be hired out to the tender attach an original letter indicating so. **(Registration documents of plant owned or letter of intent to rent the relevant plant with registration documents must be attached)** Requiring bidders to possess or have access to their own plants and equipment for the water treatment plant refurbishment offers numerous benefits. It provides better control over resources, enhances adherence to project schedules, ensures quality assurance, and allows for effective cost management. Ownership also fosters flexibility and responsiveness to on-site challenges, mitigates risks associated with external dependencies, and promotes operational efficiency. Overall, this requirement aims to facilitate a more efficient, timely, and cost-effective execution of the refurbishment project. **List of Plant and equipment:** 1. LDV on site 2. Pump 3. TLB, Cranes and Hoists 4. Welding Machines and Cutting Tools **5.** Instrumentation and Control Systems **(NB: 1 point for machine owned and 0.5 point for machine hired)**		
	Machine Owned	10 Points	
	Machine Hired	5 Points	

No. 5	Construction Method Statement		
	The Construction Method Statement (CMS) is a crucial document in the construction industry that outlines the step-by-step procedures and methodologies to be employed during the construction of a project. Its importance lies in several key aspects: 1. Safety Compliance 2. Regulatory Compliance 3. Project Understanding: 4. Risk Management 5. Quality Assurance 6. Project Coordination 7. Communication Tool 8. Environmental Considerations 9. Client and Stakeholder Confidence 10. Contractual Requirement **(NB: 1 point for each heading)**		**10 Points**
	Excellent report	10 points	
	Good report	8 points	
	Satisfactory report	6 Points	
	Fair report	4 points	
	Poor report	2 points	
	No Submission Report	0 points	

No. 6	Proof of availability of Capital		
	Contractors shall provide proof of available capital (Bidders to attach Company Bank Statements/ Proof of Availability of funds not older than 1 month from closing date).		
	Positive balance of R 1 000 001 or above in the business bank account	25 points	**25 Points**
	Positive balance of R 500 001 to R 1 000 000 in the business bank account	20 points	
	Positive balance of R 250 001 to R 500 000 in the business bank account	15 points	
	Less positive balance of R 250 000 in the business bank account	10 points	
	No Proof of available capital	0 points	
	HIGHEST POSSSIBLE SCORE		**100**

a) Dr Pixley Ka Isaka Seme Local Municipality reserves the right to contact references submitted by the bidder.
b) Bids that do not achieve a minimum score of 70 points (out of 100) for functionality will not be evaluated further and will not proceed to the next stage of the Bid Evaluation process.

Please note should any of the nominated staff be replaced, the successfully appointed service provider will be required to ensure that such replacements must have equivalent criteria as above and this need to be approved by Dr Pixley Ka Isaka Seme Local Municipality.

SPECIFIC GOALS (Stage 5)

1. GENERAL CONDITIONS

1.1 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);

	POINTS
PRICE	**80**
SPECIFIC GOALS	**20**
Total points for Price and SPECIFIC GOALS	**100**

The specific goals allocated points in terms of this tender	**Number of points allocated (80/20 system) (To be completed by the organ of state)**	**Number of points claimed (80/20 system) (To be completed by the tenderer)**
At least 51%Black	4	
At least 51%Youth	5	
At least 51%Woman	4	
At least 51%People Living with Disability	2	
Demographic/ Area/ Locality-Gert Sibande District	5	
TOTAL	20	

T2.1 List of Returnable Documents

The Bidder must complete the following returnable documents:

1 Returnable Schedules required only for Bid evaluation purposes

- Certificate of authority for joint ventures (where applicable)
- Compulsory Enterprise Questionnaire
- Record of Addenda to Bid Documents
- Proposed Amendments and Qualifications
- Schedule of Subcontractors
- Schedule of WORKS and Equipment
- Schedule of the Bidder's Experience
- Municipal statement on Bidder's rates and taxes

2 Other documents required only for Bid evaluation purposes

- completed tender documents;
- a company profile;
- a copy of company registration certificate;
- certified ID copies of the company's shareholders, members, trustees, etc.
- a valid tax clearance certificate and a compliant tax status;
- a proposed construction / works programme;
- letter confirming a signatory of authority
- CIDB registration certificate (6ME or Higher)
- an original B-BBEE certificate or a certified copy;
- Signed JV agreement in case of a JV
- Municipal Statement for municipal Services or a signed lease agreement if leasing a property for each shareholders.
- Attendance of site briefing.
- Bidders are required to bring their bid documents to the site inspection for signature of the client or consultant representative

Failure to submit the above-mentioned documents and submission of certified copies not older than 3 months will disqualify bid.

3 Returnable Schedules that will be incorporated into the contract

- Preferencing Schedule (direct preferences)

4 Other documents that will be incorporated into the contract

5 The offer portion of the C1.1 Offer and Acceptance

6 C1.2 Contract Data (Part 2)

7 C2.2 Bills of quantities

Record of Addenda to Bid documents

We confirm that the following communications received from the Employer before the submission of this Bid offer, amending the Bid documents, have been taken into account in this Bid offer:		
	Date	**Title or Details**
1.		
2.		
3.		
4.		
5.		
6.		
7.		
8.		
Attach additional pages if more space is required.		

Signed		Date	
Name		Position	
Bidder			

Certificate of Authority for Joint Ventures

This Returnable Schedule is to be completed by joint ventures.

We, the undersigned, are submitting this Bid offer in Joint Venture and hereby authorize Mr/Ms . . . . , authorized signatory of the company . . . . , acting in the capacity of lead partner, to sign all documents in connection with the Bid offer and any contract resulting from it on our behalf.

NAME OF FIRM	**ADDRESS**	**DULY AUTHORISED SIGNATORY**
Lead partner		Signature. . . . . . Name …….. Designation
		Signature. . . . . . Name …….. Designation
		Signature. . . . . . Name …….. Designation
		Signature. . . . . . Name …….. Designation

Schedule of Proposed Subcontractors

We notify you that it is our intention to employ the following Subcontractors for work in this 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 confirm that all subcontractors who are contracted to construct a house are registered as home builders with the National Home Builders Registration Council.

	Name and address of proposed Subcontractor	**Nature and extent of work**	**Previous experience with Subcontractor.**
1.			
2.			
3.			
4.			
5.			

Signed		Date	
Name		Position	
Bidder			

Schedule of Works and Equipment

The following are lists of major items of relevant equipment that I/we presently own or lease and will have available for this contract or will acquire or hire for this contract if my/our Bid is accepted.

(a) Details of major equipment that is owned by and immediately available for this contract.

Quantity	Description, size, capacity, etc.

Attach additional pages if more space is required.

(b) Details of major equipment that will be hired or acquired for this contract if my/our Bid is acceptable.

Quantity	Description, size, capacity, etc.

Attach additional pages if more space is required.

Signed		Date	
Name		Position	
Bidder			

Schedule of the Bidder's Experience

The following is a statement of similar work successfully executed by myself/ourselves:

Employer, contact person and telephone number.	Description of contract	Value of work inclusive of VAT (Rand)	Date completed

Signed		Date	
Name		Position	
Bidder			

Proposed amendments and qualifications

The Bidder should record any deviations or qualifications he may wish to make to the Bid documents in this Returnable Schedule. Alternatively, a Bidder may state such deviations and qualifications in a covering letter to his Bid and reference such letter in this schedule.

The Bidder's attention is drawn to clause F.3.8 of the Standard Conditions of Bid referenced in the Bid Data regarding the employer's handling of material deviations and qualifications.

Page	Clause or item	Proposal

Signed		Date	
Name		Position	
Bidder			

MBD 1

PART A
INVITATION TO BID

YOU ARE HEREBY INVITED TO BID FOR REQUIREMENTS OF THE DR PIXLEY KA ISAKA SEME LOCAL MUNICIPALITY					
TENDER NO	**T15/2023**	CLOSING DATE:	**26 January 2023**	CLOSING TIME:	**12:00**
DESCRIPTION	**T15/2023: APPOINTMENT OF A CONTRACTOR FOR REFURBISHMENT OF VOLKSRUST WATER TREATMENT 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

Dr Pixley ka Isaka Seme Local Municipality Offices (Entrance Foyer)
Cnr Adelaide Tambo Street and Dr Nelson Mandela Drive
Volksrust
2470

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	**Supply Chain Unit**	DEPARTMENT	**Technical Services**
CONTACT PERSON	**Ms. M. Ralinotsi**	CONTACT PERSON	**Ms M. Mabhengu**
TELEPHONE NUMBER	**017 734 6163**	TELEPHONE NUMBER	**017 734 6187**
FACSIMILE NUMBER	**086 630 2209**	FACSIMILE NUMBER	**086 630 2209**
E-MAIL ADDRESS	**melodyr@pixleykaseme.gov.za**	E-MAIL ADDRESS	**mendym@pixleykaseme.gov.za**

PART B
TERMS AND CONDITIONS FOR BIDDING

1. BID SUBMISSION:

1.1. BIDS MUST BE DELIVERED BY THE STIPULATED TIME TO THE CORRECT ADDRESS. LATE BIDS WILL NOT BE ACCEPTED FOR CONSIDERATION.

1.2. **ALL BIDS MUST BE SUBMITTED ON THE OFFICIAL FORMS PROVIDED–(NOT TO BE RE-TYPED) OR ONLINE**

1.3. THIS BID IS SUBJECT TO THE PREFERENTIAL PROCUREMENT POLICY FRAMEWORK ACT AND THE PREFERENTIAL PROCUREMENT REGULATIONS, 2017, THE GENERAL CONDITIONS OF CONTRACT (GCC 2015 3rd Edition) AND, IF APPLICABLE, ANY OTHER SPECIAL CONDITIONS OF CONTRACT.

2. TAX COMPLIANCE REQUIREMENTS

2.1 BIDDERS MUST ENSURE COMPLIANCE WITH THEIR TAX OBLIGATIONS.

2.2 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.

2.3 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.

2.4 FOREIGN SUPPLIERS MUST COMPLETE THE PRE-AWARD QUESTIONNAIRE IN PART B:3.

2.5 BIDDERS MAY ALSO SUBMIT A PRINTED TCS CERTIFICATE TOGETHER WITH THE BID.

2.6 IN BIDS WHERE CONSORTIA / JOINT VENTURES / SUB-CONTRACTORS ARE INVOLVED, EACH PARTY MUST SUBMIT A SEPARATE TCS CERTIFICATE / PIN / CSD NUMBER.

2.7 WHERE NO TCS IS AVAILABLE BUT THE BIDDER IS REGISTERED ON THE CENTRAL SUPPLIER DATABASE (CSD), A CSD NUMBER MUST BE PROVIDED.

3. QUESTIONNAIRE TO BIDDING FOREIGN SUPPLIERS

3.1.	IS THE ENTITY A RESIDENT OF THE REPUBLIC OF SOUTH AFRICA (RSA)?	☐ YES ☐ NO
3.2.	DOES THE ENTITY HAVE A BRANCH IN THE RSA?	☐ YES ☐ NO
3.3.	DOES THE ENTITY HAVE A PERMANENT ESTABLISHMENT IN THE RSA?	☐ YES ☐ NO
3.4.	DOES THE ENTITY HAVE ANY SOURCE OF INCOME IN THE RSA?	☐ YES ☐ NO
3.5.	IS THE ENTITY LIABLE IN THE RSA FOR ANY FORM OF TAXATION?	☐ YES ☐ NO

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.

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 OF BIDDER: ……

CAPACITY UNDER WHICH THIS BID IS SIGNED: ……

DATE: ……...

TAX CLEARANCE CERTFICATE REQUIREMENTS

It is a condition of bid that the taxes of the successful bidder must be in order, or that satisfactory arrangements have been made with South African Revenue Service (SARS) to meet the bidder's tax obligations.

1. In order to meet this requirement bidders are required to complete in full the attached form TCC 001 "Application for a Tax Clearance Certificate" and submit it to any SARS branch office nationally. The Tax Clearance Certificate Requirements are also applicable to foreign bidders / individuals who wish to submit bids.

2. SARS will then furnish the bidder with a Tax Clearance Certificate that will be valid for a period of 1 (one) year from the date of approval.

3. The original Tax Clearance Certificate must be submitted together with the bid. Failure to submit the original and valid Tax Clearance Certificate will result in the invalidation of the bid. Certified copies of the Tax Clearance Certificate will not be acceptable.

4. In bids where Consortia / Joint Ventures / Sub-contractors are involved, each party must submit a separate Tax Clearance Certificate.

5. Copies of the TCC 001 "Application for a Tax Clearance Certificate" form are available from any SARS branch office nationally or on the website www.sars.gov.za.

6. Applications for the Tax Clearance Certificates may also be made via e-Filing. In order to use this provision, taxpayers will need to register with SARS as eFilers through the website www.sars.gov.za.

MBD 4

DECLARATION OF INTEREST

1. No bid will be accepted from persons in the service of the state*.
2. Any person, having a kinship with persons in the service of the state, including a blood relationship, may make an offer or offers in terms of this invitation to bid. In view of possible allegations of favouritism, should the resulting bid, or part thereof, be awarded to persons connected with or related to persons in service of the state, it is required that the bidder or their authorised representative declare their position in relation to the evaluating/adjudicating authority and/or take an oath declaring his/her interest.

3. To give effect to the above, the following questionnaire must be completed and submitted with the bid.

3.1 Full Name: ……

3.2 Identity Number: ……

3.3 Company Registration Number: ……

3.4 Tax Reference Number: ……

3.5 VAT Registration Number: ……

3.6 Are you presently in the service of the state***** **YES / NO**

3.6.1 If so, furnish particulars.

……

……

3.7 Have you been in the service of the state for the past twelve months? **YES / NO**

3.7.1 If so, furnish particulars.

……

……

3.8 Do you, have any relationship (family, friend, other) with persons in the service of the state and who may be involved **YES / NO**

***** MSCM Regulations: "in the service of the state" means to be –

(a) a member of –
  (i) any municipal council;
  (ii) any provincial legislature; or
  (iii) the national Assembly or the national Council of provinces;

(b) a member of the board of directors of any municipal entity;
(c) an official of any municipality or municipal entity;
(d) an employee of any national or provincial department, national or provincial public entity or constitutional institution within the meaning of the Public Finance Management Act, 1999 (Act No.1 of 1999);
(e) a member of the accounting authority of any national or provincial public entity; or
(f) an employee of Parliament or a provincial legislature.

with the evaluation and or adjudication of this bid?

3.8.1 If so, furnish particulars.

……

……

3.9 Are you, aware of any relationship (family, friend, other) between a bidder and any persons in the service of the state who may be involved with the evaluation and or adjudication of this bid? **YES / NO**

3.9.1 If so, furnish particulars.

……

……

3.10 Are any of the company's directors, managers, principal shareholders or stakeholders in service of the state? **YES / NO**

3.9.1 If so, furnish particulars.

……

……

3.11 Are any spouse, child or parent of the company's directors, managers, principal shareholders or stakeholders in service of the state? **YES / NO**

3.11.1 If so, furnish particulars.

……

CERTIFICATION

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

…….. ……
Position Name of Bidder

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 informationand 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

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1. GENERAL CONDITIONS

1.1 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

1.2 To be completed by the organ of state

(*delete whichever is not applicable for this tender*).

a) The applicable preference point system for this tender is the 80/20 preference pointsystem.

b) 80/20 preference point system will be applicable in this tender. The lowest/ highest acceptable tender will be used to determine the accurate system once tenders are received.

1.3 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.

1.4 To be completed by the organ of state:

The maximum points for this tender are allocated as follows:

	POINTS
PRICE	**80**
SPECIFIC GOALS	**20**
Total points for Price and SPECIFIC GOALS	**100**

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

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

2. 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 price 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 thetime 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 producesrevenue for the organ of state, and includes, but is not limited to, leasing and disposalof 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).

3. FORMULAE FOR PROCUREMENT OF GOODS AND SERVICES

3.1. POINTS AWARDED FOR PRICE

3.1.1 THE 80/20 PREFERENCE POINT SYSTEMS

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

80/20

$$Ps = 80\left(1 - \frac{Pt - P\,min}{P\,min}\right)$$

Where

Ps = Points scored for price of tender under consideration

Pt = Price of tender under consideration

Pmin = Price of lowest acceptable tender

3.2. FORMULAE FOR DISPOSAL OR LEASING OF STATE ASSETS AND INCOMEGENERATING PROCUREMENT

3.2.1. POINTS AWARDED FOR PRICE

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

80/20

$$Ps = 80\left(1 + \frac{Pt - P\,max}{P\,max}\right)$$

Where

Ps	=	Points scored for price of tender under consideration
Pt	=	Price of tender under consideration
Pmax	=	Price of highest acceptable tender

4. POINTS AWARDED FOR SPECIFIC GOALS

4.1. 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 goalsstated in table 1 below as may be supported by proof/ documentation stated in the conditions of this tender:

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

(a) an invitation for tender for income-generating contracts, that either the 80/20 preference point system will apply and that the highest acceptable tender will be used to determine the applicable preference point system; or

(b) any other invitation for tender, that either the 80/20 preference pointsystem 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 80/20 preference point system.

Table 1: Specific goals for the tender and points claimed are indicated per the tablebelow.

(Note to organs of state: Where 80/20 preference point system isapplicable, 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 (80/20 system) (To be completed by the organ of state)	Number of points claimed (80/20 system) (To be completed by the tenderer)
At least 51%Black	4	
At least 51%Youth	5	
At least 51%Woman	4	
At least 51%People Living with Disability	2	
Demographic/ Area/ Locality-Gert Sibande District	5	
TOTAL	**20**	

DECLARATION WITH REGARD TO COMPANY/FIRM

4.3. Name of company/firm…….

4.4. Company registration number: ……...

4.5. 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]

4.6. 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 asindicated 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 documentaryproof 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 anyof the conditions of contract have not been fulfilled, the organ of state may, in addition to any other remedy it may have –

(a) disqualify the person from the tendering process;

(b) recover costs, losses or damages it has incurred or suffered as aresult of that person's conduct;

(c) cancel the contract and claim any damages which it has sufferedas a result of having to make less favourable arrangements due to such cancellation;

(d) 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

(e) forward the matter for criminal prosecution, if deemed necessary.

	……..
	SIGNATURE(S) OF TENDERER(S)
SURNAME AND NAME:	……..
DATE:	……
ADDRESS:	……
	……
	……
	……

CONTRACT FORM - RENDERING OF SERVICES

THIS FORM MUST BE FILLED IN DUPLICATE BY BOTH THE SERVICE PROVIDER (PART 1) AND THE PURCHASER (PART 2). BOTH FORMS MUST BE SIGNED IN THE ORIGINAL SO THAT THE SERVICE PROVIDER AND THE PURCHASER WOULD BE IN POSSESSION OF ORIGINALLY SIGNED CONTRACTS FOR THEIR RESPECTIVE RECORDS.

PART 1 (TO BE FILLED IN BY THE SERVICE PROVIDER)

1. I hereby undertake to render services described in the attached bidding documents to (name of the institution) ……. in accordance with the requirements and task directives / proposals specifications stipulated in Bid Number…….. at the price/s quoted. My offer/s remains binding upon me and open for acceptance by the Purchaser during the validity period indicated and calculated from the closing date of the bid.

2. The following documents shall be deemed to form and be read and construed as part of this agreement:

   (i) Bidding documents, *viz*
   - Invitation to bid.
   - Tax clearance certificate.
   - Pricing schedule(s).
   - Filled in task directive/proposal.
   - Preference claims for Broad Based Black Economic Empowerment Status Level of Contribution in terms of the Preferential Procurement Regulations 2011.
   - Declaration of interest.
   - Declaration of Bidder's past SCM practices.
   - Certificate of Independent Bid Determination.
   - Special Conditions of Contract.

   (ii) General Conditions of Contract; and

   (iii) Other (specify)

3. I confirm that I have satisfied myself as to the correctness and validity of my bid; that the price(s) and rate(s) quoted cover all the services specified in the bidding documents; that the price(s) and rate(s) cover all my obligations and I accept that any mistakes regarding price(s) and rate(s) and calculations will be at my own risk.

4. I accept full responsibility for the proper execution and fulfilment of all obligations and conditions devolving on me under this agreement as the principal liable for the due fulfilment of this contract.

5. I declare that I have no participation in any collusive practices with any bidder or any other person regarding this or any other bid.

6. I confirm that I am duly authorised to sign this contract.

NAME (PRINT) …….

CAPACITY …….

SIGNATURE …….

NAME OF FIRM …….

WITNESSES

1 …….

2 …….

DATE: ……..

CONTRACT FORM - RENDERING OF SERVICES

PART 1 (TO BE FILLED IN BY THE PURCHASER /THE MUNICIPALITY)

1. I…….…….. in my capacity as ……..…… accept your bid under reference number …… dated …… for the rendering of services indicated hereunder and/or further specified in the annexure(s).

2. An official order indicating service delivery instructions is forthcoming.

3. I undertake to make payment for the services rendered in accordance with the terms and conditions of the contract, within 30 (thirty) days after receipt of an invoice.

DESCRIPTION OF SERVICE	PRICE (ALL APPLICABLE TAXES INCLUDED)	COMPLETION DATE	B-BBEE STATUS LEVEL OF CONTRIBUTION	MINIMUM THRESHOLD FOR LOCAL PRODUCTION AND CONTENT (if applicable)

4. I confirm that I am duly authorised to sign this contract.

SIGNED AT …… ON …….....

NAME (PRINT) ……

SIGNATURE ……..……

OFFICIAL STAMP

WITNESSES
1 …….
2 …….
DATE: ……..

DECLARATION OF BIDDER'S PAST SUPPLY CHAIN MANAGEMENT PRACTICES

1. This Municipal Bidding Document must form part of all bids invited.

2. It serves as a declaration to be used by municipalities and municipal entities in ensuring that when goods and services are being procured, all reasonable steps are taken to combat the abuse of the supply chain management system.

3. The bid of any bidder may be rejected if that bidder, or any of its directors have:

   a) abused the municipality's / municipal entity's supply chain management system or committed any improper conduct in relation to such system;
   b) been convicted for fraud or corruption during the past five years;
   c) willfully neglected, reneged on or failed to comply with any government, municipal or other public sector contract during the past five years; or
   d) been listed in the Register for Tender Defaulters in terms of section 29 of the Prevention and Combating of Corrupt Activities Act (No 12 of 2004).

4. In order to give effect to the above, the following questionnaire must be completed and submitted with the bid.

Item	Question	Yes	No
4.1	**Is the bidder or any of its directors listed on the National Treasury's Database of Restricted Suppliers as companies or persons prohibited from doing business with the public sector?** **(Companies or persons who are listed on this Database were informed in writing of this restriction by the Accounting Officer/Authority of the institution that imposed the restriction after the *audi alteram partem* rule was applied).** **The Database of Restricted Suppliers now resides on the National Treasury's website (www.treasury.gov.za) and can be accessed by clicking on its link at the bottom of the home page.**	Yes ☐	No ☐
4.1.1	If so, furnish particulars:		
4.2	Is the bidder or any of its directors listed on the Register for Tender Defaulters in terms of section 29 of the Prevention and Combating of Corrupt Activities Act (No 12 of 2004)? **The Register for Tender Defaulters can be accessed on the National Treasury's website (www.treasury.gov.za) by clicking on its link at the bottom of the home page.**	Yes ☐	No ☐
4.2.1	If so, furnish particulars:		

Item	Question	Yes	No
4.3	Was the bidder or any of its directors convicted by a court of law (including a court of law outside the Republic of South Africa) for fraud or corruption during the past five years?	Yes ☐	No ☐
4.3.1	If so, furnish particulars:		
4.4	Does the bidder or any of its directors owe any municipal rates and taxes or municipal charges to the municipality / municipal entity, or to any other municipality / municipal entity, that is in arrears for more than three months?	Yes ☐	No ☐
4.4.1	If so, furnish particulars:		
4.5	Was any contract between the bidder and the municipality / municipal entity or any other organ of state terminated during the past five years on account of failure to perform on or comply with the contract?	Yes ☐	No ☐
4.7.1	If so, furnish particulars:		

CERTIFICATION

I, THE UNDERSIGNED (FULL NAME) ……..…….…… CERTIFY THAT THE INFORMATION FURNISHED ON THIS DECLARATION FORM TRUE AND CORRECT.

I ACCEPT THAT, IN ADDITION TO CANCELLATION OF A CONTRACT, ACTION MAY BE TAKEN AGAINST ME SHOULD THIS DECLARATION PROVE TO BE FALSE.

……...	**…….**
Signature	**Date**
……...	**……..**
Position	**Name of Bidder**

CERTIFICATE OF INDEPENDENT BID DETERMINATION

1. This Municipal Bidding Document (MBD) must form part of all bids invited.

2. Section 4(1)(b)(iii) of the Competition Act No. 89 of 1998, as amended, prohibits an agreement between, or concerted practice by, firms, or a decision by an association of firms, if it is between parties in a horizontal relationship and if it involves collusive bidding (or bid rigging).[2] Collusive bidding is a *pe se* prohibition meaning that it cannot be justified under any grounds.

3. Municipal Supply Regulation 38(1) prescribes that a supply chain management policy must provide measures for the combating of abuse of the supply chain management system, and must enable the accounting officer, among others, to:

   a. take all reasonable steps to prevent such abuse;

   b. reject the bid of any bidder if that bidder or any of its directors has abused the supply chain management system of the municipality or municipal entity or has committed any improper conduct in relation to such system; and

   c. cancel a contract awarded to a person if the person committed any corrupt or fraudulent act during the bidding process or the execution of the contract.

4. This MBD serves as a certificate of declaration that would be used by institutions to ensure that, when bids are considered, reasonable steps are taken to prevent any form of bid-rigging.

5. In order to give effect to the above, the attached Certificate of Bid Determination (MBD 9) must be completed and submitted with the bid:

[1] Includes price quotations, advertised competitive bids, limited bids and proposals.

[2] Bid rigging (or collusive bidding) occurs when businesses, that would otherwise be expected to compete, secretly conspire to raise prices or lower the quality of goods and / or services for purchasers who wish to acquire goods and / or services through a bidding process. Bid rigging is, therefore, an agreement between competitors not to compete.

CERTIFICATE OF INDEPENDENT BID DETERMINATION

I, the undersigned, in submitting the accompanying bid:

_____
(Bid Number and Description)

in response to the invitation for the bid made by:

_____
(Name of Municipality / Municipal Entity)

do hereby make the following statements that I certify 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 Certificate;

2. I understand that the accompanying bid will be disqualified if this Certificate is found not to be true and complete in every respect;

3. I am authorized by the bidder to sign this Certificate, and to submit the accompanying bid, on behalf of the bidder;

4. Each person whose signature appears on the accompanying bid has been authorized by the bidder to determine the terms of, and to sign, the bid, on behalf of the bidder;

5. For the purposes of this Certificate and the accompanying bid, I understand that the word "competitor" shall include any individual or organization, other than the bidder, whether or not affiliated with the bidder, who:

   (a) has been requested to submit a bid in response to this bid invitation;

   (b) could potentially submit a bid in response to this bid invitation, based on their qualifications, abilities or experience; and

   (c) provides the same goods and services as the bidder and/or is in the same line of business as the bidder.

6. 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 consortium[3] will not be construed as collusive bidding.

7. In particular, without limiting the generality of paragraphs 6 above, there has been no consultation, communication, agreement or arrangement with any competitor regarding:

   (a) prices;
   (b) geographical area where product or service will be rendered (market allocation);
   (c) methods, factors or formulas used to calculate prices;

(d) the intention or decision to submit or not to submit, a bid;
(e) the submission of a bid which does not meet the specifications and conditions of the bid; or
(f) bidding with the intention not to win the bid.

8. In addition, there have been no consultations, communications, agreements or arrangements with any competitor regarding the quality, quantity, specifications and conditions or delivery particulars of the products or services to which this bid invitation relates.

9. 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.

10. 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.

……...	…….
Signature	Date
……...	…….
Position	Name of Bidder

[3] 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.

DR. PIXLEY KA ISAKA SEME LOCAL MUNICIPALITY

T15/2023: APPOINTMENT OF A CONTRACTOR FOR REFURBISHMENT OF VOLKSRUST WATER TREATMENT WORKS

PROPOSED SUBCONTRACTION WORK (30% of the project to be subcontracted to local contractors)

The following work or projects will be subcontracted to local contractors for this project and is not limited to the following:

Project1: _____

Project2: _____

Project3: _____

Project4: _____

Project5: _____

Project6: _____

Project7: _____

…….. ……

Signature Date

…….. …….

Position Name of Bidder

DR. PIXLEY KA ISAKA SEME LOCAL MUNICIPALITY

T15/2023: APPOINTMENT OF A CONTRACTOR FOR REFURBISHMENT OF VOLKSRUST WATER TREATMENT WORKS

C1.1 Form of Offer and Acceptance

Offer

The employer, identified in the acceptance signature block, has solicited offers to enter into a contract for the procurement of:

T15/2023: APPOINTMENT OF A CONTRACTOR FOR REFURBISHMENT OF VOLKSRUST WATER TREATMENT WORKS

The Bidder, identified in the offer signature block, has examined the documents listed in the Bid data and addenda thereto as listed in the returnable schedules, and by submitting this offer has accepted the conditions of Bid.

By the representative of the Bidder, deemed to be duly authorized, signing this part of this form of offer and acceptance, the Bidder 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 Bidder before the end of the period of validity stated in the Bid data, whereupon the Bidder becomes the party named as the contractor in the conditions of contract identified in the contract data.

Signature . . . . . Date . . . . . .

Name . . . . . .

Capacity . . . . . .

for the Bidder
(Name and address of organization) . . . . . .

. . . . . .

. . . . . .

Name and signature of witness . . . .

Acceptance

By signing this part of this form of offer and acceptance, the employer identified below accepts the Bidder'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 Bidder's offer shall form an

agreement between the employer and the Bidder 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:

Part C1: Agreements and contract data, (which includes this agreement)
Part C2: Pricing data
Part C3: Scope of work.
Part C4: Site information

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 Bid data and any addenda thereto as listed in the Bid schedules as well as any changes to the terms of the offer agreed by the Bidder 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.

The Bidder 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 contract 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. Failure to fulfill 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 Bidder receives one fully completed original copy of this document, including the schedule of deviations (if any). Unless the Bidder (now contractor**)** within five working days of 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 a binding contract between the parties.

Signature . . . . . Date . . . . . .

Name . . . . . .

Capacity . . . . . .

for the Employer

THE MUNICIPAL MANAGER
DR. PIXLEY KA ISAKA SEME LOCAL MUNICIPALITY
Private Bag X9011
VOLKSRUST
2470

Name and signature of witness . . . . . .

Date . . . . . .

. . . . . .

Schedule of Deviations

1 Subject . . . . . .

Details . . . . . .

. . . . . .

. . . . . .

. . . . . .

2 Subject . . . . . .

Details . . . . . .

. . . . . .

. . . . . .

. . . . . .

3 Subject . . . . . .

Details . . . . . .

. . . . . .

. . . . . .

. . . . . .

4 Subject . . . . . .

Details . . . . . .

. . . . . .

. . . . . .

. . . . . .

5 Subject . . . . . .

Details . . . . . .

. . . . . .

. . . . . .

. . . . . .

By the duly authorised representatives signing this agreement, the employer and the Bidder agree to and accept the foregoing schedule of deviations as the only deviations from and amendments to the documents listed in the Bid data and addenda thereto as listed in the Bid schedules, as well as any confirmation, clarification or changes to the terms of the offer agreed by the Bidder and the employer during this 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 Bid documents and the receipt by the Bidder of a completed signed copy of this Agreement shall have any meaning or effect in the contract between the parties arising from this agreement.

C1.2 Contract Data

The General Conditions of Contract for Construction Works (2015) published by the South African Institution of Civil Engineering, is applicable to this contract Drawings. Copies of these conditions of contract may be obtained from the South African Institution of Civil Engineering (Tel: 011-805 5947).

The 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.

Each item of data given below is cross-referenced to the clause in the General Conditions of Contract for Construction Works to which it mainly applies.

	The variations to the General Conditions of Contract are:
4.5.2	Replace the term “Safety” with “Occupational Health and Safety”
49.6.1 to 4.9.6.3	Replace the term “Bank” with “Bank or Insurance Company”
55.1.8	Replace sub-clause with: The Contractor or anyone on his behalf or in his employ would pay, offer or offer as payment to any person in the employ of the Employer, or in the employ of the Engineer, a gratuity or reward or commission.
	The additional clauses to the General Conditions of Contract are:
42	Extensions of time in respect of clause 42 in respect of abnormal rainfall shall be calculated using the following formula for each calendar month or part thereof: $V = (Nw - Nn) + \frac{(Rw - Rn)}{X}$ Where: V = Extension of time in calendar days in respect of the calendar month under consideration. Nw = Actual number of days during the calendar month on which a rainfall of 10 mm or more has been recorded. Nn = Average number of days in the relevant calendar month , as derived from existing rainfall records, as stated in the Site Information, on which a rainfall of 20mm or more has been recorded for the calendar month. Rw = Actual average rainfall in mm recorded for the calendar month under consideration. Rn = Average rainfall in mm for the calendar month as derived from existing rainfall records as stated in the Site Information. For purposes of the Contract Nn, Rn, X and Y shall have those values assigned to them in the Appendix and/or the Specification. If V is negative and its absolute value exceeds Nn, then V shall be taken as equal to minus Nn.

The total extension of time shall be the algebraic sum of all monthly totals for the period under consideration, but if the total is negative the time for completion shall not be reduced due to abnormal rainfall.

Extensions of time for part of a month shall be calculated using pro rata values of Nn and Rn. This formula does not take account flood damage which could cause further or concurrent delays and will be treated separately as far as extension of time is concerned.

The factor (Nw – Nn) shall be considered to represent a fair allowance for variations from the average in the number of days during which rainfall exceeds 10 mm. The factor (Rw-Rn) shall be considered to represent a fair allowance for variations from the average in the number of days during which the rainfall did not exceed 10 mm but wet conditions prevented or disrupted work.

For the purpose of applying the formula, accurate rain gauging shall be taken at a suitable point on the Site and the Contractor shall at his own expense, take all necessary precautions to ensure that rain gauges cannot be interfered with by unauthorized persons.

Payment for the labour-intensive component of the works

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

Applicable labour laws

The Ministerial Determination, Special Public Works Programmes, issued in terms of the Basic Conditions of Employment Act of 1997 by the Minister of Labour in Government Notice N° R63 of 25 January 2002, as reproduced below, shall apply to works described in the scope of work as being labour intensive and which are undertaken by unskilled or semi-skilled workers.

1 Introduction

1.1 This document contains the standard terms and conditions for workers employed in elementary occupations on a Special Public Works Programme (SPWP). These terms and conditions do NOT apply to persons employed in the supervision and management of a SPWP.
1.2 In this document –

(a) “department” means any department of the State, implementing agent or contractor;
(b) “employer” means any department, implementing agency or contractor that hires workers to work in elementary occupations on a SPWP;
(c) “worker” means any person working in an elementary occupation on a SPWP;
(d) “elementary occupation” means any occupation involving unskilled or semi-skilled work;
(e) “management” means any person employed by a department or implementing agency to administer or execute an SPWP;
(f) “task” means a fixed quantity of work;
(g) “task-based work” means work in which a worker is paid a fixed rate for performing a task;
(h) “task-rated worker” means a worker paid on the basis of the number of tasks completed;
(i) “time-rated worker” means a worker paid on the basis of the length of time worked.

2 Terms of Work

2.1 Workers on a SPWP are employed on a temporary basis.
2.2 A worker may NOT be employed for longer than 24 months in any five-year cycle on a EPWP.
2.3 Employment on a SPWP does not qualify as employment as a contributor for the purposes of the Unemployment Insurance Act 30 of 1966.

3 Normal Hours of Work

3.1 An employer may not set tasks or hours of work that require a worker to work–
(a) more than forty hours in any week
(b) on more than five days in any week; and
(c) for more than eight hours on any day.
3.2 An employer and worker may agree that a worker will work four days per week. The worker may then work up to ten hours per day.
3.3 A task-rated worker may not work more than a total of 55 hours in any week to complete the tasks allocated (based on a 40-hour week) to that worker.

4 Meal Breaks

4.1 A worker may not work for more than five hours without taking a meal break of at least thirty minutes duration.
4.2 An employer and worker may agree on longer meal breaks.
4.3 A worker may not work during a meal break. However, an employer may require a worker to perform duties during a meal break if those duties cannot be left unattended and cannot be performed by another worker. An employer must take reasonable steps to ensure that a worker is relieved of his or her duties during the meal break.
4.4 A worker is not entitled to payment for the period of a meal break. However, a worker who is paid on the basis of time worked must be paid if the worker is required to work or to be available for work during the meal break.

5 Special Conditions for Security Guards

5.1 A security guard may work up to 55 hours per week and up to eleven hours per day.
5.2 A security guard who works more than ten hours per day must have a meal break of at least one hour or two breaks of at least 30 minutes each.

6 Daily Rest Period

Every worker is entitled to a daily rest period of at least eight consecutive hours. The daily rest period is measured from the time the worker ends work on one day until the time the worker starts work on the next day.

7 Weekly Rest Period

Every worker must have two days off every week. A worker may only work on their day off to perform work which must be done without delay and cannot be performed by workers during their ordinary hours of work (“emergency work”).

8 Work on Sundays and Public Holidays

8.1 A worker may only work on a Sunday or public holiday to perform emergency or security work.
8.2 Work on Sundays is paid at the ordinary rate of pay.
8.3 A task-rated worker who works on a public holiday must be paid –
(a) the worker’s daily task rate, if the worker works for less than four hours;
(b) double the worker’s daily task rate, if the worker works for more than four hours.
8.4 A time-rated worker who works on a public holiday must be paid –
(a) the worker’s daily rate of pay, if the worker works for less than four hours on the public holiday;
(b) double the worker’s daily rate of pay, if the worker works for more than four hours on the public holiday.

9 Sick Leave

9.1 Only workers who work four or more days per week have the right to claim sick-pay in terms of this clause.
9.2 A worker who is unable to work on account of illness or injury is entitled to claim one day’s paid sick leave for every full month that the worker has worked in terms of a contract.

9.3 A worker may accumulate a maximum of twelve days' sick leave in a year.
9.4 Accumulated sick-leave may not be transferred from one contract to another contract.
9.5 An employer must pay a task-rated worker the worker's daily task rate for a day's sick leave.
9.6 An employer must pay a time-rated worker the worker's daily rate of pay for a day's sick leave.
9.7 An employer must pay a worker sick pay on the worker's usual payday.
9.8 Before paying sick-pay, an employer may require a worker to produce a certificate stating that the worker was unable to work on account of sickness or injury if the worker is –

(a) absent from work for more than two consecutive days; or
(b) absent from work on more than two occasions in any eight-week period.

9.9 A medical certificate must be issued and signed by a medical practitioner, a qualified nurse or a clinic staff member authorised to issue medical certificates indicating the duration and reason for incapacity.
9.10 A worker is not entitled to paid sick-leave for a work-related injury or occupational disease for which the worker can claim compensation under the Compensation for Occupational Injuries and Diseases Act.

10 Maternity Leave

10.1 A worker may take up to four consecutive months' unpaid maternity leave.
10.2 A worker is not entitled to any payment or employment-related benefits during maternity leave.
10.3 A worker must give her employer reasonable notice of when she will start maternity leave and when she will return to work.
10.4 A worker is not required to take the full period of maternity leave. However, a worker may not work for four weeks before the expected date of birth of her child or for six weeks after the birth of her child, unless a medical practitioner, midwife or qualified nurse certifies that she is fit to do so.
10.5 A worker may begin maternity leave –

(a) four weeks before the expected date of birth; or
(b) on an earlier date –
    (i) if a medical practitioner, midwife or certified nurse certifies that it is necessary for the health of the worker or that of her unborn child; or
    (ii) if agreed to between employer and worker; or
(c) on a later date, if a medical practitioner, midwife or certified nurse has certified that the worker is able to continue to work without endangering her health.

10.6 A worker who has a miscarriage during the third trimester of pregnancy or bears a stillborn child may take maternity leave for up to six weeks after the miscarriage or stillbirth.
10.7 A worker who returns to work after maternity leave, has the right to start a new cycle of twenty-four months employment, unless the SPWP on which she was employed has ended.

11 Family responsibility leave

11.1 Workers, who work for at least four days per week, are entitled to three days paid family responsibility leave each year in the following circumstances -

(a) when the employee's child is born;
(b) when the employee's child is sick;
(c) in the event of a death of –
    (i) the employee's spouse or life partner;
    (ii) the employee's parent, adoptive parent, grandparent, child, adopted child, grandchild or sibling.

12 Statement of Conditions

12.1 An employer must give a worker a statement containing the following details at the start of employment –

(a) the employer's name and address and the name of the SPWP;
(b) the tasks or job that the worker is to perform; and
(c) the period for which the worker is hired or, if this is not certain, the expected duration of the contract;
(d) the worker's rate of pay and how this is to be calculated;

(e) the training that the worker will receive during the SPWP.

12.2 An employer must ensure that these terms are explained in a suitable language to any employee who is unable to read the statement.

12.3 An employer must supply each worker with a copy of these conditions of employment.

13 Keeping Records

13.1 Every employer must keep a written record of at least the following –

(a) the worker's name and position;
(b) in the case of a task-rated worker, the number of tasks completed by the worker;
(c) in the case of a time-rated worker, the time worked by the worker;
(d) payments made to each worker.

13.2 The employer must keep this record for a period of at least three years after the completion of the SPWP.

14 Payment

14.1 An employer must pay all wages at least monthly in cash or by cheque or into a bank account.

14.2 A task-rated worker will only be paid for tasks that have been completed.

14.3 An employer must pay a task-rated worker within five weeks of the work being completed and the work having been approved by the manager or the contractor having submitted an invoice to the employer.

14.4 A time-rated worker will be paid at the end of each month.

14,5 Payment must be made in cash, by cheque or by direct deposit into a bank account designated by the worker.

14.6 Payment in cash or by cheque must take place –

(a) at the workplace or at a place agreed to by the worker;
(b) during the worker's working hours or within fifteen minutes of the start or finish of work;
(c) in a sealed envelope which becomes the property of the worker.

14.7 An employer must give a worker the following information in writing –

(a) the period for which payment is made;
(b) the numbers of tasks completed or hours worked;
(c) the worker's earnings;
(d) any money deducted from the payment;
(e) the actual amount paid to the worker.

14.8 If the worker is paid in cash or by cheque, this information must be recorded on the envelope and the worker must acknowledge receipt of payment by signing for it

14.9 If a worker's employment is terminated, the employer must pay all monies owing to that worker within one month of the termination of employment.

15 Deductions

15.1 An employer may not deduct money from a worker's payment unless the deduction is required in terms of a law.

15.2 An employer must deduct and pay to the SA Revenue Services any income tax that the worker is required to pay.

15.3 An employer who deducts money from a worker's pay for payment to another person must pay the money to that person within the time period and other requirements specified in the agreement law, court order or arbitration award concerned.

15.4 An employer may not require or allow a worker to –

(a) repay any payment except an overpayment previously made by the employer by mistake;
(b) state that the worker received a greater amount of money than the employer actually paid to the worker; or
(f) pay the employer or any other person for having been employed.

16 Health and Safety

16.1 Employers must take all reasonable steps to ensure that the working environment is healthy and safe.

16.2 A worker must –

(a) work in a way that does not endanger his/her health and safety or that of any other person;
(b) obey any health and safety instruction;
(c) obey all health and safety rules of the SPWP;
(d) use any personal protective equipment or clothing issued by the employer;
(e) report any accident, near-miss incident or dangerous behaviour by another person to their employer or manager.

17 Compensation for Injuries and Diseases

17.1 It is the responsibility of the employers (other than a contractor) to arrange for all persons employed on a SPWP to be covered in terms of the Compensation for Occupational Injuries and Diseases Act, 130 of 1993.
17.2 A worker must report any work-related injury or occupational disease to their employer or manager.
17.3 The employer must report the accident or disease to the Compensation Commissioner.
17.4 An employer must pay a worker who is unable to work because of an injury caused by an accident at work 75% of their earnings for up to three months. The employer will be refunded this amount by the Compensation Commissioner. This does NOT apply to injuries caused by accidents outside the workplace such as road accidents or accidents at home.

18 Termination

18.1 The employer may terminate the employment of a worker for good cause after following a fair procedure.
18.2 A worker will not receive severance pay on termination.
18.3 A worker is not required to give notice to terminate employment. However, a worker who wishes to resign should advise the employer in advance to allow the employer to find a replacement.
18.4 A worker who is absent for more than three consecutive days without informing the employer of an intention to return to work will have terminated the contract. However, the worker may be re-engaged if a position becomes available for the balance of the 24-month period.
18.5 A worker who does not attend required training events, without good reason, will have terminated the contract. However, the worker may be re-engaged if a position becomes available for the balance of the 24-month period.

19 Certificate of Service

19.1 On termination of employment, a worker is entitled to a certificate stating –

(a) the worker's full name;
(b) the name and address of the employer;
(c) the SPWP on which the worker worked;
(d) the work performed by the worker;
(e) any training received by the worker as part of the SPWP;
(f) the period for which the worker worked on the SPWP;
(g) any other information agreed on by the employer and worker.

Part 1: Contract Data completed by the Employer

Clause	
1.1.14 1.2.2	The name of the Employer is the: **DR. PIXLEY KA ISAKA SEME LOCAL MUNICIPALITY** The address of the Employer is: Telephone: 017 734 6100 Fax : 086 630 2209 Address (physical): DR. PIXLEY KA ISAKA SEME LOCAL MUNICIPALITY, Address (postal): P. Bag X9011, VOLKSRUST, 2470
1.1.15 1.2.2	The name of the Engineer is: **Mzolo Consulting Engineers** The address of the Engineer is: Telephone: 064 534 9233 Fax : 086 425 6243 Address (physical): 04 Coronation Road, Burnside, Hillcrest 3610 Address (postal): 07 Fairhaven, Scottsville PMB 3201
1.6 and 38	The special non-working days are public holidays, Saturdays, Sundays and the days on which the contractor grants the majority of his permanent workforce leave around the 16th December and the first Monday of the subsequent year.
2.3	The Engineer is required to obtain the specific approval of the Employer before executing any of the following functions or duties: 1. Nominating the Engineer's Representative in terms of Clause 2.4. 2. Delegation of Engineer's authority in terms of Clause 2.7. 3. Providing consent for subcontracting part of the contract in terms of Clause 6.2. 4. The issuing of further drawings or instructions in terms of Clause 13.1 5. The issuing of instructions for dealing with fossils and the like in terms of Clause 15. 6. Authorizing the Contractor to repair and make good excepted risks in terms of Clause 32.2.2. 7. The issuing of a variation order in terms of Clause 36.2. 8. Issuing of instructions to carry out work on a day work basis in terms of Clause 37.1.4. 9. Granting permission to work during non-working times in terms of Clause 38.1. 10. Suspend the progress of the works in terms of Clause 39.1. 11. The issuing of an instruction to accelerate progress in terms of Clause 40.3. 12. The reduction of a penalty for delay in terms of Clause 43.2. 10. The determination of additional or reduced costs arising from changes in legislation in terms of Clause 46.4. 11. The giving of a ruling on a contractor's claim in terms of Clause 48.5. 12. The agreeing of an extension to the 28 period in terms of Clause 48.5.1. 13. The inclusion of credits in the next payment certificate in terms of Clause 48.5.2. 14. The agreeing of the adjustment of the sums for general items in terms of Clause 50.1.
7	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 included in Clause.3. The liability for the guarantee shall be for **10% of the contract amount.**
10	The Works are to be commenced within **14 days** of the Appointment Date.
12.2	The Works programme is to be delivered within **14 days** of the Commencement Date.
35.1.1.2.2	The value of the materials supplied by the Employer to be included in the insurance sum is **R0-00**
35.1.1.2.3	The amount to cover professional fees for repair or reinstatement of damage to the works to be included in the insurance sum is **R0-00**

35.1.3	The limit of liability insurance is **10% of the contract amount** per claim.
35.1.4	No additional insurance is required.
37.2.2.3	The percentage allowance to cover overhead charges is **15%**.
42.1 1.1.13	The works shall be completed within **a period determined by the Contractor considering their resources** exclusive of year end break.
43.1	The penalty for failing to complete the Works is **1.5% of the contract amount per month.**
46.2	The value of the payment certificates is to be adjusted in accordance with the Contract Price Adjustment Schedule, where: The value of "x" is 0,15 a = 0.15 (labour) b = 0.20 (WORKS) c = 0.55 (materials) d = 0.10 (fuel) The urban area nearest the site is Volksrust.
49.1.5	The percentage advance on materials not yet built into the Permanent Works is 80%
49.3	The percentage retention on amounts due to the Contractor is **10% of the contract amount.**
49.6	A Retention Money Guarantee is **permitted**.
53.1	The Defects Liability Period is **12 months**.
58.2	Dispute resolution is to be my means of adjudication
58.4	Disputes are to be referred for final settlement to arbitration.

Part 2: Data provided by the Contractor

<table>
<tr><td>Clause</td><td></td></tr>
<tr><td>1.8

1.2.2</td><td>The name of the Contractor is. . . . . .
The address of the contractor is:
Telephone: . . . . . .
Facsimile: . . . . . .
Address (physical): . . . . . .
. . . . . .
. . . . . .
Address (postal): . . . . . .
. . . . . .
. . . . . .</td></tr>
<tr><td>46.3</td><td>The variation in cost of special materials is:

<table>
<tr><th rowspan="2">Special material</th><th colspan="2">Unit on which variation will be determined</th><th rowspan="2">Price for base month ex factory, excluding transport, labour or any other costs.</th></tr>
<tr><td>Containers</td><td>Delivered in bulk</td></tr>
<tr><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td></td></tr>
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<tr><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td></td></tr>
</table>
*State unit in appropriate column</td></tr>
</table>

C1.3 Form of Guarantee

Contract No: …… Description ……

WHEREAS **The DR. PIXLEY KA ISAKA SEME LOCAL MUNICIPALITY** (hereinafter referred to as the Employer") entered into, a Contract with:

. . . . . .

(hereinafter called "the Contactor") on the . . . . . day of . . . . . .20. . . . . .,

AND WHEREAS it is provided by such Contract that the Contractor shall provide the Employer with security by way of a guarantee for the due and faithful fulfillment of such Contract by the Contractor;

AND WHEREAS . . . . . has / have at the request of the Contractor, agreed to give such guarantee;

NOW THEREFORE WE . . . . . do hereby guarantee and bind ourselves jointly and severally as Guarantor and Co-principal Debtors to the Employer under renunciation of the benefits of division and excursion for the due and faithful performance by the Contractor of all the terms and conditions of the said Contract, subject to the following conditions:

1. The Employer shall, without reference and / or notice to us, have complete liberty of action to act in any manner authorized and/or contemplated by the terms of the said Contract, and/or to agree to any modifications, variations, alterations, directions or extensions of the completion date of the works under the said Contract, and that its rights under this guarantee shall in no way be prejudiced nor our liability hereunder be affected by reason of any steps which the Employer may take under such Contract, or of any modification, variation, alterations of the completion date which the Employer may make, give, concede or agree to under the said Contract.

2. This guarantee shall be limited to the payment of a sum of money.

3. The Employer shall be entitled, without reference to us, to release any guarantee held by it, and to give time to or compound or make any other arrangement with the Contractor.

4. This guarantee shall remain in full force and effect until the issue of the Certificate of Completion in terms of the Contract, unless we are advised in writing by the Employer before the issue of the said Certificate of his intention to institute claims, and the particulars thereof, in which event this guarantee shall remain in full force and effect until all such claims have been paid or liquidated.

5. Our total liability hereunder shall not exceed the Guaranteed Sum of . . . . . .

   . . . . . .Rand (in words); R . . . . . (in figures)

   ……

6. The Guarantor reserves the right to withdraw from this guarantee by depositing the Guaranteed Sum with the beneficiary, whereupon our liability hereunder shall cease.

7. We hereby choose our address for the serving of all notices for all purposes arising here from as

   . . . . . .

   . . . . . .

. . . . . .

. . . . . .

IN WITNESS WHEREOF this guarantee has been executed by us at . . . . . .
on this . . . . . day of . . . . . 20 . . . . . .

Signature . . . . . .

Duly authorized to sign on behalf of . . . . . .

Address . . . . . .

. . . . . .

. . . . . .

As witnesses:

1 . . . . . .

2 . . . . . .

C2.1 Pricing Instructions

1 Measurement and payment shall be in accordance with the relevant provisions of clause 8 of each of the SABS 1200 Standardised Specifications for Civil Engineering Construction referred to in the Scope of Work. The Preliminary and General items shall be measured in accordance with the provisions of SABS 1200-A, *General.*

2. The units of measurement described in the Bills of Quantities are metric units. Abbreviations used in these Bills of Quantities are as follows:

%	=	percent
h	=	hour
ha	=	hectare
kg	=	kilogram
kl	=	kilolitre
km	=	kilometre
km-pass	=	kilometre-pass
kPa	=	kilopascal
kW	=	kilowatt
l	=	litre
m	=	metre
mm	=	millimetre
m^2	=	square metre
m^2-pass	=	square metre-pass
m^3	=	cubic metre
m^3-km	=	cubic metre-kilometre
MN	=	meganewton
MN.m	=	meganewton-metre
MPa	=	megapascal
No.	=	number
Prov sum	=	Provisional sum
PC sum	=	Prime Cost sum
R/only	=	Rate only
sum	=	lump sum
t	=	ton (1000 kg)
W/day	=	Work day

3. Unless otherwise stated, items are measured net in accordance with the drawings, and no allowance is made for waste.

4. The prices and rates in these Bills of Quantities are fully inclusive prices for the work described under the items. Such prices and rates cover all costs and expenses that may be required in and for the execution of the work described in accordance with the provisions of the Scope of Work, and shall cover the cost of all general risks, liabilities, and obligations set forth or implied in the Contract Data, as well as overhead charges and profit. These prices will be used as a basis for assessment of payment for additional work that may have to be carried out.

5 It will be assumed that prices included in these Bills of Quantities are based on Acts, Ordinances, Regulations, By-laws, International Standards and National Standards that were published 28 days before the closing date for Bids. (Refer to www.stanza.org.za or www.iso.org for information on standards)

6 Where the Scope of Work requires detailed drawings and designs or other information to be provided, all costs associated therewith are deemed to have been provided for and included in the unit rates

and sum amount Bided such items

7. An item against which no price is entered will be considered to be covered by the other prices or rates in the Bills of Quantities. A single lump sum will apply should a number of items be grouped together for pricing purposes.

8. The quantities set out in these Bills of Quantities are approximate and do not necessarily represent the actual amount of work to be done. The quantities of work accepted and certified for payment will be used for determining payments due and not the quantities given in the Bills of Quantities.

9. Reasonable compensation will be received where no pay item appears in respect of work required in the Bills of Quantities in terms of the Contract and which is not covered in any other pay item.

10. The short descriptions of the items of payment given in these Bills of Quantities are only for the purposes of identifying the items. More details regarding the extent of the work entailed under each item appear in the Scope of Work.

11. Descriptions in the Bills of Quantities are abbreviated and comply generally with those in the SABS 1200 Standardized Specifications.

12. Those parts of the contract to be constructed using labour-intensive methods have been identified in the scope of works. **Tenderers must price such works so as to allow for Labour-intensive construction methods**. The works, or parts of the works so designated are to be constructed using labour-intensive methods only. The use of WORKS to provide such works, other than WORKS specifically provided for in the scope of work, is a variation to the contract.

13. **Payment for items which are designated to be constructed labour-intensively will not be made unless they are constructed using labour-intensive methods. Any unauthorized use of WORKS 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.**

DR. PIXLEY KA ISAKA SEME LOCAL MUNICIPALITY

C2.2 Bill of Quantities

Bill of Quantities (BOQ)
REFURBISHMENT OF VOLKRUST WATER TREATMENT WORKS
CONTRACT NO. T15/2023

ITEM	PAYMENT CLAUSE	DESCRIPTION	UNIT	QTY	PRICE R c	TOTAL R c
		SCHEDULE 1				
		PRELIMINARY AND GENERAL				
1.1		Site Facilities (including but not limited to offices, storage sheds, workshops, ablutions, etc)	Sum	1		
1.2		Plant and Equipment	Provisional Sum	1	R 100 000,00	R 100 000,00
1.3		Project Management	months	5		
1.4		OHS Agent	months	5		
1.5		Contractual Obligations	Sum	1		
1.6						
1.6		**Documentation**				
1.6.1		Commissioning Documentation	Sum	1		
1.6.2		Operating and Maintenance Manuals	Sum	1		
1.6.3		Data Books	Sum	1		
1.7		**Full compliance to legislative requirements . This shall include but not limited to the list below:**				
1.7.1		OHS Act (Health and Safety Specifications) including HSE Plan and adherence to OHS	Sum	1		
1.7.2		Environmental Management Plan	Sum	1		
1.7.3		Quality Plans and Control	Sum	1		
1.8		Training of Dr Pixley ka Seme Personnel	Sum	1		
1,9		Student training	P Sum	1	R 50 000,00	R 50 000,00
1.9						
2,9		De-establishment on completion of work	Sum	1		
1.10		Other (Specify below)				
		Total Carried to Summary				

ITEM	PAYMENT CLAUSE	DESCRIPTION	UNIT	QTY	Price	TOTAL
					R c	R c
		SCHEDULE 2				
2		**ELECTRICAL EQUIPMENT**				
2,1	2	**ELECTRICAL SUPPLY**				
2.1.1		All required LV Diesel Generator Volkrust Water Treament Work's 60kVA Change Over Panel	Prov Sum	1		
2.1.2		Overheads, charges and profit on Item 2.1.1 above	%			
2.1.3		All required LV Diesel Generator Complete with Canopy Volkrust Water Treament Work's 60kVA Diesel Generator with 850l Tank	Prov Sum	1		
2.1.4		Overheads, charges and profit on Item 2.1.3 above	%			
2,2		**MOTOR CONTROL CENTRES**				
		Supply and Delivery to site of the following plant and equipment including quality assurance, factory testing, temporary storage and painting.				
2.2.1	8,9,10,11	Main Plant MCC-01	Sum	1		
2.2.2	8,10,11	Chemical House MCC-02	Sum	1		
		Taking delivery, handling, erection, installation, testing, final painting and quality assurance of the following plant and equipment.				
2.2.3	8,9,10,11	Main Plant MCC	Sum	1		
2.2.4	8,10,11	Chemical House MCC	Sum	1		

		Dismantling/disconnecting and removing the following plant and equipment from site, and loading and transporting to Employer's stores.				
2.2.5		Main Plant MCC-01	Sum	1		
2.2.6		Chemical House MCC-02	Sum	1		
					AMOUNT CARRIED FORWARD	

					AMOUNT BROUGHT FORWARD	
2,3	**12**	**LOW VOLTAGE POWER CABLES** **Supply and Delivery to site of the following plant and equipment including quality assurance, factory testing, temporary storage and painting.** 600/1000V copper conductor PVC/PVC/SWA/PVC ECC:				
2.3.1		Main Supply cable feeding Chemical House MCC Panel 25 mm 4C PVC/PVC/SWA/PVC ECC	m	50		
2.3.2		Main Supply cable feeding Chemical House MCC Panel 16 mm 1C Earth Wire	m	50		
2.3.3		Pump House Clean Water Pump No.1 2.5 mm 4C PVC/PVC/SWA/PVC ECC	m	40		
2.3.4		Pump House Clean Water Pump No.1 1.5 mm PVC/PVC/SWA/PVC 7C	m	40		
2.3.5		Pump House Clean Water Pump No.2 2.5 mm 4C PVC/PVC/SWA/PVC ECC	m	40		
2.3.5		Pump House Clean Water Pump No.2 1.5 mm PVC/PVC/SWA/PVC 7C	m	40		
2.3.6		Pump House Clean Water Pump No.3 2.5 mm 4C PVC/PVC/SWA/PVC ECC	m	40		
2.3.7		Pump House Clean Water Pump No.3 1.5 mm PVC/PVC/SWA/PVC 7C	m	40		
2.3.8		Pump House Backwash Pump No.1 1.5 mm 4C PVC/PVC/SWA/PVC ECC	m	40		
2.3.9		Pump House Backwash Pump No.1 1.5 mm PVC/PVC/SWA/PVC 7C	m	40		
2.3.10		Pump House Backwash Pump No.2 1.5 mm 4C PVC/PVC/SWA/PVC ECC	m	40		
2.3.11		Pump House Backwash Pump No.2 1.5 mm PVC/PVC/SWA/PVC 7C	m	40		

2.3.12		Pump House Air Blower No.1 1.5 mm 4C PVC/PVC/SWA/PVC ECC	m	40		
2.3.13		Pump House Air Blower No.1 1.5 mm PVC/PVC/SWA/PVC 7C	m	40		
2.3.14		Pump House Air Blower No.2 1.5 mm 4C PVC/PVC/SWA/PVC ECC	m	40		
2.3.15		Pump House Air Blower No.2 1.5 mm PVC/PVC/SWA/PVC 7C	m	40		
					AMOUNT CARRIED FORWARD	

		AMOUNT BROUGHT FORWARD				
2.3.16		Main Building Parameter Flood Lighting 1.5 mm 3C PVC/PVC/SWA/PVC	m	75		
2.3.17		Chlorine Room Extraction Fan 1.5 mm 3C PVC/PVC/SWA/PVC	m	75		
2.3.18		Poly Bulk Storage Room Extraction Fan 1.5 mm 3C PVC/PVC/SWA/PVC	m	75		
2.3.19		Chemical House Lime Screw Conveyor No.1 1.5 mm 4C PVC/PVC/SWA/PVC ECC	m	20		
2.3.20		Chemical House Lime Screw Conveyor No.1 1.5 mm PVC/PVC/SWA/PVC 7C	m	20		
2.3.21		Chemical House Lime Screw Conveyor No.2 1.5 mm 4C PVC/PVC/SWA/PVC ECC	m	20		
2.3.22		Chemical House Lime Screw Conveyor No.2 1.5 mm PVC/PVC/SWA/PVC 7C	m	20		
2.3.23		Chemical House Lime Hopper Vibrator No.1 1.5 mm 4C PVC/PVC/SWA/PVC ECC	m	20		
2.3.24		Chemical House Lime Hopper Vibrator No.1 1.5 mm PVC/PVC/SWA/PVC 7C	m	20		
2.3.25		Chemical House Lime Hopper Vibrator No.2 1.5 mm 4C PVC/PVC/SWA/PVC ECC	m	20		
2.3.26		Chemical House Lime Hopper Vibrator No.2 1.5 mm PVC/PVC/SWA/PVC 7C	m	20		
2.3.27		Chemical House Lime Hopper Dust Extractor Fan No.1 1.5 mm 4C PVC/PVC/SWA/PVC ECC	m	20		
2.3.28		Chemical House Lime Hopper Dust Extractor Fan No.1 1.5 mm PVC/PVC/SWA/PVC 7C	m	20		
2.3.29		Chemical House Lime Hopper Dust Extractor Fan No.2 1.5 mm 4C PVC/PVC/SWA/PVC ECC	m	20		

2.3.30		Chemical House Lime Hopper Dust Extractor Fan No.2 1.5 mm PVC/PVC/SWA/PVC 7C	m	20		
2.3.31		Chemical House Hoister Equipment 2,5 mm 3C PVC/PVC/SWA/PVC	m	20		
2.3.32		Clarifier and Filter Area Parameter Flood Lighting 2.5 mm 3C PVC/PVC/SWA/PVC ECC	m	100		
	12	**LV POWER CABLE GLANDS** Supply Eviro Gland Complete Only 600/1000V copper conductor PVC/PVC/SWA/PVC ECC:				
					AMOUNT CARRIED FORWARD	

		AMOUNT BROUGHT FORWARD				
2.4.1		Main Supply cable feeding Chemical House MCC Panel 25 mm 4C PVC/PVC/SWA/PVC ECC	No.	2		
2.4.2		Main Supply cable feeding Chemical House MCC Panel 16 mm 1C Earth Wire	No.	2		
2.4.3		Pump House Clean Water Pump No.1 2.5 mm 4C PVC/PVC/SWA/PVC ECC	No.	4		
2.4.4		Pump House Clean Water Pump No.1 1.5 mm PVC/PVC/SWA/PVC 7C	No.	2		
2.4.5		Pump House Clean Water Pump No.2 2.5 mm 4C PVC/PVC/SWA/PVC ECC	No.	4		
2.4.5		Pump House Clean Water Pump No.2 1.5 mm PVC/PVC/SWA/PVC 7C	No.	2		
2.4.6		Pump House Clean Water Pump No.3 2.5 mm 4C PVC/PVC/SWA/PVC ECC	No.	4		
2.4.7		Pump House Clean Water Pump No.3 1.5 mm PVC/PVC/SWA/PVC 7C	No.	2		
2.4.8		Pump House Backwash Pump No.1 1.5 mm 4C PVC/PVC/SWA/PVC ECC	No.	4		
2.4.9		Pump House Backwash Pump No.1 1.5 mm PVC/PVC/SWA/PVC 7C	No.	2		
2.4.10		Pump House Backwash Pump No.2 1.5 mm 4C PVC/PVC/SWA/PVC ECC	No.	4		
2.4.11		Pump House Backwash Pump No.2 1.5 mm PVC/PVC/SWA/PVC 7C	No.	2		
2.4.12		Pump House Air Blower No.1 1.5 mm 4C PVC/PVC/SWA/PVC ECC	No.	4		
2.4.13		Pump House Air Blower No.1 1.5 mm PVC/PVC/SWA/PVC 7C	No.	2		
2.4.14		Pump House Air Blower No.2 1.5 mm 4C PVC/PVC/SWA/PVC ECC	No.	4		
2.4.15		Pump House Air Blower No.2 1.5 mm PVC/PVC/SWA/PVC 7C	No.	2		

2.4.16		Main Building Parameter Flood Lighting 1.5 mm 3C PVC/PVC/SWA/PVC	No.	4		
2.4.17		Chlorine Room Extraction Fan 1.5 mm 3C PVC/PVC/SWA/PVC	No.	2		
2.4.18		Poly Bulk Storage Room Extraction Fan 1.5 mm 3C PVC/PVC/SWA/PVC	No.	2		
2.4.19		Chemical House Lime Screw Conveyor No.1 1.5 mm 4C PVC/PVC/SWA/PVC ECC	No.	4		
					AMOUNT CARRIED FORWARD	

		AMOUNT BROUGHT FORWARD				
2.4.20		Chemical House Lime Screw Conveyor No.1 1.5 mm PVC/PVC/SWA/PVC 7C	No.	2		
2.4.21		Chemical House Lime Screw Conveyor No.2 1.5 mm 4C PVC/PVC/SWA/PVC ECC	No.	4		
2.4.22		Chemical House Lime Screw Conveyor No.2 1.5 mm PVC/PVC/SWA/PVC 7C	No.	2		
2.4.23		Chemical House Lime Hopper Vibrator No.1 1.5 mm 4C PVC/PVC/SWA/PVC ECC	No.	4		
2.4.24		Chemical House Lime Hopper Vibrator No.1 1.5 mm PVC/PVC/SWA/PVC 7C	No.	2		
2.4.25		Chemical House Lime Hopper Vibrator No.2 1.5 mm 4C PVC/PVC/SWA/PVC ECC	No.	4		
2.4.26		Chemical House Lime Hopper Vibrator No.2 1.5 mm PVC/PVC/SWA/PVC 7C	No.	2		
2.4.27		Chemical House Lime Hopper Dust Extractor Fan No.1 1.5 mm 4C PVC/PVC/SWA/PVC ECC	No.	4		
2.4.28		Chemical House Lime Hopper Dust Extractor Fan No.1 1.5 mm PVC/PVC/SWA/PVC 7C	No.	2		
2.4.29		Chemical House Lime Hopper Dust Extractor Fan No.2 1.5 mm 4C PVC/PVC/SWA/PVC ECC	No.	4		
2.4.30		Chemical House Lime Hopper Dust Extractor Fan No.2 1.5 mm PVC/PVC/SWA/PVC 7C	No.	2		
2.4.31		Chemical House Hoister Equipment 2,5 mm 3C PVC/PVC/SWA/PVC	No.	2		
2.4.32		Clarifier and Filter Area Parameter Flood Lighting 2.5 mm 3C PVC/PVC/SWA/PVC ECC	No.	9		
	12	**LOW VOLTAGE POWER CABLES Installation**				

		Taking delivery, handling, erection, installation, testing, final painting and quality assurance of the following plant and equipment. 600/1000V copper conductor PVC/PVC/SWA/PVC ECC:				
2.5.1		Main Supply cable feeding Chemical House MCC Panel 25 mm 4C PVC/PVC/SWA/PVC ECC	m	50		
2.5.2		Main Supply cable feeding Chemical House MCC Panel 16 mm 1C Earth Wire	m	50		
					AMOUNT CARRIED FORWARD	

		AMOUNT BROUGHT FORWARD				
2.5.3		Pump House Clean Water Pump No.1 2.5 mm 4C PVC/PVC/SWA/PVC ECC	m	40		
2.5.4		Pump House Clean Water Pump No.1 1.5 mm PVC/PVC/SWA/PVC 7C	m	40		
2.5.5		Pump House Clean Water Pump No.2 2.5 mm 4C PVC/PVC/SWA/PVC ECC	m	40		
2.5.5		Pump House Clean Water Pump No.2 1.5 mm PVC/PVC/SWA/PVC 7C	m	40		
2.5.6		Pump House Clean Water Pump No.3 2.5 mm 4C PVC/PVC/SWA/PVC ECC	m	40		
2.5.7		Pump House Clean Water Pump No.3 1.5 mm PVC/PVC/SWA/PVC 7C	m	40		
2.5.8		Pump House Backwash Pump No.1 1.5 mm 4C PVC/PVC/SWA/PVC ECC	m	40		
2.5.9		Pump House Backwash Pump No.1 1.5 mm PVC/PVC/SWA/PVC 7C	m	40		
2.5.10		Pump House Backwash Pump No.2 1.5 mm 4C PVC/PVC/SWA/PVC ECC	m	40		
2.5.11		Pump House Backwash Pump No.2 1.5 mm PVC/PVC/SWA/PVC 7C	m	40		
2.5.12		Pump House Air Blower No.1 1.5 mm 4C PVC/PVC/SWA/PVC ECC	m	40		
2.5.13		Pump House Air Blower No.1 1.5 mm PVC/PVC/SWA/PVC 7C	m	40		
2.5.14		Pump House Air Blower No.2 1.5 mm 4C PVC/PVC/SWA/PVC ECC	m	40		
2.5.15		Pump House Air Blower No.2 1.5 mm PVC/PVC/SWA/PVC 7C	m	40		
2.5.16		Main Building Parameter Flood Lighting 1.5 mm 3C PVC/PVC/SWA/PVC	m	75		
2.5.17		Chlorine Room Extraction Fan 1.5 mm 3C PVC/PVC/SWA/PVC	m	75		

2.5.18		Poly Bulk Storage Room Extraction Fan 1.5 mm 3C PVC/PVC/SWA/PVC	m	75		
2.5.19		Chemical House Lime Screw Conveyor No.1 1.5 mm 4C PVC/PVC/SWA/PVC ECC	m	20		
2.5.20		Chemical House Lime Screw Conveyor No.1 1.5 mm PVC/PVC/SWA/PVC 7C	m	20		
2.5.21		Chemical House Lime Screw Conveyor No.2 1.5 mm 4C PVC/PVC/SWA/PVC ECC	m	20		
					AMOUNT CARRIED FORWARD	

		AMOUNT BROUGHT FORWARD				
2.5.22		Chemical House Lime Screw Conveyor No.2 1.5 mm PVC/PVC/SWA/PVC 7C	m	20		
2.5.23		Chemical House Lime Hopper Vibrator No.1 1.5 mm 4C PVC/PVC/SWA/PVC ECC	m	20		
2.5.24		Chemical House Lime Hopper Vibrator No.1 1.5 mm PVC/PVC/SWA/PVC 7C	m	20		
2.5.25		Chemical House Lime Hopper Vibrator No.2 1.5 mm 4C PVC/PVC/SWA/PVC ECC	m	20		
2.5.26		Chemical House Lime Hopper Vibrator No.2 1.5 mm PVC/PVC/SWA/PVC 7C	m	20		
2.5.27		Chemical House Lime Hopper Dust Extractor Fan No.1 1.5 mm 4C PVC/PVC/SWA/PVC ECC	m	20		
2.5.28		Chemical House Lime Hopper Dust Extractor Fan No.1 1.5 mm PVC/PVC/SWA/PVC 7C	m	20		
2.5.29		Chemical House Lime Hopper Dust Extractor Fan No.2 1.5 mm 4C PVC/PVC/SWA/PVC ECC	m	20		
2.5.30		Chemical House Lime Hopper Dust Extractor Fan No.2 1.5 mm PVC/PVC/SWA/PVC 7C	m	20		
2.5.31		Chemical House Hoister Equipment 2,5 mm 3C PVC/PVC/SWA/PVC	m	20		
2.5.32		Clarifier and Filter Area Parameter Flood Lighting 2.5 mm 3C PVC/PVC/SWA/PVC ECC	m	100		
	12	**LV POWER CABLE TERMINATIONS** Gland, crimp and terminate 600/1000V copper conductor PVC/PVC/SWA/PVC ECC:				
2.6.1		Main Supply cable feeding Chemical House MCC Panel 25 mm 4C PVC/PVC/SWA/PVC ECC	No.	2		

2.6.2		Main Supply cable feeding Chemical House MCC Panel 16 mm 1C Earth Wire	No.	2		
2.6.3		Pump House Clean Water Pump No.1 2.5 mm 4C PVC/PVC/SWA/PVC ECC	No.	4		
2.6.4		Pump House Clean Water Pump No.1 1.5 mm PVC/PVC/SWA/PVC 7C	No.	2		
2.6.5		Pump House Clean Water Pump No.2 2.5 mm 4C PVC/PVC/SWA/PVC ECC	No.	4		
2.6.5		Pump House Clean Water Pump No.2 1.5 mm PVC/PVC/SWA/PVC 7C	No.	2		
AMOUNT CARRIED FORWARD						

		AMOUNT BROUGHT FORWARD				
2.6.6		Pump House Clean Water Pump No.3 2.5 mm 4C PVC/PVC/SWA/PVC ECC	No.	4		
2.6.7		Pump House Clean Water Pump No.3 1.5 mm PVC/PVC/SWA/PVC 7C	No.	2		
2.6.8		Pump House Backwash Pump No.1 1.5 mm 4C PVC/PVC/SWA/PVC ECC	No.	4		
2.6.9		Pump House Backwash Pump No.1 1.5 mm PVC/PVC/SWA/PVC 7C	No.	2		
2.6.10		Pump House Backwash Pump No.2 1.5 mm 4C PVC/PVC/SWA/PVC ECC	No.	4		
2.6.11		Pump House Backwash Pump No.2 1.5 mm PVC/PVC/SWA/PVC 7C	No.	2		
2.6.12		Pump House Air Blower No.1 1.5 mm 4C PVC/PVC/SWA/PVC ECC	No.	4		
2.6.13		Pump House Air Blower No.1 1.5 mm PVC/PVC/SWA/PVC 7C	No.	2		
2.6.14		Pump House Air Blower No.2 1.5 mm 4C PVC/PVC/SWA/PVC ECC	No.	4		
2.6.15		Pump House Air Blower No.2 1.5 mm PVC/PVC/SWA/PVC 7C	No.	2		
2.6.16		Main Building Parameter Flood Lighting 1.5 mm 3C PVC/PVC/SWA/PVC	No.	4		
2.6.17		Chlorine Room Extraction Fan 1.5 mm 3C PVC/PVC/SWA/PVC	No.	2		
2.6.18		Poly Bulk Storage Room Extraction Fan 1.5 mm 3C PVC/PVC/SWA/PVC	No.	2		
2.6.19		Chemical House Lime Screw Conveyor No.1 1.5 mm 4C PVC/PVC/SWA/PVC ECC	No.	4		
2.6.20		Chemical House Lime Screw Conveyor No.1 1.5 mm PVC/PVC/SWA/PVC 7C	No.	2		
2.6.21		Chemical House Lime Screw Conveyor No.2 1.5 mm 4C PVC/PVC/SWA/PVC ECC	No.	4		

2.6.22		Chemical House Lime Screw Conveyor No.2 1.5 mm PVC/PVC/SWA/PVC 7C	No.	2		
2.6.23		Chemical House Lime Hopper Vibrator No.1 1.5 mm 4C PVC/PVC/SWA/PVC ECC	No.	4		
2.6.24		Chemical House Lime Hopper Vibrator No.1 1.5 mm PVC/PVC/SWA/PVC 7C	No.	2		
2.6.25		Chemical House Lime Hopper Vibrator No.2 1.5 mm 4C PVC/PVC/SWA/PVC ECC	No.	4		
					AMOUNT CARRIED FORWARD	

		AMOUNT BROUGHT FORWARD				
2.6.26		Chemical House Lime Hopper Vibrator No.2 1.5 mm PVC/PVC/SWA/PVC 7C	No.	2		
2.6.27		Chemical House Lime Hopper Dust Extractor Fan No.1 1.5 mm 4C PVC/PVC/SWA/PVC ECC	No.	4		
2.6.28		Chemical House Lime Hopper Dust Extractor Fan No.1 1.5 mm PVC/PVC/SWA/PVC 7C	No.	2		
2.6.29		Chemical House Lime Hopper Dust Extractor Fan No.2 1.5 mm 4C PVC/PVC/SWA/PVC ECC	No.	4		
2.6.30		Chemical House Lime Hopper Dust Extractor Fan No.2 1.5 mm PVC/PVC/SWA/PVC 7C	No.	2		
2.6.31		Chemical House Hoister Equipment 2,5 mm 3C PVC/PVC/SWA/PVC	No.	2		
2.6.32		Clarifier and Filter Area Parameter Flood Lighting 2.5 mm 3C PVC/PVC/SWA/PVC ECC	No.	9		
2.7	13	**CABLE SUPPORTS** **Supply and Delivery to site of the following plant and equipment including quality assurance, factory testing, temporary storage and painting.** **PUMP HOUSE CABLE SUPPORT** Heavy Duty Cable ladder (hot dipped galvansied)				
2.7.1		400 mm straight	m	10		
2.7.2		400 mm 90^{o} bend	No	6		
2.7.3		400 mm riser	No	6		
2.7.4		400 mm dropper	No	6		

2.7.5		Accessories for installation of 400 mm cable ladder, including all supports, unistruts, threaded bar, splices, fasteners,etc	Sum	1		
2.7.6		200 mm straight	m	6		
2.7.7		200 mm 90º bend	No	6		
					AMOUNT CARRIED FORWARD	

		AMOUNT BROUGHT FORWARD				
2.7.10		Accessories for installation of 200 mm cable ladder, including all supports, unistruts, threaded bar, splices, fasteners,etc	Sum	1		
2.7.11		100 mm straight	m	7		
2.7.12		100 mm 90º bend	No	7		
2.7.15		Accessories for installation of 100 mm cable ladder, including all supports, unistruts, threaded bar, splices,fasteners,etc	Sum	1		
	13	**CABLE SUPPORTS**				
		Taking delivery, handling, erection, installation, testing, final painting and quality assurance of the following plant and equipment.				
		PUMP HOUSE CABLE SUPPORT				
		Heavy Duty Cable ladder (hot dipped galvansied)				
2.7.16		400 mm straight	m	10		
2.7.17		400 mm 90º bend	No	6		
2.7.18		400 mm riser	No	6		
2.7.19		400 mm dropper	No	6		
2.7.20		Accessories for installation of 400 mm cable ladder, including all supports, unistruts, threaded bar, splices, fasteners,etc	Sum	1		
2.8.51		200 mm straight	m	6		
2.8.52		200 mm 90º bend	No	6		
2.8.55		Accessories for installation of 200 mm cable ladder, including all supports, unistruts, threaded bar, splices, fasteners,etc	Sum	1		
2.8.56		100 mm straight	m	7		

2.8.57		100 mm 90º bend	No	7		
2.8.60		Accessories for installation of 100 mm cable ladder, including all supports, unistruts, threaded bar, splices,fasteners,etc	Sum	1		
					AMOUNT CARRIED FORWARD	

		AMOUNT BROUGHT FORWARD				
2,9	**14**	**PUMP HOUSE FIELD CONTROL STATIONS** **Supply and Delivery to site of the following plant and equipment including quality assurance, factory testing, temporary storage and painting.**				
2.9.1		Emergency Stop Stations, including mouting stand and all required accessories and fasteners	No	7		
2.9.2		Emergency Stop/Stop/Start Stations, including mounting stand and all required accessories and fasteners	No	7		
	14	**PUMP HOUSE FIELD CONTROL STATIONS** **Taking delivery, handling, erection, installation, testing, final painting and quality assurance of the following plant and equipment.**				
2.9.3		Emergency Stop Stations, including mouting stand and all required accessories and fasteners	No	7		
2.9.4		Emergency Stop/Stop/Start Stations, including mounting stand and all required accessories and fasteners	No	7		
2,10		**CHEMICAL HOUSE FIELD CONTROL STATIONS** **Supply and Delivery to site of the following plant and equipment including quality assurance, factory testing, temporary storage and painting.**				
2.10.1		Emergency Stop Stations, including mouting stand and all required accessories and fasteners	No	6		
2.10.2		Emergency Stop/Stop/Start Stations, including mounting stand and all required accessories and fasteners	No	6		

	14	**CHEMICAL HOUSE FIELD CONTROL STATIONS** **Taking delivery, handling, erection, installation, testing, final painting and quality assurance of the following plant and equipment.**				
2.10.3		Emergency Stop Stations, including mouting stand and all required accessories and fasteners	No	6		
2.10.4		Emergency Stop/Stop/Start Stations, including mounting stand and all required accessories and fasteners	No	6		
					AMOUNT CARRIED FORWARD	

				AMOUNT BROUGHT FORWARD		
2,11	**15**	**EARTHING**				
2.11.1		Earthing and Lightning protection system investigation, report and remedial work approved by the Engineer	Prov Sum	1		
2.11.2		Overheads, charges and profit on Item 2.1.2 above	%			
2.11.3		Equi-potential bonding and earthing of all extraneous conductive parts of electrical equipment, cable support,etc	Sum	1		
2,12	**16**	**BUILDING SERVICES**				
		Supply and Delivery to site of the following plant and equipment including quality assurance, factory testing, temporary storage and painting				
		DISTRIBUTION BOARD				
2.12.1		Supply and Install Main Distribution Board c/w CBs and labels	No	1		
2.12.2		Supply and Install Main Distribution Board c/w CBs and labels at Chemical House	No	1		
		LIGHT SWITCHES Surface-mounted in 100 x 50mm boxes & complete with White PVC covers and chromium fixing screws where applicable (15 Amp minimum rating) and labelling as specified.				
2.12.3		Light Switch: 16A, 1 way, 1 lever, surface mounted	No	1		
2.12.4		Light Switch: 16A, 2 way, 1 lever, surface mounted installed at Pump Room	No	2		
		SWITCHED SOCKET OUTLETS Socket outlets of various configurations mountings, complete with appropriate covers etc. and labelling as specified.				
2.12.5		16A 3-pin double switched socket outlet - in surface-mounted weather proof box.	No	0		
2.12.6		32 Amp, 400V, Welding plug point	No	0		

2.12.7		63 Amp, 400V, Welding plug point **WIRING** 600/1000Volt grade PVC insulated wire (incl. insulated copper earthwire), of various colours, drawn into conduit, including wastage, tools & equipment.	No	0		
2.12.8		2,5mm^2 (Lighting)	m	0		
2.12.7		4,0mm^2 (Switched Socket Outlets)	m	0		
2.12.9		6,0mm^2 (Switched Socket Outlets)	m	0		
					AMOUNT CARRIED FORWARD	

		AMOUNT BROUGHT FORWARD				
		DAYLIGHT SWITCH 15 Amp rated daylight switch installed complete with all accessories in a suitably sized rectangular bulkhead luminaire housing with clear UV stabilised high impact acrylic lens and labelling as specified.				
2.12.11		Daylight Switch (photocell)	No	4		
		LUMINAIRES				
2.12.12		Supply and install T8 LED Weatherproof Linear Lights IP65 2x18W(4FT) 1278Lx129W90H (2x1700lm) 6000K	No	18		
2.12.13		Supply and install LED Ceiling Light Fitting ⌀300 x 50, 8W 600 lm	No	5		
2.12.14		Replace, Supply and Install LED Aluminium Floodlights 30W IP65 Surface 225x185x160 (Wall Mounted)		10		
2.12.15		Supply and Install LED Aluminium Install LED Aluminium Floodlights 30W IP65 Surface 225x185x160 (Double Opposite Pole Mounted) in Clarifier Parameter Area		18		
2.12.16		Supply and install LED Recessed Aluminium Parabolic Louvre Light Fitting 3x4FT 595mmx1195mm x90mm.		2		
2.12.17		Supply and Install Outdoor LED Bulkhead 12W LED 220V 290x290x100 (800lm) 6000K in vicinity of Clarifier		3		
		Taking delivery, handling, erection, installation, testing, final painting and quality assurance of the following plant and equipment.				
2.12.18		Remove old hot Water storage, Supply and install a 5litre Hydroboil White Epoxy plumbing to sink basin area in toilet	PC	1		
2.12.19		Supply and install INDUSTRIAL AXIAL FAN 230V 55W 1100m3/h ACDC Code: OW73302 at Chemical House & Chlorine Room	PC	2		
2.12.21		Supply and Install submersible pump 240V, 0.75KW C/W Float Switch and supply cable at Pump Room	PC	1		

2.12.22		**LIGHT SWITCHES** Surface-mounted in 100 x 50mm boxes & complete with White PVC covers and chromium fixing screws where applicable (15 Amp minimum rating) and labelling as specified. Light Switch: 16A, 1 way, 1 lever, surface mounted **SWITCHED SOCKET OUTLETS** Socket outlets of various configurations mountings, complete with appropriate covers etc. and labelling as specified.	No	1		
					AMOUNT CARRIED FORWARD	

				AMOUNT BROUGHT FORWARD		
		WIRING 600/1000Volt grade PVC insulated wire (incl. insulated copper earthwire), of various colours, drawn into conduit, including wastage, tools & equipment.				
		CONDUITS AND ACCESSORIES Galvanized mild steel plain ended conduit, including couplings, adaptors, male and female bushes, locknuts and plugs, covers, fixings saddles and screws, bending, reaming, fixing, cleaning for wiring purposes, waste and the prevention and remedy of damage during building operations, as well as consumable items such as angle grinder discs etc.				
2.8.23		25mm diameter	m	75		
2.8.24		Supply and Install Galvanised steel draw and outlet boxes into concrete or chased into brickwalls, in the following sizes: installed surface , cast: 60mm round , 2-way		15		
		Dismantling/disconnecting and removing the following plant and equipment from site, and loading and transporting to Employer's stores.				
2.8.25		Flush/ Recessed Distribution Boards	No	1		
2.8.26		Existing Light Fittings	No	35		
2.8.27		Existing Motor Cables	No	9		
2.8.28		Existing Switched Sockect Outlets	No	2		
2,9		**MISCELLANEOUS**				
2.9.1		Submit required COCs upon completion of works and prior to commissioning	Sum	1		
2.9.2		Submit the required copies of O&M manuals prior to commissioning of the works	Sum	1		

2.9.3		Electrical Cold Commissioning of Works	Sum	1		
2.9.4		Electrical Hot Commissioning of Works	Sum	1		
2.9.5		Danger signs and Notices	Sum	1		
2.9.6		Fire extinguishers and signage	Sum	1		
2.9.7		Provide training to Employer's staff regarding the operation of the plant's electrical equipment	Sum	1		
					AMOUNT CARRIED FORWARD	

		AMOUNT BROUGHT FORWARD				
2,10		**TEMPORARY AND OVERTIME WORKS**				
2.10.1		Hourly rates for Works to be carried out outside normal working hours (excluding Sunday and public holiday)				
		a) Supevisor	hrs	96		
		b) Electrician	hrs	192		
		c) Assistance	hrs	384		
2.10.2		Hourly rates for Works to be carried out on Sunday and public holiday				
		a) Supevisor	hrs	48		
		b) Electrician	hrs	96		
		c) Assistance	hrs	192		
2.10.3		Allowance for Temporary Supply (Standby Generator) including low voltage panel during phase construction	Prvo Sum			
2.10.4		Allowance for disconnection and re-routing of existing piping	Prov Sum			
2.10.5		Overheads, charges and profit on Item 2.10.3 and 2.10.4 above	%	R -		
		TOTAL AMOUNT OF SCHEDULE 1 CARRIED TO SUMMARY				

ITEM	PAYMENT CLAUSE	DESCRIPTION	UNIT	QTY	PRICE R c	TOTAL R c
		SCHEDULE 3				
3		**ELECTRONIC AND MECHANICAL SECTION**				
3.1		**DRAWINGS, MANUALS, TRAINING. SPARES AND TOOLS**				
		The supply of drawings, manuals, training, spares and tools in accordance with the relevant Standard Specifications and Clause 3.5.7.4				
3.1.1		Preparation of the Design Data Pack for Employers Agent Review	Sum	1		
3,2	**3.7.2.2**	**PROGRAMMABLE LOGIC CONTROLLERS (PLC) AND REMOTE I/O**				
		Supply, installation and programming of the Main PLC System and all associated components to equip the PLC panel (i.e. I/O, power supplies, terminal strips, interposing relays, I/O, comms modules, network switches, fibre to copper transceivers etc.) as per the project Specification C3.7.2.2				
		Volkrust Main Plant PLC WTP:				
3.2.1		Main PLC Panel Complete with Trunking, Terminals, Wiwring, Relays e.t.c	Item	1		
3.2.2		Main PLC and rack	No.	1		
3.2.3		Power Supply	No.	1		
3.2.4		CPU	No.	1		
AMOUNT CARRIED FORWARD						

AMOUNT BROUGHT FORWARD						
		Remote I/O, including all required power supplies, I/O, comms modules, network switches, fibre to copper transceivers, fused terminal blocks, surge protection devices, terminal blocks, interposing relays, wiring and all other required accessories for complete Remote I/O panel/tier as per the project Specification C3.7.2.2				
3.2.5		Main Plant MCC RIO integral to MCC	No.	1		
3.2.6		Chemical House and Sludge Plant RIO	No.	1		
3.2.7		Filtration Plant RIO	No.	1		
3.2.8		RIO Panels (as per typical drawing MD1114-104)	No.	3		
3.2.9		Setup and Confoguration of the Main PLC Control System Network and interfacing to RIOs on site	No.	1		
3.2.10		Programming of the Primary Chemical House PLC Function	No.	1		
3.2.11		Programming of the Clarifier Desludging system function	No.	1		
. 3.2.12		Programming of the Filtration Plant Function	No.	1		
3.2.13		Programming Software and licences	No.	1		
3.2.28		Managed Ethernet Switches	No.	4		
		Testing of the PLC System software and hardware in accordance with the relevant Standard Specifications				
3.2.23		Thin slice Testing	Sum	1		
3.2.24		FAT Testing	No.	1		
3.2.25		SAT Testing	No.	1		
3.2.26		Practical Completion Commissioning and Testing	No.	1		

3.2.27		FDS Preparation	No.	1		
3.2.28		Control Network Architecture Drawings	Sum	1		
AMOUNT CARRIED FORWARD						
AMOUNT BROUGHT FORWARD						
3,3	**C3.7.2.3**	**SCADA**				
		SCADA configuration in accordance with Clause C3.7.2.3 of the Project Specification. SCADA server panel and all associated components to equip the (i.e. power supplies, UPS, terminal strips, LCD monitor, keyboard, firewall, etc.)				
3.3.1		SCADA servers	No.	1		
3.3.2		SCADA switch	No.	1		
3.3.3		Engineering Operator Industrial Panel Computer(IPC/HMI)	No.	3		
3.3.4		SCADA server cabinet, including all accessories	Sum	1		
3.3.5		SCADA application software and licenses Main Server with 3 Clients	Sum	1		
3.3.6		Server Operating System Software	Sum	1		
3.3.7		Workstation PC Operating Software	Sum	3		
3.3.8		Firewall	Sum	1		
3.3.9		SCADA mimics Development Chemical House	Sum	1		
3.3.10		SCADA mimics Development Desludging system	Sum	1		
3.3.11		SCADA mimics Development 7 Filtration, Blowers and Backwash Pump Station System	Sum	1		
3.3.12		SCADA mimics Development Clean Water Pump Station System	Sum	1		
3.3.13		SCADA trends	Sum	1		

3.3.14		SCADA Alarms	Sum	1		
3.3.15		SCADA reports	Sum	1		
3.3.16		SCADA Symbol Library	Sum	1		
3.3.17		SCADA Landing Page Overview Mimics	No.	12		
3.3.18		SCADA low resolution Mimics	No.	70		
3.3.19		SCADA Equipment faceplate	Sum	1		
AMOUNT CARRIED FORWARD						

AMOUNT BROUGHT FORWARD						
3.3.21		FDS Preparation	Sum	1		
3.3.22		Thin Slice Testing	Sum	1		
3,4	**C3.7.2.4**	**Plant MCC, SCADA and PLC FAT, SAT and Commissioning**				
		Supply and installation of HMI in accordance with Clause C3.7.2.4 of the Project Specification.				
3.4.1		Chemical House Internal Testing and FAT	Sum	1		
3.4.2		Filtration System Internal Testing and FAT	Sum	1		
3.4.3		Desludge System Internal Testing and FAT	Sum	1		
3.4.4		Chemical House SAT, Stage 1, 2,3 and 4 commissioning	Sum	1		
3.4.5		Filtration System SAT, Stage 1, 2,3 and 4 commissioning	Sum	1		
3.4.6		Desludge System SAT, Stage 1, 2,3 and 4 commissioning	Sum	1		
3,5	**C3.7.2.5**	**UPS EQUIPMENT**				
		UPS hardware and all associated panel and components to equip the PLC compartments/tiers				
3.5.1		MCC PLC - UPS	No.	1		
3.5.2		SCADA Cabinet UPS	No	1		
3.5.3		FAT Testing	Sum	1		
3.5.4		SAT Testing	Sum	1		
3.5.5		UPS testing and commissioning	Sum	1		
AMOUNT CARRIED FORWARD						

AMOUNT BROUGHT FORWARD						
3,6	**C3.7.2.6**	**Filter Plant and Desludging System Actuators**				
		Supply, installation and commissioning of the Electric Actuator valves and all associated components to equip the Automatic valve control sequence as per the project Specification C3.7.2.6				
3.6.1		Provisional Sum for the Design Fabricate and install actuated Wall mounted sluice Gates Filter 1 - 7 (Inlet Valves Complete)	Prov Sum	1		
3.6.2		Contractors Mark Up	%			
3.6.3		Provisional Sum for the Replace and Automate Backwash Inlet Valves, Air Scour Valve, Filter Outlet Valve Filter 1 - 7 Valves Complete	Prov Sum	1		
3.6.4		Contractors Mark Up	%			
3.6.5		Provisional Sum for the Supply, Install and Automate Clarifier 1,2 and 3,4 Desludge Valves Complete	Prov Sum	1		
3.6.6		Contractors Mark Up	%			
3.6.7		Interface feedbacks to PLC including wiring and associated equipment	Sum	1		
3.6.8		Provisional Sum for the supply, installation and commissioning of Filter and Disludge Valve pneumatic line in including ancillary equipment	Prov Sum	1		
3.6.9		Contractors Mark Up	%			
3.6.10		Provisional Sum for the supply, installation and commissioning of Compressor + 500L Air Receiver	Prov Sum	1		
3.6.11		Contractors Mark Up	%			
3.6.12		Provisional Sum for the Replace exisiting sand filter for Filter 1 - 7	Prov Sum	1		

3.6.13		Contractors Mark Up	%			
3.6.14		Provisional Sum for the Inspect and Replace exisiting filter nozzles for Filter 1 - 7	Prov Sum	1		
3.6.16		Contractors Mark Up	%			
AMOUNT CARRIED FORWARD						

AMOUNT BROUGHT FORWARD						
3,8	**3.7.2.8**	**Fibre Optic**				
		Supply, installation, testing and commissioning of the Fibre optic including all associated components to equip the fibre optic to allow remote control of filtration valves sequence per the project Specification C3.7.2.8				
3.8.1		Multi mode fibre optic Cable	m	600		
3.8.2		Multi mode fibre Optic Terminations	No.	150		
3.8.3		Link loss calculation and Fibre Optic design data pack	Sum	1		
3.8.4		Link Loss testing	Sum	1		
3.8.5		OTDR Testing issuing certificate	Sum	1		
3,9		**Fibre Optic Distribution Panels**				
3.9.1		Supply	No	5		
3.9.2		Install (excluding cable terminations of all fibres)	No	5		
3.9.3		Circuit breakers, Power Supplies and other sundries for the fibre optic distribution panels	Sum	1		
3,10	**3.7.2.9**	**Chemical Dosing Pumps**				
		Supply, installation, testing and commissioning of the Chemical Dosing pumps including all associated components to equip the dosing stations to allow remote control of chemical as per the project Specification C3.7.2.9				
		<u>Chemical House</u>				
3.10.1		Supply and install 2 station 24VDC Poly Dosing capable of dosing 880l/hr. @ 4 Bar pressure complete with Work bench Bund System	No.	1		
3.10.2		Supply, install Replace the existing Day Tank with 500L Storage Tank (Jojo)	No.	1		

3.10.3		Supply, install Replace the existing Pipework and Valves	Sum	1		
3.10.4		Supply and install 2 station 24VDC Poly Transfer complete with Work bench Bund System	No.	1		
3.10.5		Supply, install Replace the existing Pipework and Valves	Sum	1		
3.10.6		Supply, install Replace the existing Day Tank with 1000L Storage Tank (Jojo)	No.	2		
3.10.7		Testing and commissioning	Sum	1		
3.10.8		3 m^3 Lime bulk hopper/loaders with central rottating agitation device, dust extraction equipment, outlet control valve and a load cell on each support	No.	2		
3.10.9		Supply, install Variable speed dry lime screw feeder with outlet pipe discharge	No.	2		
3.10.10		Supply, install 600 litre inverted cone hydraulically mixed lime solution tanks complete with all pipe connections	Sum	2		
3.10.11		Carrier Water solution tank inlet pipework complete with control valves, supports and potable water connection removable pipework.	Sum	1		
3.10.12		Potable water standby solution tank inlet pipework complete with control valves and supports	Sum	1		
3.10.13		Testing and commissioning	Sum	1		
AMOUNT CARRIED FORWARD						

AMOUNT BROUGHT FORWARD						
3,11	**C3.7.2.10**	**FIELD INSTRUMENTATION**				
		Supply, installation and connection of field instrumentation , in accordance with Clause C3.7.2.10 of the Project Specification.				
3.11.1		Level Transmitter - ultrasonic (Clear Well, Poly Storage and Poly Day Tanks)	No.	5		
3.11.2		Plant Air Pressure transmitter	No.	2		
		-				
3.11.3		Flow Switches	No.	8		
3.11.4		Testing and commissioning of all field instrumentation	Sum	1		
3.11.5		Calibration certificates of all field instrumentation	Sum	1		
AMOUNT CARRIED FORWARD						

AMOUNT BROUGHT FORWARD						
3,13	**C3.7.2.12**	**Control, Instrumentation Cables and Junction Boxes**				
		SWA PVC twisted-pair individually screened, overall screened copper conductor instrumentation cable in accordance with Clause C3.7.2.12 of the Project Specification. Excavations for cable trenches and cable supports are measured separately.				
		Instrumentation Cables				
3.13.7		4 pair	m	300		
3.13.8		8 pair	m	200		
		Instrumentation Cable Terminations				
3.13.9		4 pair	No	66		
3.13.10		8 pair	No	24		
		Supply, install and terminate industrial there CAT5 UTP cabling in accordance with Clause C3.7.2.12 of the Project Specification.				
		Control System Network Cabling				
3.13.11		Ethernet cabling (SWA, Cat5 UTP)	m	300		
3.13.12		Terminations	No.	30		
		All other items not included above but which are nevertheless necessary to meet the Scope of Work and/or are required for the proper, safe and effective operation of the plant (<u>Specify</u>):-				
TOTAL AMOUNT OF SCHEDULE 3 CARRIED TO SUMMARY						

ITEM	PAYMENT CLAUSE	DESCRIPTION	UNIT	QTY	PRICE R c	TOTAL R c
		SCHEDULE 4				
4		**CIVIL WORKS**				
4.1		Refurbishment of chlorine dosing area	Sum	1		
4.2		Supply and installation of 304 SS handrails Raw water flow meter chamber	m	10		
4.3		Supply and installation of 304 SS handrails Lime dosing platform	m	10		
4.4		Concrete repairs: Repair of filter crack in filter gallary and stop water leakage	Sum	1		
4.5		Remove old filter media and supply new filter media for 7 filters	m^3	120		
4.6		Draining water from the raw water storage inlet chamber and final clear water flow meter chamber	Sum	1		
		Taking out and removing glass and preparing frame for new glass				
		Glazing from steel frames.	m^2	40		
		Making good internal and external cement plaster				
		Walls in patches including filling cracks with crackfiller and preparing to receive paint.	m^2	150		
		Paint inside control room and chemical house	m^2	150		
TOTAL AMOUNT OF SCHEDULE 4 CARRIED TO SUMMARY						

Bill of Quantities (BOQ)
REFURBISHMENT OF VOLKRUST WATER TREATMENT WORKS
CONTRACT NO. T15/2023

SCHEDULE OF QUANTITIES

ITEM	DESCRIPTION	AMOUNT
Schedule 1 Schedule 2 Schedule 3 Schedule 4	PRELIMINARY AND GENERAL ELECTRICAL SECTION ELECTRONIC AND MECHANICAL SECTION CIVIL WORKS SECTION	
	Sub-total A of Sections Contingencies: Allow the sum of 10% (ten percent) of the above **Sub-total A** for Contingencies to be spent as the Engineer may direct and to be deducted in whole or in part if not required.	
	Price Escalation: Allow the sum of 8% (eight percent) of the above **Sub-total A** for Price Escalation during the Contract Period. *(The provisional sum provided here may be employed only as necessary in terms of Contract Price Adjustment Schedule)*	
	SUB TOTAL B INCLUDING CONTINGENCIES & ESCALATION	
	ALLOW 15% FOR VALUE ADDED TAX	
TOTAL CARRIED FORWARD PART C1.1 FORM OF OFFER AND ACCEPTANCE		

……
SIGNATURE(S) OF BIDDERS

C3. Scope of Work

Background

Dr Pixley Ka Isaka Seme Local Municipality is a Category B municipality situated in the Gert Sibande District Municipality of Mpumalanga Province. It is bordered by Msukaligwa Local Municipality in the north, the Free State and KwaZulu-Natal Provinces in the south, Mkhondo Local Municipality in the east, and Lekwa Local Municipality in the west. It is one of the seven municipalities that make up the district, accounting for 16% of its geographical area. It covers an area of 5227 km². It is composed of the following administration units; Volksrust, Amersfoort, Perdekop, Daggakraal and Wakkerstroom, with Volksrust being the seat of the municipality. Dr Pixley Ka Isaka Seme Local Municipality is both a Water Services Authority and a Water Services Provider. It therefore has a responsibility of providing sustainable and reliable portable water supply for its jurisdiction as well as provision of sanitation services. It has a duty to operate and maintain water and sanitation infrastructure.

Volksrust Water Treatment Works is situated in the south-western section of Volksrust. The WTW was constructed in 1963 and is located along Impala Street. The water quality served to the community is expected to comply with South African National Standards (SANS) 241-2015. The WTW is registered in terms of Section 26 of the National Water (NWA) Act 36 of 1998 as a Class C Works. Raw water is abstracted directly from a raw water storage dam (Volksrust Dam) that is fed by 3 dams, Schuilhoek Dam, Balfour Dam and Mahawane Dam. Treated water from the WTW is supplied to the Volksrust town via reservoirs and pipe networks. The recipients of treated water include domestic suburbs, small industries, commercial as well as businesses and institutions such as hospitals, schools, and municipalities buildings. The municipality plans to refurbish the Volksrust Water Treatment Works in the 2023/24 financial year (FY) as one of the Municipal Infrastructure (MIG) funded projects.

Process Overview of Volksrust WTW

Raw water is pumped from the Schuilhoek Dam, Balfour Dam and Mahawane Dam, and stored in the raw water storage dam before it is directed to the inlet of the WTW. The key unit processes for Volksrust WTW are presented and described briefly in Table 0-1.

Table 0-1: Unit Processes for the Volksrust WTW

Unit Process	Description and application
Coagulation	Lime and flocculant are added at the inlet of the works
Flocculation	Flocculation occurs in flocculation channels that feed sedimentation tanks.
Sedimentation	A total of 4 sedimentation tanks are used for solids-liquid separation
Sand filtration	The over from sedimentation tank is filter in 7 rapid gravity filters
Disinfection	Chlorine gas is used as a disinfectant in final treated water, distribution to consumers.

C3.1 DESCRIPTION OF THE WORKS

Abstraction works.

Raw water is pumped from the Schuilhoek dam and Balfour dam as well as Mahawane dam to the raw water storage tank located close to the WTW. The raw water from the raw water storage tank flows by gravity to the inlet of the water treatment facility.

Coagulation & Rapid mixing

Raw water from the storage dam gravitates to the treatment works though a steel pipe. Raw water enters a coagulation basin through a pipe underneath the channel. At the inlet lime and flocculant are dosed before rapid mixing occurs. Rapid mixing effects the mixing of the chemicals with water and the distribution of the chemicals uniformly in the raw water as it flows to the flocculation channels.

Flocculation

From the rapid mixer, the flow of water splits into two separate flocculation channels. In the flocculation channels the impurities come together to form larger aggregates called flocs. The flow of water is slowed down, and the flocs have time to increase in size. The floc then flows into sedimentation tanks.

Sedimentation

From the flocculation channels, water flows into sedimentation/clarifiers tanks where the heavy floc particles settle to the bottom and are removed through des-sludging valves which are underneath the clarifiers. Sludge is withdrawn twice a day from the sedimentation tanks. There are two clarifiers per flocculation channel. The 4 sedimentation tanks manually that are manually desludged.

Filtration

Overflow from the sedimentation tanks flows via open channels to the rapid gravity filters. The water passes through filters where it is filtered thereby removing the remaining suspended solids (filtration process). Silica filter sand is used as the filter media. There are seven (7) filters in the plant. All filters are need some repair work.

Backwashing

Backwashing for the filters is initiated manually since the automated option is no longer functional. There are three valves per filter viz backwash valve, air valve and clean water outlet valve. The backwash valve is used allow backwash water into the filter. When backwashing, the clean water outlet valve is closed. The air and wash valves are then opened (manually). After the valves are opened, the blower and back wash pumps are started (manually). The backwash pumps pump in water into the filters while the blower pump in air required for backwashing. The frequency of backwashing depends on the quality of the water being filtered. Backwashing is initiated whenever water starts overflowing from a filter bed. Filters overflowing a sign that the sand filter nozzles are blocked. As part of the proposed refurbishment, the backwashing process shall be automated.

Disinfection

Filtered water is disinfected using chlorine gas before distribution. Filtered water from each filter flows into a common channel which collects all the water and takes it to clear water sump. There is a dissipation pipe which carries chlorine from the chlorine room into the sump, where the water is disinfected.

Existing Filter Operation and Control

Conventional rapid gravity filters are used at Volksrust WTW to filter water from the sedimentation tanks. The overflow water from four (4) rectangular sedimentation tanks is distributed to seven (7) rapid gravity sand filters that are operated in parallel. After filtering through a silica sand bed in each filter, the water flows through filter nozzles mounted on a false floor and the filtered water is collected in the filter plenum. From the filter plenum, filtered water flows to the clear water well.

During filtration, particles that are trapped in the filters gradually clog the spaces between the sand grains of the filter media. The filter eventually reaches a terminal head-loss and is said to be clogged.

Each sand filter is periodically backwashed in a manual batch-mode sequence when the filter is clogged. Once the back wash sequence is complete, the filter is brought back online. The waste backwash water is discharged from the process to the sludge pond where the solids in the waste backwash water are allowed to settle, and the water is discharge from the site. Each filter can be isolated individually for maintenance when required.

FILTRATION MODE

During normal filtration, the overflow water from the sedimentation tanks is evenly distributed to each filter that is online. The inlet is in the open position to allow water from the common feed channel to flow into a respective filter. The filtered

water outlet valve stays fully open to allow the flow of filtered water from the plenum to the clear water well. At maximum fouling, back wash is initiated.

BACKWASH MODE

The manual backwash procedure starts by isolating the filter to be backwashed. The filter inlet is closed manually by the operator. The filter is backwashed for a set period of time. After backwashing each filter, the backwash pumps are stopped, and the backwash inlet valve is closed. Once the backwash procedure is complete, the filter is put back online.

Other key infrastructure and equipment include:

- Old MCC Panel that supplies power and to the Backwash Pump Station, Air Blowers and Clear water booster pump station respectively. This panel is fed from a central distribution panel.
- The booster pump station is manually started and stopped by the operator in the field to supply water to the external reservoir.
- Chemical dosing plant that consists of the following
    - One lime silo that is manually loaded with Lime bags and operated by the lime feeding rotary motor to dose lime into a lime dosing tank before the lime overflow into the inlet works. This system is not adjustable and there is no pH and NTU Analyzer instrumentation to monitor the pH and NTU Level of the Raw Water inflow.
    - Poly Dosing system that consists of the Main Plant Storage tank and the Day Tank that is used for dosing flocculant at the inlet works. The dosing system is operated manually by the operators.

C3.1.1 Employer's Objectives

Under the Volksrust WTW refurbishment Dr Pixley Ka Isaka Seme Local Municipality intends to achieve the following specific objectives:

- To rehabilitate and restore the Volksrust WTW by a combination of replacement and refurbishment works of all non-functional components of the plant.
- Improve process operation and control of the existing plant.
- To recommission Volksrust WTW
- To optimise the treatment process to ensure that the final treated water from Volksrust WTW meets the legal potable water quality standard as specified in SANS 241-1 :2015
- Implement a maintenance and operational strategy for the water treatment plant, that will ensure continuous operation without breakdowns, compliance of treated water quality and meeting Blue Drop requirements.
- To ensure access to clean potable services to the various communities served by Volksrust WTW
- Develop human resources through skills training.
- Improve the socio-economic circumstances of the communities in Volksrust through the creation of jobs during the implementation of the project.
- Automate Rapid Gravity Filter operation and the back wash process.
- Supply, install and commission pneumatic actuator valves for the rapid gravity filters and sedimentation tanks.
- Interfacing new instrumentation with the SCADA / PLC system.
- Replacement of damaged filter nozzles.
- Supply of new sand filter media.
- Assessment and repair of structural damage (cracks) inside the filter gallery. The Contractor shall assess and provide a long-term solution for resolving the cracks. This is to be provided in the form of a report detailing solutions and the associated cost.

C3.1.2 OVERVIEW OF SCOPE OF WORK

In the scope of work set out in this contract, the Employer's objective is to refurbish Volksrust WTW and recommission the works to operate at design capacity and ensure that the potable water quality standard as specified in SANS 241-1 :2015. The refurbishment of the works will focus on the following key units:

- Raw water Abstraction- Raw Water Storage Dam
- Raw water flow meter chamber
- Lime delivery and Dosing Facilities
- Flocculant storage, transfer, and dosing facilities
- Chlorine delivery, storage, and dosing system
- 4 (four) sedimentation tanks
- 7 (seven) sand rapid gravity filters inclusive of valves, nozzles, pipes, filter media, and all supporting equipment
- 2 (two) Backwash pumps
- 2 (two) Air blowers
- 3 (three) Clear water pumps
- Chlorine Dosing System
- Clear water flow meters
- All process control instruments.
- MCCs and all control panels
- The Water Treatment Works Building Structure
- Provision of a standby generator for backup power supply to the treatment works.

C3.1.2.1 MECHANICAL ENGINEERING WORKS

The mechanical scope of work includes the repair or replacement of existing mechanical equipment due to the unsuitability of the current equipment or damage caused over time or by the failure of the equipment. The scope also includes the refurbishment of equipment that has not been operational for a due to various reasons. All refurbishments will be considered in accordance with the specifications included in this document. The decision as to whether to replace or refurbish any item of plant will however be at the discretion of the Engineer. To best utilize the funds allocated to this project, potential mechanical items have been identified by the Engineer to be refurbished or repaired. The scope of the work will include mechanical condition assessments of the identified equipment including reports detailing the repairs required and a provisional sum for the work required is provided where applicable.

The mechanical components to be supplied, installed, repaired and commissioned, or alternatively refurbished, are as follows:

Raw Water Storage Dam inlet pipe

- The valve chamber must be drained.
- Establish the source of water leakage.
- Repair the pipe or valve connection to stop water leakage.

Raw Water Flow Meter

- Supply and installation of railing to reduce the risk of operators falling into the flow meter chamber.

Lime Delivery/Receiving Area

- Supply and install new bag handling frame.
- Repair existing 0.5 tonne electric hoist
- Install missing handrails next to the lime feeder.

Lime Dosing Station

- Clean and refurbish lime receiving, mixing, and dosing equipment.
- Optimize water -lime ratio and mixing conditions inside the lime mixing tank.

Flocculant Dosing Station

- Supply and install 2 (two) new dosing pumps
- Supply and install new dosing bench.

Flocculant storage and Flocculant transfer to the day tank

- Supply and install 2 (two) new flocculant transfer pumps.
- Reconnect second flocculant storage tank to flocculant transfer pumps.

Dosing Point (lime + flocculant) and Rapid mixing

- Remove old dosing pipes and install new dosing lines

.

Flocculation and Sedimentation

- Sedimentation tanks 3 and 4 shall be drained and cleaned and recommissioned.

Rapid gravity sand filters

The scope of work associated with the refurbishment of Volksrust WTW rapid gravity filters shall include the supply, delivery, installation, testing, commissioning and upholding during the trial operating period and the defects notification period of the following:

- 7 Butterfly valves DN 150 (Air inlet valves) with pneumatic actuator
- 7 Butterfly valves DN 200 (Filtered water outlet valves) with pneumatic actuator
- 7 Butterfly valves DN200 (Backwash inlet valves) with pneumatic actuator
- 7 Filter inlet sluice gates
- Replace all 7 partialization units for the siphons.

Any other mechanical work required to automate the operation and control of the rapid gravity filters.
NB: The contractor will be responsible for the removal of the existing valves.

Air Inlet Valve

The DN 150 air inlet valve shall be an isolating, wafer valve with replaceable EPDM lining and stainless-steel blade complying with “Specification for Valves The valve shall be rated to PN10. The valve shall be equipped with an pneumatic actuator which shall comply with “Specification for Actuators:

Filtered Water Outlet Valve

The DN 200 water outlet valve shall be an isolating, wafer valve with replaceable EPDM lining and stainless-steel blade complying with “Specification for Valves: The valve shall be rated to PN10. The valve shall be equipped with an pneumatic actuator which shall comply with “Specification for actuators:

Backwash Water inlet valve

The DN 200 backwash water inlet valve shall be an isolating, wafer valve with replaceable EPDM lining and stainless-steel blade complying with “Specification for Valves: Section 3 -Section 6” The valve shall be rated to PN10. The valve shall be equipped with an electric actuator which shall comply with “Specification for Actuators:”.

Filter inlet sluice gate

The Contractor shall provide a total of seven (7) sluice gates. One sluice gate for each filter inlet, including the following main components for each unit:

- Sluice gate, including frame, grout, line shafting, headstock and shaft supports.

- pneumatic actuator
- Associated electrical equipment, cabling, stainless steel conduits, and any other equipment required for a fully functional sluice and including limit switches.
- Control panel, in view of the respective sluice gate.

Detailed specifications for valves, sluice gates and actuators are provided under Specifications.

Backwash Pumps and Air Blowers

- Service both backwash pumps, connect and recommission pumps to run as duty- standby.
- Service both blowers, connect and recommission blowers to run as duty- standby.
- Backwash process must be automated.

Clear Water Pumps

- Service all 3 clear water pumps, re install and ensure that all 3 pumps are running and available.
- Supply, install and commission new level sensor and automate the operation of clear water pumps.

Portable submersible pump for draining our pump station.

- Service all 3 clear water pumps, re install and ensure that all 3 pumps are running and available.

MCC Panel in Pump Room

- New MCC must be assembled and installed outside the pump room.
- New MCC must cater for automation of backwash pumps, blowers and clear water pumps.
- Old MCC to be decommissioned and removed.

Disinfection-Chlorine dosing system

- Refurbishment and upgrade of Chlorine cylinder storage area and dosing is required to improve safety conditions for operators.

Final Clear Water Flow Meter (To Town Reservoir)

- The flow meter chamber must be drained.
- Establish the source of water leakage.
- Repair the pipe or flow meter connection.

Final Clear Water Flow Meter (To 4 ML Reservoir)

- Adequate lighting must be provided.
- Railing and other support must be installed to reduce the risk of operators falling inside the chamber and getting injured.

Removal of existing redundant equipment that will be replaced in the new installation, forms part of the mechanical scope of work.

C3.1.2.2 ELECTRICAL & ELECTRONIC ENGINEERING WORKS

The overview of the electrical scope of work will include the following:

- Connection of electrical power to all mechanical equipment and systems, i.e. pumps, valves, pressure, and level transmitters to complete the installation and commissioning requirements of the process equipment.
- Supply, installation, connection, and testing of an earthing/bonding system, where required.
- Supply, installation, and connection of all cable ladders and trays.
- Supply Installation of small lighting

- Testing, commissioning, and handing over of the complete electrical installation, in accordance with the requirements of the Electrical Contracting Board of South Africa and the issue of a Certificate of Compliance for each installation.

The control and instrumentation scope of work will include the following:

- Supply, installation, and connection of all Instrumentation, as specified.
- Supply, installation in the designated MCC's, connection, testing and commissioning of control PLC/SCADA systems to automatically operate the plant.
- Supply, installation, and commissioning of the PLC's and UPS's were required.

The electrical scope of work shall include the following:

Chemical House

The plant is equipped with two chemical dosing systems i.e. Lime and Poly dosing systems. The upgrade of the chemical house shall ensure the integration of the Chemical House into the control system in order to improve safety and the working environment of the staff.

Poly Storage Tanks and Poly Day tank Facility and Transfer Pump Station and Ancillary equipment

This section of the Contract covers the supply, installation, testing and commissioning of level monitoring instrument (Ultrasonic) to monitor the Storage Tank and the Day Tank level. The level shall be used to control the starting and stopping of the Poly Transfer Pump Station with its associated Storage and feeding the Poly Dosing Day Tank on duty.

The Poly Storage Tank situated on the ground floor shall be equipped with a level transmitter to monitor, trend the Level and raise an alarm if the level drops below the low-level set point.

The Poly Day Tank situated at the Chemical House used to feed the process using the Dosing Pumps. The PLC shall provide dosing process and a tank volume shall be calculated to indicate daily usage of the chemicals both in the Storage and Day Tank facility. Early warning to prompt the operator to order poly for the bulk storage shall be generated by the control system.

Each Day Tank shall be used to feed the Poly Dosing Pump station where one will be on Duty and the other on standby mode. A facility for the Operator to do drop test shall be the part of the Dosing Pump Station.

In addition, the scope includes programming of the Central PLC to control the dosing station and development of SCADA to allow monitoring, control, trending and alarming of Poly dosing process from the central control room (CCR).

Lime Silo and Lime Dosing Station and Ancillary equipment

This section of the Contract covers the supply, installation, testing and commissioning of all two Lime Silos fitted with screw conveyor. One Silo will be running on Duty and the other on standby with its associated equipment like Dust Fans, Agitator, and flush carrier water system.

This part of the plant shall be automated to transfer dose lime from the Silos to the mixing channel using the screw feeder and carrier water to feed the process.

In addition, the scope includes programming of the Central PLC to control the Silos through a Remote I/O Panel and development of SCADA to allow monitoring, control, trending, and alarming of Lime Dosing process from the CCR.

Filtration plant and ancillary equipment

This section of the Contract covers the supply, installation, testing and commissioning, of all 7 filters Actuator Valves to control the filtration process and a Clearwell Level Transmitter to monitor the Clearwell Level and also interlock all the pumps i.e. Backwash Pump Station and Booster Pump Station respectively..

The filters are currently operated manually by hand to run the backwash process and also set the filter into the filtration mode. Backwash Pump and Booster Pump Station are currently interlocked to Clearwell Level Probes to control the starting and stopping of all the Pumps.

The Air Blowers are used during the backwash process and they are manually controlled from the field start/Stop station during the backwash.

The Remote I/O Panel network serves to connect all the field equipment e.g. Filter Valves, Clearwell Level Probe, Clearwell and Level transmitter. All the transmit feedback and control commands communicates through to the main PLC to allow the controlling, monitoring and operation of the Filtration Mode and Filtration backwash process.

Each Filter shall be equipped with field junction box to connect all the field equipment e.g. Backwash Inlet, Air Blower and Outlet Valves signals in the Clearwell filter hall. All filters shall be equipped with an inlet Gate Valve to open and close the filter inlet during the backwash process.

In addition, the scope further covers the development of SCADA mimics to operate, control and monitor the filtration process from a CCR.

The scope of work also includes mapping of I/O signals as per Annexure A, alarming and trending of relevant process variables as applicable to control all filter valves including the Filter Inlet Gate Valve installation.

Backwash Pump Station and Ancillary equipment

This section of the Contract covers the interfacing, development of SCADA mimics to facilitate operation, control and monitoring of the pump station from a CCR.

The scope of work also includes the supply, installation, glanding and termination of all two Backwash pump including the Pump Remote Start/Stop station, Power and Control cable to the motor. All Main and control cables shall be connected to the New Main MCC Panel situated in a new location.

All status and control signals shall be connected to the Main Plant PLC and mapping of I/O signals as per Annexure A, alarming and trending of relevant process variables as applicable.

Filter Air Blowers and Ancillary equipment

This section of the Contract covers the interfacing, development of SCADA mimics to facilitate operation, control and monitoring of the pump station from a CCR.

The scope of work also includes the supply, installation, glanding and termination of all two Air Blowers including the Blower Remote Start/Stop station, Power and Control cable to the Blower motor. All Main and control cables shall be connected to the New Main MCC Panel situated in a new location.

All status and control signals shall be connected to the Main Plant PLC and mapping of I/O signals as per Annexure A, alarming and trending of relevant process variables as applicable

Booster Pump Station and Ancillary equipment

This section of the Contract covers the interfacing, development of SCADA mimics to facilitate operation, control and monitoring of the Booster Pump station from a CCR.

The scope of work also includes the supply, installation, glanding and termination of all three Booster pump including the Pump Remote Start/Stop station, Power and Control cable to the motor. All Main and control cables shall be connected to the New Main MCC Panel situated in a new location.

All status and control signals shall be connected to the Main Plant PLC and mapping of I/O signals as per Annexure A, alarming and trending of relevant process variables as applicable

Plant MCC and ancillary equipment

This section of the Contract covers the supply, installation, testing and commissioning, of New Main Plant MCC Panel for all starter compartments including a dedicated PLC RIO as per the supplied load list, MCC General Arrangement drawing No VW-114--100-200, and SLD drawing number No VW-114--100-201.

The scope of work also includes the decommissioning of the old MCC Panel in the Pump House and the removal of all redundant main and control cables currently connected to the Backwash Pump Station, Air Blower and Booster Pump Station.

The scope also calls for the supply and installation of the cable support and management racking from each field equipment to the Main MCC Panel in the new location.

In addition, the scope further covers the development of SCADA mimics to operate, control and monitor the pump station from a CCR. The scope of work also includes mapping of I/O signals as per Annexure A, alarming and trending of relevant process variables as applicable.

Chemical House New MCC and ancillary equipment

This section of the Contract covers the supply, installation, testing and commissioning, of New Chemical House MCC Panel for all starter compartments including a dedicated Chemical House PLC RIO as per the supplied load list, MCC General Arrangement drawing No VW-114--100-203, and SLD drawing number No VW-114--100-204.

The scope of work also includes the decommissioning of the old MCC Panel in the Chemical House and the removal of all redundant main and control cables currently connected to the Silo Hopper, Dosing Pumps, Crane and any other equipment connected to this MCC Panel.

The scope also calls for the supply and installation of the cable support and management racking from each field equipment to the Main MCC Panel in the new location. All the new External Lighting shall be fed from a small Power DB coming from the New Chemical House MCC Panel.

In addition, the scope further covers the development of SCADA mimics to operate, control and monitor the Chemical House Dosing system from a CCR. The scope of work also includes mapping of I/O signals as per Annexure A, alarming and trending of relevant process variables as applicable.

Clarifier plant and ancillary equipment

This section of the Contract covers the supply, installation, testing programming and commissioning, of Desludge Valve Actuators to control each Clarifier desludging in auto mode. The Clarifiers are currently operated manually by hand to run the Clarifier desludging process.

The scope further covers the development of SCADA mimics to operate, control and monitor the Clarifier Desludging Valves through the chemical house RIO from a CCR. The scope of work also includes mapping of I/O signals as per Annexure A, alarming and trending of relevant process variables as applicable.

The Main Plant PLC and Remote I/O Panel

This section of the Contract covers the supply, installation, testing and commissioning, of the following Electronic equipment:

- Main Plant PLC panel and peripheral equipment, including programming routines to control the Chemical Storage and Dosing process, Clarifier Desludging Valve automation System, Filtration process Backwashing including all the Filters Valves, Backwash Pump Station and Air Blower during the backwash process, The control of the Booster Pump Station to feed the external Reservoir with water, scanning and obtaining real time information from the RIOs, MCC Panel and any other field instrumentation equipment.

- Plant Remote I/O that connect all the field equipment to the Main Plant PLC to decentralized plant equipment connectivity and cable to the Main PLC via the distribution Remote I/O Panels. This covers three sections of the plant i.e. Chemical House connecting all the Filter Inlet Valves control signals, Chemical House and Desludging equipment, Filter Hall Way Backwash Inlet, Air Blower Valves and Filter Outlet Valve control signal and the Clear well Level transmitter and Level probe. Main Plant MCC Field Equipment starting and stopping control signals from the Main Plant PLC.

Plant Fibre Optic and Control System LAN network

This section of the Contract covers the supply, installation, testing and commissioning, of the following electronic equipment:

- Fibre optic cables including terminations linking all Remote I/O stations back to the Main Plant PLC and patch panels to plant wide fibre optic ring.

- Install Central Network equipment to link all the Remote I/O Panel to the Main Plant PLC and the SCADA system through a Local Area Network.

- Connect all Operator workstation i.e. Control Room Operator workstation and the Filter Gallery IPC/HMI workstation.

Plant SCADA and Operator workstation

This section of the Contract covers the supply, installation, testing and commissioning, of the following Electronic equipment:

- The SCADA Server Machine to enable logging, trending and alarm management functionality of critical process variables complete with peripheral equipment.

- Central Control Room SCADA Client Workstation to allow operator to control, Monitor, Control, trend all field critical field signal through the Operator work station.

- Filter Gallery Operator IPC SCADA Client Workstation to allow operator to Monitor and control any filter backwashing from the filter Gallery through the Operator IPC/HMI work station.

- Development of SCADA mimics including plant overview mimics, mimics for all the unit processes and major plant equipment face plates in detail.

- UPS to power up the critical PLC and SCADA equipment, server machines and LCD display in the CCR.

Miscellaneous Electrical and Mechanical Works

This section of the Contract covers the following ancillary works of the detailed scope of works:

Chemical House Electrical and Mechanical Remedial work

This section of the Contract covers the repairs and replacement of faulty electrical equipment in this area.

- Supply and install T8 LED Weatherproof Linear Lights IP65 2x18W(4FT) 1278Lx129W90H (2x1700lm) 6000K
- Supply and install new power trailing cable 2.5mm 3core flexible for hoist refurbishment.
- Supply and install 4x2 surface mounted SSO similar or like cabtree or clipsal 2000.
- Supply and install LED Ceiling Light Fitting ⌀ 300 x 50, 8W 600 lm
- Remove old hot Water storage, Supply and install a 5 litre Hydro-Boiler White Epoxy and replace plumbing to sink basin area in toilet
- Supply and install INDUSTRIAL AXIAL FAN 230V 55W 1100m3/h
- Supply, install gland and terminate new PVC/SWA, copper cables to SANS 1507-3 2core ECC for the INDUSTRIAL AXIAL FAN
- Supply and install an additional two pole 20A Isolator for the Industrial Axial Fan.

Top passage Chemical House Electrical and Mechanical Remedial work

This section of the Contract covers the repairs and replacement of faulty electrical equipment in this area.

- Supply and install LED Ceiling Light Fitting ⌀300 x 50, 8W 600 lm

LAB Room Electrical and Mechanical Remedial work

This section of the Contract covers the repairs and replacement of faulty electrical equipment in this area.

- Supply and install LED Recessed Aluminum Parabolic Louvre Light Fitting 3x4FT 595mmx1195mm x90mm.

Filter 1-7 External Electrical and Mechanical Remedial work

This section of the Contract covers the repairs and replacement of faulty electrical equipment in this area.

- Replace, supply and install LED Aluminum Floodlights 30W IP65 Surface 225x185x169(Wall Mounted)

Clarifier 1-4 Parameter External Electrical and Mechanical Remedial work

This section of the Contract covers the repairs and replacement of faulty electrical equipment in this area.

- Replace, supply and install LED Aluminum Floodlights 30W IP65 Surface 225x185x169 (Pole Mounted Double opposite) covering the Clarifier parameter area
- Supply and Install 3.5 METER IRON ZINC PLATED POLE 76MM DIA SPIGOT C/W Mounting base
- Decommission existing disused floodlight and remove the cable feeding the light.
- Supply and install cable tray and accessories to support the cable feeding the external lighting.
- Supply and install PVC/SWA, copper cables to SANS 1507-3 2core ECC for the lighting circuit in the cable tray.

Filter Gallery Area Electrical and Mechanical Remedial work

This section of the Contract covers the repairs and replacement of faulty electrical equipment in this area.

- Replace, supply and install T8 Weatherproof Linear Light IP65 2x18W(4Ft) 1278Lx129W90H(2x1700lm) 6000k
- Decommission existing stairway Ceiling Lighting

Filter Clearwell Area Electrical and Mechanical Remedial work

This section of the Contract covers the repairs and replacement of faulty electrical equipment in this area.

- T8 Weatherproof Linear Light IP65 2x18W(4Ft) 1278Lx129W90H(2x1700lm) 6000k

Chlorine Room Area Electrical and Mechanical Remedial work

This section of the Contract covers the repairs and replacement of faulty electrical equipment in this area.

- Supply, install, gland and terminate new SWA ECC 2core for the Chlorine FAN to a dedicated Circuit in the DB
- Replace, supply and install LED Ceiling Light Fitting ⌀300 x 50, 8W 600 lm
- Replace, supply and install LED Wall Light Fitting ⌀300 x 50, 8W 600 lm

Pump House Area Electrical and Mechanical Remedial work

This section of the Contract covers the repairs and replacement of faulty electrical equipment in this area.

- Supply, install, gland and terminate new PVC/SWA, copper cables to SANS 1507-3 2core ECC for the submersible pump 240V, 0.75KW C/W Float Switch and supply cable
- Supply and install New Cable PVC/SWA, copper cables to SANS 1507-3 5core Plain Cable for the Submersible Pump Station Start/Stop Station.
- Supply, install, gland and terminate new PVC/SWA, copper cables to SANS 1507-3 2core ECC for the Flood Alarm in the Pump House with a siren and a strobe light
- T8 Weatherproof Linear Light IP65 2x18W(4Ft) 1278Lx129W90H(2x1700lm) 6000k
- Replace, supply and install Two Way switch in the stairway
- Decommission the Old MCC Panels
- Decommission and remove all redundant cables
- Supply and install New Cable racking for all the Pumps and Blower cack to the new MCC Panel area.
- Supply and install new Start/Stop stations for the Blower, Backwash Pumps and the Booster Pump Station
- Supply and install New Cable PVC/SWA, copper cables to SANS 1507-3 3core ECC for the Backwash Pump Station with a Local Isolator next to the Pump.
- Supply and install New Cable PVC/SWA, copper cables to SANS 1507-3 7core Plain Cable for the Backwash Pump Station Start/Stop Station.
- Supply and install New Cable PVC/SWA, copper cables to SANS 1507-3 3core ECC for the Blower with a Local Isolator next to the Pump.
- Supply and install New Cable PVC/SWA, copper cables to SANS 1507-3 7core Plain Cable for the Blower Start/Stop Station.
- Supply and install New Cable PVC/SWA, copper cables to SANS 1507-3 3core ECC for the Booster Pump Station with a Local Isolator next to the Pump.
- Supply and install New Cable PVC/SWA, copper cables to SANS 1507-3 7core Plain Cable for the Booster Pump Station Start/Stop Station.
- Supply and install cable tray and accessories to support all the Pump House cables running back to the New MCC Panel location.

Main Building External Area Electrical and Mechanical Remedial work

This section of the Contract covers the repairs and replacement of faulty electrical equipment in this area.

- Supply and Install LED Aluminum Floodlights 30W IP65 Surface 225x185x160 (Wall Mounted) parameter lighting

Main Plant DB Electrical and Mechanical Remedial work

This section of the Contract covers the repairs and replacement of faulty electrical equipment in this area.

- Migrate all electrical circuit to the New MCC Panel that shall accommodate the existing Plant DB and Ancillary equipment that is fed from the existing Plant DB

Chemical House Plant DB Electrical and Mechanical Remedial work

This section of the Contract covers the repairs and replacement of faulty electrical equipment in this area.

- Migrate all electrical circuit to the New Chemical House MCC Panel that shall accommodate the existing Plant DB and Ancillary equipment that is fed from the existing Plant DB and all new circuit around this area.

- Migrate the existing Crane electrical circuit to the New Chemical House MCC Panel that shall is accommodated in the Crane Feeder Isolator Bucket.

- Rewiring of the Poly Transfer Pump according to Installation Rule SANS 1402 standards to fulfil safety and installation requirements. Correct cable and local Isolator shall be installed next to the Pump. Cable Support racking or Bosal shall be installed and the cable shall be glanded and terminated on both side in the MCC Panel and the Start/Stop Station.

- Refurbish the Poly Dosing Pump station to provide a Pump Station Bench with bund wall to prevent spillage on the floor and a second standby Pump that is missing. This system shall be controlled in local mode and remote through SCADA and the PLC

- . Refurbish the Lime Silo System with Duty and Standby Lime Silo with adjustable Screw feeder and Carrier Water Flush Tank dosing Lime into the Raw Water Main Chamber.

- Supply Analytical Instrumentation to monitor the Raw Water pH and NTU to save on chemical usage. E.g. Lime dosing.

- Supply Analytical Instrumentation to monitor the Raw Water Ion Charges to save on chemical usage. e.g. Poly dosing.

<u>Filter 1-7 Refurbish and Mechanical Remedial work</u>

This section of the Contract covers the repairs and replacement of faulty electrical equipment in this area.

- Refurbish all filters i.e. Filter Nozzles and Sand replacement. This is covered under the Main Building Process Control Maintenance section.

- Decommission and remove all Filter Consoles and replace with an HMI Panel

<u>New Plant P&ID and Electrical Drawing</u>

This section of the Contract covers the repairs and replacement of faulty electrical equipment in this area.

- Development of a full comprehensive as built P&ID and electrical drawings to show a true reflection of current plant status.

NOTE: A Mechanical and Electrical Engineering contractor under the construction Contract No T15/2023 will carry out the work of the upgrade of the Volksrust Water Treatment Plant including associated Electrical and Electronic works. The nature of upgrade required to meet the mechanical and electrical the two aforementioned plants (Desludging, Filtration Valve upgrade, Poly transfer and dosing and Lime Silos and dosing) equipment level of automation to be supplied and installed under this Contract. It is envisaged at handover the Entire Plant and aforementioned Plant Processes level of automation will be such that it will allow remote monitoring, control, trending and alarming from the CCR.

C3.1.5 Temporary Works

The Contractor is to allow for all temporary works required for the complete erection and installation of the Electrical and Electronic plant and equipment to be supplied under this Contract. Temporary work shall include temporary power supply

during the changeover period. Provisional sums have been allowed in the Bill of Quantities to hire suitably sized portable generators to ensure minimal process disruptions of the plant , relocation of New MCC Panel, Installation of the New Poly Dosing pumps stations and associated piping work, Installation of the New Lime Dosing Silos stations and associated piping work, Maintenance and Refurbishment of all seven filter Nozzles and Sand Replacement to allow continuous water production process, to allow the rigging in of old MCC Panel during decommissioning and the installation of the new Main Plant MCC Panel with the Distribution Panel and discard the old MCC Panels and make good of the building structure.

C3.1.2.3 CIVIL ENGINEERING WORKS

The civil scope of works for the refurbishment contract consist of the following components:

- Refurbishment of the water treatment building structure
- Taking down and removal of damaged doors and windows and replacing with new, where necessary
- Refurbishment of chlorine dosing area
- Supply and installation of handrails on the lime feeder platform
- Supply and installation of handrails around raw water flow meter
- Draining water from the raw water storage inlet chamber and final clear water flow meter chamber
- Remove old filter media for 7 filters.
- Supply and apply new filter media for 7 filters.
- Supply and install new filter nozzles to 7 filters.
- Concrete repairs to stop water leakage from the filters into the pipe gallery.

C3.1.2.4 OPERATIONS AND MAINTENANCE MANUALS

The contractor shall provide 3 copies of the complete operations and maintenance manuals for the new equipment supplied. This manual shall contain comprehensive information as set out hereafter and in accordance with standards set out by the Employer.

- Drawings of the equipment detailing all part numbers and materials
- A complete spare list
- Electrical loop drawings (if required)
- A lubrication and maintenance schedule showing all maintenance and lubrication operations, their recommended frequency and the grades of lubricant required.
- A maintenance brochure describing all maintenance, adjustment and replacement procedures.
- Operating manual describing the operation of the equipment with performance curves where applicable.
- A manual detailing all dismantling and reassembly procedures.
- Maintenance procedure for corrosion protection painting systems (if required)
- Maintenance procedure for cleaning (if required)
- Complete Data book of the equipment on completion of the Contract

The contractor shall amplify and amend such drafts until the Employer/Engineer is satisfied that they shall fulfil the purpose of ensuring that the Employer's staff is adequately instructed to operate and maintain the works. Once the drafts have been approved by the Engineer, the contractor shall prepare three suitably bound copies and deliver them to the Engineer.

3. VALVE SPECIFICATIONS

3.1 *VALVE SPECIFICATIONS*

This Specification covers the material, constructional and corrosion protection requirements for Butterfly Valves.

3.2 *GENERAL*

The definitions as contained in SABS191 and 664 are applicable to this specification.

Valve sizes to which reference is made in this specification are nominal bore sizes. Details and/or requirements on supporting drawings, in the project specification or in any letter of invitation to quote etc., may conflict with certain aspects of this specification, and in such cases are to take precedence over this specification. The Tenderer should check all the requirements of drawings and supporting documentation and, particularly and more specifically, in those cases where phrases such as “unless otherwise specified” are used in this specification.

“Knife” valves will not be acceptable as either shut-off or modulating valves. Lifting lugs are to be fitted on all valves which have a mass more than 100kg.

Each valve shall have a plate made of corrosion-resistant metal securely fixed to the body with corrosion- resistant fastenings, on which the following information shall be stamped: -

- The Manufacturer’s name
- Size of valve
- Class of valve
- Arrow indicating the direction of flow, where relevant.
- The contract number
- The serial number
- The material designations of the body and trim (see material specifications below)

Each valve shall be so protected as to minimize the possibility of damage during transit and storage. The gates of wedge gate valves shall be placed in the closed position. The body ends of all new valves shall be effectively sealed to prevent entry of foreign matter. Valves of 150 mm NB and smaller shall be individually wrapped. Larger valves shall be crated, individual crating of valves is dependent on size.

All valves shall be supplied with a copy of the relevant factory test certificate which reflects the test pressure and valve serial number. Original factory test certificates together with the Quality Control Plans for each valve shall be issued on completion of delivery of the valve consignment.

3.3 *BUTTERFLY VALVES*

Butterfly valves shall be used on water services for positive shut-off only. This type of valve shall not be used for controlling the flow in any way. The valves shall be manufactured in accordance with BS 5155 (cast-iron and carbon steel butterfly valves for general purposes), as far as is applicable. Where conflict exists, the requirements in this specification shall take precedence.

The following criteria for construction shall be met :-

3.3.1 Body

These shall be of the wafer-lug type with, (depending on valve size), drilled/tapped bolt holes to allow the valve to be used at maximum working pressures, in respective terminal positions. This facility is required to enable downstream pipework to be disassembled with the upstream pipework under pressure.

Double flange valves and U-section wafer-type valves, as described in BS EN 593:2004 shall be acceptable, provided that: -

- The valve is suitable for individual bolting of each flange and

- The dimension between the inside faces of the flanges is not less than 3D, where D is the diameter of the flange bolts as specified in BS 4504: Part 1, or SABS 1123.

The use of single flanged and flangeless valves shall not be permitted unless otherwise specified in the Project Specification.

Bodies shall be one piece casting Ductile Iron for sizes up to 1 500mm. Sizes above 1 500 mm shall be of cast steel. Bodies shall never be in contact with the fluid conveyed and shall be fully protected internally by the resilient seat.

3.3.2 Disc

Shall be cast or stamped, spherically machined and positively splined or keyed internally to the driving shaft. (Use of pins or bolts is totally unacceptable).

The selection of disc material shall be made by taking into account the aggressivity of the fluid being handled. (Cupro-aluminium or stainless steel 316 or equivalent will be considered). Alternatively, suitably coated ductile iron disc will be considered. Disc Material will be specified in the Project Specification.

3.3.3 Shaft

Butterfly valve technology shall be such that the shaft will be located inside the disc and will never be wetted. (Dry shaft). 316 Stainless steel shall be used.

It is required that the shaft shall be internally positively splined or keyed to the disc. The upper and lower shaft and tie-bolt, when assembled to the disc, shall give in effect a one-piece shaft/disc assembly.

Valves with “0” ring shaft backup seals shall only be considered for particular applications. The Manufacturer shall be able to offer varying grades to cope with different fluids.

3.3.4 Liner

The resilient, synthetic rubber seat shall be easily replaceable, and shall entirely cover the inside of the body overlapping over the sides to form the seal between the body and matching pipe work. Liners shall be manufactured from EPDM unless otherwise specified.

Note that the dimensions of flanges to be used on connecting pipe work shall comply with the relevant requirements of SABS 1123.

Where necessary, the liner shall be keyed to the body with annular grooves, in the bore of the valve. The design shall be such as to allow the disc to seal drop-tight to the liner, so that there is no ingress of fluid to the shaft area.

3.3.5 General

The valves shall be capable of being easily operated by one person, against the maximum unbalanced pressure and the effort required to operate each valve shall not exceed a torque of 180Nm.

Quarter-turn handles may be supplied for valves up to and including 150mm nominal diameter. The handle shall be lockable in all intermediate positions and be adaptable to the valves.

For valves larger than 150mm a gear shall be used. The gear operator shall be designed with a worm and nut system. The gear operator shall be irreversible in any position. The gear shall have a hand wheel and an indicator protected by plexiglass or equivalent showing the position of the disc. The gear ratio shall be a minimum of 5:1 and such that the time to close from fully open is not less than 3 minutes. If specified, limit switches shall be fitted, mounted in a waterproof and dustproof housing.

Where applicable, the direction of opening of the butterfly blade shall be such that the bottom of the blade moves in a downstream direction.

All hand wheels shall be fitted with a suitably sized shear-pin, that shall fail before damage can be done to the drive gearing of the valve.

4. EXTENSION SPINDLES

4.1 *GENERAL*

Where specified, valves shall be supplied complete with flanged extension spindles.

4.2 *MATERIALS OF CONSTRUCTION*

The spindle and brackets shall be fabricated from galvanized mild steel, unless otherwise stated in the Project Specification. Prior to galvanizing all burrs and weld splatter shall be removed. Galvanizing shall be to SABS 763.

Fasteners shall be M10 stainless steel (HILTI LKD or similar approved) and shall be supplied with the extension spindle.

4.3 *SPINDLE*

The spindle shall be hollow round tube with a minimum diameter of 50mm. The design of the spindle shall be such that it has adequate torsional rigidity for the length and operating torque of the valve.

4.4 *BRACKETS*

Brackets shall be fabricated from angle section and shall be sufficiently rigid to prevent deflection of the spindle. At least two fasteners per bracket shall be used to secure the bracket to the wall.

Brackets shall be spaced at no more than 2m centres.

The uppermost bracket shall be fitted with a Brass/Vesconite bush which shall be designed to fully support the mass of the spindle and ensure that no load is imposed on the valve.

4.5 *CAPS AND HAND WHEELS*

Spindle ends shall be designed and fabricated to accommodate the supplier's recommended caps and hand wheels which shall comply with this specification.

Hand wheels shall be removable.

For the purpose of tendering the length of the spindle in metres (measured from valve centre line to the top of the spindle) and the offset of the spindle centre-line to the mounting wall in metres will be provided.

Prior to fabrication the Contractor shall furnish the engineer with fabrication details for approval within 14 days.

5 CORROSION PROTECTION OF VALVES

5.1 *GENERAL*

5.1.1 Options

All valves shall be coated (external) and lined (internal) as specified hereunder. Unless otherwise specified in the Project Specification, the use of either a Fusion bonded Epoxy Powder Coating System (Option 1) or a Solvent Based Epoxy Coating System (Option 2) may be used.

5.1.2 Toxicity and Tainting of Conveyed Water

All products shall be approved by a recognized national body (SABS or similar) as suitable for use on potable water systems.

The cured material shall be chemically unaffected by free chlorine or chloramine in water in concentrations up to 10mg/l and to ozone concentration up to 5mg/l in water and by pH ranging from 4 to 10.

5.1.3 Tender Submissions

A comprehensive Quality Control Plan (QCP) shall be submitted with the Tender. The QCP shall be based on the proformas given in Annexure A. No change shall be made to the QCP without the approval of the Engineer.

Failure to submit a QCP with the minimum information required for tender purposes may disqualify the Tenderer.

Prior to coating and lining application, the QCP shall be approved by both Umgeni Water and the Epoxy Supplier. The Contractor will be responsible for obtaining such approval.

5.1.4 Inspection During Manufacture

The Employer reserves the right to insist upon inspection of valves following grit-blasting and following application of coating in the event of there being a problem with coatings or linings.

In the event that inspections are required, the Contractor shall give The Employer 48 hours' notice for inspection. All costs due to any delays for such inspections shall be to the Contractor's account.

Excessive coating build up in flange bolt holes will not be permitted.

5.2 *SURFACE PREPARATION*

5.2.1 Substrate Condition

The surface shall be free of all weld splatter, slag and loose scale.

5.2.2 Degreasing

Valves shall be degreased by the use of a water rinsible solvent degreaser such as that complying with SABS 1344 or, for use in enclosed systems, with SABS 1365.

After complete removal of oil or grease contamination, the valve shall be thoroughly washed with clean potable water to remove all residues. The surface shall be water break free. The valve shall then be allowed to dry.

Abrasive used for blast cleaning shall be free from oil or grease, as shall be the compressed air used in air blast cleaning.

5.2.3 Blast Cleaning

The valve shall be blast cleaned by air blast cleaning methods, then vacuum cleaned or blown off to achieve the following standards :-

- Cleanliness shall be equal to SA3 of Swedish Standard SIS 05 5900 when tested in accordance with SABS method 767.
- The profile produced by blast cleaning shall be angular and shall have an average peak to valley height of 60 to 100 micrometers, when tested in accordance with SABS Method 772. Hackles shall be removed with coarse abrasive paper.
- Residual dust and debris shall not exceed 0.2% when tested in accordance with SABS Method 769.
- Water soluble salts shall not exceed 100mg/m^2 at any point when tested with the Weber-Reilly Reagent.
- Any laminations revealed by blast cleaning shall be ground out and re-blasted. If grinding penetrates the body to a depth greater than 8% of the nominal wall thickness, the valve shall be rejected.

5.2.4 Handling of Cleaned Valve

After cleaning, the valve surface shall not be contaminated in any way. Operators shall wear clean gloves and all surfaces in contact with the valve surface shall be clean and free from oil, grease, grit, dirt and other contamination.

5.2.5 Chemical Treatment

Chemical pre-treatment of the blast cleaned pipe may be applied provided that :-

- The process to be used is approved by the Engineer in writing.
- The process is applied in a manner and in such quantities as specified by the manufacturer of the process.

5.3 *CORROSION PROTECTION OF FLANGES*

The mating face of flanges shall be masked and left uncoated. All runs or drips of epoxy shall be removed from the mating faces of the flanges and the flange profiling shall be clearly visible over the entire flange face.

The mating flange face shall then receive one coat of rust inhibitor (Plascon Rustix 84 or equal approved).

Care shall be exercised to ensure that after application of all coatings there are no runs or drips and that the flange profiling is clearly visible over the entire flange face.

Excessive coating build up in flange bolt holes that could snag bolts will not be permitted.

5.4 *FUSION BONDED EPOXY POWDER COATING SYSTEM (OPTION 1)*

5.4.1 Heating of the Valve

Heating of the valve shall be affected by heat soak in an oven provided that:-

- The valve surface is not contaminated by fumes, soot deposition, acid deposits or other harmful contamination.
- The valve surface is not discoloured by excessive heat.
- The surface temperature of the valve is uniform and does not vary by more than ± 5 degrees Celsius from optimum coating temperature when measured immediately prior to coating. Valve temperature shall not exceed 275 degrees Celsius at any point.
- Infra-red pyrometers for measurement of pipe temperature shall be calibrated by thermocouple, heat sensitive crayon or other approved method.

5.4.2 Requirements in Respect of Fusion Bonded Epoxy Powder

5.4.2.1 **Approval of Supplier**

The epoxy coating shall be a fusion bonded epoxy powder coating, Mobilox 1004-R1, Vedoc VPC 2001 or similar approved.

To obtain approval, the supplier shall provide manufacturer's test results in writing that demonstrate that the powder is capable of meeting the requirements specified in Table 4.

TABLE 4

REQUIREMENT OF FUSION BONDED EPOXY POWDER			
	PROPERTY	REQUIREMENT	TEST METHOD
1	I.R. Spectrogram	For reference against Contract supplies	Potassium Bromide disc
2	Thermal Characteristics	For reference against contract supplies Delta H (Enthalpy). Delta H (Enthalpy), Tg1 and Tg2 (Glass transition temperatures uncured and cured) to be supplied	Differential Scanning Calorimetry 20° C/min scan rate
3	Gel Time at 180°C	For reference against contract supplies	Hot plate
4	Sieve analysis	Sieve sized in micrometers Zero retained on 500. Not more than 1% retained on 250	Mechanically agitated stack of sieves
5	Dielectric Strength	Not less than 30kV/mm	SABS 1217. Section 8.10
6	Cathodic Disbonding	Total disbonded area does not exceed 20mm diameter after 30 days. Current flow not to exceed 5 mA	AST< G8. Method B - Magnesium Anode - 20°C 7mm diameter holiday
7	Accelerated Cathodic Disbonding	Total disbonded area not to exceed 12mm diameter inclusive of artificial holiday	Impressed current -3,5 volts potential at 75°C for 48 hours 3mm diameter holiday
8	Adhesion (Hot water Soak)	Disbonded length not to exceed 5mm from point of V	Immerse in water at 75°C 48h. Remove and make V-cut at 30° angle. Test adhesion when cooled to 25°C
9	Flexibility Test	No electrical insulation defects after bending	Bend at 0° to 2% strain
10	Impact Resistance	No electrical insulation defects after impact	ASTM G14 but using flat panel clamped firmly to a rigid base such as 12mm thick flat steel, impacted at 2 Joules

NOTE: Tests 5-10 are carried out on 6mm thickness steel test panels, blast cleaned, prepared, coated and cured in accordance with the powder manufacturer's recommendations.

5.4.2.2 Approval of Batches

The Contractor shall satisfy himself as to the suitability of the powder in terms of the requirements of Table 4 prior to commencement of coatings.

Before commencing work, the Contractor shall furnish The Employer with documentation indicating that the proposed Epoxy Powder will comply with requirements of Table 4.

5.4.3 Application of Coating

5.4.3.1 Method of Application

Powder shall be applied by electrostatic spray guns.

Powder shall pass through a magnetic separator (which shall be regularly cleaned) in order to remove any iron or steel particles.

Powder reclaimed from the spray booth shall not be mixed with virgin powder.

The specified thickness shall be achieved in one application. In the event of thickness being less than the minimum specified the coating shall be removed and the valve shall be re-blasted and recoated to comply with the specification.

5.4.3.2 Handling of Coated Valve

Until the coating has cured, the valve shall be handled in such a manner to ensure that the coating is not damaged and remains blemish free.

5.4.3.3 Quenching of the Coated Valve

Quenching of the valve with clean water is permitted provided that the coating is fully cured and complies in all respects with the requirements of the specification.

5.4.4 Requirements of Cured Fusion Bonded Epoxy Powder Coating

The cured fusion bonded epoxy powder coating shall meet the requirements specified in Table 5.

TABLE 5

REQUIREMENTS OF CURED FUSION BONDED EPOXY POWDER COATING				
	PROPERTY	**REQUIREMENT**	**TEST METHOD**	**FREQUENCY**
1	Visual	Smooth glossy or semi glossy finish, free from excessive runs, sags, orange peel, occlusions or other visible defects	Use an experienced observer	Each Valve
2	Coating Thickness	Min. 200 Max. 500 microns	SABS Method 141. Minimum 6 readings/valve.	
3	Electrical Insulation Defects	Nil defects at 3500 Volts. For conditions for repair see Clause 3.4.7	SABS 1217 Section 8.12.2	Each Valve
4	Impact Resistance	No defects at 2 Joules	SABS 1217 Section 8.7	Random 5 % of valves
5	Degree of cure: Dynamic Test	No softening or discoloration	20 double rubs with cotton wool swab soaked in MEK	Each Valve

5.4.5 Repair of Small Areas of Mechanical Damage

This procedure describes the method of repair of small areas of mechanical damage to the coating film.

- Thoroughly degrease the affected area and surround by washing with water - rinsible solvent or detergent to achieve a water break-free surface. Rinse the washed area with running clean, potable water and allow to dry.
- Remove any loose or cracked paint, by suitable mechanical means such as grinding or sanding. If the metal substrate is exposed, clean to rough bright metal during this process. Be sure not to burnish or polish the metal substrate if sanding is the selected method, as this may result in poor adhesion.
- Thoroughly roughen the paint surface to minimum of 100mm radius around the areas treated as above, feathering the coating towards the outer perimeter of the repair. Brush off any dust formed.
- Immediately apply an approved repair “squish pack” (Plascon Hicote 151 or similar approved).
- On completion a 10mm halo of feathered sound coating should be evident around the entire repair.
- Holiday testing of all repairs shall comply with the original coating specification.

5.5 *SOLVENT BORNE & SOLVENT FREE EPOXY COATING SYSTEM (OPTION 2)*

5.5.1 Materials

The materials shall comply with SABS 1217 - 2001 Type 1A or Type 1C solvent borne or solvent free chemically cured epoxies.

The following proprietary products are acceptable to The Employer:

SOLVENT BORNE	SOLVENT FREE
Carboline 891	Sigma Pine 523
Denso ST 700	Denso ST 100 Pipe Coat Belzona 1341

The applied coating & lining shall comply with the requirements of Table 6 and with the relevant product data sheet.

5.5.2 Dry Film Thickness

External Coating: 350 microns ± 50 microns

Internal Coating : 250 microns ± 50 microns

The number of coats to achieve these coating thicknesses will be addressed in the Quality Control Plan (Annexure A).

5.5.3 Requirements for Epoxy

The cured solvent-based epoxy coating shall meet the requirements specified in Table 6.

TABLE 6

REQUIREMENTS FOR EPOXY				
NO	**PROPERTY**	**REQUIREMENT**	**TEST METHOD**	**FREQUENCY**
1	Visual	The lining shall be smooth, free from excessive runs, sags, orange peel, occlusions or other visible defects.	Use an experienced observer.	Each Valve
2	Coating Thickness	Minimum: 200 microns Maximum: 500 microns	SABS Method 141	Minimum 6 readings/valves
3	Electrical Insulation Defects	Nil defects when tested at 90 Volts 2 Megaohms	SABS 1217 - Section 8:12	Each Valve
4	Degree of Cure	No softening or discoloration	20 double rubs with cotton wool swab soaked in MEK	Each Valve
5	Adhesion	Destructive testing not recommended		

5.5.4 Repair of Small Areas of Mechanical Damage

This procedure describes the method of repair for small areas of mechanical damage to the coating film. Three repairs per square metre of valve coating will be permitted. In the event that more repairs are required, the coating will be rejected, and the entire valve shall be prepared for re-coating.

- Thoroughly degrease the affected area and surround, by washing with water - rinsible solvent or detergent to achieve a water break free surface. Rinse the washed area with running clean, potable water and allow to dry.

- Remove any loose or cracked paint, by suitable mechanical means such as grinding or sanding. If the metal substrate is exposed, clean to rough bright metal during this process. Be sure not to burnish or polish the metal substrate if sanding is the selected method, as this may result in poor adhesion.

- Thoroughly roughen the paint surface to minimum of 100mm radius around the areas treated as above, feathering the coating towards the outer perimeter of the repair. Brush off any dust formed.

- Immediately apply a coat of the original coating (repair kits available in small packages) to the prepared area, in accordance with the original coating specification. Build up with successive coats to achieve required total dry film thickness, observing application and curing conditions as stated on the relevant product data sheet.

- On completion a 10mm halo of feathered sound coating should be evident around the entire repair.

- Holiday testing of all repairs shall comply with the original Coating Specification.

5.6 *THERMOPLASTIC POLYAMIDE 11 POWDER COATING (RILSAN) OPTION 3*

The use of Rilsan (an 11 carbon atom polyamide manufactured from castor oil) is acceptable if the coating is supplied and applied in accordance with the provisions of the The Employer Standard Specification for the application of Rilsan (Polyamide 11) coating to valves, pipe couplings, fittings and similar items for use in the water industry is acceptable, unless otherwise specified in the Project Specification.

ANNEXURE A

PROFORMA QUALITY CONTROL PLAN

FUSION BONDED EPOXY POWDER COATING SYSTEM
(OPTION 1)

ESSENTIAL INFORMATION TO BE FURNISHED WITH THE TENDER	
ITEM	**INFORMATION**
Powder Supplier	:
Address & telephone no. of Powder Supplier, Contact Person, Powder Brand Name	:
Name of Body which has approved product for use on potable water systems.	:
Coating Applicator	:
Address & telephone no. of Coating Applicator	:
Contact Person	:

Before commencing work the Contractor shall furnish The Employer with documentation indicating that the proposed epoxy powder will comply with the requirements of Table 4 of this Specification.

USION BONDED EPOXY COATING SYSTEM
(OPTION 1)

QUALITY CONTROL PLAN			
NO	ITEM	STANDARD (CLAUSE REF.)	OBSERVATION
1	Valve Description:		
2	Valve Serial No:		
3	Surface Preparation		
	• Substrate Condition	5.2.1	
	• Degreasing	5.2.2	
	• Blast Cleaning	5.2.3	
	• Chemical Treatment	5.2.5	
4	Corrosion Protection of Flanges	5.3	
5	Heating of Valve	5.4.1	
6	Coating Performance		
	• Visual	Table 5 (1)	
	• Coating Thickness	Table 5 (2)	
	• Electrical Insulation Defects	Table 5 (3)	
	• Impact Resistance (Check 1 in 10 valves only)	Table 5 (4)	
	• Degree of Cure	Table 5 (5)	

SIGNED:THE EMPLOYER……

CONTRACTOR……

POWDER SUPPLIER……

The Contractor shall obtain approval of the QCP from The Employer and the Powder Supplier before commencing work.

PRO FORMA

QUALITY CONTROL PLAN

SOLVENT BORNE / FREE EPOXY COATING SYSTEM
(OPTION 2)

ESSENTIAL INFORMATION TO FURNISHED WITH THE TENDER	
ITEM	**INFORMATION**
Proposed Product	:
Address & Telephone No of Supplier	:
Contact Person	:
Name of Body which has approved Product for use on Potable Water Systems	:
Coating Applicator	:
Address & Telephone No of Coating Applicator	:
Contact Person	:
Application Method (e.g. Airless Spray)	:

PRO FORMA

SOLVENT BORNE / FREE EPOXY COATING SYSTEM (OPTION 2)

QUALITY CONTROL PLAN			
NO	**ITEM**	**STANDARD (CLAUSE REF.)**	**OBSERVATION**
1	Valve Description		
2	Valve Serial No:		
3	Surface Preparation		
	• Substrate Condition	5.2.1	
	• Degreasing	5.2.2	
	• Blast Cleaning	5.2.3	
	• Chemical Treatment	5.2.5	
4	Corrosion Protection of Flanges	5.3	
5	No. of Coats	No.	No.
6	Minimum Overcoat Time	Hr.	Hr.
7	Maximum Overcoat Time	Hr.	Hr.
8	Minimum Temperature	ºC	

9	Maximum Humiture		
10	Coating Performance		
	• Visual	Table 6 (1)	
	• Dry Film Thickness (min)	Table 6 (2)	
	• Dry Film Thickness (max.)	Table 6 (2)	
	• Electrical Insulation	Table 6 (3)	
	• Degree of cure	Table 6 (4)	

SIGNED: ***THE***

EMPLOYER……

CONTRACTOR……

POWDER SUPPLIER……

The Contractor shall obtain approval of the QCP from Umgeni Water and the Epoxy Supplier before commencing work.

7. SLUICE GATE SPECIFICATION

7.1 Performance Requirements

Over its full travel and under full design pressure, the sluice gate opens and closes smoothly and without snag or slew.

The sluice gates shall be designed to withstand the maximum specified water pressure for the application and to seal acceptably when subject to this pressure.

The acceptable leakage rate for off-seating sluice gates is 0,015 ℓ/s per metre of seating perimeter per 3 metre pressure head.

The acceptable leakage rate for on-seating sluice gates is 0,008 ℓ/s per metre of seating perimeter per 3 metre pressure head.

The acceptable leakage between the sluice gate frame and the concrete structure is zero.

7.2 Operation and Control

Manual override of actuated sluice gates shall be provided.

The sluice gates shall be electric actuator operated as specified.

Manual start and stop of sluice gate actuators shall be provided but all protections shall be active during manual operation.

Actuated sluice gates shall be designed to remain in position upon failure of the electrical supply unless automatic shutdown is specified.

If the contract includes a SCADA system, monitored readings shall appear on the SCADA or the HMI mimics

7.4 Design Requirements

The design shall allow for removal of the gate and replacement of the seals without having to remove or damage the frame structure.

The headstock beam shall accommodate the gate opening and closing forces with no visible deflection. The gate, when open, shall be out of the path of the maximum design flow.

Sluice gates shall be designed so that solid material in the flow cannot snag on protrusions such as adjusters and, thereby, prevent closing of the gate.

Fabricated gates which require reinforcing ribs shall have these ribs welded onto the gate.

Bolted ribs are not acceptable. Welded ribs shall be continuously welded, without crevices.

Gates in off-seating applications shall incorporate guides which provide a sealing force. Such guides shall be of low friction polymer or of non-ferrous metal.

Wide gates shall be provided with dual spindles which are connected by gearing. This applies to all gates with a width to depth ratio greater than 1,8m.

Sluice gates shall be of the rising spindle configuration unless not feasible in the application.

Sluice gates which are operated via line shafting shall be provided with shaft guides so that the maximum length of unsupported shaft is 1 800 mm.

Manually operated sluice gates shall have handwheels of cast iron, of cast aluminium or of stainless steel. The handwheels shall be mounted approximately 1 000 mm above floor level if feasible. The complete unit shall have environmental protection which is suitable for washing by hose.

7.5 Channel Mounted Sluice Gate

The gate height when open shall be at least 200 mm above the maximum specified water depth in the channel.

7.6 Wall mounted Sluice Gate

Wall mounted sluice gates shall, unless inapplicable, seal on all 4 sides.

Gates, frames and guides shall be structurally capable of resisting the specified differential pressure without unacceptable leakage and shall also be capable of being operating under this differential pressure.

7.7 Frequent Operation

Sluice gates which are operated frequently, i.e. which will have to be operated every day and/or which will be used for regulation; shall comply with the additional requirements in this sub-clause.

Gates shall be provided with adjustable guides. The sliding face of the guide shall be of low friction polymer.

The gate shall slide between polymer, elastomer, or non-ferrous alloy materials. Sliding contact between similar metals is not acceptable.

Guides, seals, gate nuts and thrust nuts shall be replaceable.

7.8 Materials

On wastewater applications, copper alloys shall not be used; i.e. thrust nuts for sluice gates for wastewater applications shall not be of brass or bronze unless completely encapsulated. For non-wastewater applications, thrust nuts shall be of manganese bronze or better.

Gate seals shall be of synthetic elastomer or of non-ferrous alloy materials. The gate and frame shall be of cast iron, of EN Grade 1.4401 (316 stainless steel) or of LDX 2101 duplex stainless steel.

Spindle covers for rising spindles shall be of stainless steel. Clear butyrate or clear polycarbonate will also be acceptable but clear PVC is not acceptable.

Spindles, muff couplings, spindle adaptors, universal joints and line shafting shall be of EN Grade 1.4401 (316 stainless steel) or of LDX 2101 duplex stainless steel. Fasteners shall be of EN Grade 1.4401 (316 stainless steel).

8. ACTUATOR SPECIFICATION

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8. CONTROL VALVE ACTUATORS
8.1 SPECIFICATION FOR CONTROL VALVE ACTUATORS

General

Actuators shall be Pneumatic diaphragm, Piston type or electrically motorized.
Diaphragm actuators shall be protected from ingress of dusts and moisture to IP55.
Fail safe action shall be reversible in the case of piston type actuators.

Actuators for modulating control valves shall be provided with an I to P, a positioner and filter regulator unless specified otherwise.

Piston actuators up to and including those fitted on 200 mm valves shall be spring return, unless specified otherwise.

Actuators shall be sized to allow for at least 150 % of maximum required torque.
Corrosion endangered parts such as cylinder wall and piston rod shall be manufactured of hard wearing and rustless metal with high lubricity.

Manual override (handwheels) shall be supplied when asked for.

Notes:
Positioners for diaphragm actuators shall be equipped with a regulator and shall have the following performance:-

Accuracy	:	+1 % of output span
Hysteresis	:	+0.5 % of span
Air Delivery Capacity	:	4,5Nm3/hr or greater at 1.36 bar supply (20 psi)
Air Exhaust Capacity	:	4,5m3/hr (normal) or greater

Limit switches and solenoid valves shall be weatherproof and where feasible shall have 20mm ISO conduit electrical connections.
Design Diaphragm Actuators
Either air to push down stem or air to raise stem options shall be available.
A travel indicator scale shall be included as part of the actuator.
Standard range shall be 20 - 100 kPa unless otherwise specified.
The Bonnet/Diaphragm assembly shall be able to withstand 300 kPa without damage. The bench set shall be adjustable.
Piston Actuator
Shall be of the compact double piston rack and pinion type Unit shall operate on air supply pressures up to 650 kPa.
A lubricated air supply should not be required.
The unit shall have a spindle onto which a position indicator is fitted and to which a positioner may also be fitted if required.
A solenoid and two position limit switched shall form an integrated part of the actuator for on/off valve applications.
Preferred :
Diaphragm :

VOLKSRUST WATER TREATMENT WORKS PLC AND ELECTRICAL STANDARD AND TECHNICAL SPECIFICATION

VW-ES-00123

VOLKSRUST WATER TREATMENT WORKS

TECHNICAL SPECIFICATION FOR

ELECTRICAL INSTALLATIONS

SECTION 1 GENERAL REQUIREMENTS

SECTION 2 STANDARD EQUIPMENT SPECIFICATIONS

VOLKSRUST WATER TREATMENT WORKS

TECHNICAL SPECIFICATION

ELECTRICAL INSTALLATIONS

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GR 1 GENERAL

GR 1.1 This general technical specification specifies the standard of workmanship and quality of materials for the electrical installations. **The applicable specification shall be SANS 10142-1: 2009.**

GR 1.2 Prices for articles and equipment described by trade names or catalogue references must refer to the type and manufacture specified. If it is desired to use substitutes, the onus will be on the Electrical Contractor to prove that such substitutes are similar and equivalent to the articles specified and meet with the approval of the Engineer.

GR 1.3 The decision whether the specified articles are to be used and installed, or whether the alternatives offered are acceptable, shall rest solely with the Engineer, and this decision will be final.

GR1.4. When the installation commences, with the appropriate approvals, of any type and make of articles and equipment then the same type of articles and equipment shall be used throughout the project for that specific application, unless other wise specified.

GR 1.5 The following terminology will be used for different voltages:

GR 1.5.1 **Low Voltage** AC Voltages up to and including 1000volts and DC voltages up to and including 1500volts as per SANS 10142-1:2009

GR 1.5.2 **Medium Voltage:** All voltages, AC and DC higher than those mentioned in 5.1 And includes 11 000 volts.

GR 2 SCOPE OF CONTRACT

GR 2 This contract covers the supply, delivery, installation, testing, commissioning and handing over in proper working order of the complete electrical installation, including instrumentation as specified in detail in the project specification which must accompany this document.

GR 2.1.1 Where any statement in the Project Specifications is at variance with a statement in the Standard Specification, then the Project Specification shall take precedence.

GR 2.1.2 The installation work shall include the supply, erection, installation and connecting up of all the necessary equipment and materials, whether specifically mentioned or not, and the provision of all necessary plant, skilled and unskilled labour required to complete the Contract or SubContract.

GR 2.1.3 The Contractor, shall before commencing work on any section of the installation, obtain from the Engineer confirmation of the positions of all control gear, plant and machinery, cables, lighting

outlets, socket outlets, power points, etc. Failure to obtain such approval to proceed with the installation shall result in the Contractor being made responsible for any alterations which may be found necessary or desirable during the progress of the work.

GR 2.1.4 All electrical installation work shall be carried out tested and in all respects comply with the electrical installation regulations of the Occupational Health and Safety Act (Act Nº 181 of 1993).

GR 3 COMPLIANCE WITH REGULATIONS

GR 3 The entire electrical installation shall be carried out in accordance with the latest revision and amendments of the following:-

GR3.1: The Occupation Health and Safety Amendment Act (Act Nº 181 0f 1993) including all regulations, compulsory and safety standards promulgated in terms of the Act.

GR3. 2: The Wiring Code SANS 10142-1: 2009 as issued by the South African Bureau of Standards, referred to herein as the "Wiring Code".

GR3. 3: The Municipal By-Laws and any special requirements of the Supply Authorities of the area and district concerned.

GR3. 4: The local Fire Office Regulations.

GR3. 5 The Post Office Regulations.

GR3. 6 VOLKSRUST WTW Technical Specifications for Electrical Installations version 5

GR 3.7: VOLKSRUST WTW Specifications for Instruments and Instrumentation.

GR3.8: VOLKSRUST WTW Requirements for Innovative Wiring Systems.

GR3.9: VOLKSRUST WTW Specifications for Colour Coding. Oct 1998.

GR 3.10 A Certificate of Compliance shall be issued on completion of the installation.

GR 4 COMPLIANCE WITH SPECIFICATIONS

GR 4.1 The equipment to be supplied shall comply with the following specifications:

GR 4.2: National Rationalised Specifications and Codes of Practice. Where no such specification exists:

GR 4.2.1: SANS Specification and Codes of Practice. Where neither of the above exists;

GR 4.2.2: BSS and/or IES specifications and codes.

GR 4.2.3: NRCS. RCC (Regulatory Compliance Certificate)

GR 4.3 The following list of specifications is given as a guide to Tenderers. It is not complete and in no way limits the application of this specification.

SANS 60432-1: Incandescent Lamps for Domestic and Similar General Lighting Purposes. SANS 60432-2

SANS 164-1-2: Plug and socket outlets for household and similar purposes Part 1-2
(VC 8008) Plugs, socket outlets and socket outlet adaptors.

SANS 151 Fixed electric storage water heaters.

SANS 152 Low voltage air break switches, air break disconnectors. Air break switch disconnectors and fuses combination units.

(VC 8003) Manually operated switches for fixed installations.

SANS 156 Moulded case circuit breakers.

SANS 61058-1 Switches for appliances Part 1 General

SANS 61058-2-1 Cord switches

SANS 61058-2-4 Independently Mounted Switches

SANS 61058-2-5 Changeover/Selector Switches

SANS 61184: Bayonet Lamp holders.

SANS 60238 Edison Screw Lamp holders

SANS 61643-1 Surge Protective Devices Connected to Low Voltage Distribution Systems Part 1

SANS 60099-1 Surge arrestors Part 1: Non Linear resistor type gapped surge arresters for AC Systems

SANS 60099-4 Surge arresters Part 4: Metal oxide surge arresters without gaps for AC systems

SANS 60099-5 Surge arresters Part 5: Selection and application recommendations

SANS 60269-1 Low voltage fuses Part 1: General requirements see also 60296-2, 60269-2-1 60269-3. 60269-3-1 and 60269-4

SANS 529 Heat resisting wiring cables.

SANS 555: Unused and reclaimed Mineral insulating oils for transformers and switchgear.

SANS 753 Pine poles, cross-arms and spacers for power distribution, telephone and street lighting.

SANS 754 Eucalyptus poles, cross-arms and spacers for power distribution and telephone systems.

SANS 935 Hot-dip (galvanised) zinc coatings on steel wire

SANS 767-1 Earth leakage protection units Part 1: Fixed earth leakage protection circuit breakers

SANS 767-2 Earth leakage protection units Part 2: Single phase, portable units

SANS 780: Distribution transformers.

(NRS 054) Power Transformers

SANS 60076-1 Power Transformers Part 1: General. See also Parts 2, 3, 3.1,5, 8, and 10.

SANS 61084-1 Cable trunking and ducting systems for electrical installations Part 1: General requirements see also Part 2-1 and Part 2-4

SANS 890-1 Ballasts for fluorescent lamps Part 1 see also Part 2

SANS 60439-5 Cable distribution cabinets

SANS 1804-2 Induction motors Part 2: Low voltage three phase standard motors See also 1804- 1, 1804-3 and 1804-4

SANS 950: Unplasticized polyvinyl chloride rigid conduit and fittings for use in electrical installations.

SANS 1019: Standard voltages and currents and insulation levels for electricity supply.

SANS 1041: Tubular fluorescent lamps for general service.

SANS 1063: Earth rods, and couplers.

SANS 61035-1 Specifications for conduit fittings for electrical installations Part 1: General Requirements See also 61035-2-1 and 61035-2-2.

SANS 1085: Wall outlet boxes for the enclosure of electrical accessories.

SANS 60598 Luminaries Part 1: General requirements and tests See also 60598-2-1, 2-2, 2-3, 2-4 2-5, 2-6, 2-7, 2-8, 2-9, 2-10, 2-17, 2-18, 2-19, 2-20, 2-23, 2-24, 2-25

SANS 1973-3 Low –voltage switchgear and control gear assemblies (Distribution Boards) with a rated short circuit withstand strength up to and including 10kA

SANS 1973-1 Low –voltage switchgear and control gear assemblies – Part 1: Type tested, partially type tested and specially type tested assemblies with a rated short circuit withstand strength above 10kA.

SANS 1195: Bus bars.

SANS 61084-1 Cable trunking and ducting systems for electrical installations Part 1: General Requirements See also 2-1, 2-2, 2-4

SANS 1213: Mechanical cable glands.

SANS 60529 Degrees of protection provided by enclosures (IP Code)

SANS 1250 Capacitors for use with fluorescent and other discharge lamp ballasts.

SANS 61010-1: Safety Regulations for hand held probe assemblies for Electrical Measurement and test General Requirements.

SANS 61010-031: Safety Regulations for hand held probe assemblies for Electrical Measurement And test Part 1.

SANS 61010-2-031: Safety Regulations for hand held probe assemblies for Electrical Measurement And test Part 2.

SANS 10313: The Protection of structures against lightning. See also 61024-1, 61024-2 and 61312-1.

SANS 1063: Earth Rods and Couplers.

SANS 10198-4: The Selection, handling and installation of electric power cables of ratings not exceeding 33kV. Part 4 Current ratings

SANS 10199: The design and installation of an earth electrode.

NRS 002 Electrical diagrams and symbols.

BS 89-7:1990
EN 60051-
IEC 60051-7:1984 } Direct Acting Indicating Analogue 7:1989 Electrical Measuring Instruments and their Accessories

See Also BS89 1, 2, 3, 4, 5, 6,8 and 9

BS.EN 62271-100:2001 High Voltage Switchgear and Control Gear. High Voltage Alternating Current Circuit Breakers

BS EN.60947-4-2001 Low Voltage Switch Gear and Control Gear, Contactors and Motor Starters, Electromechanical Contactors and Motor Starters

BS 5000-50:1982
IEC 60681-1:1980 Specification for rotating electrical machines of particular types or for particular applications includes induction motors and Fractional horsepower motors

BS 4999-141:2004 General requirements for Rotating Electrical Machines Specifications for Standard Dimensions

BS EN60044-1:1999
IEC 60044-1:1996 Instrument transformers and Current transformers.

BS EN 62384:2006 DC or AC Supplied Electronic Control Gear for LED Modules Performance Requirements

SANS 1765 Low Voltage switchgear and assemblies (distribution Boards) with a Rated short circuit withstand strength up to and including 10kA

GR 4.4 Where conflict exists between any of the above regulations and/or specifications, the said conflict must be referred to the Engineer in writing for his ruling.

GR 4.5 No claims for extras in respect of failure by the Electrical Contractor to comply with any of the above regulations and/or specifications will be considered.

GR 5 NOTICES

GR 5.1 The successful Tenderer for this Contract shall, immediately after he has been officially notified that his tender has been accepted, and at any time thereafter as may be necessary, notify all the relevant authorities, pay fees, and take any other steps which may be required or prescribed to execute the installation as specified.

GR 5.2 Copies of such correspondence shall be forwarded to the Engineer, who shall at all times be kept informed.

GR 6 ELECTRICITY SUPPLY

GR 6.1 Unless otherwise specified in the project document, the electricity supply system is a nominal 400V, ± 5%, 3-phase, 50Hz, with a neutral earthed at the transformer, but insulated elsewhere.

GR 6.2 Unless stated in the project document, application for and the cost of the temporary and permanent electricity supply, shall be the responsibility of the Contractor. The Contractor shall apply timeously for such supply.

GR 6.3 The Electrical Contractor is responsible for informing the Engineer of the capacity of the electrical power supply required by the complete plant included in the specification.

GR 6.4 All temporary electrical supplies for construction sites shall be installed and connected in accordance with SANS 10142-1: 2009, Section 7.4, Page 225. Any temporary supplies that do not conform will not be acceptable.

VOLKSRUST WTW will have the right to have the installation(s) brought up to standard at the Contractor's expense.

GR 7 TESTING AND COMMISSIONING

GR 7.1 Prior to the delivery of all major electrical equipment to the site, factory tests shall be carried out to establish as far as practicable, that the equipment can function as intended. When this fact has been established, the equipment will be visually inspected for compliance in general with the specification. One week's notice is required for this test. If the equipment is in order, preliminary acceptance will be given for the purpose of delivery to site.

GR 7.2 On completion and connection of the equipment on site the Contractor shall arrange to carry out a preliminary inspection/test, in the presence of the Engineer or authorised representative, and if approved, the final acceptance test date will be set. One week's notice is required for this test.

GR 7.3 The Electrical Contractor shall provide all testing equipment and make preliminary tests before calling the Engineer to witness tests. The Electrical Contractor shall record all electrical test results on certificates and submit two copies to the Engineer for approval.

GR 7.4 Acceptance tests on all electrical plants will be carried out in the presence of the Engineer or authorised representative, and only upon successful completion of these tests, shall the guarantee period commence. One week's notice is required for this test.

GR 8 GUARANTEE

GR 8.1 The whole of the electrical installation, fittings and equipment installed under this Contract/Sub-Contract shall be guaranteed against defective workmanship or materials for a period of twelve months from the date of issue of the completion certificate for a portion or the whole of the works as the case may be.

GR 8.2 During the guarantee period the Contractor may be called upon to repair, replace or make good any defects or latent defects at his expense.

GR 9 VERIFICATION OF DRAWINGS

GR 9.1 All drawings and layouts shall be regarded as diagrammatic and all positions and dimensions shown on drawings shall be verified on-site. The Contractor shall check with the Engineer before putting work in hand on any section of the work that he is in possession of the latest drawings.

GR 10 MATERIALS

GR 10.1 The Electrical Contractor shall submit samples of all materials or equipment for approval by the Engineer before installation, unless prior approval to the contrary has been obtained in writing from the Engineer. Such samples will be held for purposes of comparison with equipment and materials installed and will be released on satisfactory completion of the contract.

GR 10.2 All materials shall be installed to the satisfaction of the Engineer**.**

GR 10.3 The Engineer may instruct the Electrical Contractor to supply and/or deliver, and/or install any other make or manufacture of articles than that/those specified, and will issue variation orders where such change has cost implications.

GR 10.4 All materials used shall be suitable for the environment and service for which the material is to be used.

GR 10.5 Where protective coatings are damaged, these should be made good by the Contractor to the satisfaction of the Engineer before handover.

GR10.6 All materials used in electrical installations shall be SANS approved and have an **RCC** authorisation or permit number as required by SANS 10142-1: 2009, Section 4.

Any conditions or expiry dates relating to the material are to be noted on the Certificate of Compliance.

GR 11 FIXING MATERIALS

GR 11.1 The Electrical Contractor shall fix all metal and non-metal surface-mounted material equipment only as described hereunder:

GR 11.1.1 INTO CONCRETE

Expanding rawl-bolts, bolts cast in, or gun-bolted with sizes and lengths as approved by the Engineer or as specified.

GR 11.1.2 INTO PRE-CAST CONCRETE

Services shall not be fixed to pre-cast concrete structures unless otherwise specified or approved by the Engineer in writing.

GR 11.1.3 INTO BRICKWORK

Expanding rawl-bolts, plastic rawl plugs or built-in metal fixing of sizes approved by the Engineer or as specified.

GR 11.1.4 ONTO STEELWORK

Drilled or gun-bolted, tapped and screwed with specified or approved sizes of screws or steel gunbolt nails, by means of welding where so permitted by the Engineer.

GR 11.1.5 ONTO WOODWORK

To be fixed by means of wood screws of ample sizes and quantity as specified or approved by the Engineer. Nails shall not be used.

GR 11.1.6 INTO HOLLOW TILES

Spring toggles of not less than 6mm diameter and then only upon specification or approval of the Engineer.

GR 11.1.7 IN AREAS EXPOSED TO WEATHER

Stainless steel, galvanised or solid brass bolts, screws and nuts shall be used.

GR 11.2 Gun bolting into concrete will only be allowed into cast concrete and then only after permission has been obtained from the Engineer.

GR 11.3 No gun bolting shall be undertaken into ash bricks, brickwork or pre-cast concrete except where permission has been granted by the Engineer.

GR 11.4 The Electrical Contractor will be held responsible for any damage to Builder's work, due to unauthorised, inadmissible gun bolting.

GR 11.5 The use of plastic plugs will be acceptable for the fixing of switch boxes, plug boxes, single phase surface distribution boards, saddles and all light weight accessories. Permission is to be obtained from the Engineer for all other types of equipment fixings.

GR 11.6 Material shall be installed in accordance with manufacturer's instructions and recommendations in all respects including type, size and spacing of fixings.

GR 12 EARTHING

GR 12.1 The entire installation shall be earthed in accordance with:-

GR 12.1.1: The Occupational Health and Safety Act.

GR 12.1.2 The latest issue and amendments to the Code of Practice for the Wiring of Premises SANS 1014 2-1: 2009.

GR 12.2 Section 4 of SANS 10142-1: 2009 applies totally to this installation. The additional information forms part of this contract.

GR 12.2.1 6.12 Basic Earthing Provision

The earthing lead shall be connected to the consumer's earth terminal as per SANS 10142-1: 2009, Section 6.11 and shall be of copper and be of a rated area as determined in accordance with Table 6.28. The supplier's main earth terminal will be in the substation or meter box.

GR 12.2.2 6.12.1 Earth Continuity Conductors

Table 6.28 – minimum size and maximum length of copper earth continuity conductor applies to this contract.

Section 8 of SANS 10142-1: 2009 with regards to testing and the issue of a Certificate of Compliance – applies to this contract and Test Certificates shall be provided by the Contractor to the Engineer. The test method shall be in accordance with Section 8.2.4.

The Engineer shall be advised of the date and time of any earthing tests and may wish to witness such tests.

GR 12.2.3 6.12.2 Earth Electrodes

If required, shall be in accordance with SANS 10142-1:2009, Section 6.12.2 and shall comply with SANS 1063 and 10199 and the requirements of project documents and the Contractor shall test the electrode in accordance with Section 8.7.7.2 and provide the test results to the Engineer.

GR 12.3 Where standard copper conductors are to be connected to earth bars, conductors shall be properly soldered or hydraulically crimped into tinned lugs, indentation crimping is not permitted. The lugs shall be bolted onto copper bars.

GR 12.4 Section 6.12.3 – The earthing of exposed conductive parts shall apply to this contract with the addition of all electric motors, which shall be provided with a machined boss, tapped for a bolt of suitable size for earthing purposes.

GR 12.5 If required in the detailed project specification, an earth electrode system shall be installed. Such system shall comply in all respects with SANS Code 10199: The design and installation of an earth electrode. The Contractor shall test the earth electrode system and provide test results to the Engineer.

GR 13 LIGHTNING PROTECTION

GR 13.1 If required in the detailed project specification, a lightning protection installation shall be installed to comply with the requirements of the SANS Code of protection of Structures against Lightning: SANS 10313 and SANS-61024-1.

DR PIXLEY KA ISAKA SEME LOCAL MUNICIPALITY

VOLKSRUST WATER TREATMENT WORKS PLC AND ELECTRICAL TECHNICAL SPECIFICATION

VOLKSRUST WATER TREATMENT WORKS

TECHNICAL SPECIFICATION FOR ELECTRICAL INSTALLATIONS

SECTION 2 – STANDARD EQUIPMENT SPECIFICATIONS

VOLKSRUST WATER TREATMENT WORKS

TECHNICAL SPECIFICATION FOR ELECTRICAL INSTALLATIONS

SECTION 2 – STANDARD EQUIPMENT SPECIFICATIONS

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SS 1 CABLES SS 1.1 GENERAL

SS 1.2 All cables shall be new and unused.

SS 1.3 Cables shall be manufactured and supplied in one length to the lengths specified unless these lengths exceed a standard drum length in which case a ruling shall be obtained from the Engineer.

SS 1.4 Unless otherwise specified or approved, cables with copper conductors shall be used throughout.

SS 1.5 Unless otherwise specified or approved, all unarmoured cable shall be installed in metal wiring Channel, sleeves or conduit.

SS 1.6 LV CABLES 600 / 1000V GRADE

- PVC Cables 600 / 1000V Grade
- Unless otherwise approved the cables shall be manufactured in accordance with SANS 1507.
- The insulation shall be general purpose PVC 600/1000V Grade.
- Cables shall be constructed as follows :-

Unarmoured Cables: PVC-insulated / PVC sheathed.

Armoured Cables: PVC-insulated / PVC-bedded/SWA/PVC sheathed.

ECC Cables: PVC-insulated / PVC-bedded/SWA armored with copper earth continuity wire in amour PVC sheathed.

Single Core Cables: PVC – insulated and unsheathed (for installation in wire ways and switchboards).

- Where armoring is specified it shall consist of one layer of galvanized steel wire in the case of multi-core cables and non-magnetic metallic wire in the case of single core cables. Aluminum strip or tape armoring is not acceptable.

- Where specified, an earth continuity conductor shall be provided in the armouring in accordance with SANS 1507.

SS 1.7 PAPER-INSULTATED CABLES

The cable construction shall be:-

- Paper insulated/lead covered (PILC) sheathed/double steel tape armoured/jute serving – 6.35/11kV cables to SANS 97-1991, Table 17.

- Impregnated paper insulated/lead covered/double steel tape armoured/PVC/sheathed.

- Impregnated paper insulated/lead covered/steel wire armoured/PVC sheathed.

The conductor insulation shall be mass impregnated with a non-draining type of compound as (mind).

The bedding shall consist of a bitumen impregnated fibrous material and the sheath shall be lead alloy E. The serving shall consist of bitumen impregnated fibrous material.

Armouring shall consist of double steel tape or galvanised steel wire.

The cable insulation shall be suitable for the supply voltage specified and the cable must be suitable for a system with an unearthed neutral.

SS 1.8 XLPE-INSULATED CABLES

The cables shall be manufactured in accordance with SANS 1339 - 1991.

XPLE cable shall consist of high conductivity annealed or hard-drawn stranded copper or aluminium conductors, a stress equalising layer of extruded semi-conducting cross-linked polyethylene, extruded cross-linked polyethylene insulation, a conducting compound applied over a semiconducting coating or a layer of extruded semi-conducting compound applied directly to the dielectric. A collective metallic screen of annealed copper tape enclosing all the cores and interstitial filler shall be protected by an extruded PVC sheath.

Where armoured cables have been specified, a bedding consisting of a continuous impermeable layer of PVC shall be provided. The galvanized steel wire armour shall be enclosed in an outer sheath of PVC.

SS 1.9 GROUPING AND SPACING OF CABLES

Cable routes shall be planned to produce a minimum of crossovers.

Cables with a cross-sectional area of more than 16mm^2 shall be spaced two outside cable diameters apart, for which no grouping factor need be applied.

High voltage cables shall be separated from other cables and services throughout the installation and shall as far as possible be installed in separate floor trenches, pipes or metal channels. Where this is not feasible, a minimum spacing of 500mm shall be maintained.

Cables for telephone, communication and alarm systems and all other low voltage systems (less than 50V), shall be separated from power cables by at least 1m. All control or pilot cables shall be at least 300mm from power cables. In building ducts a physical barrier shall be provided between power cables and cables for other services. Where armoured cables are used for such other services, they shall be at least 1m away from power cables or shall be installed on separate cable trays. In the case where unarmoured cables are used for these other services they shall be installed in separate metal channels or conduits.

SS 1.10 CABLE INSTALLATION SS 1.10.1 GENERAL

The Contractor shall install and terminate the necessary cabling between various items of equipment. The cable shall be installed in accordance with SANS 10142-1: 2009 and Code 10198-4: Installation of Electric Power Cables.

All ends of cables are to be made off with a suitable gland (for PVC-insulated cables), which shall be effectively earthed and bolted to equipment or switchboards.

No joints in cable runs will be allowed, except where specifically approved. Where joints are approved, proper jointing kits, approved by the Engineer, shall be used. Where written permission is given for a cable joint, the Contractor shall provide, in writing, an unconditional two-year guarantee
No joints in cable runs will be allowed, except where specifically approved. Where joints are approved, proper jointing kits, approved by the Engineer, shall be used. Where written permission is given for a cable joint, the Contractor shall provide, in writing, an unconditional two-year guarantee for each joint, prior to the joint being made. A minimum of 1m of slack should be provided at each end of the cable at each joint.

All joints shall be made either by means of compound filled boxes, according to best established practice by competent cable jointers using first-class materials, or by means of approved epoxy resin pressure-type jointing kits. Epoxy resin joints must be made entirely according with manufacturer's instructions, and entirely with the materials stipulated in such instructions.

Before terminating or jointing PILC and XLPC cables, a test to establish the presence of moisture must be carried out.

The Electrical Contractor shall install cables in such a manner to avoid twisting and to ensure they are not bent to a radius less than that specified in the regulations.

Cables shall always be solidly supported and shall never be allowed to span any distance unsupported and shall never be laid over any sharp edges without suitable protection against damage.

Suitable tinned lugs, terminals and other fittings shall be used to match the different sizes of stranded copper core or solid aluminium core cables. The correct type of crimping tools shall be used to crimp the lugs, terminals and other fittings onto the cable.

Aluminium cables shall not be directly connected to copper cables, terminals, bus bars, etc. Tinned lugs and fittings suitable for connecting aluminium to copper shall be used.

Where cables are cut and not immediately made off, the ends must be sealed without delay. If the cables are cut and the ends not immediately made off or sealed, the cable may be rejected and the Contractor will be required to replace it at his own expense.

All cables shall be clearly marked at each termination end, and at each cable joint by means of metal, plastic or recognised marker bands, firmly fixed to the cable. The numbers or codes, as specified, to identify the cable, shall be clearly embossed on the marker bands.

Trenching, cable laying and jointing is specified elsewhere.

SS 1.11 CABLES ON SURFACE

Cables shall be planned by the Electrical Contractor to produce minimum crossovers.

Cables shall be fixed and supported by means of clamping devices approved by the Engineer, which shall not damage the cable during installation or over a period of time during usage of the cable.

Where cables are specified to be run along horizontal or vertical building surfaces, structural steel members, in vertical ducts, etc., they shall be secured with approved saddles or other approved means of fixing, at intervals not less than those specified in the standard Wiring Code. All cable runs shall be plumbed and levelled or run parallel to building or structural members and shall at all times present a neat appearance.

Cables in vertical riser ducts shall be secured with proper cable clamps or cleats and pressure shoes, at intervals as specified in the standard Regulations for the Wiring of Premises.

In no case must cable be installed in positions where they may be exposed to direct sunlight, whether indoors or outdoors, e.g. in certain cases approved shade shields may have to be installed.

Where single core cables are specified to be run in trefoil, this shall mean that each group of three single core phase conductors shall comprise a red, yellow and blue conductor, placed in triangular formation. Clamps or straps used to secure groups run in trefoil shall be of non-ferrous material.

Cables shall always be solidly supported to prevent sag and shall never be allowed to span any distance unsupported.

Cables shall never be laid over any sharp edges without suitable protection against damage.

SS 1.12 TESTING

Each cable shall be tested after installation in accordance with SANS 1507 (up to 11 kV) as well as the requirements of the Local and Supply Authorities.

The Contractor shall make all arrangements, pay all fees and provide all equipment for these tests. The cost of testing shall be included in the tender price.

The Contractor shall notify the Engineer timorously so that he may witness the tests.

LV cables shall be tested by means of a suitable megger at 1 kV and the insulation resistance shall be tabulated and certified.

SS 1.13 CABLE GLANDS

Cable glands shall be suitable for PVC SWA cable and shall be complete with neoprene shrouds. Glands shall be in accordance with SANS 1213.

The correct size and type of gland shall be used for the particular cable and application. Glands shall be fitted in accordance with the cable and gland manufacturer's instructions.

Glands shall be suitable for general purpose 600/1000 V Grade cable with steel armouring and shall be made of heavily nickel-plated bronze or brass provided with ISO thread.

The glands shall consist of a barrel carrying a cone bush screwed into one end and a nickel-plated brass nipple carrying a nickel-plated brass lock nut screwed into the other end.

For unarmoured cables the cone bush and compression ring of the gland shall be replaced with a synthetic rubber compression bush and ring to provide the required grip on the outer sheath of the cable.

Suitable accessories shall be provided with glands to be used on ECC armoured cables for facilitate a bolted lug connection of the earth continuity conductors. Grooves cut into the barrel or cone bush to accommodate the earth continuity conductors are not acceptable.

The shrouds shall be made of non-deteriorating neoprene or other synthetic rubber and shall be resistant to water, oil and sunlight. The shrouds shall fit tightly around the glands and cable.

All glands fitted to cables in corrosive areas and coastal areas are to be the Corrosion Guard or the Envirogland type.

All glands that are made off into IP Rated enclosures, boxes etc are to have water proofing gaskets fitted to maintain the IP rating of the enclosure or equipment.
When cables are glanded into non-conducting enclosures, the gland shall be provided with a suitable earth tag washer and an earth wire taken to the earth bar.

SS 2 SHORT STANDARD STREET LIGHTING POLES SS 2.1 GENERAL

All street lighting poles shall be suitable for installation in a corrosive environment.

SS 2.2 DIMENSIONS

A drawing showing the dimensions and giving all relevant information shall be submitted by the Contractor.

The poles shall be continuously tapered with the following dimensions.

Total length	:	5000mm
Diameter as base	:	150mm
Diameter at top	:	77mm

SS 2.3 FACTOR OF SAFETY AND DEFLECTION

Tenderers shall state the minimum factor of safety of the pole when supporting a fitting 5, 25 kg mass and with a projected area of 0, 31 sq.m and subjected to a wind pressure of 700 Pa.

The maximum horizontal deflection shall not exceed 2,5% of the length of the poles when subjected to wind pressure, or when a ladder is placed against the pole at an angle of 40º and a man with a mass of 90 kg is working on top of it.

SS 2.4 CABLE ENTRY

The cable entry hole must not be less than 100mm by 50mm.

SS 2.5 INSPECTION DOOR

The inspection door is to be not less than 230mm high and 100mm wide.

SS 2.6 FIXING BRACKET

A 6mm thick earth bar welded to pole and drilled and tapped to accept 6mm earth stud and SAMITE, or similar, MCB clip tray.

SS 2.7 WELDING

If welded poles are offered, all welds shall be finished flush.

SS 2.8 COLOUR

If fibreglass reinforced polyester poles are offered they shall be of the colour (G54) Pastel Grey to SANS 1091 of 1975.

SS 2.9 GALVANISING

Steel poles are to be hot dipped galvanised on all surfaces in accordance with specification SANS 121 latest edition and EN ISO: 10240

Before galvanising, all fabricating is to be completed, which will include completion of all cutting, drilling, bending, punching, forming and welding and the removing of all burrs and welding slag. In the event of the offer not complying with all the provisions of SANS 121, VOLKSRUST WTW require in writing the reasons as to why the offer does not comply.

A certificate stating that all galvanising has been carried out to the requirements of SANS 121 shall be forwarded with each delivery of poles.

All material shall be free from white rust when received.

SS 2.10 FIBREGLASS REINFORCED POLYESTER POLES

These shall comply in all respects with the latest revision of SANS Specification 141–2006: Glass Reinforced Polyester (GRP) Laminated Products.

SS 3 CREOSOTED WOODEN POLES SS 3.1 GENERAL

The poles shall be in accordance with SANS 754 – 2007 except that no sweep or crook is to be permitted in the final 4,0m of the thin end of the pole.

SS 3.2 DIMENSIONS

The pole shall have a length of 11 metres, a top diameter of 140/160mm and a diameter at theoretical ground line of 190/210mm.

SS 3.3 PRESERVATIVE

The type of preservative used is to be in accordance with one of the following standards.

- SANS 871-2009
- SANS 6278-2007

- SANS 6303-2004

SS 3.4 IMPREGNATION PROCESS

Treatment shall be carried out in accordance with SANS 10005. The process used shall be one of the following.

- Empty-cell pressure process
- The full-cell pressure process
- The hot/cold open- tank process

SS 3.5 CANTILEVER AND MID-POINT LOADING

The pole shall have a cantilever and mid-point loading of 3, 95 kN and 9, 76 kN respectively, corresponding to a maximum fibre stress of 55 mPa.

SS 4 CABLE TRAYS, LADDERS AND RACKS SS 4.1 SUPPLY

The Contractor shall supply and install all cable trays, ladders and racks complete and ready for the installation of cables including all fixing materials, deviations, bends, angles, tees, reducers and other components.

SS 4.2 DESIGN

All materials associated with the cable trays shall be hot-dipped galvanised to SANS 121.

Cable trays are to be manufactured of slotted or perforated sheet steel of minimum thickness of 1,6mm or as otherwise specified.

Cable trays shall be designed to a width to permit the addition of one extra cable equal of that of the largest diameter of the group.

45º cornices of adequate size, to permit compliance with minimum allowable cable bends, shall be provided at all bends, corners, tees and reduction joints. Deviations in vertical bends shall have radii, sufficient to permit compliance with minimum cable bends. No butting up or right angle jointing of cable trays, ladders or racks will be allowed.

Cable ladders shall be manufactured of 2,0mm sheet steel with cross members at 375mm centre spacing.

The cable racks shall be mechanically and electrically continuous and where changes in dimensions occur, reducer pieces installed.

Cable racks to be fabricated mild steel and hot dipped galvanised similar or equal to the 'O' line support system. 3CR12, 304L and 316L SS may be considered.

SS 4.3 INSTALLATION

Minimum shoulder height shall be 38mm for trays up to 300mm wide and 76mm for wider trays.

Cable tray supports shall be spaced adequately to avoid sagging between supports, and shall consist of two steel hanger rods of minimum thickness of 9mm on both sides of the tray with a substantial steel cross-member to support the tray, maximum allowable sag to be 10mm.Where necessary, to achieve this end, the run of cable tray shall be reinforced along its length, with angle iron or similar stiffening members. Brackets or hangers must be constructed to permit the easy removal of any cable from the cable tray.

Minimum cable ladder side rails shall be 38mm.

Cables run on cable tray shall be laid on top (not underside) of the tray and secured by means of saddles or approved straps to present a neat appearance. The brackets or hangers must be so constructed as to permit the easy removal of any cable from the cable tray. The tray shall always be of such width as to permit the addition of 1 extra cable equal to that of the largest diameter of the group.

Cable tray suspended from slabs shall be at a depth of not less than 200mm from soffit of slab to bottom of tray and cable tray crossing a beam to top of largest cable to enable it to be removed. However, where there is any doubt about height restrictions or other considerations affecting the position of cable tray, this matter must be referred to the Engineer.

Cable trays shall be bonded to a suitable earth in accordance with Section 6.12.3 of SANS 10142 -1: 2009.

SS 5 CONDUIT SS 5.1 GENERAL

All conduits for normal use shall be for heavy duty applications and shall be either, Black Enamel Screwed, Hot-dipped galvanised, PVC or Bosal type and shall be in accordance with SANS 60614-1. Conduits for electrical installations Part 1: General Requirements -1994. SANS 60614--2-1 Part 2 for metal conduits, SANS 60614--2-2 Part 2 for rigid plain conduit. SANS 60614-2-5 Flexible conduits Bosal Conduit to be installed in accordance with manufacturers recommendations.

Conduit boxes shall be in accordance with SANS 950:2007 and Section SS 13 – Outlet Boxes, Draw Boxes and Cover Plates.

SS 5.2 GALVANISED CONDUIT

All galvanised conduit shall be heavy gauged, hot-dipped galvanised and shall comply with SANS 60614-1:1994. And shall bear the SANS mark.

Galvanised conduit accessories shall be malleable iron, or pressed steel and, except in the case of brass bushes, shall be hot-dipped galvanised as may be applicable to conditions of use and shall comply with SANS 950:2007

SS 5.3 PVC CONDUIT

- PVC conduit shall not be threaded.
- PVC conduit shall not be installed outside in direct sunlight.

PVC CONDUIT INSTALLATION

- Draw in boxes or inspection couplings shall be provided to avoid the necessity of drawing cables round two 90º bends.
- Straight runs shall be provided with draw boxes at intervals not exceeding 20m.
- Where conduits are run in roof spaces, ceiling voids or other exposed areas, the runs must be parallel and at right angles to structural elements, diagonal runs will not be permitted.
- No boxes other than loop-in boxes shall be installed in roof spaces or ceiling voids where there is less than 1m clearance.
- All conduit boxes that have spare entries or knockouts shall be blanked off with suitable blanks or stoppers.
- All PVC conduits shall be glued into their respective accessories with the manufacturer's recommended adhesive.
- Where PVC conduit is fitted to accessories that are installed in concrete apart from being glued they shall also have PVC tape wrapped around the joints to stop the ingress of water.

- PVC conduits that are installed in concrete shall be securely fastened to the shuttering and steelwork and supervision is required at all times while concrete is being poured.
- PVC conduits that protrude through the deck shall have the ends tapped or proper stoppers fitted to stop the ingress of brick dust or chippings.
- All PVC conduits that are to be connected to a flush box, DB tray or other like accessory are to terminate in an adaptor.

PVC conduit shall comply with SANS 950 current edition and must be installed strictly in compliance with the manufacturer's recommendations.

PVC accessories shall be in accordance with SANS 950 current edition

PVC conduit and accessories may not be used where they may be exposed to temperatures in excess of 50ºC or to mechanical damage.

Bosal conduit shall be either screwed end or plain end for use in electrical installations.

SS 5.4 CONDUIT INSTALLATION

All conduit installation shall be strictly in accordance with SANS 10142-1:2009 manufacturer's recommendations. In addition the following clauses shall apply.

- Draw-in boxes with metal covers shall be provided in such positions as to enable cables to be easily drawn in after the conduit system has been completed. Draw boxes shall be provided to avoid the necessity of drawing cables round more than two 90º bends.
- Straight runs must also be provided with draw boxes at intervals not exceeding 12m.
- Where conduits are carried in roof spaces, ceiling voids and other exposed areas the runs must be parallel and at right angles to structural elements. Diagonal runs will not be allowed.
- Larger draw boxes, as applicable, shall be used in positions where more than two conduits join. The number of single draw boxes shall not be used in such positions, except where approved by the Engineer.
- Where conduits are run on surface, they shall be fixed with spacing saddles, the maximum distance between the saddles shall not exceed 2000mm. Where an outlet box with a switch or other accessories is mounted independently, saddles shall be installed with 100mm of each side of the outlet box.
- Where conduits are run adjacent to gas or hot water piping, they shall under all conditions be prevented by spacers or other means from coming into contact with these other services.
  Conduit must be kept at least 160mm clear of, and preferably below steam or hot water pipes.
- Care must be taken that the interior surface of conduits shall have no sharp protrusions of metal which may damage the cables and all open ends shall be provided with brass bushes. Only brass bushes will be permitted.

- Any conduit which is damaged, or from which the galvanising has been removed, shall be covered with two layers of anti-rust paint after erection.
- All steel conduits shall be securely bonded to terminating equipment, ensuring complete electrical and mechanical continuity throughout, and every conduit run shall be bonded to earth. Conduit shall either be screwed to or have lock nuts fitted on both sides and bushed on the inside of the box or appliance in which it is terminated. Only solid brass bushes shall be used. Alternatively, and particularly in distribution boards, conduits may be terminated with couplings and brass male bushes.
- Where false ceilings are provided under concrete slabs, conduits feeding outlets in the ceiling shall be run on surface in the ceiling space.
- All running joints shall be provided with locknuts to ensure that all connections in the installation are secure.
- The resistance between any two points of the galvanised conduit system shall not exceed 0.2 ohm, although conduit shall not be relied upon for earth continuity.
- All conduit and accessories, including the metal surround of electrical control apparatus shall be mechanically and electrically continuous.

Where possible, conduit shall be run in straight, symmetrical lines with easy curves and bends and shall be drained. Internally screwed bends shall be avoided if possible and the minimum radius of a bend shall not be less than as stated in the following table :-

20mm conduit -	80mm
25mm conduit -	100mm
32mm conduit -	130mm
40mm conduit -	160mm
50mm conduit -	200mm

- Care shall be taken to exclude the ingress of dirt or moisture in partially completed runs and all open ends must be plugged temporarily while work is not in progress.

SS 5.5 CHASING

The outer face of conduit shall be not less than 12mm back from the finished plastered surfaces. All chasing of walls shall be done by means of powered chasing machines. No chasing of concrete or face bricks shall be done except with the written permission of the Engineer.

SS 5.6 BUILDING IN OF CONDUIT

All built-in conduits and associated terminations and boxes shall be accurately aligned and plumbed at the time of building in. The Contractor shall not delay other trades by failing to provide the necessary extensions and boxes in their correct positions in good time.

SS 5.7 CONDUIT IN CONCRETE

Conduit installed within concrete slabs, beams, columns or walls shall be firmly fixed in position before the concrete is cast. Where conduit runs occur in groups or large concentrations, as near distribution boards, draw boxes or in similar situations, they shall be fixed with clearance between adjacent conduits of not less than one conduit diameter to permit of adequate penetration of concrete. Steel conduits may not be run in breeze or ash. Where this is unavoidable such conduit shall be encased in mass concrete to ensure no contact with the breeze or ash.

Where conduit is buried in concrete, it shall be efficiently swabbed out to remove all traces of condensation before the cables are drawn in and suitable provision for future drainage must be made.

SS 6 CABLE TRUNKING, WIRING CHANNEL and DUCTING SYSTEMS

SS 6.1 GENERAL REQUIREMENTS

Cable Trunking, Wiring Channel and Ducting Systems shall be in accordance with SANS 61084-1, 61084-2-1 and 61084-2-4. For electric cables and shall be approved by the Engineer.

Cable trunking shall be complete with end clamps, internal spliced plates, corner pieces and tees, snap-in covers, internal partitions, z-clips, knock-outs and all other accessories needed to complete the installation. No butting up or right angle jointing of Cable Trunking, Wiring Channel or Ducting Systems will be allowed.

Cable trunking shall be partitioned, if required, to keep different sections of wiring apart, as indicated on the drawings. Partitions shall be of perforated steel and shall be installed to the dimensions indicated.

Cable trunking shall be manufactured of steel plate of minimum thickness of 1,2mm, shall be galvanised and properly cleaned, a lead oxide or other suitable undercoat shall be applied, and thereafter two coats of good quality paint. Any part of the cable trunking channel or covers in offices which is exposed to view shall be finished in white baked enamel.

All cable trunking shall be fitted with cover plates. Cover plates on channels up to 125mm width shall be of the snap-in type. Cover plates on larger trays shall be fixed by means of screws, which shall be

permanently tapped to the cover plates. Knockouts for conduits shall be provided in the sides of all trunking as indicated on the drawings or as required to complete the installation.

Snap-in covers for concealed channels shall be supplied in approximately 500mm lengths. Snap-in covers for exposed channel shall be in approximately 2500mm lengths where feasible. Ends of covers abutting partitions, light fittings or other covers shall be accurately cut to fit square and neatly. Covers shall not be installed prematurely.

Where the channel is mounted flush with plastered surface or recessed into concrete slab, the covers shall overlap the open face of the channel to conceal rough edge of plaster.

The cable trunking shall be supplied with all the necessary brackets, clamps, bolts and nuts, hanger supports and materials to secure the trunking into the structure.

Cable trunking supports shall be spaced to avoid sagging between supports.
Channels or covers shall be packed to ensure protection against damage during transport. Any such channel covers so damaged during transport storage or erection may be rejected by the Engineer.

Conduit connections to cable channels shall either be terminated direct to the channel using male and female brass bushes or by means of a conduit box with a bushed back entry to the channel. Care shall be taken to avoid wiring passing over sharp edges. Wiring connection from channel to light fitting, switch drops or similar, shall be taken through solid tubing, flexible tubing, nipples, bushes or other incombustible approved lead-in tubes depending of the relative positions of channel and fitting, etc. Open wiring through ceiling material will not be permitted.

A standard earth wire complying with the SANS 10142-1: 2009 Code of Practice for the Wiring of Premises but not less than 2,5mm shall be installed in each run of ceiling channel and wired back to the earth terminal of the distribution board. In addition each section of metallic channel shall be bonded to the earth wire. A jumper shall be taken from the earth wire in the channel to each light fitting without breaking the main earth wire.

PVC Cable Trunking, Wiring Channel and Ducting System will be accepted where specified or approved by the Engineer.

SS 7 SURGE PROTECTION DEVICES (SPD'S)

SS 7.1 LOW VOLTAGE (SURGE PROTECTION DEVICES (SPD'S)

Surge Protection Devices shall be installed on all MCC Panels, Distribution Boards, Kiosks etc.

SPD's shall conform to SANS 61312-3-2006, SANS 61643-1:2006 and IEC 61643-1: 2005, 61312-32000, 61024-1 and 61042-1-1. And shall bear the SABS mark they shall be installed and connected as detailed in SANS 10142-1:2006 Annexure L with respect to the different supply system earthing arrangements.
Cognisance shall also be taken with respect to the manufacturer's recommendations and instructions.

SS 7.2 MEDIUM VOLTAGE (SURGE DIVERTERS)

SS 7.2.1 STANDARDS

The design, manufacture and testing of surge diverters shall be in accordance with the latest edition and amendments of the following standard specifications:-

- Surge diverters : BS 2914 NRS139-1-1999
- Galvanising : SANS 121

SS 7.3 CONSTRUCTION SS 7.3.1 SEALING

Diverters shall be hermetically sealed to prevent ingress of moisture and corrosion of parts.

SS 7.3.2 GALVANISING

All ferrous metal parts shall be heavily galvanised.

SS 7.3.3 MOUNTING

Brackets shall be provided to enable the diverters to be mounted on a steel cross-arm, preferably so that the axis of the diverters is inclined from the vertical.

SS 7.3.4 TERMINAL CONNECTIONS

Diverters shall be fitted with live and earth terminals suitable for securely clamping steel cored aluminium or copper conductors.

SS.7.3.5 DISCONNECTION DEVICE

Offers for surge diverters having a device for disconnecting the earth wire in the event of the failure of the unit will be preferred.

SS 7.3.6 NAME PLATE DATA

Diverters shall have a data plate inscribed with at least the following details:-

- Manufacturer's name
- Manufacturer's identification number and type
- Voltage rating (maximum line-to-ground voltage)

SS 7.4 ELECTRICAL DESIGN

The design of the surge diverters shall be such that the following characteristics are obtained:-

- Low impulse spark over voltage
- Low residual voltage
- Adequate thermal capacity and mechanical strength to withstand the discharge of low current long duration and high current short duration surges
- Substantially constant gap spark over value for both positive and negative impulse waves, regardless of external weather conditions

SS 7.5 TESTING

Tenderers shall also submit standard acceptance tests in accordance with BS Standard 2914:1972 Clause 7.2 or latest edition/amendment thereof.

SS 8 LUMINAIRES

Energy saving luminaries will be as equivalent replacements for the lighting requirements. Engineer will approve requirements.

SS 8.1 GENERAL

ALL LUMINAIRES SHALL COMPLY WITH SANS 60598-1:2007 Part 1 General Requirements in all respects and with the various additional codes as detailed therein for the relevant items of equipment.

The luminaries to be supplied are to be selected from those specified in the Project Specification. In general, the following guidelines are to be adhered to:-

Workshop	:	Mercury vapour with appropriate fittings
Offices	:	Open channel fluorescent or recessed fittings
Plant Rooms, Motor Room	:	Corrosion-resistant fluorescent fittings
Exterior Lighting	:	Bulkhead fittings fitted with 70W HPS lamps Bulkhead fittings fitted with PL9, PL18 or PL22 CFL lamps
Street Lighting.		Street light fittings fitted with 70W / 150W HPS lamps, PL9's PL18 and PL22 as specified.

All luminaries shall be complete with lamps, indicator lamps, ballasts, chokes, control gear and all other accessories required to make the luminaire fully operative.

SS 8.2 DESIGN

All luminaires shall be equipped with a terminal block and an earth terminal.

The internal wiring shall consist of flexible stranded copper conductors of not less than 0,5mm with suitable heat resisting insulation to SANS 529.

Luminaires shall not cause radio or television interference in accordance with the GP0 requirements.

The voltage rating and lamp wattage shall be clearly and indelibly marked on control gear. Ballasts shall be power factor corrected to at least 0,9. lagging and shall have a minimum circuit efficiency of 0,85. Capacitors shall comply with SANS 1250: 1979.

Switch-start ballasts shall be wound lengthwise around pre-assembled laminations welded into a steel channel. No compound shall be used.

Starters shall comply with PS3772/IEC155.

All fluorescent luminaries shall have telescopic or sprung-ratchet lamp holders.

SS 8.3 FLUORESCENT LUMINAIRES SS 8.3.1 INTERNAL

Interior luminaries shall comply with the latest edition of SANS 60598-1:2007 and ballasts shall comply with the latest revision of SANS 890-1 and 2

All luminaire metal work shall be painted with an approved Epoxy/Polyester baked powder coating process to SANS 1274.

SS 8.3.2 EXTERIOR

Exterior luminaries shall be weatherproof and shall be classified at least IP65.

Lenses shall be resistant to degradation from ultra-violet light.

All materials selected shall be corrosion resistant.

All exterior luminaries shall be manufactured from cast aluminium, aluminium alloy or glass fibre. The luminaries shall be fully gasketted to eliminate the ingress of dirt and moisture and the lens material shall be either polycarbonate or acrylic material.

SS 8.4 INSTALLATION

The Contractor shall be responsible for installing fittings including all brackets and mounting accessories. The Contractor shall also be responsible for commissioning and testing and where necessary aiming and adjustment of luminaries.

All fittings shall be properly earthed to the earth terminal.

SS 9 LAMPS SS 9.1 GENERAL

All general lighting service lamps of South African manufacture shall be made in accordance with the latest revision of SANS 60432-1-2006 and shall bear the SANS mark. Imported lamps shall conform to the latest requirements of British Standard Specification BS161:1990, EN 60064:1989, BS5971:1988, EN 60432:1988 and EN 60432-1 as amended or to such other standards as may be approved by the Engineer.

SS 9.2 TUNGSTEN FILAMENT LAMPS FOR GENERAL LIGHTING SERVICE

Tungsten filament and lamps shall be in accordance with SANS 60432-1-2006 and shall bear the SANS mark.

SS 9.3 TUBULAR FLUORESCENT LAMPS (For General Service)

All lamps shall be suitable for use at 220V. Rapid start types shall be rated at 40W and shall be supplied in 1220mm lengths. 65W lamps shall be supplied in 1524mm lengths and 55W lamps shall be supplied in 1828,8mm lengths, single pin type. 18W lamps shall be supplied in 600mm lengths, 80W ratings shall be supplied in 2440mm lengths and of the slim line, single pin type.

Fluorescent lamps shall comply with SANS 1041: Tubular Fluorescent Lamps for General Service and shall be suitable for their ballasts.

Unless specified in the Project Specification, all fluorescent lamps shall be cool white – Type T8.

SS 9.4 MERCURY TUNGSTEN

Lamps shall be rated at 220/230V. The 80W lamps shall have ES caps. All lamps are required for vertical burning without control gear.

SS 9.5 HIGH PRESSURE MERCURY VAPOUR

Shall be in accordance with SANS 60188: 2001 or as amended
Lamps shall be rated at 220/230V. The 80W lamps shall have ES caps and the 250 and 400W lamps shall have GES type caps. All lamps are required for horizontal and vertical burning.

SS 9.6 LOW PRESSURE SODIUM LAMPS

Shall be in accordance with SANS 60192: 2001 or as amended

Lamps shall be rated at 220/230V, 135W SOX and 90W SOX. All lamps shall be of the integral type and suitable for burning in any position from cap 5º below horizontal to cap 20º above horizontal.

SS 9.7 HIGH PRESSURE SODIUM LAMPS

Shall be in accordance with SANS 60662:2003 or as amended

Lamps shall be rated at 220/230V and shall be suitable for universal burning positions.

250 and 400W lamps shall be SON/E and SON/T for use in floodlight and street light luminaries.

210W SON/H shall be suitable for use with standard mercury vapour lamp choke.

SS 9.8 METAL HALIDE LAMPS

Lamps shall be rated at 380/415V. 2000W metal halide lamps for horizontal operation in floodlight fittings.

- With external ignitor HP1/T
  With built-in ignitor HQ1/T

SS 9.9 TUNGSTEN HALOGEN LAMPS

These will not be used with immediate effect.

SS 9.10 PAR 38 REFLECTOR LAMPS

Lamps shall be of the energy efficient type and rated at 220/230V, with an equivalent or similar lux output of the 150W type. They shall be of the reflector type with high quality internal mirror of pressed glass. They shall be available in wide and medium flood with a 2000 hour life guarantee.

SS 10 PHOTO-ELECTRIC CELLS

SS 10.1 DESIGN

The operational level shall be factory preset for “ON” at a light level of approximately 40 lux and

“OFF” at approximately 100 lux. Voltage variations shall not materially affect the operational levels.

The photo-electric cells shall have a timing delay of not less than 30 seconds.

The photo-electric cells shall be completely waterproof, corrosion proof and shall be of robust construction.

The unit shall be effectively safeguarded against voltage surges by means of a suitable surge protector which shall form an integral part of the unit.

The cover of the unit shall be manufactured from a tough, durable material providing protection against tampering. It shall be ultraviolet resistant and shall not deteriorate when exposed to sunlight for prolonged periods.

The units shall be SABS approved and supplied with authorisation number and shall have a suitable bracket for mounting against a wall or pole.

The units shall be capable of operating in dusty conditions and between temperatures of 5ºC and 55ºC.

SS 10.2 INSTALLATION

The photo-electric cells shall be so mounted that light emitting from the light fitting shall not interfere with the proper functioning of the photo-cell.

Individual outside lighting circuits on a building may be connected directly to the daylight sensitive switch if the total current does not exceed 20A.

A by-pass switch enabling the lights to be turned on at any time shall be provided wherever daylight sensitive devices are utilised.

SS 11 ILLUMINATION LEVELS

SS 11.1 GENERAL

The illumination levels shall be not less than that specified in Section 3 and schedule in the Occupational Health and Safety Amendment Act (Act Nº 181 of 1993).

SS 12 WIRING

SS 12.1 GENERAL

All wiring work shall be strictly in accordance with SANS 10142-1: 2009 as amended and in addition the following clauses shall apply.

SS 12.2 STANDARDS

Unless otherwise specified in the Project Specification, all wiring shall be carried out with PVC insulated single core copper conductors made in accordance with SANS 1507-2 bearing the SANS mark and delivered on-site with seals intact.

SS 12.3 DESIGN

All wiring in conduit shall be done by means of a loop in system. No joints will be allowed except under extreme conditions authorised by the engineer. The number of wires per conduit shall be in accordance with the SANS 10142-1: 2009 Code of Practice for the Wiring of Premises. Unless specifically permitted, no more than one circuit shall be run in one conduit.

The engineer may allow 2 circuits of a similar type to be wired in one conduit. Only 3 conductor ends will be allowed at any one-termination point. Cutting away of wire strands of any cable will not be allowed and no jointing of conductors in draw boxes, or the cutting away of insulation is permissible. Where joints are used by approval of the engineer they shall be in heavy brass terminals with porcelain insulators or approved and authorised terminal connectors.

Vertical runs of wiring exceeding 15m shall be provided with suitable clamping supports at 15m intervals to take up the weight of conductors and to relieve any strain on terminals.

PVC insulated conductors may only be used where the ambient temperature does not exceed 50ºC. PVC insulated conductors shall not be directly terminated to a water heater, or any other appliance, apparatus or luminaire which operates at temperatures above 50ºC. Where temperatures exceed 50ºC, heat resisting wiring to SANS 529 shall be used.

Colour insulated wiring shall be used for all multi-phase circuits to correspond strictly to the phase colours i.e. red, white (or yellow), blue for phases and black for neutral. Single-phase circuits, however, may be wired with red and black.

Unless otherwise specified in the Project Specification, the following minimum stranded PVC insulated conductor sizes shall be used for various types of circuits :-

TYPE OF CIRCUIT	CONDUCTOR SIZE
Lighting	1,5mm²
Switched sockets: 16A single phase	2,5mm²
Space heaters up to 5kW	4,0mm²
Water heaters up to 4kW	2,5mm²
Motors: Single phase up to 2,2kW	2,5mm²
Motors: 3-phase up to 4kW	2,5mm²

Wiring installed in wiring trunking shall be installed in the correct compartment to prevent any crossovers and shall be bound together in groups not exceeding 10 conductors by means of “Helvin” straps, or equivalent at spacings not exceeding 1000mm. No joints will be permitted in wiring trunking.

Circuits for different services e.g. control and/or instrumentation circuits; lighting circuits; power circuits; inter-communication circuits and telephone circuits, shall each be taken in separate conduit runs.

A neutral conductor, equal in size to the phase conductors shall be run to each 3-phase outlet unless otherwise specified.

Emergency and standby circuits shall be run in separate wire ways to normal circuits.

Outlets for Future Lights: Where wiring passes through outlet boxes for future light points, sufficient slack shall be left in the boxes to permit the cutting in and making of future connections.

SS 12.4 INSTALLATION

Wiring in conduit shall only be carried out after the conduit installation and plaster work has been completed, but before paint work has commenced. No cables shall be drawn in before conduits have been thoroughly cleaned and dried out. Except where otherwise specified, wiring shall be drawn into screwed conduits according to normal wiring practice.

Extreme care must be taken not to apply excessive mechanical tension to PVC insulated conductors when drawing in and care must also be taken not to draw PVC insulated conductors around sharp corners or protruding surfaces in conduits.

PVC insulated conductors may be lubricated with high quality French chalk before they are drawn into conduit. The use of lubricating oil for drawing in PVC insulated conductors is not permitted.

SS 12.5 INNOVATED WIRING SYSTEMS

At the Engineer's discretion, innovated wiring systems may be installed. VOLKSRUST WTW 's specification for Innovated Wiring Systems must be adhered to as well as SANS 10142-1: 2009, Section 6.3.5 to 6.5.4.

SS 13 OUTLET BOXES, DRAW BOXES AND COVER PLATES

SS 13.1 DESIGN

All outlet boxes, draw boxes and inspection boxes shall comply with the requirements of the relevant SANS Specifications and all the conduit accessories relating to the conduit system chosen must be of one manufacturer.
PVC boxes shall comply with SANS 950: 2007.

Cover plates for switches in plug outlets (blanks included), shall be of the rust proof type, not less than 1,2m thick and of a finish as specified. PVC type may be used with permission of the Engineer.

Where the temperature may exceed 60ºC, for instance where incandescent luminaries are mounted against an outlet box, ordinary PVC outlet boxes shall not be installed, but steel or heat resistant PVC outlet boxes shall be installed.

SS 13.2 VERIFICATION OF POSITIONS

The positions in which lighting fittings are mounted shall be verified on-site and fittings shall normally be mounted symmetrically in relation to ceiling patterns and building lines. Should the arrangement of the ceiling or architectural features be such that the layout of fittings as shown on the drawings cannot be adhered to, or should it be found that points would come in close proximity to beams, cover strips or other obstructions, then the matter shall be referred to the Engineer.

SS 13.3 INSTALLATION

Where draw boxes are required, they shall be located and installed in such a manner as to avoid spoiling the appearance of the building. Where several conduits run close to each other, common draw boxes shall be used which can accommodate all conduit and wiring.

Draw boxes shall be provided with neat cover plates. Ceiling mounted cover plates shall be installed before ceilings are painted by others. Cover plates over wall outlet boxes and draw boxes shall be metal or PVC with a finish as specified.

All unused switch and socket outlet boxes and draw boxes are to be fitted with blank cover plates. Unused light outlet boxes are to be fitted with round metal or PVC covers which shall fit flat on the finished ceiling.

Where plug or switch boxes have been installed with fixing lugs below the finished wall surface, only coiled steel wire or piping of suitable size shall be allowed for spacers.

SS 14 WALL SWITCHES

SS 14.1 DESIGN

RATING: All switches shall be 16A, 250V grade, single pole to SANS 60669-1: 2007 Switches for household and similar fixed-electrical installations Part 1: General Requirements. SANS 60669-21, SANS 60669-2-2, SANS 60669-2-3, SANS 60669-2-4 and shall bear the SABS mark.

SS 14.2 DOMESTIC TYPE WALL SWITCHES

Where conduit has been built into walls, switches shall be of the flush type.

The colour of the switch toggles and plates shall be ivory, Colour B77 of SANS 1091: 2004 National Colour Standards. Unless otherwise specified.

Where indicating lights are specified, these shall be incorporated as an integral part of the switch and shall be of the Neon or LED type.

SS 14.3 INDUSTRIAL TYPE SURFACE SWITCHES

These shall consist of the single switch, mounted in a pressed steel box, or maximum of three switches operating on the same circuit mounted in one common box. Rocker or toggle action must be vertical.

The box and cover must be heavy gauge approved metal, with all corners and sides rounded and shall be dust-proof. The box and cover shall be finished in baked enamel, mid grey, Colour G25 of SANS 1091:2004 or Electrical Orange B26. The cover shall fit neatly over the box and shall be fixed by means of two chromium-plated countersunk screws. The switch toggle or rocker must be shrouded where it protrudes through the cover. Electric Orange is preferred.

SS.14.4 WATERTIGHT SWITCHES

Watertight switches shall be 16amp and have an IP 66/68 rating and be SANS approved.

SS.14.5 INSTALLATION

Where conduit or cable is installed on the surface or where specified, lighting switches of the surface mounted, metal clad type shall be used.

Unless otherwise specified in the Project Specification or shown on drawings, all switches shall be mounted 1400mm above floor, i.e. from finished floor level to bottom of box.

Multiple switches shall be allowed only if the switches control the same circuit. Switches controlling separate circuits shall be built into separate outlet boxes.

The Electrical Contractor shall be responsible for the correct positioning of switch boxes.

SS 15 SWITCHED SOCKET OUTLETS

SS 15.1 DESIGN

Unless otherwise specified in the Project Specification or indicated on the drawings, switched sockets shall consist of a 16A, 250V, 3-pin (live, neutral and earth) and shall comply with SANS 164-0: 2007, SANS 164-1:2007, SANS 164-2:2006, SANS 164-3:2007 and SANS 164-4:2007 and shall bear the SABS mark. The switch and socket may be integrated or mounted together on a common cradle or plate and shall be metal clad.

Where indicating lights are specified these shall be incorporated as an integral part of the socket outlet and shall be of the Neon or LED type.

All socket outlets shall be provided with safety shutters.

SS 15.2 DOMESTIC TYPE SWITCH SOCKET OUTLETS

The switch and socket shall be rated for 250V, 16 ampere. The unit shall consist of a 3-pin socket outlet and switch, or two 3-pin socket outlets and two switches in 100mm x 100mm x 50mm outlet box, if so required and shall be in accordance with the SANS specifications as detailed above.

The colour of switch toggles and plates shall be Ivory, Colour B77 of SANS 1091, unless otherwise specified.

SS 15.3 INDUSTRIAL TYPE SURFACE MOUNTED SWITCH SOCKET OUTLETS

These shall consist of a combined switch and 16 ampere, 3-pin, socket outlet, mounted in a pressed steel box suitable for surface mounting.

The box and the cover must be heavy gauge pressed steel with all corners and sides rounded. The box and cover shall be finished in baked enamel, Mid-Grey, Colour G25 of SANS 1091 or Electric Orange. Electric Orange is preferred.

The covers must fit neatly over the box and is to be fitted by means of two chromium-plated countersunk screws. The switch toggle must be shrouded where it protrudes through the cover.

SS 15.4 3-PHASE SOCKET OUTLETS

3-Phase socket outlets shall be of the CEE-17, 380V, 6H pattern with 5 contact pins for 3-phases, neutral and earth. The outlets shall incorporate the switch which can only operate with the plug inserted. The socket outlets shall comply with SANS 1239:2004.

SS 15.5 WATERPROOF SWITCH SOCKET OUTLETS

Waterproof switch socket outlets shall be equipped with a spring-loaded, hinged, and gasketted cover, which renders the socket outlet watertight when the plug is removed, Or

Watertight switch socket outlets shall each be equipped with a screwed and gasketted cover, with a retaining chain, which renders the socket outlet watertight when the plug is removed. Plugs shall be available with threaded covers which suit the socket outlets so that the socket outlet and plug combination is watertight.

The watertight socket outlets and their combination with plugs shall be classified IP65 to IEC Publication 162.

SS 15.6 MOUNTING HEIGHT

Where no other mounting heights are indicated on drawings or specified in the Detail Specification, switched sockets shall be mounted at the following heights from finished floor level to bottom of box :-

Flush switched sockets generally	200mm
Factories, Workshops and Garages	1400mm
Domestic Kitchens and Tea Kitchens	1000mm
Commercial Kitchens	1400mm

SS 16 TRENCHING EXCAVATIONS

SS 16.1 GENERAL

The proposed routes of the cables will, if necessary, be indicated to Tenderers on-site.

SS 16.2 TRENCHING

The Contractor shall, before trenching commences, familiarise himself with the route and conditions on-site and shall be provided with such information as is known to the Engineer regarding site conditions and other plant along the route, to enable the Contractor to ensure that every effort is made to avoid unnecessary damage.

Where the relevant survey pegs/markers of the existing/proposed route are not apparent or easily located, the exact location of the trench shall be approved on-site.

Power-driven mechanical excavators may be used for trenching operations provided that they are not used in close proximity to other cables, water mains, or any other plant liable to be damaged by the use of such Power-driven mechanical excavators. Their use along sections of the route must in each case be approved by the Engineer.

Trial holes shall be made as and when requested by the Engineer, or by the Contractor where reasonable doubt exists regarding the proximity of other plant. The request for trial holes by the Engineer does not absolve the Contractor for liability for damage to plant during excavation.

Trenches shall be kept as straight as possible and each trench shall be excavated to approved formations and dimensions.

Where required in terms of OHASA Act (Occupational Health and Safety Amendment Act i.e. Act Nº 181 of 1993) or where otherwise considered necessary, the sides of trenches shall be timbered to avoid subsidence or collapse.

Trenches shall be suitable for laying cables as follows.

- MV 850mm
- LV 550mm

The bottom of each trench shall be of smooth contour.

The trench excavations shall be so executed that all railways, walls, roads, sewers, pipes, cables, structures and such like, shall be reasonably secure against risk of other subsidence or injury to personnel and shall be carried out to the satisfaction of the relevant authorities.

Where trenches pass from one section to another, where a change of level is necessary, the bottom of the trench shall rise or fall gradually to the approval of the Engineer.

If, during the course of excavating, obstructions are encountered which necessitate alterations to the trench, or the adoption of a special form of trench, such trenching must receive the prior approval of the Engineer.

The material excavated from each trench shall be placed adjacent to the trench in such a manner as to prevent nuisance or damage to adjacent hedges, trees, ditches, drains, gateways and other property, and shall be stacked so as to avoid undue interference with traffic. Where, owing to certain considerations, this is not permissible, the excavated materials shall, with the approval of the Engineer, be removed from the site and returned for re-filling the trench on completion of the cable laying. Surplus material shall be disposed of by and at the cost of the Contractor.

In order to facilitate the re-use of excavated material for road foundations and surfacing, the excavated material shall be separated into hard road material metal, soil and other materials.

Unless otherwise agreed, provision shall be made by the Contractor (at his cost) during excavation and until interim restoration has been completed, for reasonable access of persons and vehicles to property.

The Engineer shall be notified immediately by the Contractor of any exceptional conditions which are encountered during excavations.

When the excavations for trenches have been accurately executed, notice shall be given by the Contractor to the Engineer to enable an inspection of the trench to be carried out without undue delay.

Joint bays shall be constructed to an approved minimum size to enable Jointers to carry out their work efficiently and expeditiously.

SS 17 CABLE LAYING

SS 17.1 GENERAL

Tenderers must satisfy the Engineer that they are competent to lay the cables as specified in the Data Schedules and must have had previous experience of cable laying and jointing of the size and type of cable specified.

The Contractor shall, before installing the cables, familiarise himself with the conditions on-site and shall be provided with such information as is known to the Engineer through the route, to enable the Contractor to ensure that the conditions on-site are such as to permit maximum current carrying capacity of the cables in service.

Where site conditions are likely to reduce the maximum current carrying capacity of the cables, the Contractor shall, before installing the cables, notify the Engineer and shall not proceed with that section of the works until advised by the Engineer on the course to be adopted.

The Contractor shall take all reasonable steps to ascertain where the cables are liable to be subjected to chemical or other damage or electrolytic action and shall submit this recommendation for approval, for any precautionary measures to be taken in such instances.

Except where ducts, tunnels or pipes are provided and unless instructed to the contrary by the Engineer, the Contractor shall lay the cables direct into the ground.

Cables shall be tested per drum length on delivery to site prior to installation. Results shall be documented. All full Cable Drums shall be delivered with a factory test certificate.
Cable drums shall be rolled in the proper direction to prevent loosening of the cable. Cable shall be drawn into position using a sufficiency of rollers and cornering apparatus to avoid damaging the cable by excessive bending or dragging. Cables shall be stored in dry areas.
Where cables come out of the ground, a trench, or pass through a floor, they shall be protected by a metal pipe or suitable mechanical protection, extending from 50mm to 350mm above floor or ground level.
The Contractor shall observe the manufacturer's recommendations for minimum bending radius but shall never use less than the following radii:

- Unarmoured cables: 5 times the overall outside diameter of the cable.
- Armoured cables: 10 times the overall outside diameter of the cable.

All cables shall be supported on trays/racks or in conduit. Under no circumstances may cables be attached directly to walls or structures.

Instrument signal and electric power may not be run bunched in the same rack/tray. A minimum distance of 300mm shall separate such racks/trays. If instrument cables are required to run on the same cable rack as electrical cables, then there must be at least a 300mm gap between the electric and instrument cables.
To avoid interference arising from electrical power supply voltage dips or spikes, instrument signals and electrical power cables shall only cross at right angles to each other.
On no account will instrument signal and electrical power wiring be transmitted in the same multi-core cable.
Instrumentation cables may only be installed a maximum of 2 deep on racks if approved by the Engineer.

Coaxial cable for data highways shall be run individually in 20mm conduit as per 8.16. Conduits used for this purpose shall be installed a minimum of 300mm from electrical cables. Dual redundant data highways shall follow two separate routes between device locations.

CABLE AND WIRE TERMINATION AND CONNECTIONS

All instruments, control panels, junction boxes, etc, shall be wired in accordance with the relevant project drawings.
Each conductor shall be fitted with an insulated double crimp lug of the correct size. Pin lugs shall be used for pressure type terminals. Ring or spade lugs shall be used for post type terminals.
A proprietary type of wire stripper must always be used. The stripping tool must be checked regularly and is subject to inspection by the Engineer. The termination of stranded conductors where one or more strands have been damaged or broken is expressly prohibited.
The crimping tool used for attaching termination lugs shall be of the ratchet type which requires a specific amount of pressure prior to release, recommended by the manufacture of the crimp lugs. All wires are to be terminated. Spare terminals shall be provided for unused pairs or cores. All spare terminals of field multi-cores shall be connected together and bonded to instrument earth. All PLC I/O modules shall be terminated and connected to the relevant marshalling terminals. Terminated wires shall be arranged neatly and loomed where necessary using cable ties. Spiral lacing shall be used for flexible or semi flexible looms.
Each wire shall be numbered with the respective terminal number by means of interlocking slip-on plastic ferrules of the correct size. Split or clips on ferrules are not acceptable. The ferrules shall be a tight or interference fit on the wire.
Cable / wire / terminal numbers shall be according to the design drawings as supplied. Cable colours:

- Normal signal cables : black outer sheath
- Shutdown cables - : red outer sheath
- Intrinsically safe cables - : blue outer sheath
- Conductors to be 1,0mm flexible stranded twisted copper wire for normal instrument signals and 1,5mm to solenoid valves.

- Nylon washers shall be put on all cable glands and cable gland adapters on weatherproof boxes, and boxes used in potentially explosive areas.
- Cables must not be trapped in lagging.
- Cables to field instruments must have at least 30cm slack which should be neatly looped before the instrument.
- Load cell cable joints are to be soldered as to manufacturer's instructions.
- Cables incorporating shields or screens shall have the shield or screen isolated for electrical earth throughout its length and it shall be earthed only at the point indicated on the drawing.
- Analog signals from the field shall pass through lightening and surge arrestors, such as "minithor" or similar isolators. Refer to section Section 3, FI 11.

JUNCTION BOXES

Junction boxes must be numbered on the door or lid with an engraved plastic type label having numbers at least 5mm in height.
Terminal rails and individual terminals shall be numbered.
Terminal rails shall be installed complete with blanking plates and end stops.
Klippon or similar terminals shall be used. Knife edge switch terminals shall be used at the power supply end terminal rail, to permit easy electrical isolation.
Terminal rails and individual terminals shall be numbered.
Trunking shall be grey slotted PVC, with 50% spare capacity.
An earth plate or rings for the cable glands shall be put in the bottom of each junction box, where required.
Cables must enter from the bottom of the junction box.
25% Spare holes for cable glands shall be provided, plugged with the approved type of plugs. Boxes with pneumatics inside shall have a vent at the bottom of the box and shall be fitted with a port protector/silencer.
The box shall be classified IP65 or better.
The box shall be mounted securely.
Boxes shall have a separate or integrally mounted canopy which protrudes over the top door seal.

EARTHING.

The installation shall be properly and effectively earthed, to comply with SABS 10142-1:2009. The installation shall be bonded to the main earth by means of separate earth conductors.

Where stranded copper conductors are to be connected to earth bars, these conductors shall be properly soldered into suitable tinned lugs. The lugs shall be securely bolted to tinned copper bars.
The complete earth resistance of each earthing system, when completed, shall be measured by the Contractor and submitted to the Engineer.

The main earth connection will be obtained from the earth bar, situated in the substation from which the electrical supply is taken.

Where specified, lightning conductors, to SANS10313:2008 as amended, shall be installed.

SS 17.2 CABLE LAID IN THE GROUND

Prior to laying the cable, the trench shall be inspected thoroughly by the Engineer or his appointed representative to ensure that it is free from all objects likely to damage the cable either during or after cable laying operations.

The method of laying the cables shall be in accordance with the cable manufacturer's recommendations and SANS 10198-8:2002 Specification.

SS 17.3 INSTALLATION DEPTHS

Unless otherwise specified cables shall be installed at the following minimum depths below final ground level:

Up to 1kV	:	550mm
Up to 11kV	:	850mm

All cable depth measurements shall be made to the top of the cable when laid directly in ground or to the top of the duct or sleeve where these are provided.

The abovementioned depths shall apply to the top layer where cables are installed in layers.

The Contractor may only deviate from the above depths provided prior authority in writing has been obtained from the Engineer. In this event the cables shall be protected with a suitable concrete covering.

SS 17.4 BEDDING

The bottom of the trench shall be filled across the full width with a 75mm layer of suitable soil sifted through a 6mm mesh and levelled off.

Only sandy clay or loam soil with a satisfactory thermal resisitivity reading (not exceeding 1, 5ºC m/W) may be used for this purpose. Sea or river sand, ash, chalk, peat, clinkers or clayey soil shall not be used. The use of crusher sand is acceptable.

Where no suitable soil is available on-site, the Contractor shall import fill from elsewhere and make all the necessary arrangements to do so. The cost of importing soil for bedding purposes shall be included in the contract price.

After cable laying a further layer of bedding shall be provided to extend to 75mm above the cables.

The bedding under joints shall be fully consolidated to prevent subsequent settling.

SS 17.5 BACKFILLING

The Contractor shall not commence with the backfilling of trenches without prior notification to the Engineer so that the cable installation may be inspected. Should the Contractor fail to give a reasonable time notification, the trenches shall be re-opened at the Contractor's cost.

Medium voltage cables (above 1kV to 11kV) shall be protected by means of the following:-

- Concrete tiles or orange "ESKOM" type plastic tiles shall be installed immediately above the bedding in a continuous run. Only unbroken concrete tiles shall be used.

- A plastic marking tape shall be installed 400mm above the protective tiles or slabs. The tape shall be yellow, with red skull and crossbones and the words "ELECTRIC CABLE – ELEKTRIESE KABEL" printed on not more than 1m spacing.

Low voltage cables (up to 1kV) shall be protected by means of the following:-

- A plastic marking tape shall be installed 300mm above the cable. The tape shall be red and white and the words "ELECTRIC CABLE – ELEKTRIESE KABEL" shall be printed at 500mm distances on it.

Backfilling shall be done with soil suitable to ensure settling without voids. No large stones or rocks shall be present in the backfill material. All soil used for backfilling shall pass through an 80mm mesh to ensure that the maximum allowable diameter of stones present in the backfill materials is 75mm.

The Contractor shall allow in his tender for the importation of suitable backfill materials if required.

The backfill shall be compacted by hand in layers of 150mm and sufficient allowance shall be made for final settlement. The Contractor shall maintain the refilled trench at his expense for the duration of the contract. Surplus material shall be removed from site and suitably disposed of.

On completion, the surface shall be made good to match the surrounding area. In the case of roadways or paved areas, the excavations shall be consolidated to the original stability and the surface finish reinstated. On completion of the cable installation concrete cable markers shall be placed as per the Engineers instructions. They shall follow the cable route and shall show any change of direction. The reference plates shall be Brass or Stainless Steel with the detail etched into the plate.

SS 18 CABLE JOINTING

SS 18.1 GENERAL

Tenderers must satisfy the Engineer that they are competent to joint and terminate the cables specified in the Data Schedules, copies of their proficiency certificates are to be issued to the engineer.

Joints in cable runs will not be allowed unless specified in the Project Specification or authorised by the Engineer.

The Contractor shall notify the Engineer in good time of the day on which jointing is to be carried out in order that an inspection may be arranged if so required. Any cable joint not inspected by the Engineer because of insufficient notice being given, shall be opened for inspection and re-done at the discretion of the Engineer and at cost to the Contractor.

If any jointing and terminations on this contract are planned to be done on Saturdays or Sundays, the Engineer must be given reasonable notice beforehand in order that an inspection can be arranged. Failing the receipt of due notice, any joints made during the weekend and closed without official inspection, will be required to be opened for inspection.

During outdoor jointing operations the joint bays shall be adequately covered by tents of waterproof material suitably supported. When necessary a trench shall be excavated around the bay to prevent the ingress of moisture. The sides of the hole shall be draped with small tarpaulin or plastic sheeting to prevent loose earth from falling in during jointing operations.

The cores of the cables are to be jointed through number to number or colour to colour. The core phase rotation must be in accordance with the standard phase sequence and maintained throughout the cable route.

Joints shall be fully water and airtight and shall be free of voids and air pockets.

The joint shall not impair the anti-electrolysis characteristics of the cable.

The electrical continuity of all the conductors, screens and armouring shall not be impaired by the joints and the earth continuity shall be accomplished within the joints, i.e. no external earth continuity conductor that will be subject to corrosion, is acceptable. The joints shall be completely covered by a watertight sheath to prevent corrosion.

In the case of joints in cables with an outer PVC anti-electrolysis sheath, the joints shall be subject to the same electrical insulation test as the outer sheath of the cable.

Unless otherwise specified low voltage cable joints shall be of the epoxy resin type.

Unless otherwise specified medium voltage cable joints shall be of the heat shrinkable type.

SS 18.2 CABLE JOINTS WITH HEAT SHRINKABLE MATERIALS

The complete joint kit shall be packed in a container that is marked for the type of cable insulation and construction as well as the voltage range for which the materials are suitable.

Jointing of cables shall be in accordance with SANS 10198-9:1988 and the relevant cable manufacturer's recommendations.

An illustrated set of instructions for the installation of the materials shall accompany every kit.

The joints shall make minimal, if any, use of insulating or stress relieving tapes. The use of electrical stress control and insulating tubing that is heat-shrunk onto the various wiring joints will be preferred above other methods.

The materials shall comply with VDE 0278 and the supplier shall be called upon to confirm this aspect before acceptance of the materials or installation.

The heat-shrinkable and other materials used for joints shall be of a high quality and shall retain their electrical and mechanical properties without deterioration.

Approved heat-shrinkable joint kits shall be used for all joints above 1kV.

SS 19 LOW VOLTAGE DISTRIBUTION BOARDS

SS 19.1 SUPPLY

The Contractor shall allow for the supply, installation, testing and commissioning of all LV Distribution Boards.

All switchboards and distribution boards shall be made by approved Specialist Manufacturers, who shall also install and fit the switchgear and equipment and carry out all internal wiring.

The Contractor shall install any apparatus, accessories, equipment and systems that may be required by the Supply Authority as part of his electrical contract.

The Electrical Contractor shall note the dimensions of the room or openings, in which the panels will be mounted and also the dimensions of the access routes and doors. Panels shall be so constructed that they may be taken through the doors, after doors have been placed in position.

Four copies of working drawings of wiring diagrams, schematic diagrams, general arrangements and construction details of all distribution boards shall be submitted to the Engineer for approval prior to manufacture. These drawings shall indicate all electrical and mechanical information as well as make and type of equipment, dimensions, ratings and other relevant technical information.

The Contractor shall furnish the Board Manufacturer at the time of tendering and at all other times, with all the necessary information as regards access and the requirements of this standard specification.

The distribution board shall be inspected before delivery to site by the Engineer or his representative and a routine test certificate issued as per those detailed in SANS 1973-3:2008, Low-voltage switchgear and control gear ASSEMBLIES with a short circuit rating up to and including 10kA and SANS 1973-1:2007 for Factory built distribution boards with a short circuit rating above 10kA.or similar.

SS 19.2 DESIGN

All distribution boards shall be in accordance with SANS 1973-3 and SANS1973-1.

The following types of board may be required in accordance with this specification:-

- Floor standing boards
- Flush mounted boards
- Semi-flush or partly-recessed boards
- Surface mounted boards
- Flat boards
- Weatherproof boards
- Distribution boards incorporated in other boards.

SS 19.3 GENERAL

Boards and all components shall be constructed to be able to withstand fault currents in accordance with any specified or implied values.

All metal work and welds shall be ground smooth and rendered free from blemishes. Self-threading screws may not be used in the construction of boards, nor for fixing of any panels.

All front panels shall be hinged and fitted with flush, square key, operating catches at the other side of the panel.

Space for 30% future expansion on MCCB's and CFS units and 50% future expansion on contactors, time switches and isolators, shall be allowed on all boards unless otherwise specified.

SS 19.4 DOORS

Where doors are required, they shall be manufactured of the same gauge material as the remainder of the panels.

Doors shall be suitably braced to ensure stiffness and shall have a smooth, flat finish.

Door hinges shall be heavy duty and shall be constructed to permit easy removal of doors.

All doors shall be fitted with locks unless otherwise specified. Locks shall be Union, Yale or Solid and shall have master key facilities for the entire installation and separate key facilities for each board. Two individual keys shall be provided with each board and four master keys shall be provided for the entire installation.

All the panel doors shall be mechanically and electrically interlocked to ensure that they cannot be opened unless the starter is off and the interior of the panel is safe.

SS 19.5 REMOVABLE PANELS

Panels of sheet steel, finished in the colour required, shall be suitably stiffened with machine punched slots to allow for flush-mounting of equipment.

Blank-offs to consist of dummy MCCB's in vacant MCCB positions and to be firmly secured. Easily removable metal covers to be fixed in all other positions.
All removable front panels shall be secured by means of quick-release fasteners, similar and equivalent to a suitable size DZUS type.

Where panels on any boards are accidentally interchangeable, the fixing, e.g. locating pins, shall be arranged or staggered in such a way as to make it impossible accidentally to interchange such panels.

Instruments and other equipment which is designed for panel-mounting only shall be mounted on a hinged front panel and the wiring thereto laced together and having sufficient slack to allow full opening of hinged panel. Slack wiring shall be neatly clipped to back of panel.

The chassis shall be of rigid channel section, rust-proof steel with clip-on trays for the MCCB's and the main isolator. The main isolator is to be mounted at the bottom of the panel.

Unless otherwise specified, motor starters shall have push buttons protruding through the front panel, unattached thereto. However, push buttons, having mechanical push rod operation, may be attached to the front panel, provided the front panel can be freely removed and re-installed.

Equipment shall be chassis-mounted, flush behind a removable front panel. This front panel shall have returned edges to give it greater rigidity and shall be secured to the frame of the board at a minimum number of fixing points by means, other than self-tapping screws. Approved handles or knobs shall be provided on the panel to facilitate removal.

The chassis shall be arranged for adjustment in depth and for plumb alignment. No equipment shall be mounted on the front panel, except as provided for elsewhere. The front panels shall be fitted with plastic windows, in front of the kWh meters and other instruments which are arranged for chassis mounting. Time switches shall have hinged flaps to allow ample access for adjustment of time switch and for operation of by-pass switches without the front panel having to be removed.

Where re-settable instruments or meters are specified, eg maximum demand indicating, suitable cutouts shall be provided in the front panel to permit resetting without opening or removing the panel.

SS 19.6 VERMIN-PROOF

All distribution boards shall be completely vermin-proof.

SS 19.7 VENTILATION

Boards fitted with heat generating equipment shall be arranged to prevent heat building up to a temperature which could damage any of the equipment or cable on the board. Additional forced ventilation shall be installed onto the panels if situated in a chlorine/corrosive gas atmosphere.

SS 19.8 ACCESS

Sufficient removable panels shall be provided to afford access to all equipment for maintenance purposes.

Main LV boards shall be arranged for back access as well as front access and shall be installed with a minimum of 1000mm clear access space behind. The back panel shall be of similar construction to the front panels.

SS 19.9 CLEARANCES

Sufficient space shall be left inside panels for incoming and outgoing cable connections and for interconnections and control wiring, taking into account the sizes and quantities of cables and wires involved.

Equipment on distribution boards may be installed abutting. Undue clamping of equipment and wiring shall, however, not be permitted and the following clearances must be maintained:-

- Clearance of not less than 75mm between sides, top and bottom of architrave and any equipment mounted on the chassis.

- Clearance of not less than 75mm between rows of equipment (measured between terminals).

SS 19.10 BUSBARS

All boards shall be equipped with copper Bus bars to SANS 1195 and SANS 10142-1:2009 section 6.6.2

The main Bus bars and connections shall be of hard drawn high conductivity copper for low voltage equipment, having a constant cross-section throughout. Unless specified Aluminium Bus bars may not be used.

Copper or brass neutral bars for sub-circuit distribution shall be provided of sufficient size to accommodate a neutral conductor for each way (including spares) specified and conductors shall be connected to bars by means of double grub screws.

Bus bars are to be installed in all distribution boards and may be installed either horizontally or vertically as required their current rating should not be less than that specified for the main switch or isolator.

Bus bars shall be identified as to there phase, neutral and earth designation by suitable coloured tape, heat shrink or other recognised insulating material as per SANS 10142-1:2009 section 6.6.2.4.and shall be fully insulated. They shall be able to withstand the specified voltage and impulse voltage tests and shall comply with BS 159:1992 (Specification for High Voltage Bus bars and connections).

Bolts for supporting or jointing Bus bars shall be of high tensile phosphor bronze or high tensile plated steel, not less than size M8, provided with wide flat plated washers at each end and spring back washers under the nuts. Connections shall be kept as short and straight as possible and where dissimilar metals are connected, means shall be provided to prevent electrochemical reactions and corrosion.

Spacing of Bus bars shall be calculated in accordance with SANS 1195, but shall not be less than 50mm.

Bus bar supports shall comply with SANS 1195and shall be mounted on substantial porcelain or other approved insulators. The insulators shall be non-hygroscopic, non tracking and unaffected by sweating. Their conductors shall be so spaced, that with all clamps, lugs and lead-offs in position, the spacing between any conductor and earth shall not be less than 40mm. In multiple parallel bus bar arrangements, the space between bars of the same phase shall be equal to the thickness of each bar.

Current rating of boards shall be not less than that specified for the main switch or isolator. Current ratings for Bus bars shall be in accordance with the manufacturer’s recommended rating multiplied by a de-rating factor of 0,75. Bus bar cross-sections may not be reduced without the approval of the Engineer.

Connections to the Bus bars must be effected by means of the correct clamps or lugs, with soldered connections or with connections crimped with the correct equipment.

All Bus bars and any other un-insulated connecting links shall be sleeved with heat-shrunk material by the Board Manufacturer, except at joints and take-offs. The latter including cable lugs, shall be taped after installation of boards and connecting of cables thereto. Colour coding of Bus bars shall be strictly observed.

Where Bus bars are mounted horizontally, the longer dimensions shall be in the vertical plane. The Bus bars shall be designed to withstand the mechanical and thermal stresses of any possible short circuit that could occur at that point in the system.

Ratings for Bus bars shall be in accordance with Tables A1 and A2 of SANS 1195 (as amended), except that current ratings of bus bars shall not exceed 1,5 amps per square mm for copper and 1,0 amps per square mm for aluminium. Neutral Bus bar cross-sections may not be reduced without the approval of the Engineer.

The maximum current density of Bus bars and connections shall be such that in no part of the switchgear equipment including circuit breakers, isolating equipment, Bus bars, current transformers, cable boxes and connections, shall exceed the temperature rise values stated in SANS 60439-1, BS 159:1992, BS 5486: Part 1:1977 as amended BS 159 and BS 5424 and other relevant British Standards. The temperature rise of operating coils shall not exceed the values specified in BS 5424.

A copper earth bar of not less than 25 x 6mm² for medium voltage switchgear, or 25 x 3mm² for low voltage switchgear or nearest equivalent metric size, shall be provided running the full length of the board. This bar may run externally at the back of the board. If it is broken into short sections within each cubicle, the sections shall be joined together in a substantial way. The steel work of a switchboard and in particular gland plates must be solidly and effectively bonded to the main earth bar. An earthing lug shall be provided. Where withdraw able chassis's are used the method of bonding these shall be to approval. If cable is used for bonding, it shall be not less than 2,5mm². Metal instrument cases shall be bonded to earth. Earth bars shall have sufficient ways for all the earth conductors and 30% spare space shall be provided.

Where small leads are connected directly onto the bus bars, such as voltmeters, fuses, etc., they shall be provided with a 20-ampere fuse mounted at the bus bar and a 2 ampere fuse at the equipment.

SS 19.11 PAINTING

The interior of all switchboard cases shall be painted with two coats of best quality white "arc-free" paint and the outside shall be painted with two coats of paint before delivery to site. Compartments containing telemetry equipment shall have a central brown stripe of ⅓ the cubicle area.

SS 19.11.1 Surface Preparation

All metal parts are to be de-greased and rinsed, pickled, rinsed, phosphated, neutralised and then to be thoroughly dried. This process shall be followed up within 48 hours by application of one layer of high quality zinc-chromate primer of minimum thickness 0,04mm.

SS 19.11.2 Baked Enamel Finish

Two coats of a good quality Alkyd-based baked enamel of the required colour are to be applied. The minimum film thickness of the paint after baking is to be not less than 0,06mm. Care is to be taken that all edges are properly covered.

Paint used on boards is to have an impact resistance of 5,65J on cold rolled mild steel plate and scratch-resistance to withstand 2kg.

In coastal areas the dry film thickness shall be increased to at least 0,1mm.

All distribution board finishes shall be made good to the satisfaction of the Engineer after final handover.

SS 19.11.3 Powder Coated Finish

Immediately after cleaning the metal part shall be pre-heated and then covered by a micro-structured paint powder applied electro statically.

The paint shall be baked on and shall harden within 10 minutes at a temperature of 190ºC.

The minimum paint thickness after baking shall be 0,05mm. The dry film thickness shall be increased for coastal areas. The paint cover shall have an impact resistance of 5,65J on cold rolled steel plate and a scratch resistance of 2kg.

SS 19.11.4 Colours

Unless otherwise specified, the colours of finishes shall be as follows:-

- Boards in offices, public spaces, corridors, laboratories shall be white or light ivory.

- Main boards, boards in industrial areas, plant rooms, machine rooms, cupboards and any others positions not specified shall be finished in standard electrical orange colour.

SS 19.12 WIRING

All wiring shall be carried out by the Board Manufacturer. The wiring of control and instrument circuits shall be carried out in heavy duty PVC insulated 2,5mm² stranded annealed copper wire or 1,0mm² multi-strand (29/0, 21) flexible wire. These circuits shall be marked with numbered ferrules to facilitate circuit identification.

All internal wiring to the board shall be carried out in PVC insulated conductors of adequate size. The insulation colour shall correspond to the phase colour code. Where standard conductors are used, these shall be bound together by means of “Helvin” strap or equivalent, in groups not exceeding 10 conductors and shall be arranged in neat, vertical or horizontal rows. All jumpers between Bus bars and circuit breakers rated over 200 ampere, shall be solid copper, insulated by means of at least 2 half lapped layers of PVC tape. All wiring shall be ferruled or provided with lug at terminations.

No joints will be allowed in internal wiring and all connections to Bus bars or earth bars shall be made with tinned copper cable lugs, soldered or crimped to the ends of the conductors and bolted to Bus bars by means of cadmium-plated high tensile steel bolts and nuts provided with spring washers.

All wiring is to be kept free and away from any exposed terminals or other un-insulated current carrying parts.

Only wires of the same potential shall be grouped or bunched together.

Looping of wiring connections between switchgear phase or neutral terminals is not permitted. Bus bars on same phase CB is permitted. All connections and jumpers shall be run individually from the appropriate bus bars or neutral bars or neutral terminal box.

PVC trunking with slotted sides shall be used for control wiring.

Wires shall be clearly marked at all termination points, in accordance with the numbering of the Distribution Board Manufacturer’s Wiring Diagram, by means of “Critchly” or similar and equivalent markers.

When the board main switch is switched off, no live incoming or other wiring shall be accessible. The incoming terminals must be screened or inaccessible. Where connections are taken from the incoming side of the main switch, they shall be screened by a screen marked “Isolate Feeder before Removing Screen”. If any circuits are energised from other sources, clear warning notices to that effect shall be fitted and such terminals shall be clearly marked.

All wiring shall be neatly grouped and laced. Wiring is not to be run at random, but shall follow board construction features as far as possible.

The wiring to feeder terminals e.g. MCB's, shall be long enough to allow for current measurement by means of a clamp-on type ammeter.

A common 15-ampere terminal strip shall be provided for the connection of external control wiring. The terminal strip shall be of robust construction, firmly secured to the board and all terminals shall be clearly marked in accordance with the Distribution Board Manufacturer's working drawings and wiring diagrams. The terminals shall be of the shoe-clamping type.

All main and sub-main switchboards, unless otherwise specified, shall be equipped with a test terminal block, of an approved manufacturer. The test block shall be mounted directly below the ammeters and voltmeters on the front panel of the board and shall be wired in series with these instruments.

SS 19.13 LABELLING

All safety warning notices shall be in English and Zulu or as Specified by the Engineer.

Each distribution board shall be labelled in accordance with SANS 10142-1:2006 section 4.5 and the relevant sections of Table 4.3.

All circuit breakers on distribution boards shall be properly labelled, indicating number of circuit controlled and location of such circuit.

A legend card, covered by a removable glass or 2mm transparent acrylic plastic ("Perspex") or equivalent panel, shall be installed on the inside of the door of the distribution boards or cubicles and circuits shall be designated on this card. All other equipment to be individually labelled indicating function.

Black letters on white background shall be used for all normal letters and red letters on white or yellow background for danger notices. Labels shall be of sandwich-type, or other approved plastic board, fixed level to the frame panel and neatly by means of blunt-ended screws. Lettering shall be not less than 5mm in height and labels shall be mounted centrally below items of switchgear and generally in approved positions. Consideration will be given to use alternative type of labels which must be approved by the engineer.

The main isolating switch or switches shall be clearly labelled in accordance with the regulations.

Size and origin of supply cables and Bus bars shall be clearly labelled on all boards, e.g. “Fed from Main Board with 25mm – 4-core copper cable”.

All equipment situated inside the board, eg Contractors, relays, fuses, timers and time switches shall be clearly marked, indicating function, circuit controlled and fuse rating.

All items of equipment, i.e. switches, plugs, lighting, isolators etc shall be labelled as to where fed from, i.e. LSI-DB6-MCB2-B Phase.

SS 19.14 STANDBY SECTION

The section of a distribution board accommodating circuits on a standby supply shall be mechanically and electrically separated from the normal section. And shall be in accordance with SANS 10142-1: 2009 annex S Figures S.1, S.2, S.3 and S.4 as required.

All panels associated with the standby sections shall be painted signal-red. Colour Nº 537 of BS7645:1993 and IEC 60757:1983

SS 19.15 EARTHING

Earthing shall comply with the respective clauses of SANS 10142-1:2006. SANS 1973-3: 2008 and SANS 1973-1: 2007.

Copper earth bars shall be provided in all boards of cross-sectional area equal to that of the phase Bus bar up to a maximum of 160mm². Earth bars must be efficiently bonded to the metal framework of the board and shall be of sufficient size to accommodate a separate earth wire for each circuit requiring one.

SS 19.16 WORKING DRAWINGS FOR APPROVAL

Four copies of working drawings of wiring diagrams, schematic diagrams, general arrangements and construction details of all distribution boards shall be submitted to the Engineer for approval prior to manufacture. These drawings shall indicate all electrical and mechanical information as well as make and type of equipment, dimensions, ratings and other relevant technical information.

The Contractor shall check all details and sizes in respect of location and accessibility and shall ensure compliance with the specifications. Comments made by the Engineer on drawings and layouts shall not relieve the Contractor from any obligation in terms of the specification.

SS 19.17 INSPECTION

All distribution boards, upon completion, shall be inspected by the Engineer at the manufacturer's premises prior to them being delivered to site. Seven (7) days notice must be given to the Engineer before the date of such inspection is required. All test facilities and necessary equipment shall be supplied by the manufacturer. No distribution boards will be ACCEPTED ON-SITE without approval in writing by the Engineer. Any costs involved due to failure of this requirement will be the Contractor's liability.

The board must be supplied with a certificate as required by SANS 1973-3: 2008 and SANS 1973-1: 2007 as required or similar.

SS 19.18 TYPES OF BOARD

SS 19.18.1 FLOOR MOUNTED DISTRIBUTION BOARDS

Floor-standing boards shall be of the free-standing, pedestal type, with or without doors as required and shall be made up in sections which shall be assembled on-site. The boards shall be so designed as to enable the board to be extended without undue difficulty.

The distribution/switchboards shall be constructed of 2mm sheet steel, suitably stiffened and reinforced by angle-iron framework and shall be complete with all equipment, internal wiring and labelling.

A suitable gland plate for mounting cables shall be provided for termination of cables. Cables and Bus bars can enter the leave boards from both above and below, as required.

Gland plates shall be bolted down in sections not wider than 600mm. Any gland plate shall be able to be removed without interfering with the adjoining gland plates.

Gland plates shall be a minimum of 375mm from cable terminals.

SS 19.19 FLUSH MOUNTED BOARDS

These shall be of the adjustable architrave type to SANS 1973-1, 3 or 8 (1765 and SANS 1473-1). Comprising a wall mounted bonding tray of 1,6mm (min) galvanised sheet steel with edges returned for additional rigidity and over which is fitted a 1,6mm architrave frame formed to provide a rebate for

front panels and doors and suitable for the fitting of doors at any time. The architrave shall overlap the wall tray be at least 25mm on all sides to cover rough plaster edges around the bonding tray and shall be so fixed to the tray as to allow for adjustment in depth and plumb alignment. Trays which take up the full depth of walls shall be fitted with expanded metal sheeting welded to backs of trays, having an overlapping border 75mm all round, to provide a bond for plaster.

SS 19.20 WEATHERPROOF BOARDS

Where these are specified they shall always be of the surface mounted type, but installed either flush r on surface as specified in the Project Specification. Lockable doors shall in all cases be provided. In addition weatherproof boards shall be so constructed as to prevent any ingress of water and shall be made hose proof. A sloping canopy shall be fitted along the top of the board to divert any water falling on the board.

SS 19.21 INSTALLATION

All distribution boards shall be installed at a convenient height, with the top edge of the tray not exceeding 2300mm above finished floor level. The maximum height of any switchgear handle, meter or instrument face, shall be limited to 2000mm.
The Electrical Contractor shall level, fix and grout all distribution boards to the satisfaction of the Engineer.

The Electrical Contractor shall note sizes and positions of cable trenches and vertical shafts and shall include in his tender all supporting steel work to straddle trenches and vertical shafts to support distribution boards securely.

The Electrical Contractor will be required to balance the load as equally as possible across multiphase supplies. Balancing of loads across the three phases must be finally approved by the Engineer after commissioning.

SS 20 EQUIPMENT

SS 20.1 GENERAL

These specifications refer to equipment installed mainly in distribution boards, but may be installed elsewhere.

Surge protection devices shall conform to SANS 61643-1 and shall be as specified in the section on surge arrestors.

All main distribution boards and boards situated on remote buildings shall be provided with lightning arrestors or surge diverters of approved manufacture and bearing the SABS mark, one for each phase of the incoming supply and neutral. The lightning arrestors shall be mounted inside the main board case in an approved manner. The supply side connections shall be made to the main phase Bus bars and earth side connections by means of a copper strap. The SPD's shall be installed as per SANS 10142-1: 2009, Section 6.7.6.and to conform to the respective Installation methods in Annexure L. Figures L.1 and L.2.

All surge protection devices installed on distribution boards, Panels etc with a main switch circuit breaker above 125 amps shall be suitably fused in accordance with the manufacturer's recommendations.
A Label shall be installed stating "DISCONNECT THE SURGE PROTECTION DEVICES BEFORE INSULATION TESTING" and shall be Red letters on a white background.

SS 20.2 AIR CIRCUIT BREAKERS

The following specifications apply to air circuit breakers. Air Break Switches

SANS 60947-1: 2005, SANS 60947- 2: 2007 and SANS 60947-3:2006
SANS 60439-1, 2, 3, 4, and 5 as required for the particular application.

SANS 61084-1	Cable Wiring Channel
SANS 60050-441:1984	Fuses and Holders
SANS 60269-1:2007	Fuses and Holders
SANS 60269-2:2007	Fuses and Holders
SANS 60269-3:2007	Fuses and Holders

The air circuit breakers shall be of the 3-pole withdrawal type, suitable for the service voltage and fault capacity of the system.

The breakers shall be fitted with both an adjustable thermal-type overload protective device and an adjustable magnetic-type short-circuit protective device. All devices shall be direct acting.

The circuit breakers shall be arranged for trip-free manual closing and manual and electrical tripping.

Interlocking shall be provided to ensure that the breaker is fully isolated before access to any live terminals can be obtained. The breakers shall have the facility of pad locking in the “off” position.

The breakers shall be horizontally mounted and withdraw able, allowing full maintenance and tests without the breaker having to be removed from the withdrawal mechanism.

Interlocks shall be incorporated to allow the breaker to be operated in a withdrawn maintenance/test position. Also to prevent the breaker from being closed, unless fully in the engaged or test position, and from being moved when the mechanism is closed.

Special equipment should not be required to remove the circuit breaker from its withdrawal mechanism for transporting. If special equipment is required, the cost must be included in the circuit breaker price and be provided with the distribution board.
Circuit breakers shall be fitted with a mechanically operated on/off position indicator.

All non-current carrying metal parts of the circuit breaker shall be solidly inter-connected and connected to an earth contact which shall engage with a copper plate connected to the main earth bar of the switchboard and the arrangements shall be such that the circuit breaker frame is earthed before the breaker contacts engage with the live fixed contacts.

Lockable safety shutters shall be provided to screen the fixed contacts and shall operate automatically with the movement of the circuit breaker.

Facilities shall be provided for the mounting of “Castell” or equivalent interlocking arrangements, if specified.

Two normally open or two normally closed spare auxiliary contacts shall be provided, unless otherwise specified.

SS 20.3 MOULDED CASE CIRCUIT BREAKERS (MCCB’s)

All moulded case circuit breakers shall comply with SABS 156. All MCCB’s shall be of flush panelmounting type with inverse current time delay overload characteristics.

Mechanically coupled, single pole circuit breakers when used as double, or triple pole circuit breakers, are not acceptable unless overload releases are internally coupled. No MCCB of fault current interrupting rating of less than 5kA shall be installed.

SS 20.4 SWITCHES AND SELECTOR SWITCHES

Triple, double and single pole switches shall conform to SANS 61058-2-5:1994.

All switches and selector switches shall be capable of breaking the full load and closing onto a full system fault.

The fault level of the switches and selector switches shall be equal to, or higher than, the fault level of the associated bus bar, but in any case not less than 5kA.

Voltmeter selector switches shall be suitable for a 3-phase 50Hz system and must be so arranged that voltages between phases and phases to neutral, can be read. Voltmeter selector switches shall be suitable for the system voltage. Voltmeter selector switches shall be of the break-before-make type.

The voltmeter selector switch shall have one “Off” and six “Metering” positions and must be suitable for panel mounting in such a way that the operating knob and indicator plate can be mounted on the front of the panel and the switch itself at the back of the panel.

Ammeter selector switches shall be of the make-before-break type, with one “Off” and three “Metering” positions. When in the “Off” position, the metering circuit shall be short-circuited.

The physical construction of ammeter selector switches shall conform to that of voltmeter selector switches.

The operating knob and indicator plate shall be manufactured of insulating material and the switch positions must be clearly and indelibly marked thereon.

The switches shall be provided with substantial contacts and the terminals must be clearly marked and arranged for easy wiring.
The voltmeter or ammeter selector switch shall be mounted directly below the associated voltmeter or ammeter.

SS 20.5 COMBINATION FUSE-SWITCH UNITS

The fuse-switch units shall be rated as required in the Project Specification.

The fuse-switch units shall comply with BS 60947-3:1999 and amendments and shall be fitted with HRC fuses, complying with SANS 60947-3

Fuse-switch units shall be of the chassis type and shall be designed to accommodate HRC fuses. Fuse-switch units shall be of the double air-break, quick-make, quick-break type and shall have a spring mechanism smoothly driven by springs on both sides of the mechanism.

The fixed contacts shall be shrouded and the arrangements shall be such that when the switch is in the open position, the double-break isolates the HRC fuses so that they can be replaced in complete safety.

The fuse switch shall have a hand-operated lever and an On/Off position indicator shall be provided and shall be operated mechanically by the moving contacts, to ensure accurate and position indication.

Fuse-switch units shall be provided with interlocks in accordance with BS 60947-3:1999 and the latest amendments and the arrangement shall be that:

The cover panel cannot be opened while the switch is closed;

The unit cannot be operated with the cover open, unless an interlock is purposely defeated.

Fuse-switch units shall be single or triple pole units and neutral links shall be provided inside the back of the switchboards to facilitate routine testing.

Fuse-switch shall be capable of breaking the rated current and shall have a short-circuit rating of not less than 35kA.

Fuse-switches with the fuses mounted in the lid of the unit will not be accepted.

All components shall be capable of continuously carrying rated normal current without excessive temperature rise.

All fuse-switches shall have facilities for pad locking in the “Off” position.

SS 20.6 HIGH-RUPTURING CAPACITY FUSES AND HOLDERS

All high-rupturing capacity fuses (HRC fuses) shall conform to SANS 60280-1:2006 and SANS 2822:2004.

All HRC fuse holders shall be of the withdrawal Bakelite type and shall conform to SABS 173. Each fuse link and holder shall incorporate a visual inspection eye for fault location.

Fuses which are connected directly to the bus bars shall be suitably rated, ie to SANS 172, Category AC5, Fusing Factor Class Q1, depending on the prospective fault current.

Class Q fuses shall normally be used provided attention is given to the following:

Special fuses with minimum energy let through shall be used for the protection of semi-conductor circuits.

If Class Q fuses are used to protect PVC cables – the current ratings of the cables should be taken as 85% of the fuse rating.
Fuses protecting a specific instrument shall be mounted as a group in close proximity to the relevant instrument. The function and rating of all fuses shall be clearly indicated on labels attached to the board adjacent to the particular fuse.

SS 20.7 CONTACTORS, RELAYS and MOTOR STARTERS

All contactors and relays shall comply with SANS 60947-4 -1,2and 3.

All contactors and relays shall be able to withstand the maximum prospective fault current that can occur at the point where the contactor or relay is installed and as specified in the detailed specification.

All relays and contactors used in normal/standby changeover circuitry shall be electrically and mechanically interlocked.

All contactors, unless otherwise specified, shall have two normally open and two normally closed spare auxiliary contacts of 10 ampere rating.

All contactors and relays shall be clearly labelled.

SS 20.8 PROTECTION RELAYS SS 20.8.1 GENERAL

Overload relays shall be adjustable, manual reset, units with single phasing protection.

For motors exceeding 50kW, additional protection must be provided against phase reversal and earth faults. Solid state electronic or electro-mechanical devices are acceptable.

All protection devices shall be capable of withstanding the fault currents that could occur at the point in the system where the unit is installed.

All relays shall be clearly labelled and if applicable, marked with the ratio of the current transformers associated therewith.

SS 20.8.2 TESTING

All protective relays shall be injection tested to check their satisfactory operation. The Contractor shall supply all instruments and test equipment required for these tests and shall issue calibration certifications for the relays.

SS 20.9 EARTH LEAKAGE PROTECTION UNITS

All earth leakage protection units must fully comply with SANS 767-1 and shall have the SABS mark.

All units shall be suitable for operation at the specified system voltage shall have test push-buttons and, unless otherwise specified, the sensitivity of all units shall be 30mA.

SS 20.10 TIME SWITCHES

All time switches shall be suitable for use at the system voltage. Accuracy: one second per day with a minimum 72 hours battery reserve.

The contact shall be silver-to-silver, or other approved contacts rated at 10 ampere.
All time switches shall be clearly marked indicating function.

All time switches shall be fitted with a manual-overriding switch.

An external by-pass switch shall be provided in all time switch circuits.

Time switches shall have the following features:-

- Daily programmable with minimum 30 minute On/Off control segments

- Weekly programmable with day omission segments of minimum 12 hours, i.e. morning or afternoons.

The whole mechanism shall be totally enclosed in a dust-proof enclosure.

SS 20.11 PUSH-BUTTONS

Push-buttons shall be of robust construction, suitably rated with facilities for interchanging from normally open to normally closed contacts. Push-button construction shall be suitable for the operating conditions.

SS 20.12 INSTRUMENTS

All instruments shall comply with the requirements of SANS 1816:2005 for instruments of industrial grade accuracy.

SS 20.13 AMMETERS

Unless otherwise specified, the ammeters shall be of the flush-mounted type.

The ammeters shall be 5 ampere instruments of 96mm square format or otherwise as approved by the Engineer.

Unless otherwise specified, all ammeters shall be combined maximum demand registering an instantaneous indicating type.

Ammeters shall be of the MISC movement, with both instantaneous and thermal demand implication, having an integrating lag of 15 minutes.

The ammeters scales shall be direct reading with the full-scale deflection, corresponding to approximately 120% of the rated circuit current. Full load rating shall be indicated with an indelible red line on ammeter.

Each ammeter shall be marked with the appropriate phase to which it is connected and ammeters shall be mounted in groups of three in horizontal line, clearly marked to indicate to which phase they are connected. The ratio of the current transformer associated with the ammeter shall be clearly indicated on the ammeter scale.

All ammeters shall be fitted with zero adjustment screws.

SS 20.14 CURRENT TRANSFORMERS

Current transformers shall comply with the requirements of SANS 60044 -1: 2003 Part 1. SANS 60044-6: 2004 Part 6 and SANS 60044 – 8: 2004 Part 8.
The indication circuit current transformers shall be Class 5 in accordance with the above standards for metering applications; current transformers shall be as per the above standards according to primary current.

0-200 Amp	:	Class 1
200 to 600 Amps	:	Class 0.5
600 Amps and above	:	Class 0.2

The current transformer ratio for all outgoing circuits shall be suitable to match the rating of the circuit.

Each current transformer shall be provided with a robust mounting bracket and proper terminal studs on the circumference of the coil for the connections.

A nameplate shall be fixed to each current transformer on the circumference of the coil in such a position that it can be easily read from outside the board after removal of the access panels. The nameplate shall clearly indicate class, rating, ratio and the functioning of the current transformers.

The current transformers shall be mounted on rigid supports above the relevant switchgear in such a way that the access of the coil is in a vertical plane to facilitate the threading through of the interconnecting wiring to the load side of the relevant switchgear.

LV current transformers shall be insulated for 660V between phases.

Current transformers shall be capable of withstanding for the duration of time taken by the circuit breaker to clear the fault, with protective devices set at the maximum settings, the fault currents that could occur at the point in the system where the current transformers are installed.

All current transformers shall be earthed through a removable earth link.

SS 20.15 VOLTMETERS

Voltmeters shall be of the flush panel mounting 400V moving-iron suppressed zero type, scaled from 0-500V. The 400V mark shall be clearly indicated by an indelible red line on the scale.

Unless otherwise approved, voltmeters shall be of the 96mm square format and shall match the ammeters previously specified. Ammeters shall also comply with the requirements laid down in BS 89-2:1990, for indicator instruments of industrial grade accuracy.

All voltmeters shall be fitted with zero adjustment screws.

All voltmeters shall be protected by HRC fuses.

SS 20.16 MAXIMUM DEMAND AND CONSUMPTION METERS

All maximum demand and consumption meters, three and single phase, up to 100 amperes shall be directly operating types and those above 100 amperes shall be operated through current transformers.

Kilowatt/hour meters shall have cyclometer dials and shall be direct reading without the use of the multiplication factor.

Maximum demand indicators shall be re-settable from the front without removal of the panel and shall have security seal facilities.

Any multiplication factor applicable for maximum demand meters shall be clearly indicated on the meter in unit form and not as a combination of several factors and any current transformer ratios shall be incorporated in the factors.

SS 20.17 HOUR METERS

Hour meters shall comply with BS 89-2:1990 for indicating instruments of industrial grade.

Hour meters shall be of the flush panel mounting, 48mm square format, with white dial and white numerals on black background, suitable for 220V system voltage and of the non-reset type with an indicating range of 99999, 9.

SS 20.18 INDICATOR LAMPS

Indicator lamps shall be incandescent, neon or LED's 2-2, 6 watt standard with BA9s base fitting designed for long life under indication duty.

Indicator lamps shall be labelled as to function and/or status.

Indicator lamp lenses shall have a minimum diameter of 15mm and shall be of the front removable screw type. The lamps shall be replaceable from the front of the panel.

The following lens colours shall be used:

- Fault - Orange / Yellow
- On, Run, Normal - Green
- Off - Red

SS 21 ELECTRIC MOTORS

Motors to be used must be rated at the appropriate efficiency class and be compatible with starters i.e. VSD's, VFD's etc.

SS 21.1 GENERAL

Motors shall be designed and manufactured in accordance with SANS 60034-1 to 11 and the following have reference:

- BS 4999-141:2004 General requirements for rotating electrical machines Part 10: Standard dimensions.

- BS 50347:2001 Rotating electrical machines of particular types or for particular applications. Part 10: General purpose induction motors.
- SANS 3743-1, 2 : 1994 Determination of sound power levels of noise sources Part 1 and Part 2
- SANS 10108:2005 The classification of hazardous locations and the selection of electrical apparatus for use in such locations.

Unless otherwise specified, all motors shall be wound for a 3-phase, 4 pole 50Hz 380V alternating current supply.

All motors are to be rated for operation at the altitude and under the conditions stated in the detailed specification.

Constant speed AC motors shall be of the induction type suitable for operation on a 3-phase supply and shall be capable of operating continuously, at rated torque, at any voltage between ± 5% of the nominal value, nominal frequency ± 2Hz and at the altitude specified in the detailed specification.

SS 21.2 ENCLOSURES

All motors of 110kW rating or less shall be totally enclosed, fan cooled and larger motors shall be standard protected, drip-proof and be IP 55 protected.

Variable speed motors shall be of a type to be approved by the Engineer and shall conform to the details as stated in the Project Specification. Tenderers are to supply information as to the measures

taken to ensure that variable speed motors do not overheat during long periods of low speed operation.

SS 21.3 RATINGS

The specified rated output will be as required in the Project Specification and shall be one of the ratings in Clause 5.2 of SANS 60034-1.

Unless otherwise specified motors shall be duty Class S1 subject to the following:

- 20kW or under, not less than 33% in excess of the maximum likely to be drawn by the pumps within the operating range.

- Over 20kW and up to 50kW, not less than 25% in excess of the maximum likely to be drawn by the pumps within the operating range.

- Over 50kW and up to 100kW, not less than 15% in excess of the maximum likely to be drawn by the pumps within the operating range.

- Over 100kW, not less than 10% in excess than the maximum likely to be drawn by the pumps within the operating range.

Where operating at other than continuous running duty is required, (ie short time or intermittent periods, as for valve actuators, hoists, etc), motors shall have appropriate ratings in respect of output, duty and starting class.

SS 21.4 TEMPERATURE RISE

The temperature rise shall be in accordance with Table 1 and 2 of SANS 60034-11 for motors for use at site conditions as set out in the Project Specification.

SS 21.5 WINDINGS

Windings shall be impregnated to render them non-hygroscopic and oil-resistant and shall be braced to prevent any movement of the coils during all conditions of service. Vacuum impregnated varnish is preferred on windings.

SS 21.6 BEARINGS SS

21.6.1 TYPE

Bearings shall be plain ball, or roller type, as appropriate. Vertical shafts shall have approved thrust and guide bearings. Grease-lubricated bearings shall be sealed or re-grease able.

Ball or roller bearings shall be loaded conservatively in order that the grease may be renewed at intervals of not less than one year and they shall not be equipped with grease nipples or cups. If these are supplied they shall be replaced with threaded plugs.

Care shall be taken that bearings are sealed properly in order to prevent ingress of bearing lubricant into windings and cores. For purpose of maintenance, end-shield bearings are preferred. A minimum bearing life of 40 000 hours is required. Unless otherwise approved in writing, motor bearings shall be designed to allow the motor to run indefinitely when uncoupled from the driven machine.

SS 21.6.2 INSULATION

Where necessary to prevent damage by any shaft currents which may be produced, the bearings and their lubricating and cooling systems shall be insulated from the bed-plate or frame.

SS 21.6.3 FLOW INDICATOR

A flow indicator and/or pressure switch shall be provided on forced-lubricating systems to indicate failure of the system. Adjustable alarm and cut-out contacts shall be provided.

SS 21.6.4 THERMOMETERS

Dial-type bearing thermometers with adjustable alarm and cutout contacts shall be provided as required. Where such thermometers are also provided on the pump, they shall be of the same type and manufacture.

SS 21.7 ANTI-CONDENSATION HEATERS

Anti-condensation heaters shall be provided on all motors with a rating over 45 kW. The heaters shall be suitable for use on a single-phase, 220V, 50Hz, AC supply and wired to a separate terminal box.

Unless otherwise specified, anti-condensation heaters shall operate continuously whenever the motor is at standstill.

SS 21.8 EARTHING

Motors shall have provision for earthing in accordance with Clause 11.1 of SANS 60034-1 and motors shall be provided with a machined box, tapped for a bolt of suitable size for earthing purposes.

SS 21.9 POWER FACTOR CORRECTION

Motor control equipment will incorporate capacitors for power factor correction (PFC), which will be connected to the control gear via cables and fuses.
The motors shall be capable of meeting all the requirements of these specifications with the capacitors connected, as well as with one or more of the capacitors disconnected.

The motors shall exhibit no adverse affects when starting or running continuously at any load up to the nameplate rating, with one or more of the capacitors disconnected.

Where variable speed drives have been used, combined power factor correction equipment and harmonic filters shall be provided in the MCC's. The harmonic filters shall be designed to eliminate the harmonic currents generated by the variable speed drives.

The PFC/harmonic filters shall be connected across the motor starter terminals for automatic connection to the motors when these are started.

The motor manufacturer shall liaise with the design of the power factor control equipment to ensure that no harmful effects, due to harmonics, will arise under normal operation.

SS 21.10 BALANCE AND CRITICAL SPEED

Motors and couplings shall be accurately and efficiently balanced statically and dynamically, so that there will be no unbalanced end-thrust when either new or worn and to eliminate noise and vibration when running.

Where end-thrust arises, adequate long-wearing thrust bearings shall be provided. Dynamic balancing shall be done by the removal of parent metal, in a manner, which does not affect the structural strength of the rotating element.

The use of solder or similar deposits for balancing will not be accepted. The operating speed of rotating elements shall be below and as far removed as possible from the critical resonant speeds thereof.

SS 21.11 VIBRATION LEVELS

Operating vibration levels of all rotating equipment installed shall be to the satisfaction of the Engineer and in accordance with Clause 4.12 of SANS 948. Strict attention shall be paid to this aspect of the installation.

Notwithstanding the acceptance of the vibration limits during the works test, the Engineer reserves the right to call for a vibration test on the installed equipment, if he considers it necessary and the Contractor shall be responsible for reducing the vibrations to within the specified peaks.

SS 21.12 NOISE LEVELS

Noise levels shall comply with the requirements of Clause 5 of SANS 60034-14.

SS 21.13 TEMPERATURE DETECTORS

All motors between 50kW and 150kW rating shall have embedded in their stator windings, two PTC thermistors per phase, suitable for Class B temperature rise. All motors rated 150kW and larger, shall have embedded in their stator windings, two PTC thermistors and one platinum RTD of type PT100 per phase and one platinum RTD of type PT100 per bearing. The bearing detectors shall touch the outer bearing race, shall be spring-loaded and shall be of the screw type. The characteristics of these temperature detectors shall match the thermal limitations of the motor electrical installation.

The wires of all detectors shall be wired to a terminal strip in a suitable terminal box.

SS 21.14 TERMINAL BOXES

Terminal boxes shall be in accordance with Clause 2.3 and 3.5 of SANS 60034-7 and shall be on the right-hand side when viewed from the drive end. The terminal box for the supply cable shall be suitable for the cables required and shall be over-sized. It shall have a removable cover and gland plate. The degree of protection shall not be less than IP55.

Cable outlets shall be capable of pointing to any of four directions at 90º intervals.

Heaters and embedded temperature detectors shall be wired up to separate secondary terminal boxes. These boxes shall be suitable for an armoured, multi-core cable and shall be over-sized.

All terminals shall be properly and permanently marked for easy identification.

SS 21.15 INTERCHANGEABILITY

All similar parts shall be made accurately to dimensions and shall be interchangeable with each other, so that a spare part or any part of another similar motor can be used satisfactorily in the relevant position on a motor without recourse to additional matching or filling.

SS 21.16 ROTATION

The standard direction of rotation shall be clock-wise, looking on the shaft as required by clause 5 of SANS 60034-8:2007.

All AC motors shall be capable of having their direction of rotation reversed, merely by interchanging the supply leads. AC motors, fitted with uni-directional fans are therefore not capable of being easily reversed, shall where necessary, be supplied with a double-ended shaft and the holding-down bolt holes shall by symmetrical about both centre lines.

SS 21.17 MOUNTING

The motors shall be mounted as required by either driven equipment supplier or in accordance with the detailed specification.

Horizontally mounted motors shall be mounted on a common base plate with the driven equipment. When uncoupled from the load it shall be possible to lift the motor clear without withdrawing the rotor and with the minimum amount of dismantling.

SS 21.18 NAMEPLATES FOR MOTORS

The nameplates shall be made of corrosion-resistant metal and shall be permanently attached to the motor.

In addition to the information required by Clause 10 of SANS 60034-1:2006, the following shall also be marked on the nameplates of motors greater than 110kW:-

- Year of Manufacture.
- Total Mass of Motor in kilograms.
- Diagram indicating number type and positions of heaters and temperature detectors.
- Bearing types and sizes.

  Bearing grease interval or bearing replacement interval, where pre-packed bearings are used.
- Frame size and serial number.

SS 21.19 TYPE OF MOTOR

SS 21.19.1 SQUIRREL-CAGE INDUCTION MOTORS

Squirrel-cage induction motors shall be suitable for direct on line starting at full voltage. The starting current of motors shall not exceed the limit specified in Clause 5 of SANS 60034-12: 2003.

For two-speed motors, the starting current shall not exceed six times the full load current of the highspeed rating.

All motors shall be capable of starting against the associated load with a minimum of acceleration torque of not less than 5% of full load torque, when the voltage at a motor terminal during starting, is reduced to 80% of the nominal value.

SS 21.19.2 SLIP RING INDUCTOR MOTORS

These motors will not be used.

SS 21.19.3 SUBMERSIBLE ELECTRIC MOTORS

The motors shall be of the 3-phase, squirrel-cage wet type, suitable for a 380V, 3-phase, 50Hz AC or 230volt single phase 50Hz. The motor casing shall be of steel, double surface protected. The bolts and nuts shall be 316 stainless steel. The stator winding shall be completely surrounded by water. The insulation shall be very reliable, as thin as practicable and manufactured in either polyamide or polyethylene. The resistance shall be at least 100 Meg ohms. Unless otherwise specified, the motor shall be wired for direct on-line starting.

The connections between the single windings shall be absolutely watertight.

The stator and rotor shall have special protection against corrosion.

The two leads of each thermistor element shall be separately brought out to one terminal box on the outside of the motor where the three thermistors shall be connected in series.

The bearings shall be of the journal type made of bronze or rubber adequately sized for the motor to operate in a vertical position, to take the axial thrust and shall be water-lubricated. The thrust bearing shall be made of special synthetic material and shall have mechanical and electrical properties as that of at least 316 stainless steel.

The motors shall be protected against any dirt by means of a mechanical seal in the coupling casing. The shaft shall be as that of at least 316 stainless steel.

To compensate for change in volume with different temperatures in the lower part of the motor, compensating devices shall be fitted.

The pump and motor shall be direct coupled.

The motor shall be completely sealed by an oil-bath lubricated, double, self-adjusting, mechanical seal on the shaft. The seal shall preferably be of the tungsten carbide or other material possessing great resistance to abrasion. The motor enclosure shall be at least IP68 and the cable entry shall be triple-sealed.

SS 21.20 ERECTION AND COMMISSIONING SS 21.20.1 ERECTION

Where practicable, motors of 110kW or larger shall be erected by the motor supplier. Care shall be taken to ensure that adequate tolerance margins are made available to ensure interchange ability with replacement motors. In particular, minimum of 10mm of packers shall be provided under the motor frame or motor bedplate to allow for adjustments in height.

Before holding-down bolts are grouted in, the motor shall be lined up and the bolts shall be properly centred in the line of the bedplate.

The Electrical Contractor shall satisfy himself that the motors are properly installed, aligned and sufficiently protected and shall check the settings of all motor protection gear before any motor is switched on.

The Engineer shall be notified at least seven days in advance of any commissioning or testing to enable him to be present.

SS 21.20.2 ALIGNMENT

After erection, the alignment of the half-coupling, between the motor and the driven machine shall be measured. In the case of a pedestal bearing motor, the air gap clearance between the rotor and the stator shall also be measured. A record shall be kept of these figures and they shall be submitted to the Engineer for approval.

A horizontal sleeve bearing or limited end-float roller bearing motor shall be run uncoupled from its load to ensure that it rotates at the axial position indicated on the shaft and that the rotor is free to move to either side of this position.

SS 21.21 INSTALLATION AND OPERATING REQUIREMENTS SS 21.21.1 INSULATION RESISTANCE

Before energising any of the motors for the purpose of commissioning, the Contractor shall measure the insulation resistance of each motor between phases and to frame. For stator windings rated in excess of 3500V use a 1000V megger and for all other windings use a 500V megger and the values shall be recorded and forwarded to the Engineer for information. If any of the readings for a particular motor are lower than 1,5 meg ohms, that motor shall not be energised until it has been dried out by the Contractor by a method to the Engineer's prior approval.

The method adopted for drying out shall be by applying heat, preferably by circulating current through windings or, alternatively, by means of space heaters located in and around the machine or other methods approved by the Engineer.

All equipment and the personnel required for the drying-out operation shall be provided by the Electrical Contractor. The onus remains on the Electrical Contractor to make certain that a motor is dry before it is connected to the supply. Any motor that is faulty as a result of being commissioned in a damp condition shall be repaired free of charge by the Electrical Contractor.

SS 21.22 DRAWINGS AND INFORMATION FOR APPROVAL

The following drawings and information shall be submitted for approval before manufacture of motors of 150kW or larger commences:

- Dimensioned outline and required foundation drawings of the motors. (Shaft diameter, shaft height and motor mass to be clearly shown).

- Cross-sectional, dimensioned drawings of the cable boxes.

- Detailed drawings of the motor base plate showing full constructional details with dimensions.

SS 21.23 INSPECTION OF MANUFACTURED EQUIPMENT SS 21.23.1 GENERAL

The Engineer or his appointed representative reserves the right to inspect the motors or associated parts at any stage of manufacture.

The Electrical Contractor or Supplier shall ascertain whether inspection is required. The Engineer shall be given not less than seven days notice of when the inspection may be undertaken.

SS 21.23.2 BEARING INSPECTION

Motors have ball/roller bearings shall be inspected by the Engineer. The grease shall be examined to ensure that it is not hard. Providing that no roughness is felt when the shaft is rotated by hand and that the motor runs without undue noise or vibration, the bearings will be considered acceptable.

SS 21.24 TESTING/COMMISSIONING

SS 21.24.1 ROUTINE TESTS

Tests as required in SANS 60034-1-14 shall be carried out and the following tests shall be carried out in addition to the routine tests specified in SANS 60034-1-14.In addition all the resistances of temperature detectors and heaters shall be measured and recorded.

SS 21.24.2 TYPE TESTS

Type test certificates on identical motors will be acceptable in lieu of those tests for motors smaller than 50kW. Should type test certificates for motors smaller than 50kW not be available, then the first motor of each size manufactured shall be tested. All motors larger than 150kW shall be fully performance tested as required in the schedule. At least one motor in four of every type of 50kW and up to 150kW shall be tested for temperature rise, efficiency and pullout torque.

The measurement of the temperature rise of the stator windings of the motors shall be by the increase in resistance method.

SS 21.24.3 WORKS TESTS

Motors shall be tested at the maker’s works and test certificates shall be endorsed to the effect that the motors are properly balanced and free from vibration and comply where applicable with. BS 5000-3:2006. Tests shall include a locked rotor test to establish the maximum starting current.

In addition to the type test specified in SANS60034-1-14, the following shall be done:-

- Vibration Test: The amplitude of vibration (peak to peak) is to be measured in micrometers.

- Efficiency Test: The efficiency shall be measured for full load and rated duty load.

- Temperature detector readings shall be taken at all intervals of test.

SS 21.24.4 TEST CERTIFICATES

Four copies of all test certificates, showing the results of all tests performed shall be supplied at a date not later than the delivery date of the motors.

SS 22 MOTOR CONTROL CENTRES (MCC'S)

SS 22.1 GENERAL

The motor control centres shall comply in all respects with the section on Low Voltage Distribution Boards and where applicable to the Standard Specifications for Instrument and Instrumentation Installation.

The motor control centres complete with control circuits shall be suitable for the system fault levels as specified. Smaller control circuits which cannot conform to this requirement, must be provided with isolating transformers. The output rating of the transformers shall be suitable for 130% of the sum of the burdens of all the contactor and relay coils operating simultaneously at 120% of rated voltage.

SS 22.2 CONTACTORS

Contactors shall be in accordance with SANS 60947-4 -1,2and 3.and/or IEC 60947. Category AC 3 or DC2 shall in general be used, whichever is applicable or specified. Category AC4 and DC3, whichever is applicable shall be used for heavy plugging and inching duty systems.

All contactors for low voltages shall be of the electro-magnetic operated air-break type with specific requirements as required, e.g. AC/DC coil voltage; dip proofing, latched contacts and co-ordination with fuses.

Contactors shall have suitable capacities for direct-on-line starting, star delta starting, electronic soft starting or any other form of starting, whichever is applicable or specified. The contactors shall be rated for at least 130% of the associated load current.

Each contactor shall be provided with at least two normally open and two normally closed auxiliary contacts, unless otherwise specified.

Contactors shall be suitable for remote and automatic operation, via a PLC. Where the number of auxiliary contacts required for remote and automatic operation is greater than can be accommodated on the contactor, an auxiliary relay or additional contactor shall be provided.

Each contact shall be capable of carrying and making and breaking at a recovery voltage of not less than 90% of the specified system voltage :-

- Over-current during the operating time of its own over-current tripping devices.

- All over-currents and all fault currents up to the maximum specified during the operating time of the associated back-up circuit breaker or fuses.

All contactors for starting squirrel-cage motors direct-on-line shall be so rated that they can break ten times the full load running current of the motor.

SS 22.3 CONTROL PUSH BUTTONS

All motor starter cubicles shall be provided with “STOP/START” push buttons with the following colours:-

Start Button	:	Green
Stop Button	:	Red
Emergency Stop Button	:	Red
Trip Reset Button	:	Black
Siren-mute Button	:	Black
Lamp Test Button	:	White

Start push buttons shall have normally open contacts. Stop push buttons shall have normally closed or normally open contacts as required or specified.

All motors shall be provided with a Pad Lockable push button for emergency stopping. The push button shall be clearly marked “EMERGENCY STOP”, and shall be mounted in an enclosure which shall be solidly mounted on an angle iron post next to the motor.

SS 22.4 MOTOR CONTROL PROTECTION

All relays, electronic relays and programmable logic controllers (PLC’s) shall be approved by the Engineer and selected from a schedule of makes. If alternative make of equipment is offered full technical details shall be supplied and the difference in price shall be stated.

Motors may be controlled either by:-

Relays, timers etc.

Programmable logic controllers.

Requirements for all Motors up to and including, 55kW

All motor control contactors shall be provided with one thermal overload device per pole, so designed that the associated motor will be protected against overloads.

All three-phase motors shall be protected against single-phase operation.

The overload devices shall have suitable inverse time current characteristics to match the motor thermal damage curve.

The overload devices shall not operate under motor starting conditions.

All overload devices shall be provided with hand-reset contacts.

Requirements for Low Voltage Motors Larger than 55kW

Each motor shall be protected with approved relays. The protection relays shall make provision for the following:-

- Thermal Overload (characteristic to match motor thermal damage curve).
- Phase reversal.
- Single phasing.
- Earth fault (capable of being delayed if motor fuse protected).
- Short circuit.
- Recognition of cooling characteristics of motors.
- Maximum number stops/starts per hour (adjustable).
- Consecutive starting during a certain time.
- Facility to reset protective relay from front of panel.

SS 22.5 ELECTRONIC MOTOR CONTROL DEVICES

SS 22.5.1 GENERAL

The system voltage for the electronic control devices is the supply voltage for the installation in the Project Specification.

Where the equipment offered shall operate at other voltages, step-down transformers shall be provided. The ratings of the transformers shall be compatible with the drive requirements taking harmonics into account.

The control circuitry shall consist of independent electronic control and protective circuits, arranged on separate printed circuit boards. This circuitry shall be isolated from the main supply by means of isolating transformers.

The harmonics generated by the electronic control devices shall be compensated not to exceed the following levels as laid down by Eskom:-

- The individual harmonic voltage may not exceed 1%.

- The total harmonic voltage may not exceed 3%.

Any equipment which is sensitive to harmonics shall be designed to function under voltage conditions which may have up to 5% total harmonic distortion and up to 2% individual harmonic content.

Electronic equipment shall be of a modular construction, mounted on plug-in boards. Such modules shall be suitably coded so as to prevent insertion into the wrong sockets.

Solid state electronic components shall be used throughout.

The availability of spares shall be guarantee for ten years after the contract is accepted.

SS 22.5.2 VENTILATION

The ventilation equipment provided shall be suitably rated to operate in the environmental conditions previously specified.

The thyristors shall be air-cooled by means of appropriate fans.

The fans shall be mounted directly on top/bottom of the thyristor stack or a single fan shall be mounted on top of the cubicle.

Air filters shall be provided at the air intake of the cubicle.
The hot air shall be exhausted into the MCC room.

SS 22.5.3 FACTORY TESTS AND INSPECTIONS

General

The Engineer or his appointed representative reserves the right to inspect the motors or associated parts at any stage of manufacture.

Tests

The Electrical Contractor or supplier shall ascertain whether inspection is required. The Engineer shall be given not less than seven days notice of when the inspection may be undertaken.

The manufacturer shall perform all routine tests in the factory as required by the relevant SANS, IEC and/or BS, as well as their own standard routine tests on all materials, equipment and/or auxiliary equipment.

The Contractor shall submit a list of tests and inspections to be performed on the equipment for approval.

The Contractor shall perform any additional standard tests that may be required by the Engineer.

The Engineer will indicate which tests shall be witnessed by the Engineer or his representative.

The Contractor shall submit four copies of the test certificates with the test results of all the tests performed to the Engineer not later than the delivery date of the equipment.

SS 22.6 SITE TESTS

On completion of erection and installation on-site, the Contractor shall perform all the tests which may be required to ensure that the works are ready for handing over and putting into regular use.

The Contractor shall provide his own test equipment which shall be of acceptable standards.

The Contractor shall submit a list of site tests and inspections to be performed on the equipment for approval.
The Contractor shall perform any additional standard tests that may be required by the Engineer.

All the tests shall be witnessed by representatives of the Client and the Engineer.

Four copies of the site test certificates shall be submitted to the Engineer within 7 days after completion of each test.

SS 22.7 MAINTENANCE MANUALS

Operation and Maintenance manual submitted must comply with VOLKSRUST WTW 's Operation and maintenance manual specification.

SS 22.8 VARIABLE SPEED DRIVES

This part of the specification describes the general requirements for the Variable Speed Drives, herein referred to as AC Drives, for use with standard IEC or [NEMA A] [NEMA B] [NEMA D] [NEMA E], [Wound Rotor] design AC motors and synchronous motors with permanent magnets**.** Refer to Annexure A for the detailed technical requirements.

ANNEXURE A

SS 22.9 VARIABLE SPEED DRIVES

SS 22.9.1 REQUIREMENTS FOR THE MANUFACTURER CERTIFICATIONS

The Frequency Converter Manufacturer shall have a valid ISO 9001 (2000 version) certification and an applicable quality assurance system.

The Frequency Converter Manufacturer shall have the Environment Certification ISO 14001. The Frequency Converter Manufacturer shall furnish the Product Environmental Profile (P.E.P.) on the engineer's request.

SS 22.9.2 EXPERIENCE

The Frequency Converter Manufacturer shall have adequate experience in frequency converter manufacturing and have adequate business volume in order to provide credibility in his commitments and a capability of long term support.

SS 22.9.3 LOCAL SUPPORT

The Supplier shall have a permanent representative office with a trained and skilled support staff, in the country where the goods are delivered, in order to prove his commitment for local support and to provide a channel for communication. The local representatives shall be easily accessible and shall be able to arrive at the site within 24 to 48 hours' notice.

The engineers employed by the Supplier's regional office shall be certified by the Manufacturer and provide start-up service including physical inspection of the drive, connected wiring and final adjustments, to ensure that the AC Drive meets the required performance.

The Supplier shall be able to give basic drives training to the Customer's engineers, preferably on the site but anyway, in the country where the customer's site is. The training shall, as a minimum, include system concepts and basic troubleshooting. The Supplier shall also be capable of solving most AC Drive problems quickly..

The Manufacturer shall be able to offer commissioning of the drive to be done by the local office.

The most common spare parts like fuses, IGBTs as well as main control- and I/O-boards shall be available within 48 hours from the notification through a regional service centre of the Supplier. The more rarely used spare parts should be available within a maximum of 5 days on site.

SS 22.10 BASIC REQUIREMENTS FOR THE AC DRIVES SS 22.10.1 SS 22.10.1 GENERAL REQUIREMENTS

The AC Drive shall comply with National and International standards and the recommendations for electrical industrial control devices (IEC, EN, UL, NFC, and VDE).

1. ANSI/NFPA 70 : National Electrical Code
2. EN50178 : Electronic equipment for use in power installation
3. CSA C22.2 No. 14-M91 : Industrial Control Equipment
4. IEC 68 Part 2-3 : Basis Environmental Testing Procedures Part 2: Tests – Test Ca: Damp Heat
5. IEC 146.1 : Semiconductor Converters – General Requirements and Line Commutated Converters Part 1-1: Specifications of Basic Requirements
6. IEC 664 : Insulation Co-ordination for Equipment Within Low-Voltage Systems
7. IEC 447 : Man-Machine Interface Actuating Principles
8. IEC 439 Part 1 :Low Voltage Switch gear and Control gear Components
9. IEC 364 : Electrical Installation of Buildings
10. IEC 204/NFPA 79 : Electrical Equipment of Industrial Machines/Industrial Machinery
11. IEC 106 : Guide for Specifying Environmental Conditions for Equipment Performance Rating
12. IEC 529 : Degrees of protection Provided by Enclosure
13. IEC 1000 : Electromagnetic Compatibility
14. IEC 1800 : Adjustable speed Electrical power drive systems
15. IEC 721 : Classification of Environmental Conditions
16. IEC 255-8 : Overload Relays
17. IEC 801-2,-3,-4,-5 : Immunity Tests
18. NEMA ICS Part 4 : Overload Relays
19. NEMA ICS7 : Industrial Control and Systems Variable Speed Drives
20. UL 508C : UL Standard for Safety Power Conversion Equipment

The AC Drive shall be of the most modern design, user friendly and be simple to install commission and maintain. The AC Drive shall be able to start and control the speed of a standard squirrel cage induction AC motor. The AC Drives shall be:
CE marked, conforming to European Low Voltage (73/23/CEE and 93/68/CEE) and EMC (89/336/CEE) Directives,
UL/CSA marked according to UL 508C.
The AC Drives have to be built to comply with the IEC standards.

The materials used in the AC Drive shall be recyclable, non-toxic and flame retardant. The AC Drive shall comply with the European directive ROHS (Restriction of Hazardous Substances) that prohibits the use of materials such as lead, chromium 6...

The AC Drive shall be a digitally controlled drive, using, at least, the Pulse Width Modulation (PWM) with flux vector control open loop and closed loop, with both speed and torque control modes, an algorithm to control unbalanced loads (ENA system), and a safety function (see chapter safety). It shall have IGBT's in the inverter section of the throughout the power range, and it shall have the following minimum specifications.

Operating conditions:

Rated Input Voltage	:	200V -15% 240V +10%, three-phase, or
	:	380V -15% 480V +10%, three-phase, or
	:	200V -15% 240V+10%, single-phase (ONLY up to 5.5kW, 7.5 HP)
Rated Input Frequency	:	50Hz –5% to 60Hz +5%
Fundamental Power Factor	:	0.97 or better at nominal load
Efficiency	:	□ 98 % at nominal load
Output Voltage	:	0 - U_N, three-phase
Output Frequency Range	:	0 to 1000 Hz up to 37kW (50HP), adjustable
	:	0 to 500 Hz above 37kW (50HP), adjustable
Accel/Decel Time	:	0.01 – 6000 s, adjustable, linear, with S, with U or customised shapes
Overload capability (Constant Torque)	:	150% of nominal AC drive current for, and 165% of nominal AC Drive current for 2sec

Operating ambient Temperature : -10°C up to 50 °C, for higher temperatures see below

Storage ambient Temperature : -25°C up to 70 °C Maximum operating altitude

: 1000 m without derating

1000…3000 derating the current by 1% per additional 100 m.

Limited to 2000 m for the "Corner Grounded" distribution network

Max. Relative Humidity : 95 %, without condensation and dripping water.

(IEC 60068-2-3)

Max. Corrosion Level of the Cooling Air : IEC 721-3-3, class 3C1. In option, conformal Chemical Gases : coating shall be requested to comply with

IEC 721-3-3 Class 3C2.

Solid Particles	:	IEC 721-3-3, class 3S2
Max. Vibration Level (IEC 60068-2-6)		
2 to 13 Hz	:	1.5 mm, peak to peak
13 to 200 Hz	:	1 m/s2
Shock Level		according to IEC/EN 60068-2-27
Max. Ambient Pollution degree		
According to EN 50178	:	Degree 2, up to 15 kW (20 HP)
According to UL 508C	:	Degree 3, above 15 kW (20HP)

Main Protection : Over current, short circuit between phase, short circuit between phase and ground, impedance short circuit, input phase loss, output phase loss, motor overload, over voltage, under voltage, over speed, IGBT over temperature, heat sink over temperature, other internal faults.

Control supply : could be internal so provided by the AC Drive itself, or provided by an external 24V dc supply

The AC Drive shall be able to give a 100 % output current continuously in the above specified conditions. In order to ensure that the drive can provide the required output current in the specified ambient conditions, the Manufacturer shall inform the required derating, if the ambient temperature given in the project-specific specification is higher than 50 °C or if the installation altitude is more than 1000 m above the sea level. The derating factor shall be specified so that neither the lifetime of the AC Drive nor the unit's performance, overload capability included, nor the reliability of the AC Drive shall suffer.

SS 22.10.2 AC DRIVE PERFORMANCE

1. Motor control type
    - Sensoreless (SVC) voltage vector control for AC motors for multiple motors supply
    - Sensoreless (SVC) current vector control for AC motors for a single motor supply
    - Closed loop current vector control for AC motors for a single motor supply
    - Volt per hertz 2 or 5 points for AC motors
    - Sensoreless vector control for synchronous motors
    - Energy Adaptation system (ENA) for unbalanced load
2. Speed range in the motor quadrant
    - 1:100 in sensoreless vector control
    - 1:1000 in closed loop vector control
    - 1:50 in Sensoreless vector control for synchronous motors
3. Speed range in the generator quadrant
    - 1:50 in sensoreless vector control
    - 1:1000 in closed loop vector control
    - 1:50 in Sensoreless vector control for synchronous motors
4. Overtorque capability
    - at least 170% of the rated motor torque during 60s
    - at least 200% of the rated motor torque during 2s
5. Speed accuracy

- □ 10% of the nominal slip of the motor in sensoreless vector control
- □ 0.01% of the nominal speed of the motor in closed loop vector control

6. Torque control accuracy
    - □ 15% in sensoreless vector control for AC motors
    - □ 5% in closed loop vector control for AC motors 7. Current at standstill
    - 100% of the nominal peak current up to 75kW
    - 80% of the nominal peak current above to 75kW

8. Braking capabilities
    - Up to 160kW, the drive shall integrate a braking IGBT
    - 100% of the rated torque continuously
    - 170% of the of the rated motor torque during 60s
    - From 200 kW up to 500kW, the braking IGBT could be external

SS 22.10.3 QUALITY ASSURANCE AND WARRANTY

Every AC Drive has to be tested functionally. The inverter part of the AC Drive or each inverter module at least has to be tested by running it with a motor at full nominal load. A test report of the tests made shall be delivered by the Frequency Converter Manufacturer on engineer's request.

An 18-month parts warranty shall be provided on materials and workmanship from the date of purchase.

SS 22.10.4 PROTECTION

1. Circuit breaker coordination and short circuit protection shall eliminate the need for currentlimiting and semiconductor fuses. Tables for Type 1 and Type 2 coordination, combining circuit breaker, contactor and AC Drive shall be provided and certified.
2. The AC Drive shall be UL 508C listed for use on distribution systems. The AC Drive shall have a coordinated short circuit rating designed to UL 508C and NEMA ICS 7.1 and listed on the nameplate. The AC Drive shall not create a hazard in the event of a short circuit at any point within the AC Drive when it is connected to a power source as specified on the nameplate and protected as specified.
3. Upon power-up the AC Drive shall automatically test for valid operation of memory, option module, loss of analogue reference input, loss of communication, dynamic brake failure, DC to DC power supply, control power and the pre-charge circuit.
4. The Power Converter shall be protected against short circuits, between output phases and ground; supplies provided by the AC Drive shall be protected against short circuits and overloads
5. The AC drive shall have a minimum AC under voltage power loss ride-through of 200 msec. The AC Drive shall have the user-defined option of frequency fold-back to allow motor torque production to continue to increase the duration of the power loss ride-through.
6. The AC drive shall have a selectable ride through function that will allow the logic to maintain control for a minimum of one second without faulting.
7. The deceleration mode of the AC drive shall be programmable for normal and fault conditions. The stop modes shall include freewheel stop, fast stop, DC injection braking and as fast as possible.
8. Upon loss of the analogue process follower reference signal, the AC Drive shall fault and/or operate at a user-defined speed set by a software programmed speed settings or last speed.
9. The AC Drive shall integrate a protection against IGBT chips over temperature that is different from the heat sink overheat.
10. The AC drive shall have solid state thermal protection that is UL Listed and meets UL 508C as a Class 20 overload protection and meets IEC 947. The minimum adjustment range shall

be from .25 to 1.36% of the current output of the AC Drive. The motor thermal state shall be memorized and shall decrease following the motor rating even when the power is OFF.

11. The AC Drive should be able to protect the motor when PTC probes are connected.
12. The AC drive should be able to limit the motor terminal voltage to twice the DC bus voltage
13. The AC drive shall display all faults in plain text and help screens shall be available to guide the user in the troubleshooting. Codes are not acceptable.

SS 22.10.5 SAFETY

1. The AC drive shall be integrated directly in the safety chain complying with EN 954-1 category 3, and with IEC/EN 61508-1 SIL2.
2. The AC drive shall integrate the “Power Removal” safety function which prohibits unintended equipment operation. The motor no longer produces torque.
3. This safety function shall comply with standard for safety of machinery EN 954-1, category 3 ; standard for functional safety IEC/EN 61508, SIL2 capability (safety control-signalling applied to processes and systems)
4. The “Power Removal” safety function shall have a redundant electronic architecture that shall be monitored continuously by a diagnostics function.
5. This SIL2 and category 3 level of safety function shall be certified as conforming to these standards by a certification body under a program of voluntary certification.
6. The Power removal function shall comply with the definition of the draft product standard IEC/EN 61800-5-2 for both stop functions, Safe Torque Off (“STO”) and Safe Stop 1 (“SS1”)
7. The AC drive manufacturer shall provide the certified schematics and the list of devices in order to comply with IEC/EN 60204-1 stopping category 0 and 1. 8. The relay contacts shall comply with EN-81 13.2.2.3

SS 22.11 ENCLOSURE AND MOUNTING

SS 22.11.1 Open style

1. Mounting type

- Side by side
- Vertical position □ 10°

When mounted in an enclosure, the AC Drive shall have an IP54 / NEMA 12 power section in order to evacuate the heat outside the enclosure 2. protection degree : IP20, or IP21, or IP54

SS 22.11.2 PACKAGED STYLE

Power range : from 90kW to 500kW 380/480V

i. Protection degree : IP23 or IP54 ii.

Panel design specs:

- Standards : IEC 439-1, EN 60439 & VDE660 Part 500.
- Cabinet access : From front
- Cable entry and exit : Bottom entry
- Colour, front : RAL 7032 – not critical

Standard equipment of the enclosure

b. Protection by Switch and Super Fast Fuses
c. The Programming terminal of the AC Drive shall be accessible for programming and controls with the main door closed.
d. The whole assembly shall be implemented with a strict consideration of the EMC Compatibility and Regulations as described further in this specification.
e. Total harmonics distortion shall comply with IEC 61800-3-12. Harmonic reduction shall be carried out with a 3% inductance or equivalent
f. Cables shall be handled by mechanical fixation
g. Air output shall not be located in on the front of the enclosure.

Other equipments could be integrated depending on the request.

SS 22.12 USER INTERFACE

SS 22.12.1 GENERAL

The user interface shall be identical throughout the power range to avoid confusion amongst the users and need for training in several different units.

SS 22.12.2 INPUTS AND OUTPUTS

1. At least, the following standard Inputs and Outputs shall be provided, to be used in interface with the control system:

Analogue Inputs	1 x Programmable differential voltage input ± 10V
	1 x Programmable current input 0(4) - 20mA
	1 x Programmable voltage input 0 – 10V
Analogue Output	1 x Programmable analogue outputs 0(4) - 20mA or 0 – 10V
Logic inputs	6 x Programmable logic Inputs isolated from the mains
	(One of these inputs could be used for PTC probe)
	All logic inputs may be used either in sink or source
Safety input	one input dedicated to the Power removal safety function
	In option, digital inputs may be used with 115V control supply

Relay Outputs	2 x Programmable Digital outputs with a changeover dry contact
Reaction time	2ms □ 0.5ms (except for the relays)

All the control terminals shall be clearly marked.

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It shall be possible to extend the number of inputs/outputs of the AC Drive up to:

- 14 logic inputs
-4 analogue inputs
-3 analogue outputs
-2 logic outputs (open collector)
-4 relays

3. At least, it shall be possible to assign the following functions to the I/Os:

SS 22.12.3 COMMUNICATIONS

1. The AC drive shall integrate as standard a minimum of 1 Modbus port.
2. The AC drive shall have the capability for internal mounted communication card. The following protocols shall be the minimum available :
    - Ethernet TCP/IP
    - Modbus Plus
    - Profibus DP
    - DeviceNet
    - InterBus-S
3. The speed or torque command and reference may come from different control sources :
    - I/O terminals
    - Communication network
    - programmable card
    - Remote graphic display terminal
4. The AC Drive shall be capable of switching these control sources according to the application requirements.
5. The AC drive shall integrate its own programmable communication scanner to always provide periodic variable exchange.
6. The control section of AC drive shall be supplied separately if necessary with 24V DC, to keep the network communication always available even if the power supply is OFF.
7. The AC drive behaviour shall be programmable on communication fault
8. Advanced monitoring and diagnostic functions shall be available through the programming terminal: Monitoring of :
    - The communication scanner
    - Command words sent by the different sources
    - Command words taken by the AC drive
    - 4 words which addresses are selectable

SS 22.12.4 PROGRAMMING TERMINAL

1. The AC drive shall have a detachable keypad with a back lit 8-line, with a minimum of 23character alphanumeric operating display for programming and controlling purposes. An IP54 or IP65 remote mounting shall be possible at a distance of 10m. The programming shall be able to operate in a multi-point connection. The displayed messages shall be in user friendly, descriptive text in multiple languages, including English, German, French, Italian, Spanish and Chinese. It shall be possible to change to replace 5 languages by other ones by a simple download. Coded messages are not acceptable.
2. Using a shuttle button shall carry out the navigation in the menu and the parameter setting.

3. Parameter setting shall be easily accessible and user friendly with actual text messages and actual setting range.
4. Visibility and protection shall be selected for each parameter. Password protection shall be provided to avoid unauthorized tampering with the set parameters.
5. The programming terminal shall offer the possibility of memorizing and downloading 4 configurations of the AC drives to save time during the commissioning and to avoid mistakes.
6. Direct access to the 10 last modifications shall be provided.
7. 4 programmable function keys shall be available for short cuts, application functions
8. Monitoring shall be possible up a distance of 5 meters. By using digital values and/or bar graph. Dedicated functions shall be provided such as I/O map, Communication map.
9. The programming terminal shall be able to display the commercial reference of the AC drive and of the options, the software version, the serial number
10. The user shall be able to customize the interface :
11. Creation of a user menu
12. Customization of 15 parameters : name, scaling, unit
13. Integration of bitmaps
14. The programming terminal shall integrate a Simply Start menu for fast and easy commissioning.
15. Direct keypad entry shall be provided to observe the following actual parameters. Any two of the following parameters or actual values shall be selected to always be displayed whatever the operation carried out with the programming terminal.
    - Signed Frequency reference
    - Input Frequency
    - Output Voltage
    - Output Frequency
    - Mains Voltage
    - Output Power
    - Motor Torque
    - Motor Speed
    - Motor voltage
    - Motor current
    - Motor power
    - Motor Thermal state
    - Drive Thermal state
    - PID actual values

The following parameters shall always be displayed during normal operation. -

Drive Status

- Command source (terminal, keypad)

16. The AC Drive shall have self-diagnostic properties to display faults and warnings as they occur. The AC Drive shall be able to store at least 8 last faults into the fault memory including the value of 11 parameters of monitoring for each fault. The fault memory shall be accessible by the programming terminal.

SS 22.12.5 APPLICATION PROGRAMMING

The AC Drive shall be designed for both simple and the most complicated applications, yet it shall be user friendly. The AC Drive shall have built-in application macros available in the Simply Start menu, to allow selection of the range of pre-programmed control configurations and further, the AC Drive shall be able to store at least two customer modified macro-configuration, to suit the specific application. It shall be possible to reset the parameter settings back to the original macro settings through the keypad. The parameter readouts shall be in text format and not coded.

SS 22.12.6 PC TOOLS

The AC Drive Supplier shall have Windows based PC software available for monitoring and controlling the AC Drives, and the software shall be offered as an option. The software shall be supplied with the necessary hardware and a provision for connecting a PC with the AC Drives. It shall be possible to set and modify parameters, control the drive, read actual values, and display and configure the oscilloscope function of the AC Drive.

SS 22.13 Software features

1. Power loss ride-through
   The drive shall have a power loss ride-through capability. This means that the drive controls should stay alive during a power loss by means of the energy stored in the load. The ride through time shall be the longer the higher the kinetic energy of the load is. The motor shall be magnetized as long as there is kinetic energy in the system.
2. Multi-motor or multi-configuration
   The AC drive shall have 3 configurations, which can be activated remotely, allowing it to adapt to:
   2 or 3 different motors or mechanisms in multi-motor mode. Each motor shall be protected thermally by the AC Drive
   2 or 3 configurations for the same motor in multi-configuration mode. This function can also be used in another memory area, which can be retrieved from.
3. Multi-parameters
   The AC Drive shall integrate and shall be able to switch 3 sets of 15 parameters when the motor is Running.
4. Oscilloscope
   The drive shall be able to store a total of 4000 points for one up to four channels. Trigger, time base, and channels shall be fully programmable by using the PC software. Display of the channels with zoom functions by using the PC Software.
5. Service message

The drive shall be able to store 5 lines of 23 characters in order to display a message to the user or the maintenance people.

6. Diagnostic functions

   The drive shall integrate test procedure to check the motor connection and the power components. Motor connection shall be tested at each run command.

7. Flying start

   The drive shall have a built-in Flying Start feature. This feature will allow a Motor unit which is still rotating, to be restarted without first stopping it. The AC Drive shall restart the motor from the rotating speed and then reaccelerate to the speed indicated by the speed reference signal. The Flying Start feature shall be available in both directions, to be able to start the drive in the required direction regardless of the rotation direction of the motor.

8. Pre-fluxing

   The AC Drive shall have a built-in pre-fluxing function. The pre-fluxing function minimises the time to establish the magnetising current and the load current so that the drive can still follow the given reference.

9. Flux braking

   There shall be a possibility for Flux Braking, where AC Drives increases the motor magnetisation to dissipate the extra energy in case of need for small braking power. It shall be possible to use the braking to decelerate the motor from one speed to another – not only for stopping the motor.

10. Current/speed limiting

    In case the acceleration or deceleration ramps are too fast for the drive capacity, the drive shall be able to automatically adapt the ramp to prevent tripping. Also, in case of transient overloads the drive shall automatically reduce speed to prevent an over current trip, if the drive capacity is not sufficient to handle the load.

11. PID-regulator

    The AC Drive shall have a built-in PID-controller for control of the customer process. Others functions such as Preset PID reference, automatic/manual, predictive speed shall be available.

12. Restart

    In the event of a fault trip due to over voltage, over current or loss of analogue signal, the AC DRIVE shall be programmable to attempt an automatic restart. For safety reasons, the maximum number of attempts shall be within a selectable time. If the fault does not clear after the attempts, the drive shall lock out.

13. Unbalanced load function (“ENA system”)

    The AC DRIVE shall have a built-in function for control of the unbalanced loads such as petrol pumps, printing press, in order to minimise mechanical constraints, to reduce line current, to save energy and to run without any external braking device.

14. Downstream contactor control

    The AC Drive shall have a built-in function for control downstream contactors in order to follow the safety requirements for lift applications, for instance. The AC Drive shall monitor and manage the consistency between the contactor command and its effective state.

17. Brake logic control

    The AC Drive shall have a built-in function to control a mechanical brake in order to move the load in a smooth and safe way. The brake logic control shall be adapted to the different movements : hoisting, translation, orientation.

    Others functions such as brake feedback management, high speed hoisting, brake impulse, limit switch management, load sharing, weight measurement shall be available.

18. Load sharing and Master-Slave functions

    The AC Drive shall have a built-in function for control of the loads mechanically linked in order to balance the torque between the 2 motors. The torque sharing should be carried out by either modifying the speed of the slave motor or by controlling the slave motor in torque mode.

19. Operations on reference

    The speed reference shall be able to be summed, subtracted or multiplied.

20. Torque control

    The AC Drive shall be able to operate as speed control or torque control. Both control modes could be switched. Motor torque could be individually limited in motor and generator quadrant.

21. Line contactor command

    The AC Drive shall be able to manage a line contactor depending on the Run command it receives.

SS 22.14 ENVIRONMENTAL EFFECTS SS 22.14.1 HARMONIC DISTORTION

Note,: Guidelines for voltage and current distortion are addressed in IEEE Standard 519-1992 titled "IEEE Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems", which suggests distortion limits dependent upon the electric power distribution system for industrial and commercial consumers. Collectively, all facility loads and the building electrical distribution network determine the harmonic levels at the user & electric utility interface. The Electrical Power Research Institute (EPRI) recognizes the 'Point of Common Coupling' or PCC as the interface between user and electric utility (energy meter) in the electrical distribution network. The AC Drives manufacturer can provide calculations through computer modelling, specific to the installation, showing total harmonic voltage distortion. Contractor to provide one line diagram drawings to supplier including transformer impedance. The AC Drive manufacturer needs this information.

1. A harmonic distortion analysis shall be performed and priced as a separate line item by the AC Drive manufacturer based upon documentation supplied by the contractor. The documentation shall consist of one-line diagrams, distribution transformer information (kVA, %Z, and X/R ratio) and emergency standby generator performance specifications. The harmonic distortion analysis report shall be part of the approval drawing process, submitted to the engineer for approval.

2. If the calculations determine that harmonic distortion values are higher than the voltage and current values specified, the drive manufacturer shall provide solutions to comply with : - IEC 61800-3-12
   - IEEE 519-1992 guidelines

SS 22.14.1 EMC REGULATIONS AND COMPATIBILITY / UL/CSA / C-TICK

1. The supplied AC Drive shall have built-in EMC filters and carry the CE marking indicating that they comply with the essential requirements of the relevant EU directives. The AC Drives shall meet the requirements set in EN 61800-3 for Industrial Low-Voltage Networks.
2. A detailed description and other directions to ensure the EMC Compatibility during the installation of the AC DRIVE and associated field cables and connections, shall be given by the Supplier to comply with the EMC Directives. The Contractor shall follow the directions during installation, in order to achieve attenuation of the RFI.
3. The supplied AC Drives shall carry the C-Tick mark indicating that they comply with the essential requirements of the relevant Australian directives
4. The supplied AC Drives shall carry the UL mark indicating that they comply with the essential requirements of the relevant American directives.
5. The supplied AC Drives shall carry the CSA mark indicating that they comply with the essential requirements of the relevant Canadian directives.

SS 22.15.1 DOCUMENTS SS 22.15.1 DOCUMENTS TO BE DELIVERED WITH THE QUOTATION

The following documents have to be delivered with the quotation:
Drawings: Dimension drawings, control connection diagrams and CAD drawings for a standard unit. If order specific engineering is required, the engineered drawings have to be sent for approval before the delivery.
Quality assurance and Quality Plan.

SS 22.15.2 DOCUMENTS TO BE DELIVERED WITH THE DELIVERY

The following documents have to be delivered with the delivery:
Operation and Maintenance Manuals
Drawings: Dimension drawings, control connection diagram. Quality assurance and test reports.

SS 22.15.3 CONTROL, INDICATION AND INSTRUMENTATION

The following minimum controls and instrumentation shall be provided on the front panel of the electronic compartment:-

- Start/Stop bush buttons for local operations.
- Emergency stop push button.
- Local/Remote switches shall be provided.
- Test/Off/Normal.
- Protection trip reset push buttons.
- Indication test push button to test lamps.
- Speed control.
- A potential free contact, wired to terminals at the back of the panel shall be provided to indicate a system fault for remote indication.

SS 22.16 SOFT STARTERS (SS)

SS 22.16.1 INTRODUCTION:

1. This specification relates to 3-phase controlled progressive electronic starters, i.e. 6 thyristor type.

2. The starter assures the starting and stopping of 3-phase asynchronous squirrel cage IEC or Nema type motors. The possible stopping modes will be: freewheel, braked or decelerated.

SS 22.16.2 QUALITY OF PRODUCT AND OF SUPPLIER:

1. The electronic starter will have to be developed and qualified in conformity with international standards and, in particular, with the product standard EN/IEC 60947-4-2 for starters.

2. The starter will have to be CE marked in accordance with the harmonised standard EN/IEC 60947-4-2.

3. With regards to electromagnetic compatibility, the starter will have to conform to the class A level for radiated and conducted emissions as detailed in the product standard EN/IEC 60947-4-2, and this applies to all available standard functions within the starter. Class B will be obtainable with additional accessories and only applies to starters with a nominal current not exceeding 170 A.

4. The starter will have to be UL 508 and CSA certified “Industrial Control Equipment”.

5. The manufacturing plant of the electronic starters and associated design activities will have to be ISO 9001 version 2000 and ISO 14001 certified.

6. 18 months warranty will be offered from the date of delivery or 24 months from the date of manufacture.

SS 22.16.3 PRODUCT DESCRIPTION:

1. The operating principle of the starter will not have to rely simply on motor current limitation during the transitory phases or on a voltage ramp, but on motor torque control. The starter will have to provide a torque ramp throughout the accelerating phase. Therefore, it will be able to control the torque throughout the entire starting phase and, if necessary, provide a constant motor torque throughout the accelerating phase.

2. For pumping applications, the deceleration will have to be made on a torque ramp.

3. All starter ratings will have to have the same control card. This control card will have to be identical for all applications and also, the same starter will be able to be used on a crusher, a pump or a conveyor (taking into account the dimensioning).

4. All the starters will have to incorporate means whereby the actual current is measured in order to ensure protection of the motor.

5. The incoming power supply terminals will have to be positioned at the top of the starter and the terminals for connecting the motor will be at the bottom (through wiring).

6. All ratings of starter will have to have connection terminals for the starter bypass contactor. The current measurements will have to be maintained when the starter is bypassed by the contactor.

7. The starter will have to have a separate control supply.

8. The control terminal block for logic and analogue commands will have to be removable.

SS 22.16.4 ENVIRONMENT:

1. The starter will have to be capable of operating, without derating, at an ambient temperature range between –10 and +40°C and between 40 and 60°C with a derating factor of 2% per degree C above 40°C.

2. The maximum relative humidity will be 95%, without condensation or dripping water, conforming to the standards IEC 60947-4-2.

3. The storage temperature range can be between -25°C and +70°C.

4. The maximum operating altitude will be 1000 metres (3280 feet). Above this, the starter will be derated by 2.2% per 100 metre increase.

5. The manufacturer will have to indicate the noise level of the starter, which must not exceed 65 dBA.

6. If the starters incorporate fans for cooling, their continuous operation will have to be avoided. They will have to be switched automatically in relation to the temperature of the heat sink.

7. The maximum ambient degree of pollution will be degree 3 conforming to IEC 60664-1 (or IEC 60947-4-2).

8. The supplier will have to provide the wiring diagrams of the starters.

9. The supplier will have to make available motor starter combination tables comprising circuitbreakers, fuses, contactors and starters in order to assure type 1 or type 2 coordination.

SS 22.16.5 ELECTRICAL CHARACTERISTICS OF THE STARTER:

1. The utilisation category of the starters will be AC 53a conforming to the product standard EN/IEC 60947-4-2.

2. The supplier will have to be capable of offering starters in one or several ranges to cover supply lines of 208 to 690 V (208 –15% to 690 V +10%).

3. The current range of the starters will be comprised between 17 and 1200 A.

4. The starter will have to automatically adapt to 50 or 60 Hz, with a tolerance of +/-5%. By configuration, it will have to be capable of operating at a supply line frequency that can vary by +/-20%.

5. Logic inputs; the starter will have to include a minimum of 4 x 24 V isolated logic inputs.

6. Outputs; the starter will have to include a minimum of 3 relays with a N/O contact. Maximum switching capacity on inductive load: 1.8 A at 230 V a.c. and 30 V d.c. Minimum switching capacity: 10 mA for 6 V d.c.

7. Outputs; the starter will have to include a minimum of 2 x 24 V logic outputs.

8. Analogue outputs; the starter will include 1 analogue output with either a 0 - 20 mA or 4 - 20 mA signal. This signal will be able to be scaled.

9. The starter will have to include its own 24 V power supply for the logic inputs/outputs.

10. The supplier will have to offer a starter selection table for 2 types of dimensioning:

- Dimensioning 1:

From cold state (motor duty S1): 1 start at 3 In for 46 seconds.

Cycle comprising starting (motor duty S4), with a load factor of 50% and 10 starts per hour, or an equivalent thermal cycle: 1 start at 3 In for 23 seconds.

- Dimensioning 2:

From cold state (motor duty S1): 1 start at 4 In for 48 seconds.

Cycle comprising starting (motor duty S4), with a load factor of 50% and 5 starts per hour, or an equivalent thermal cycle: 1 start at 4 In for 25 seconds.

SS 22.16.6 PROTECTIVE FUNCTIONS:

1. The starter will have to incorporate PTC probe processing.

2. The starter will have to continuously calculate the heating of the motor from the actual current measured (the current having to be measured and not estimated). Several classes of thermal protection will have to be offered conforming to the standard EN/IEC60947-4-2: classes 10A, 10, 20, 30 as well as the intermediary classes; one inferior to class 10A, one between classes 10 and 20 and one between classes 20 and 30. The calculation of the thermal protection must be performed even when the starter is not being supplied.

3. The starter will have to be protected against thermal overloads.

4. The starter will have to detect an under load from the motor torque information. The detection threshold as well as the allowed duration of the under load will have to be adjustable. This protection will be able to lead to either a fault on the starter or simple indication in the form of an alarm via a logic output.

5. The starter will have to detect an overload from the motor current information. The detection threshold as well as the allowed duration of the overload will have to be adjustable. The duration of the overload will be able to be adjusted from 0.1 seconds. This protection will be able to lead to either a fault on the starter or simple indication in the form of an alarm via a logic output.

6. The starter will have to have protection against supply line phase inversion and also against phase failure of the supply or motor.

7. The starter will take into account management of an external fault. When the contact is open, the starter goes to fault mode.

8. The protective functions will have to be maintained even when the starter is bypassed by a contactor.

S 22.16.7 COMMUNICATION:

1. The starter will have to include a multidrop serial link for its direct connection on Modbus.

2. The starter will have to be able to be connected to Ethernet and other networks, with connection to communication bus as an option.

3. The communication will have to provide access to the control, to the adjustment and to the supervision of the starter.

SS 22.16.8 MAIN FUNCTIONS:

1. The starter will be able to start and decelerate several motors in cascade.

2. A second set of motor parameters will be able to be switched to by a logic input.

3. In order to protect the motor against condensation when stopped for long periods, the starter will have to have a pre-heating function that does not involve rotation of the motor. The pre-heating current will have to be adjustable.

4. The starter will have to pilot the starter bypass contactor: control closing of the bypass contactor on completion of start-up and opening on receipt of the stop instruction. This function will have to be compatible with the stop modes: freewheel, braked and decelerated.

5. The starter will be able to control the line contactor. The contactor will have to close following the start instruction and open when the motor has come to a stop.

6. Access to the settings will be able to be code locked. The monitoring parameters will have to remain visible.

SS 22.16.9 SUPERVISION:

1. The standard starter will have to have a dialogue screen and programming keys. As an option, a remote programming terminal kit will have to be available.

2. The following information will have to be accessible on the dialogue screen:
- Motor current
- Motor torque
- Thermal state of motor
- Cosine □
- Active power
- Current status (accelerating, decelerating, etc.)
- Elapsed operating time of starter
- Last fault detected

3. The following information will have to be accessible on the analogue output:
- Motor current
- Motor torque
- Thermal state of motor
- Cosine □
- Active power

4. The starter will include optional evolved dialogue solutions, such as:

- software workshop for PC in order to prepare, store, download and print the settings, - terminal with display, clearly showing the parameters.
- These tools must at a minimum be available in English.

22.16.10 MOTOR DATA:

1. The starters will have to be dimensioned for operation with IEC or NEMA motors, details of which will be provided with the tender specification.

22.16.11 CONTROL, INDICATION AND INSTRUMENTATION

1. Start/Stop push buttons for local operations.

2. Emergency stop push button.

3. Local/remote switches shall be provided.

4. Protection trip reset push buttons.

5. Indication test push button to test lamp.

6. Starting time adjustable 4 – 20 seconds.

7. Starting current limit, adjustable 100 – 300% of full load current.

SS 22.17 TERMINAL BOARDS FOR MULTICORE CABLES

Terminal boards shall be of good quality, non-flammable insulating material, with a comparative tracking index (CTI) of not less than 500.

Terminal boards shall be mounted vertically at the sides of the cubicles and set out obliquely towards the access doors to give easy access to terminations and to enable ferrule numbers to be read without difficulty.

Terminal boards shall be spaced apart to provide adequate space for cable tails, the spacing shall be related to the number of terminals in any one bank, and the terminals shall be arranged in such a way that there is easy access to them.

All terminal boards shall have a minimum of 20% spare terminals and all spare cores in interconnection cables shall be terminated on the terminal boards.

Terminal boards shall have pairs of terminals for incoming and outgoing wires. Insulated barriers shall be provided between adjacent pairs. The height of barriers and the spacing between terminals shall be such as to give adequate protection while allowing easy access to terminals. Where there is

a possibility that live terminals may accidentally be touched by the bare hand, then covers of transparent insulating materials shall be provided. Such covers shall be sectionalised so that groups of associated terminals may be exposed without uncovering the whole board.

No live metal shall be exposed at the back of the terminal boards.

Studs of stud type terminal boards shall be of 6mm or 5mm phosphor bronze or stainless steel, locked in the base to prevent turning. All connections shall be made on the front of the terminal board using a plain brass washer and phosphor bronze lock-washer with brass nuts or brass locknuts. No more than two wires shall be connected to any one terminal.

Terminal blocks of the insertion type shall incorporate captive pinching screws and have serrated clamping plates with an inherent locking feature. Terminal screws shall be of phosphor bronze or stainless steel of not less than 4mm diameter. Only one wire shall be terminated on a terminal of this type and where more wires are required to be terminated, more terminals shall be provided and be connected to adjacent terminals by means of bridge pieces or bars.

SS 22.18 TERMINATION AND NUMBERING OF SMALL WIRING AND MULTICORE CABLES

All small wiring and multicore cable ends shall be fitted with interlocking numbered ferrules in accordance with the circuit diagram. Double ferrules shall be installed where necessary when connecting up equipment of different suppliers.

All conductor ends shall be terminated with crimped lugs of the proper type and size for the conductor and terminals in use. Only the correct crimping tool and dies shall be used strictly in accordance with the manufacturer's instructions.

The method of stripping insulation off cable cores shall be such as to preclude damage to the conductors.
Cable tails shall be neatly laced in a cable form, each core branching off to its appropriate terminal.

Identification ferrules shall be of insulating material with a glossy finish to prevent the adhesion of dirt and shall not be affected by damp or oil.

Ferrules shall be engraved black on a white background. For tripping circuits an additional ferrule with a letter T engraves black on a red background shall be provided.

SS 22.19 LOW VOLTAGE MOTOR CONTROL CENTRES BASIC EQUIPMENT

The following clauses specify the basic equipment which shall be installed in motor control centres. This basic equipment shall be altered or supplemented by the additional equipment called for in the project specification:-

SS 22.19.1 INCOMING PANEL

Suitably rated Main Circuit Breaker or Isolator as required.

- Three Current transformers
- Three 72mm square maximum demand indicating ammeters
- Three HRC volt meter fuses
- One voltmeter selector switch – phase to phase and phase to neutral
- One voltmeter (0-500V)

SS 22.19.2 DIRECT-ON-LINE STARTER

- One triple pole motor isolator mechanically and electrically interlocked with compartment door
- One suitably rated contactor for motor offered
- One suitable overload and anti-single phase relay
- One suitably rated MA type circuit breaker for motor back-up protection
- One miscellaneous ammeter with 72 or 48mm dial
- One running hour meter
- One manual-off-auto switch
- One set Start/Stop push buttons
- One Green “Motor Running” indicator light
- One Red “Motor Stopped” indicator light
- One motor heater MCB
- One Blue heater on indicator light
- One yellow overload trip indicator light

SS 22.19.3 STAR DELTA STARTER

- One triple pole motor isolator mechanically and electrically interlocked with compartment door
  One set suitably rated circuit breaker for motor back-up protection
- One MCB control
- One MCB control link
- One main contactor
- One star contactor
- One delta contactor
- One electronic transition timer
- One suitable overload and anti-single phase relay
- One miscellaneous ammeter with 72 or 48mm dial
- One running hour meter
- One manual-off-auto switch
- One set Start/Stop push buttons
- One green “Motor Running” indicator light
- One red “Motor Stopped” indicator light

- One MCB motor heater MCB
- One Blue heater on indicator light
- One yellow overload trip indicator light

SS 22.20 OVERLOAD PROTECTION

Unless otherwise specified in the project document, three element thermal overload relays shall be used for motor overload protection. These should be sensitive enough to give protection under single phasing conditions. Bi-metal strip type may be used provided there is no question of permanent distortion of the element as a result of a severe over-current condition. Provision for adjustment must be incorporated into the design so that the overload can be accurately set.

If required in the Project Document overload protection shall be brought to the front of the panel for resetting by operating staff without having to gain control panel access.

SS 22.21 ADDITIONAL EQUIPMENT FOR MOTOR STARTERS

Unless otherwise specified the following additional equipment shall be incorporated in each motor starter :

- One relay or set of auxiliary contacts and suitable fuses for the motor heater
- One motor “HEATER ON” indicator light (blue)

Systems which Require “No Flow” Protection

- One timer for “No Flow”
- One relay for “No Flow”
- One “Amber” “No Flow” trip indicator light
- One “No Flow” cancel push button

Submersible Pumps

- One TP 250 or 300 MA earth leakage relay
- One earth leakage test push button
- One green “Motor Run” indicator light
- One amber “Motor Trip” indicator light

Standby Selector

- Where two or more machines are required to operate in a Duty/Standby mode suitable stepping equipment and circuitry shall be incorporated in the relevant motor starter cubicle to transfer the signal automatically from one starter to another. This facility is required to ensure that the machines share the duty cycle alternately

OR

- Where the project specification specifically calls for manual change-over selector switches. These switches shall be supplied instead of an auto change-over system and shall be mounted independently of the starters they control.

Power Factor Correction

All starters for motors of 15kW and above shall incorporate.

One suitably rated contactor

- Three suitably rated circuit breakers for the capacitor/s which shall raise the power factor to 0,9.

SS 23 DISTRIBUTION TRANSFORMERS

SS 23.1 GENERAL

This specification covers the manufacture of single-phase or three-phase distribution transformers for general reticulation and distribution systems in normal environmental conditions for 50 Hz, threephase, medium voltage primary systems and three-phase, four-wire 400V/231V secondary systems. In view of the impending change in standard voltages, transformers shall be supplied with 420V secondary windings.

The general design and construction of the transformer shall comply with the requirements of SANS 780. The following standards have reference:-

BS 171:1970	Power transformers
BS 60076-8:1997	Power transformers
BS 2562	Cable boxes for transformers and reactors
IEC 76	Power transformers
IEC 60085	Recommendations for the classification of materials for the insulation of electrical machinery and apparatus in relation to their thermal stability in-service
IEC 60354	Loading guide for oil-immersed transformers
IEC 551	Measurement of transformer and reactor sound levels
SANS 555	Insulating oil for transformers and switchgear (un-inhibited)
SANS 32	Internal and or External Protective Coatings for Steel Tubes
EN10240:1997	
SANS 1019:2001	Standard voltages and currents for electric power supply
SANS 780-4.9.3:	Insulated bushings
IEC 71-1	
SANS 1037	Standard transformer bushings

SANS 1158 Two -pack epoxy-resin based primers

SANS 1325 Two -pack epoxy-resin based solution and solvent-free paints

SANS10064 Preparation of steel surfaces for coating

SANS Methods 140, 141

The bushings and cable sealing boxes shall comply with the requirements of paragraph 4.9 of the current issue of SANS 780.

Unless otherwise stated in the schedule of requirements (SOR), the transformer shall be of the twowinding type and the vector group shall be Dyn ll.

The transformers shall be designed for the system fault level as set out in the schedule of requirements.

SS 23.2 RATINGS

The rated power of the transformer shall be stated in the SOR and shall be one of the standard values given in Table 7 of SANS 780.

The transformers shall be capable of operating continuously on any tapping at the rating, altitude and under the atmospheric and climatic conditions as set out in the detailed specification.

In the case of a tapped winding, the rated voltage corresponds to the no load voltage at 0% tap, this being the tap on which all normal guarantees and ratings apply.

SS 23.3 LOSSES

The losses shall be in accordance with Clause 5.8 of SANS 780. No transformer having a total loss in excess of the tolerance (Table 7) will be accepted.

SS 23.4 TANKS

Single-phase transformers shall be of the sealed type with the tank covers welded to the tank.

Three-phase transformers shall be of the sealed type up to power ratings of 400kVA. Transformers rated at 500kVa and above may be of the free-breathing or sealed type.

Sealed transformers with a rating of 500kVA and above shall be fitted with a pressure relief device, secured to the welded tank cover.

Free-breathing transformers shall be fitted with a dehydrating breather.

Welded tops will only be considered provided both LV and HV V bushings and the tap changed mechanism can be replaced without the removal of the top.

SS 23.5 CONSTRUCTIONAL DETAILS AND FITTINGS

Unless otherwise specified in the SOR, the fittings for transformers as specified in Table of SANS 780.

The transformer shall have tapings provided on the higher voltage winding for varying the no-load voltage by ± 2,5% and ± 5% of the rated primary voltage.

The transformer shall provide for tap changing to be carried out with the transformer off circuit by means of an externally operating tapping switch. Particular attention shall be paid to preventing leakage of oil through the tapping switch mechanism. Tenderers shall submit a drawing showing the tapping switch.

A maximum indicating thermometer shall be provided on all transformers with a power rating of 500kVa and above to sense the oil temperature directly above a winding. One pair of alarm contacts shall be calibrated to close at 85ºC and one pair of trip contacts shall be calibrated to close at 95ºC. These contacts shall not b e easily adjustable without removal of a cover or shell. The maximum temperature indicator shall be manually re-settable.

Guides shall be provided inside the tank to locate the core and windings securely. A drawing showing the method of locating the core and winding shall be submitted with the tender.

Longitudinal skid under bases shall be provided on all transformers of power ratings of 100kVA and above. Axles and wheels are not required.

Jacking lugs shall be provided if required in the SOR.

A drain valve for oil sampling purposes shall be provided on all free-breathing transformers.

The dimensions of the transformer shall be in accordance with Table 2 SANS 780.

SS 23.6 BUSHINGS AND CABLE BOXES

Open bushings or cable boxes will be specified for the primary side and outdoor terminals shall be provided on secondary side of the transformers.

If cable boxes are specified for the high voltage side these shall be as follows:-

- Porcelain bushings shall have screwed stems with nuts and locknuts enclosed in a cable box directly attached to the transformer tank and independent of the tank cover. The box shall be suitable for 3-core, 95mm² AL PL PVC SWA S cable entering vertically from below and shall be provided with a brass wiping gland. The distance between the top of the gland and the terminals should be 500mm minimum and the distance between the bottom of the cable gland and floor level should be 300mm minimum. The cable box cover-plate and base-plate shall be removable and there shall be no fixed front bottom barrier flange.

The low voltage side shall consist of:-

- Four outdoor type porcelain bushings with screwed stems, nuts and locknuts and flag-type connectors shall be provided.

The boxes shall be suitable for filling with hard-setting, semi-fluid or fluid compound.

Disconnecting chambers, as per paragraph 4.9.4a of SANS 780, and shall be in accordance with BS 2562:1979 shall be supplied on transformers on which oil or compound filled cable boxes are specified.

Where XLPE cables are specified on the MV side or where PVC/SWA/PVC cables are specified on the LV side, cable boxes, which comply with the following requirements, shall be provided :-

- The cable boxes shall be of the metal clad type suitable for indoor and outdoor use and suitable to accept PVC or XLPE insulated and armoured cables as specified.

- The boxes shall be air insulated and shall be equipped with an un-drilled Brass or Non ferrous gland plate of adequate size to accommodate the required cable glands for bottom cable entries.

- Where single core cables are used the base plate of the cable box shall be manufactured of nonferrous material.

- Clamps to support the cable immediately below the crutch of the termination shall be provided.

Where oil or compound filled cable boxes are specified an adequate quantity of filling compound shall be provided.

SS 23.7 CORROSION PROTECTION

Corrosion protection shall comply strictly with paragraph 4.17 of SANS 780. Where the transformers are required for installation within 50km of the coast, the total dry film thickness of the paint shall be increased to at least 0,125mm.

Painting shall preferably be by the flow process and Tenderers shall state the method used for painting the unit. The colour of the outer coat shall be an acceptable match to colour Nº C12 Avocado of SANS 1091.

SS 23.8 METHOD OF COOLING

The transformer shall be of the oil-immersed, naturally cooled type (ONAN).

SS 23.9 OIL

The transformers shall be supplied completely filled with oil. The oil shall comply with SANS 555. Sealed transformers shall be fitted with passivated transformer oil.

The transformers shall be dried out at the factory and shall be filled with oil to normal level before despatch and shall be delivered ready for service.

SS 23.10 TEMPERATURE RISE

Temperature rise shall be in accordance with Clause 5.3 of SANS 780 and shall be in accordance with SANS 60076-2

SS 23.11 TECHNICAL INFORMATION

All the relevant technical information, i.e. outline drawings and drawings of rating plate, etc as specified in paragraph 7.1 of SANS 780, shall be submitted to the Engineer.

The transformer may be used at points in the system where the fault level will be 350 MV.A at 11kV. The units shall be designed for this fault level.

The transformer, when assembled and ready for service, shall be guaranteed to be capable of withstanding the requirements of SANS 780, Table 5 for a system highest voltage as specified in the SOR.

Tenderers shall complete the Performance Data Schedule attached hereto. Failure to do so will render the tender document incomplete and therefore be disqualified from adjudication.

The following drawings shall be supplied:

- Two copies of outline drawing.
- Two copies of diagram of connections.
- Two copies of drawing of tap-changing switch.
- Two copies of drawing of core-arrangement.

SS 23.12 TESTS

Routine tests in accordance with SANS are required. Type tests may be required if specified in the detailed specification.

VOLKSRUST WTW shall be permitted to have a representative present when the tests are carried out. Seven days notice shall be given of the date of the tests and as many tests as possible shall be conducted concurrently.

Two copies of the Contractor's record of the results of all tests carried out on each transformer shall be supplied, i.e. routine and type tests.

SS 23.13 INSTALLATION

If a buchholz relay is fitted to the transformer, it shall be tested on-site which shall be witnessed by the Engineer.

Once the transformer has been placed in position on-site, a 1000V "Megger" test shall be performed between windings and also between windings and earth before any cables are connected to the transformer. Arrangements shall be made by the Contractor for the Engineer to witness these tests.

If required in the Project Specification, the transformer shall be installed in the position indicated on the drawing. Cognisance shall be taken of trench layouts and the transformer positioned so as to avoid unnecessary bends in the cables or bus bars.

In the case where bus bars are used on the low voltage side of the transformer, the Contractor is responsible for the co-ordination between the transformer and bus bar manufacturer to ensure that the neutral point termination is accessible at the transformer. The neutral point is to be bonded to the transformer earth point by means of an insulated 70mm copper conductor.

SS 23.14 GUARANTEE

Transformers shall be supplied with a twelve month guarantee for the replacement free of charge, of any portion of the transformer in which any manufacturing and/or design that may develop within that period.

3 PROCUREMENT

3.1 Preferential procurement procedures

The works shall be executed in accordance with the conditions attached to preferences granted in accordance with the preferencing schedule.

3.2 Scope of mandatory subcontract work

The following portions of the works shall be subcontracted to CIDB registered contractors in accordance with the subcontracting procedures described hereunder:

Competitive Bids shall be invited in respect of each of the above portions of the works in accordance with the relevant provisions of the latest edition of the CIDB Standard for Uniformity in Construction Procurement. The Contract Data in the associated procurement documents shall be based on the use of BIFSA Non-Nominated Subcontract for use with the JBCC Series 2000 Principal Building Agreement / CIDB Standard subcontract (labour only) / JBCC series 2000 Nominated / Selected Subcontract Agreement / SAFCEC General conditions of subcontract (2003 edition) (select appropriate option) / NEC Engineering and Construction Subcontract / NEC Engineering and Construction Short Subcontract with m inimal project specific variations and amendments that do not change their intended usage.

The Employer together with the Contractor shall evaluate the Bids received in accordance with the provisions of the Standard Conditions of Bid contained in Annex F of Standard for Uniformity in Construction Procurement. The evaluation panel shall comprise equal representatives from the Employer and from the Contractor.
The Contractor shall without delay enter into contract with the successful Biding subcontractor based on their accepted Bid submission. The Contractor shall remain responsible for providing the subcontracted portion of the works as if the work had not been subcontracted.

4 Construction

Setting out of Works (Subclause 5.1.1)

The contractor together with the beneficiary of the toilet shall arrange the preferable position of the toilet taking in it account the distance from and too the household. ”

4.1 Applicable national and international standards

- SANS 1200

4.2 Particular / generic specifications

The relevant provisions of the SANS 1200 (1981 edition) shall apply to the contract with the following amendments:

1115 Replace clause with the following:

The general conditions of contract are the General Conditions of Contract for Construction Works (2015) as published by the South African Institution of Civil Engineering read in conjunction with the Contract Data.

1202 Replace “Clause 15” with “Clause 12”.

1206 Replace the first sentence with the following:

The contractor shall comply with all legal provisions in regard to surveying and setting out work.

1209(e) Replace “Clause 52” with “Clauses 29 and 49.2”.

1210 Replace “Clause 54” with “Clause 51”.

1212(1) Replace “Clause 49” with “Clause 46”.

1215 Replace “Clause 45” with “Clause 42”.

1217 Replace “Clause 35” with “Clause 31”.

1303 Replace “Clauses 49 and 53” with “Clause 50”.

13.01(3) Replace “Clauses 12 and 45” with “Clauses 1.1.4 and 42”.

14.03(c) Replace “Clause 40(1)” with “Clause 37”.

1505 Replace “Clauses 40 and 53” with “Clause 37”.

3204(b)(iii) Replace “Clauses 40 and 53” with “Clause 37”.

4.3. EPWP labour intensive specification

4.3.1 Labour intensive competencies of supervisory and management staff

Contractors having a CIDB contractor grading designation of **3CEPE** and higher shall only engage supervisory and management staff in labour intensive works who have either completed, or for the period 1 April 2004 to 30 June 2006, are registered for training towards, the skills programme outlined in Table 1.

The managing principal of the contractor, namely, a sole proprietor, the senior partner, the managing director or managing member of a close corporation, as relevant, having a contractor grading designation of 1CE, 2CE and 3CEPE shall have personally completed, or for the period 1 April 2004 to 30 June 2006 be registered on a skills programme for the NQF level 2. All other site supervisory staff in the employ of such contractors must have completed, or for the period 1 April 2004 to 30 June 2006 be registered on a skills programme for, the NQF level 2 unit standards or NQF level 4 unit standards.

Table 1: Skills programme for supervisory and management staff

Personnel	NQF level	Unit standard titles	Skills programme description
Team leader / supervisor	2	Apply Labour Intensive Construction Systems and Techniques to Work Activities	This unit standard must be completed, **and**

		Use Labour Intensive Construction Methods to Construct and Maintain Water and Sanitation Services	any one of these 3 unit standards
		Use Labour Intensive Construction Methods to Construct, Repair and Maintain Structures	
		Implement labour Intensive Construction Systems and Techniques	
Foreman/ supervisor	4	Use Labour Intensive Construction Methods to Construct and Maintain Water and Sanitation Services	This unit standard must be completed, **and**
		Use Labour Intensive Construction Methods to Construct, Repair and Maintain Structures	any one of these 3 unit standards
		Manage Labour Intensive Construction Processes	
Site Agent / Manager (i.e the contractor's most senior representative that is resident on the site)	5		Skills Programme against this single unit standard

4.3.2 Employment of unskilled and semi-skilled workers in labour-intensive works

4.3.2.1 Requirements for the sourcing and engagement of labour.

4.3.2.1.1 Unskilled and semi-skilled labour required for the execution of all labour intensive works shall be engaged strictly in accordance with prevailing legislation and SANS 1914-5, Participation of Targeted Labour.

4.3.2.1.2 The rate of pay set for the EPWP is R 180 per task or per day.

4.3.2.1.3 Tasks established by the contractor must be such that:

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.

4.3.2.1.4 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 4.3.2.1.3.

4.3.2.1.5 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

4.3.2.1.6 The Contractor shall endeavour to ensure that the expenditure on the employment of temporary workers is in the following proportions:
a) 60 % women;
b) 20% youth who are between the ages of 18 and 25; and
c) 2% on persons with disabilities.

4.3.2.2 Specific provisions pertaining to SANS 1914-5

4.3.2.2.1 Definitions

Targeted labour: Unemployed persons who are employed as local labour on the project.

4.3.2.2.2 Contract participation goals

4.3.2.2.2.1There is no specified contract participation goal for the contract. The contract participation goal shall be measured in the performance of the contract to enable the employment provided to targeted labour to be quantified.

4.3.2.2.2.2 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.

4.3.2.2.3 Terms and conditions for the engagement of targeted labour

Further to the provisions of clause 3.3.2 of SANS 1914-5, written contracts shall be entered into with targeted labour.

4.3.2.2.2.4 Variations to SANS 1914-5

4.3.2.2.2.4.1The 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.

4.3.2.2.2.4.2 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.

4.3.2.2.2.5 Training of targeted labour

4.3.2.2.2.5.1The 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.

4.3.2.2.2.5.2 The cost of the formal training of targeted labour, will be funded by the provincial office of the Department of Labour. This training should take place as close to the project site as practically possible. The contractor, must access this training by informing the relevant provincial office of the Department of Labour in writing, within 14 days of being awarded the contract, of the likely number of persons that will undergo training and when such training is required. The employer must be furnished with a copy of this request.

4.3.2.2.2.5.3 A copy of this training request made by the contractor to the DOL provincial office must also be faxed to the EPWP Training Director in the Department of Public Works– Cinderella Makunike, Fax Number 012 328 6820 or email cinderella.makunike@dpw.gov.za Tel: 083 677 4026.

4.3.2.2.2.5.4 The contractor shall be responsible for scheduling the training of workers and shall take all reasonable steps to ensure that each beneficiary is provided with a minimum of six (6) days of formal training if he/she is employed for 3 months or less and a minimum of ten (10) days if he she is employed for 4 months or more.

4.3.2.2.2.5.5 The contractor shall do nothing to dissuade targeted labour from participating in training programmes.

4…2.2.2.5.4 An allowance equal to 100% of the task rate or daily rate shall be paid by the contractor to workers who attend formal training, in terms of 4.3.2.2.2.5.4 above.

4.3.2.2.2.5.5 Proof of compliance with the requirements of 4.3.2.2.2.5.2 to 4.3.2.2.2.5.6 must be provided by the Contractor to the Employer prior to submission of the final payment certificate.

4.4 WORKS and equipment

Add Subclause 4.4: Restriction on the use of WORKS.

"Except for the type of WORKS, and to the extent permitted in terms of the project specification or approved by the Engineer, in writing, the Contractor shall use only hand tools and equipment in the construction of the Works, or portion(s) of the Works, that are required in terms of the project specification to be constructed using labour intensive methods.
Failure by the Contractor to adhere to this clause will put him in breach of contract. The provisions contained in this contract with regard to labour content and labour intensive construction, are binding, and will be enforced accordingly."
The WORKS and equipment used on the site shall not be inferior to that described in the Schedule of WORKS and Equipment.

5 Management

5.1 Applicable SANS 1921 standards

The following parts of SANS 1921 Construction works standards and associated specification data are applicable to the works:

1) SANS 1921-1:2004
2) SANS 1921-2:2004
3) SANS 1921-6:2004

The abovementioned South African National Standards make several references to the Specification Data for data, provisions and variations that make these standards applicable to this contract. The Specification Data shall have precedence in the interpretation of any ambiguity or inconsistency between it and these standards.

Each item of Specification Data given below is cross-referenced to the clause in the standard to which it mainly applies.

The associated Specification Data is as follows:

SANS 1921-1, Construction and management requirements for works contracts – Part 1: General engineering and construction works	
Clause	**Specification data**
Essential data	
4.1.7	There are no requirements for drawings, information and calculations for which the contractor is responsible
4.2.1	The responsibility strategy assigned to the contractor for the works is A.
4.3.1	The planning, programme and method statements are to comply with the following: 1)Microsoft projects programme 2)Detailed method statements 3)Milestone dates for completion State requirements for format of programme, level of detail, critical path activities and their dependencies, frequency of updating, etc., if not provided in the contract data. Provide particulars of phased completion, programme constraints, milestone dates for completion, etc., as necessary. State requirements for sequencing, as required. State any requirements for software for programmes.
4.3.3	The notice period for inspection is 24 hrs
4.7.3	The over break allowances for blasting are provided for in the scope of work.
4.9.3	The trees and shrubs which are not to be disturbed are identified in the scope of work.

4.12.2	The samples of materials, workmanship and finishes that the contractor is to provide and deliver to the employer.
4.14.3	The office accommodation, equipment, accommodation for site meetings and other facilities for use by the employer and his agents are: 1) **Site office** which shall be used for site meetings and for the contractor's use. Such an office shall comprise a minimum of $20m^2$ in area and 3 m high, be ventilated, have good lamination, must be reasonably sound proof, and have a hard floor construction. It shall be furnished with a desk on which drawings can be rolled open and on which there is sufficient writing space and sufficient temporary chairs or benches to accommodate all persons present at site meetings.
4.14.5	The Contractor is required to provide latrine and ablution facilities.
4.14.6	The requirements for the provision and erection of separate sign boards for consultants and subcontractors are: 1) The boards must comply with the official standard type signboard of the Employer and be at least 2750 x 1800 mm high. 2) The boards must be constructed with a firm flat exposed face using suitable material of firm construction, painted and lettered according to the standard drawings available from the Employer on request and mounted on sturdy pipe-standards at a height of 1800 mm above natural ground level.
4.17.1	The requirements for the termination, diversion or maintenance of existing services are: 1) Water 2) Electricity 3) Sanitation
4.17.3	Services which are known to exist on the site are: 1) Water 2) Sanitation 3) Electricity
4.17.4	Requirements for detection apparatus.

Variations

Additional clauses

1 **Site meetings and procedures**

The Employer's Representative and the Contractor shall hold meetings relating to the progress of the works at regular intervals and at other such times as may be necessary. The Contractor shall attend all site meetings and shall ensure that all persons under his jurisdiction are notified timeously of all site meetings should the Employer's Representative require their attendance at such meetings.

The Contractor shall keep on site a set of minutes of all site meetings, daily records of resources (people and equipment employed), a site instruction book, a complete set of contract working drawings and a copy of the procurement document and make these available at all reasonable times to all persons concerned with the contract.

Water: The Contractor is to provide, and remove and make good upon completion, all the necessary temporary plumbing connections and purchase water from the local authority for the works at his own cost.

Electricity: The Contractor is to provide, and remove and make good upon completion, all the necessary temporary electrical connections and installations and purchase electricity form the local authority / ESKOM for the works at his own cost.

5.2 Particular / generic specifications

The management of the site shall be in accordance with the provisions of the COLTO Standard Specification for Road and Bridge Works for State Authorities (1998 edition), obtainable from the South African Institution of Civil Engineering.

5.3 Recording of weather

The Contractor shall erect an effective rainfall gauge on the site and record the daily rainfall figures in a book. Such book shall be handed to the employer's representative for his signature no later than 12 days after rain that is considered to justify an extension of time occurs.

5.4 Unauthorized persons

The Contractor shall keep unauthorized persons from the works at all times Under no circumstances may any person except guards be allowed to sleep on the building site.

5.5 Management meetings

Site meetings will be held on monthly basis. The following parties are required to attend these meetings: the Employer's Representative, the Engineer and/or Representative, the Contractor and/or Representative, the Community Liaison Officer, the Health and Safety Officer and all members of the Project Steering Committee.

5.6 Forms for contract administration
5.7 Electronic payments

5.8 Daily records

All accidents and incidents shall be recorded daily in a site diary. Apart from the site diary the Contractor shall provide a site instruction notebook for use by the Engineer. The notebook shall be signed by both the Engineer and the Contractor whenever a site instruction is issued by the Engineer.

5.9 Payment certificates

Contractor to submit claims for the work done. All claims are subjected to verification by the Engineer.

5.10 Permits

Contractor to ensure that no unauthorized persons are permitted to site.

5.11 Proof of compliance with the law

Contractor to submit copies of the CIDB Registration and the Company Registration Certificates.

DR. PIXLEY KA ISAKA SEME LOCAL MUNICIPALITY

T15/2023: APPOINTMENT OF A CONTRACTOR FOR REFURBISHMENT OF VOLKSRUST WATER TREATMENT WORKS

C4. Site Information

Site Inspection

The tenderer shall inform him/ herself on the nature of the site and inspect the site.

The Employer will consider a tender only if the site inspection and/or tenderer's meeting arranged by the Engineer has been attended by a representative who must:

- Be suitably qualified to comprehend the implications of the work involved and
- Be the tenderer him/herself or a person in the direct employ of the tenderer

Locality Maps for Volksrust Water Treatment Work

Locality	Volksrust
Province	Mpumalanga Province
District	Gert Sibande District Municipality
Municipality	Dr Pixley Ka Seme Local Municipality
GPS Coordinates	27°22'23.5"S "29°51'52.2"E.

ANNEXURE A

SCHEDULE OF PERSONNEL AND EMPLOYEES

The Tenderer shall state below the number of Personnel and Employees to be employed on the Works.

PERSONNEL AND EMPLOYEES	**TENDER**			**TENDER**
	FULL TIME	**PART TIME**	**FULL TIME**	**PART TIME**
1. Technical staff				
2. Clerical staff				
3. Artisans				
4. Semi-skilled				
5. Unskilled labour				
Total				

State the name, qualifications and experience of permanent Site agent:

Date: ……

SIGNATURE OF TENDERER: ……..

ANNEXURE B

PRELIMINARY PROGRAMME

The Tenderer shall detail below or attach a preliminary programme reflecting the proposed order and rate of progress for each portion of the work comprising this Contract. The programme shall be consistent with and in support of his time required for completion and shall be in accordance with the requirements of this tender.

PROGRAMME												
ACTIVITY	**WEEKS / MONTHS**											

SIGNATURE OF TENDERER; ……..

ANNEXURE C

SITE INSPECTION CERTIFICATE

This is to certify that I,
……

representing and duly authorized by (Tenderer) …….

……..

attended the site inspection on

……

Having prior to this site visit carefully examined the tender document, technical information and drawings supplied, I confirm that I was given unrestricted access to inspect those sections of the Site necessary for the execution of the Works.

I further confirm that I am completely satisfied with the scope of work as explained by the Engineer, and am fully aware of all Site conditions and regulations of whatsoever nature that could influence the preparation of our tender.

I therefore append my signature below in agreement that we will not institute any claim against the Employer after submission of our tender based on lack of knowledge of site conditions or regulations appertaining to the execution of this Contract.

Signature of Tenderer's Representative Date

Signature of Representative of the Municipality Date

ANNEXURE D

FINANCIAL DETAILS, STATEMENTS AND BANK REFERENCES

1. FINANCIAL STATEMENTS

I/We agree, if required, to furnish a copy of the latest audited set of financial statement together with my/our Director's and Auditor's report for consideration by the DR. PIXLEY KA ISAKA SEME LOCAL MUNICIPALITY.

2. DETAILS OF CONTRACTOR'S BANK ACCOUNT

I/We furnish the following information:

a) Account Holder Name:……..
b) Name of Bank:……
c) Branch of Bank: …….
d) Town/city/suburb where bank is situated:……..
e) Contact Person at the Bank:……
f) Telephone number of Bank: Code: ……. Number: ……..
g) Account Number:……..
h) Bank rating (include confirmation from bank or financial institution):……

I/We hereby authorize the Employer to approach the above Bank for a reference.

SIGNED ON BEHALF OF THE TENDERER:……

DATE: ……

ANNEXURE E

4. SPECIAL CONDITIONS OF CONTRACT

The following Special Conditions of Contract (SCC) shall apply to this contract and the Employer undertakes that the only variations from the General Conditions of Contract are as follows:

SCC 1 Clause 1(1)(1) **"Employer "** means **DR. PIXLEY KA ISAKA SEME LOCAL MUNICIPALITY** Herein represented by their Nominee.

SCC 2 Clause 1(1) m **"Engineer"** means the Employer's representative.

SCC 3 Clause 14 **Survey References**

The following sub-clause is added at the end of Clause 14(3) and is numbered 14(4):
"The Contractor shall take adequate precautions to preserve any permanent beacons such as erf boundary pegs, reference marks and bench marks which may be present on or in the vicinity on the site, irrespective of whether any such beacon may have been placed before or during the construction period. "Should any such beacon be distributed by any act or omission on the part of the Contractor or any officer, servant, agent or invitee of the Contractor then the Contractor shall arrange for the displaced beacon to be replaced by a registered land surveyor within such limits of time as the Engineer may prescribe and all costs, charges and expenses arising from such replacement shall be borne by the Contractor.
"Survey diagrams relating to the replacement of beacons in the circumstances described in the previous paragraph shall be submitted by the land surveyor concerned to the Director for Works of the Mpumalanga Department of Works for approval. IN this regard, attention is drawn to Clause 35(1) of the Survey Act No. 9 of 1927 (as amended)."

SCC 4 Clause (1) **Drawings and Documents**

The following shall be added to this Sub-Clause:
Upon receipt of the final payment in respect of the Contract, the Contractor shall forthwith return to the Employer's name. "None of the documents herein before mentioned shall be used by either of the parties hereto for any purpose other than the performance of their respective obligations under the Contractor. "Drawings supplied to the Contractor by the Employer or Engineer, or supplied by the Contractor and approved of by the Engineer or Employer shall not be departed from without the written instructions of the Engineer or Employer. "All dimensions will be figures on the drawings and are to be considered correct even if not to scale. No dimension shall be obtained by scaling."

SCC 5 Clause 24 **Competent employees**

Add the following:

Approved on-site training of the labour force by the Contractor will be required for all facets of the construction work involved under this contract.

SCC 6 Clause 16(2) **Contractor's copies**

The Contractor will be issued free of charge two sets of paper prints of all drawings, one copy of the tender document and one copy of the signed contract document. Additional copies will be to the Contractor's account.

SCC7 Clause 38(7) **Workmen's compensation**

Amend Clause 38(7) as follows:

The Contractor shall provide proof, that he has paid all contributions required in terms of the provisions of the Workmen's Compensation Act (Act No 30 of 1941, as amended), within 28 days of the Commencement Date.

SCC 8 Clause 45(2) **Extension of Time for Completion**

Where the Engineer grants the Contractor extension of time for the completion of the Works the Contractor shall not be entitled to any additional payment for items included under Quantities in respect of such extension of time. This provision shall, however, not prejudice any claim under Clause 51 of the Conditions of Contract.

SCC 8(b) Shortage of Materials

The Tenderer shall ascertain that materials on which his tender based will be available on a continuous basis for the execution of the contract. No additional remuneration or extension of time will be granted should it become necessary to obtain material from other sources.

SCC 9 Clause 49(2) **Application of Contract Price Adjustment**

These clauses shall be deleted in total. Allowances for escalation must be made in the rates tendered for the items stated in the Schedule of Quantities, ie rates shall remain fixed for the full contract period.

SCC 10 Clause 52(2) **Valuation of Material Brought onto site**

Add the following:

Payment for materials on site will only be made for those materials which are physically on site, for which proof of ownership by the Contractor is given an for which ownership has been ceded to the Employer.

The Contractor shall remain responsible for the materials and shall insure them against all risks until such time as they are used or built into the works and taken over by the Employer.

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C3 PREAMBLE TO SCOPE OF WORK

GENERAL

This section specifies and describes the engineering and construction works which are to be provided and any other requirements and constraints relating to the manner in which the contract work is to be performed.

SCOPE

These Project Specifications are set out in two portions:

PORTION A: COVERS A GENERAL DESCRIPTION OF THE PROJECT, THE FACILITIES AVAILABLE AND THE REQUIREMENTS TO BE MET.

PORTION B: COVERS VARIATIONS TO THE STANDARDISED SPECIFICATIONS AND PARTICULAR SPECIFICATIONS WHICH ARE APPLICABLE TO THE CONTRACT.

STATUS

The Project Specifications together with the drawings and Schedule of Quantity indicate the section of Standard Specification applicable to this Contract.

In the event of any discrepancy between parts of the Standard Specification and the Project Specifications, the latter shall take precedence and shall govern.

PORTION A: PROJECT DESCRIPTION AND GENERAL INFORMATION

PS 1 DESCRIPTION OF THE WORKS

PS 1.1 EMPLOYER'S OBJECTIVES

There are four primary objectives of the Project.

1) Raw water abstraction
2) Raw water flow meter
3) Lime dosing
4) Lime delivery/Receiving of lime bags
5) Flocculant dosing

6) Flocculant storage and transfer
7) Dosing Point (lime + flocculant) and Rapid mixing
8) Flocculation and Sedimentation
9) Rapid gravity filtration
10) Filter Backwashing
11) Disinfection
12) Clear water meters
13) Civil structures
14) Clean Water to Reservoirs

PS 1.2 OVERVIEW OF THE WORKS

The work to be carried out under this contract includes the supply of equipment, material, and labour for the successful completion of the project within the constraints of time, cost and quality. The project entails construction of a bulk water mains, bulk sewer outfall and sewage transfer pump station with electromechanical installation of Pumps and concrete palisade fence enclosures.

PS 1.3 EXTENT OF THE WORKS

Extent of the works

Raw water abstraction

- The valve chamber must be drained.
- Establish the source of water leakage.
- Repair the pipe or valve connection.
- Grass cutting is required around the Raw Water storage dam

Raw water flow meter

- Adequate lighting must be provided.
- Railing and other support must be installed to reduce the risk of operators falling inside the chamber and getting `injured.

Lime dosing

- Clean and refurbish lime receiving, mixing, and dosing equipment.
- Optimize water -lime ratio and mixing conditions inside the lime mixing tank

Lime delivery/Receiving of lime bags

- Supply and install new bag handling frame.

- Repair existing 0.5 tonne electric hoist
- Install missing handrails next to the lime feeder

Flocculant dosing

- Redo installation of electrical wiring, piping and dosing pump installation.
- Supply and install standby dosing pump.

Flocculant storage and transfer

- Supply and install new standby flocculant transfer pump.
- Reconnect second flocculant storage tank to flocculant transfer pumps.
- Improve housekeeping.

Dosing Point (lime + flocculant) and Rapid mixing

- An alternative standby dosing procedure must be implemented to ensure dosing of chemicals at the inlet works is uninterrupted during Eskom Load shedding periods.

Flocculation and Sedimentation

- In addition to daily desludging, Sedimentation tanks 3 and 4 must be drained and cleaned and recommissioned

Rapid gravity filtration

- Refurbish/replacing faulty valves.
- Repair and replacement of partialisation units for the siphons
- Concrete repairs are required around the filters.
- Refurbishment of 7(seven) sand filters inclusive of nozzles, pipes, filter media, fixing floor cracks and wall cracks, replace all stop lead and replace floats
- Consider replacement of spindles with valves with different type of actuators (pneumatic or electric)
- Consider automating valves for the filters.
- Repair broken tiles and leakages

Filter Backwashing

- Service both backwash pumps, connect and recommission pumps to run as duty- standby.
- Service both blowers, connect and recommission blowers to run as duty- standby.
- Backwash process must be automated.

Disinfection

- Refurbishment and upgrade of Chlorine cylinder storage area is required to improve safety conditions for operators.

Clear water meters

- Service all 3 clear water pumps, re install and ensure that all 3 pumps are running and available.
- Repair level sensor and automate the operation of clear water pumps.

MCC Panel in Pump Room

- New MCC must be assembled and installed outside the pump room.
- New MCC must cater for automation of backwash pumps, blowers and clear water pumps.
- Old MCC to be decommissioned and removed.

Final Clear Water Flow Meter (To Town Reservoir)

- The flow meter chamber must be drained.
- Establish the source of water leakage.
- Repair the pipe or flow meter connection.

Final Clear Water Flow Meter (To 4 ML Reservoir)

- Adequate lighting must be provided.
- Railing and other support must be installed to reduce the risk of operators falling inside the chamber and getting injured.

Main building and other civil structures

- Refurbish windows and doors.
- Carry out repairs inside and outside the building

The Contractor ’s obligations shall also include strict compliance with any Environmental requirements and/or reports deemed to form part of this Contract as well as any Occupational Health and Safety requirements.

This description of the works is not necessarily complete and shall not limit the work to be carried out by The Contractor under the Contract. Approximate quantities of each type of work are given in the Schedule of Quantities.

PS 1.4 LOCATIONS OF THE WORKS

The works are in Volksrust , Volksrust, under Dr Pixley ka Seme Isaka Seme Local Municipality.

PS 1.5 TEMPORARY WORKS

The Contractor shall, as relevant:

a) provide temporary drainage works, temporary pumps and other equipment as might be necessary for the protection, draining and dewatering of the works; and

b) construct and maintain haulage, temporary access and construction roads, subject to the approval of the Employer, and permit the Employer, other The Contractor s, statutory bodies or any other person who might require legitimate access to or through the site for executing legitimate business, free and unhindered usage of such roads.

c) temporary water connections, The Contractor 's offices, storage sheds, latrines, barricading of Works shall be in an approved position and subject to the approval of all authorities concerned.

d) Safety and security of the Contractor s' temporary works shall be at the Contractor s' discretion, but always in accordance with stipulated Occupational Health and Safety requirements.

e) The camp shall be adequately guarded during or outside working hours.

f) include the works required to locate, verify and protect existing services within the works area;

g) be such to ensure no or limited interruption to vehicular and pedestrian traffic; and

h) be such that existing storm water flow shall not be impeded during survey and construction activities.

Further, The Contractor vshall note that no stockpiling of materials, WORKS, excavated material or any other construction related infrastructure shall be allowed in locations that may interfere with the operations of the Employer and the public in general.

PS2 ENGINEERING

PS 2.1 EMPLOYER'S DESIGN

The Contractor undertakes only construction based on designs issued by the Employer. The Contractor is to follow the specification, the design and construction drawings as laid out by the Employer.

PS 2.2 DRAWINGS

PS 2.2.1 LIST OF DRAWINGS

Drawings are included in this Contract Document based on current available information. Such drawing may be updated (based on actual site situation uncovered during execution of the works) and re-issued during the Contract Period as required.

Drawings include:

a) Typical construction details.

b) Construction Drawings

PS 2.2.2 CONSTRUCTION DRAWINGS

a) As above

PS 2.2.3 SHOP DRAWINGS

Where an item to be supplied in conformance with this Contract specification has not been designed by the Employer, The Contractor shall be required to supply the Employer with 3 copies of detailed shop drawings prior to delivery of materials, including an electronic copy in drawing format that is compatible with the software packages (AutoCAD or DXF) used by the Employer.

NOTA BENE: Only on approval of such shop drawings or an amended version thereof, shall The Contractor proceed with the manufacturing, supply and installation of the designed item.

PS3 PROCUREMENT

PS 3.1 PREFERENTIAL PROCUREMENT PROCEDURES

The Employer promotes preferential procurement.

PS 3.2 SUBCONTRACTING

The commitment of the Employer to Government Policy concerning the empowerment of the SMMEs shall be noted and adhered to by The Contractor. It is against this background that the Employer has made provisions under this contract to ensure that The Contractor impart skills to the local sub-The Contractor s within the project area during the project implementation.

It is the intention of the Employer that the minimum targeted participation goal for the local sub-The Contractor s is for but not limited to the full value of subcontracting works identified by the Employer as covered in the Bill of Quantities. The onus is upon the main The Contractor to handle and manage the procurement process of the sub-The Contractor s and once appointed, should be dealt with in accordance with the provisions of Clause 4.4 of the General Conditions of Contract 2010.

The identified scope of work by the Employer includes but not limited to the above.

The minimum requirements for selection of the sub-The Contractor s are as follows:

1. Valid CK registration
2. SA ID copies of owners
3. Active CIDB membership: **minimum grading 1CE/ME/EE**
4. Valid Tax clearance certificate
5. COIDA certificate
6. Company Profile including relevant experience and skilled personnel CVs
7. Health and Safety Plan

The Contractor is:

a) to enter contract with any (nominated, selected) Sub - Contractor (s) in accordance with the requirements of Clause 4.4 in the General Conditions of Contract for Civil engineering Works (2010),2nd edition. The number of Sub - Contractor (s) will be determined by the main The Contractor depending on the Subcontracting Scope of Work and the amount of work that is to be carried out under this Contract as outlined above and in the Bill of Quantities.

b) Required to utilise local Sub - Contractor (s) (or regional if he fails to find suitable Sub - Contractor (s) from within the project locality)

c) Responsible for all work executed (including QUALITY, CONTRACTUAL LIABILITIES) on his behalf or under his supervision and/or management by all sub-The Contractor s, including nominated or selected sub-The Contractor s.

Note:

- **Local** Sub - Contractor (s) are Sub - Contractor (s) from within the project suburb or ward.
- **Regional** Sub - Contractor (s) are Sub - Contractor (s) from within the region as per the Dr Pixley ka Isaka Seme Local Municipality demarcation of the regions.

The Contractor shall be expected to enter a contract with the nominated or selected Sub - Contractor (s) in accordance with the requirements of Clause 4.4 the General Conditions of Contract. The Employer must be supplied with a copy of the contract/agreement for records.

***NOTA BENE**: The Employer shall not negotiate directly with sub-contractors and all problems relating to programming, workmanship, etc., as they are matters between the Contractor and his sub-contractor (s).*

In the execution of the Subcontract Work, the Contractor shall ensure that the Sub - Contractor (s) comply with all relevant legislation and regulations including, but not confined to, the Occupational Health and Safety Act. The Contractor hereby indemnifies the Employer against any loss, damage, or claim for Subcontract Works set out for the Project Scope arising out of the former's failure to comply with instructions issued to him regarding these requirements.

PS 3.2.1 PERFORMANCE AND EXECUTION OF THE SUBCONTRACT WORK

The Contractor must ensure that his Sub - Contractor (s) shall supply sufficient, suitable resources (e.g. equipment, labour, material) to execute all the Subcontract Work including the portion identified by the Employer as outlined in the Scope of Work PS 3.2 and Bill of Quantities.

The Contractor shall also ensure that the Sub - Contractor (s) shall execute the Subcontract Work in accordance with the Scope of Work and Programme to the reasonable satisfaction of the Employer.

PS 3.2.2 QUALITY OF THE SUBCONTRACT WORK

In accordance with the requirements of Clause 4.4 in the General Conditions of Contract for Civil Engineering Works (2015), 3nd edition, it is the responsibility of The Contractor to ensure that the Sub-Contractor shall be capable of executing the Subcontract Work efficiently and in accordance with the Scope of Work.

PS 3.2.3 Laws and Regulations

The Contractor shall ensure that the Sub - Contractor (s) complies with the paying of all amounts due in respect of his employees and himself in terms of all relevant legislation and regulations including, but not confined to, the

- Income Tax Act, the
- Compensation for Occupational Injuries and Diseases Act,
- Unemployment Insurance Act,
- Basic Conditions of Employment Act,

PS 3.2.4 RESOURCES TO COMPLETE SUBCONTRACT WORK

Although it is preferred by the Employer that The Contractor ensure that the Sub - Contractor (s) supply all required resources such as labourers, equipment, hand tools, power-driven tools if need be, which are required by him for the execution of the Subcontract Work, however the onus is upon The Contractor to determine the extent of resources the Sub- Contractor shall supply to ensure that the works are completed in time. The agreement between The Contractor and Sub- Contractor is The Contractor 's responsibility and Employer is indemnified from any agreements entered between The Contractor and his Sub- Contractor(s)

PS 3.2.5 PAYMENT

The Contractor shall ensure that Sub - Contractor (s) are paid within stipulated time as per the Agreement with the Sub- Contractor failure which The Contractor can be reported to the Employer and may prejudice his future employment with Employer.

PS 3.2.6 RETENTION MONIES

The Employer will deduct Retention money for the overall works including the Sub-Contract Work at the percentage stated in the Contract Data.

PS 3.2.7 Resolution of Disputes

Should any dispute between The Contractor and the Sub- Contractor arise out of the provisions of the Subcontract, or the execution of the Subcontract Work, every effort shall be made by

the Parties to resolve the matter themselves without the intervention of the Employer. The agreement signed between The Contractor and Sub- Contractor should state dispute resolution procedure.

PS4 CONSTRUCTION

PS 4.1 GENERAL CONDITIONS AND APPLICABLE STANDARDS

PS 4.1.1 GENERAL CONDITIONS

The “Special Condition of Contract” to be read in conjunction with the “General Conditions for Construction Works (GCC 2015).

PS 4.1.2 APPLICABLE STANDARDIZED SPECIFICATIONS

The Standard Specifications for all associated civil work applicable to this Contract shall be:

SANS DESCRIPTION

28 : Metal ties for cavity walls (1986)

227 : Burnt clay masonry units (2007)

282 : Bending dimensions and scheduling of steel reinforcement for concrete (2004)

523 : Limes for use in building (2007)

558: Cast iron surface boxes and manhole and inspection covers and frames (1973)

674: 2008

920 : Steel bars for concrete reinforcement (2005)

1024 : Welded steel fabric for reinforcement of concrete (2006)

1083 : Aggregates from natural sources - Aggregates for concrete (2006)

1090 : Aggregates from natural sources - Fine aggregates for plaster and mortar (2002)

1200 A : General (1986)

1200 AB: Employer's office (1986)

1200 C : Site clearance (1980)

1200 D : Earthworks (1988)

1200 DB: Earthworks (Pipe trenches) (1989)

1200 DK: Gabions and Pitching (1996)

1200 G : Concrete (Structural) (1982)

1200 GA: Concrete (Small works) (1982)

1200 GE: Precast Concrete (1984)

1200 L : Medium pressure pipelines (1983)

1200 LB: Bedding (Pipes) (1983)

1200 LC: Cable ducts (1981)

1200 LF: Erf connection (water) (1983)

1200 LG: Pipe jacking (1983)

1200 DM: Earthworks (Roads, Subgrade) (1981)

1200 LD: Sewers (1982)

1491-1 : Portland cement extenders Part 1: Ground granulated blast-furnace slag (2005)

1491-2 : Portland cement extenders Part 2: Fly ash (2005)

1491-3 : Portland cement extenders Part 3: Silica fume (2005)

1882: Polymer concrete surface boxes, manhole and inspection covers, gully gratings and frames (2003)

50197-1: Cement - Part 1: Composition, specifications and conformity criteria for common EN 197-1 cement

5831 : Presence of chlorides in aggregates

5861-2 : Concrete tests - Sampling of freshly mixed concrete (2006)

5862-1 : Concrete tests - Consistence of freshly mixed concrete - Slump test (2006)

5863 : Concrete tests - Compressive strength of hardened concrete (2006)

5864 : Concrete tests - Compressive strength of hardened concrete (2006)

5865 : Concrete tests - The drilling, preparation, and testing for compressive strength of cores taken from hardened concrete (1994)

0268-1 : Welding of thermoplastics – Welding Processes

1476:2009: Fabricated flanged steel pipework

Reference is made to certain provisions of:

SANS 1921-5 Construction and management requirements for works contracts: Earthworks activities which are to be performed by hand.

SANS 1914-5 Targeted construction procurement: Participation of targeted labour.

All the above specifications are not issued with this volume but are available at the Contractor ’s expense from: Standards South Africa,

For "Workmen's Compensation Act" read "Compensation for Occupational Injuries and Diseases Act, 1993 (Act No.130 of 1993)" wherever it appears. For "Machinery and Occupational Safety Act" and "Mines and Works Act" read "Occupational Health and Safety Act, 1993 (Act 85 of 1993)" wherever they appear. For "maintenance period" read "Defects Liability Period in terms of Clause 1.1.1.13 of the General Conditions of Contract, 2010" wherever it appears

PS4.1.3 OTHER STANDARDS

Other Standard Specifications applicable to this Contract shall be:

a) ASTM C.309 Type 1 (Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete)

b) WRC MSCC

PS4.2 PARTICULAR GENERIC SPECIFICATIONS

PS4.2.1 MINIMUM HEALTH AND SAFETY REQUIREMENTS

This section of the specifications is to be read in conjunction with the Contract Health and Safety specifications, included as Volume 2. The following requirements shall be deemed minimum compliance requirements to ensure the health and safety of the public and workers during the execution of the Contract:

PS4.2.1.1 ROAD SAFETY EQUIPMENT

The internal conduit survey unit shall be provided with:

a) an amber-flashing beacon, which shall comply with and be operated in accordance with any governing road vehicle lighting regulations or similar.

b) appropriately sized and quantity of road signs, including delineators and cones which shall be displayed at the works area in accordance with safety regulations or similar.

c) bright coloured overalls, fluorescent over-jackets and belts for each team member for use at all working times during the day or night.

PS4.2.1.2 PERSONAL SAFETY EQUIPMENT

The internal conduit inspection unit shall be provided with:

a) oxygen deficiency and gas detector apparatus, which shall be regularly serviced and operable.

b) fresh air breathing apparatus, face mask and demand value, with a sufficient minimum compressed air supply, determined by the duration of manhole and/or conduit entry.

c) an approved full vertical lift safety harness.

d) personal equipment per member:

i) safety helmet;

ii) safety boots;

iii) sewer wading boots; and

iv) disposable protective gloves.

e) First Aid Kit suitable to cater for the number of team members.

f) facilities for washing, including:

i) soft soap;

ii) disinfectant; and

iii) clean water.

g) radio equipment and cellular phone for onsite and emergency communication.

h) fire extinguisher.

PS4.2.2 TRAFFIC CONTROL

a) A traffic control plan shall include detailed diagrams showing the location of all traffic control devices and the length of time for all lane closures, as well as location of any flaggers, as necessary.

b) One lane of traffic in each direction must be maintained at all times.

c) A written method of handling traffic for each different phase of the project shall be submitted and include both vehicular and pedestrian traffic.

d) The name and number of The Contractor representative responsible for traffic control shall be made available to solve traffic problems at each job site location.

PS4.2.3 METRIC MEASUREMENT

All survey recorded dimensions of infrastructure shall be in metric units, including for conduits, chambers and manholes.

PS4.2.31 CONCRETE, FORMWORK AND REINFORCEMENT

NOTA BENE: All in situ concrete work (mass and reinforced) shall comply with SANS 1200G (”8. Measurement and Payment" is not applicable) supplemented by the clauses in this section. Where:

- SANS 1200G and the clauses in this section are in conflict, the clauses in this section shall take precedence.
- the term "plain concrete" appears in SANS 1200G it shall be read as "mass concrete".

PS4.2.31.1 CEMENT

Cement shall be Portland cement (or similar approved) complying with the requirements of SANS 50197-1/EN 197-1 or SANS 5831.

Samples of cement from anyone, or from every consignment, may be required by the Employer’s authorized representative for test purposes. Cement in any consignment from which a sample may have been taken for testing shall not be used until it has been approved. Allowance shall be made for possible delay in that tests may take 10 days to carry out.

Bags of cement shall be stacked in a waterproof, solidly constructed shed with a central door and a floor rendered damp-proof with a tarpaulin. The bags of cement shall be closely stacked (but not

against walls) in order to reduce air circulation in such a manner that the cement is used in the order in which it was received, i.e. first in first out.

PS4.2.31.2 SAND (FINE AGGREGATE)

The fine aggregate shall comply with the requirements of SANS 1083. Other aggregates may be approved if they have a satisfactory history and/or test results.

No aggregate may be used until it has been approved. Samples having a mass of 25kg (16,5l) of the aggregate proposed to be used may be required by the Employer's authorized representative for test purposes. Samples having a mass of 25kg shall be forwarded every 3 months during concreting work and also if the source of supply is changed. Allowance must be made for possible delay in that the tests may take 14 days to carry out.

PS4.2.31.3 STONE (COARSE AGGREGATE)

a) The coarse aggregate shall comply with the requirements of SANS 1083. No aggregate may be used until it has been approved. Samples having a mass of 25kg (16,5l) of the aggregate it is proposed to use may be required by the Employer's authorized representative for test purposes. Samples shall be during concreting work and also if the source of supply is changed. Allowance must be made for possible delay in that the tests may take 14 days to carry out.

NOTA BENE: Certain fine-grained sand and stone originating from the Beaufort Series and Karoo Systems which are known by reputation, local experience or tests, to exhibit excessive shrinkage when used in concrete, may be deemed unacceptable by the Employer's authorized representative

b) A certificate of proof is required from The Contractor that the aggregates are not alkali reactive. The cost of testing and certification are to be done by Contractor.

PS4.2.31.4 CONCRETE

Concrete shall be of the classes given in the following table. The proportions of the ingredients and the nominal size of the coarse aggregate for each class shall be as laid down therein:

Class	**Cement**	**Aggregate**			**Strength (MPa)**
	Part	**Fine**	**Coarse**	**Size**	
		Part	**Part**		
A	1	4	8	50	10
B	1	3	6	38	15
C	1	3	6	19	15

D	1	2	4	38	25
E	1	2	4	19	25
F	1	1 1/2	3	19	30
G	1	1	2	19	40

The strength given in the above table shall be the minimum required at 28 days. Unless otherwise specified Class B concrete shall be used for mass concrete and Class E concrete for reinforced concrete.

Maximum concrete slumps acceptable for different types of construction concrete are as follows:

a) Vibrated reinforced concrete = 50mm

b) Un-vibrated reinforced concrete = 75mm

c) Mass concrete = 75mm

When so required by the Employer's authorized representative, and whilst concreting is in progress, the consistency of the mixture shall be ascertained by means of the slump test as later described herein.

PS4.2.31.5 VOLUME BATCHING

The coarse and fine aggregate shall be measured by volume and, unless otherwise directed, cement shall be measured by mass: the volume of a 50-kg bag of cement shall be taken as 33l. Suitable measuring boxes for the coarse and fine aggregates shall be provided to the approval of the Employer's authorized representative

The proportions given above are approximate only, and should the Employer's authorized representative consider that the voids in the coarse aggregate require more or less matrix than is formed by the proportions specified, he may vary the quantities of coarse and fine aggregates to obtain the required density and workability of the concrete, provided that the proportion of cement to the total volume of the aggregate shall not be less than that specified.

When the sand is not completely dry, allowance must be made for bulking due to the moisture content. The amount of bulking shall be determined by The Contractor in the presence of the Employer's authorized representative

The amount of water shall never exceed 34l to every bag of cement used, including the water contained in the sand.

Effective screens shall be provided to protect the mixing of concrete during windy weather.

PS4.2.31.6 WEIGH BATCHING

The proportioning of the coarse and fine aggregates by mass shall be permitted, providing the method used is approved by the Employer's authorized representative

a) All requests received by the Employer's authorized representative to make use of weigh batching shall be submitted to the Structural Engineer for approval.

b) If the weigh batching process is preferred to volume batching, the proposed mix proportions are to be equivalent to the relevant volumetric mixes as documented previously herein and be based on a minimum cement content.

c) The following procedures must be complied with:

i) The Contractor must timeously obtain written approval for the use of weigh batching and submit all information as set out below, with his application.

ii) The mix transformation from volume to weigh batching shall be carried out at an approved laboratory.

iii) Weigh batching equipment must be calibrated and a certificate of accuracy must be submitted before such equipment may be used. On contracts of long duration and/or requiring large quantities of concrete, new calibration certificates may be required every four months.

iv) The cement to aggregate ratio by volume for the following mixes will apply:

- Class C (15 MPa) - c/a = 1:9
- Class E (25 MPa) - c/a = 1:6
- Class F (30 MPa) - c/a = 1:4.5
- Class G (40 MPa) - c/a = 1:3

v) The following cement/water ratios by mass must also be complied with:

- Class C (15 MPa) - c/w = 1.30 to 1.35
- Class E (25 MPa) - c/w = 1.65 to 1.80
- Class F (30 MPa) - c/w = 1.90 to 2.05
- Class G (40 MPa) - c/w = 2.30 to 2.50

PS4.2.31.7 READY MIXED CONCRETE

Any application to use ready mixed concrete shall be submitted by The Contractor at an early stage for approval by the Structural Engineer. Only suppliers on the Employer's approved list will be considered.

New applications must be submitted to the Employer, well in advance.

PS4.2.31.8 STRENGTH CONCRETE

The Contractor shall be responsible for the design of strength concrete and for the measurement of the constituent materials to produce concrete that complies with the specified requirements.

a) Trial mixes

The Contractor shall ensure that samples of the constituent materials of the concrete, together with evidence that they comply with the provisions, are supplied for approval in good time and provide the

Employer's authorized representative with:

i) a statement from an approved independent laboratory of the results of tests; or

ii) an authoritative and acceptable report, or record of the previous use of and experience with, the material concerned.

The cement, types of aggregate and their origins shall not be changed throughout the duration of the Contract without giving prior notification to the Employer who shall verify that the above requirements are complied with and that the important qualities of the concrete shall not be impaired.

b) Consistency

Unless otherwise indicated by the general workability of the concrete, method of transportation, conditions of placement or otherwise specified by the Employer, the suggested slump values, for different mixes of concrete shall be as specified in this document.

c) Workability

Ensure that the concrete is of such workability that it can be readily compacted into the corners of the formwork and around reinforcement without segregation of the materials and without excessive "bleeding" of free water at the surface.

PS4.2.31.9 EXPANSION ALKALI-AGGREGATE REACTION

The use of some local aggregates may lead to an expansive alkali-aggregate reaction if the concrete in the structure will be exposed to continual dampness or will be subject to alternate wetting and drying.

Alkali reactive aggregates, i.e. certain granites, quartzites and Malmesbury hornfels (shale), shall not be used in conjunction with high alkali cement for concrete in any part of the works. Where a high alkali cement shall be one in which the equivalent alkali content exceeds 0,60% by mass of the cement.

If the Contractor chooses to use one of the aggregates stated above in lieu of stone as described in this document, he shall:

a) ensure that no high alkali cement is delivered to the site. Any such high alkali cement shall be rejected and the cost of its removal and replacement with cement having an acceptable alkali content shall be borne by him.

b) provide certificates stating the alkali content of each delivery of cement to the site, based on tests carried out at a laboratory approved by the Employer. The cost of testing, including sampling, transporting of samples and issuing of certificates, shall be borne by him.

c) be entitled to use an approved brand of cement as a means of ensuring that the permissible alkali content is not exceeded. Where he shall make allowance for the higher price of such approved brand, if he chooses to use this method.

PS4.2.31.10 PUMPING OF CONCRETE

The placing of concrete by pumping in any section of the works shall be subject to the written approval of the Employer's authorized representative The Contractor shall furnish full details regarding the mix proportions of the concrete that he intends to place by pumping.

PS4.2.31.11 ADMIXTURES TO CONCRETE

The use of admixtures in concrete shall only be considered should special circumstances warrant this and only with the prior written approval of the Employer. The Contractor shall provide the following information:

a) the trade name of the mixture, its source and the manufacturer's recommended method of use;

b) typical dosage rates and possible detrimental effects of both under and over dosage; and

c) the expected average air content of freshly mixed concrete containing an admixture which causes air to be entrained when used at the manufacturer's recommended rate of dosage.

PS4.2.31.12 SLUMP TEST

The apparatus and the method of determination of the slump of freshly mixed concrete shall comply with SANS 5862-1.

a) Apparatus

i) A mould in the form of a frustum of a cone and having the following nominal internal dimensions:

- Bottom diameter : 200mm
- Top diameter : 100mm
- Height : 300mm

The mould shall:

- be of a metal (other than brass or aluminum) of side thickness at least 1.6 mm and shall have a smooth internal surface.
- have suitable base plate and handles to facilitate lifting it from the test specimen in a vertical direction.

ii) The tamping bar shall have a nominal diameter of 16mm, a length of 600mm and with sharp corner rounded off at one end.

d) Procedure:

The test shall be carried out in an area that is free from vibration and shocks. Ensure that the internal surfaces of the mould are free from set concrete and are clean and dry.

Place the mould with the bottom on a smooth, horizontal, rigid, non-absorbent surface and hold the mould firmly in place while it is being filled as follows:

i) in four layers, each thickness approximately one-quarter of the height of the mould. Tamp each layer with 25 strokes uniformly spaced over the cross-section of the mould. Tamp the bottom layer throughout its depth and ensure that when tamping the second and subsequent layers the strokes penetrate into the underlying layer.

ii) after the top layer has been tamped, strike off the concrete level so that the mould is exactly filled. Clean off any concrete that may have leaked out between the mould and the supporting base-plate surface. Remove the mould from the concrete immediately by slowly and carefully raising it in a vertical direction. This will allow the concrete to subside.

Immediately measure the slump, to the nearest 5mm, by determining the difference between the height of the mould and the height of the specimen.

Regard the test as invalid, if a slump specimen collapses or shears off laterally, discard the result and repeat the test.

PS4.2.31.13 CONCRETE CUBES

The apparatus for making and testing of concrete cubes shall comply with SANS 5863.

a) Apparatus

Cubic metal moulds shall:

- be steel;
- be machined and adequately strengthened to resist distortion;
- have an internal distance between faces of 150mm;
- be constructed so as to facilitate the easy removal without damage of the moulded specimen; and
- have a metal base plate which shall be attached to the mould by springs or screws.

When assembling the mould for use, the joints between the sections of the mould, the contact surfaces between the bottom of the mould and the base plate, and the internal faces of the assembled mould shall be thinly coated with a grease or oil that will prevent leakage of water through the joints and adhesion of the concrete to the mould.

The tamper must be a steel bar of length 400mm and mass 1.8kg and having a 25mm square ramming face.

b) Sampling and making cubes

Sampling shall comply with SANS 5861-2.

One set of 3 cubes shall be required for every 40m3, or part thereof, of concrete cast. The sample taken from a batch of concrete and sufficient to make 3cubes shall be placed in a tray or on a platform and mixed thoroughly.

The moulds shall each be filled in 3 layers of approximately 50mm thick concrete. Each layer shall be compacted with the tamping rod, with at least 35 blows to give full compaction of the concrete.

After the top layer has been compacted, strike off the surface of the concrete with a trowel, level with the top of the mould.

Any small hollows shall be filled in with additional concrete. Cement/sand slurry shall not be worked into the surface.

At this stage, the identity of each sample shall be placed on the moulded cube, by means of a label of absorbent material and not by scouring of the surface of the concrete.

c) Curing cubes on site

Cover the test cubes in their moulds with an impervious sheet or wet sacking and store indoors in a place that is free from vibration, excessive draughts, cold and direct sunlight.

After 24 hours, the cubes shall be demoulded, remarked with a waterproof crayon or marker and placed in a curing tank for 7 days before being transported to the laboratory.

The Contractor shall supply the curing tank which shall incorporate a thermostat to control the water temperature at 22 to 25°C and shall be kept within a building.

d) Testing of cubes

The testing of all concrete cubes shall be done in accordance with SANS 5863 by a laboratory approved by the Employer.

A suitable testing machine of sufficient capacity having an accuracy and repeatability that comply with the requirements for Grade A machines of BS 1610 "Method for the load verification of testing machines" shall be used to test the compressive strength of each cube.

The Contractor is responsible for the provision of the cube moulds and for timeous delivery of the cubes to the laboratory.

PS4.2.31.14 CONCRETE QUALITY

Should the Contractor dispute any results obtained from concrete test cubes, the concrete represented by the cubes shall be considered acceptable if The Contractor , at his own cost, proves to the satisfaction of the Employer's authorized representative that the estimated actual strength of cores taken from the structure (by an approved independent testing laboratory and determined in accordance with SANS 5865 is not less than the specified strength. If the concrete fails to meet the strength criteria stipulated, the Employer's authorized representative may at his sole discretion and in addition to the options listed in SANS 1200G:

a) accept the concrete subject to approved remedial measures being undertaken by The Contractor at his own cost; or

b) permit the concrete to remain, subject to reduced payment for lower strength concrete.

PS4.2.31.15 CONCRETING

It is essential that the Contractor 's representative who has charge of the construction of all concrete work, whether reinforced or not, shall be skilled in this class of work, and shall personally supervise the whole construction, paying special regard to:

a) the quality, testing and mixing of the materials;

b) the laying of the material in place and the thorough compaction of the concrete to ensure solidity and freedom from voids;

c) the construction and removal of formwork; and

d) the sizes and positions of the reinforcement.

Particular care shall be taken to work concrete against formwork and around reinforcement. Internal vibrators may be used with the approval of the Employer's authorized representative but external vibrators which act only on the formwork WILL NOT be permitted.

Concrete to be reinforced shall be deposited in such quantities as will permit of it being properly compacted around the reinforcement.

The placing of concrete shall be completed within ½ hour after mixing or within ½ hour after agitating and within 2,5 hours after mixing in the case of ready mixed concrete. Under no circumstances shall concrete be incorporated into the work after it has attained its initial set.

Care shall be taken to prevent, as far as possible, the formation of laitance or scum. Laitance is to be understood to mean the scum of strengthless and inert material which forms on the surface of concrete.

Concrete shall not be dropped into position from a height greater than 2.5m unless prior approval is obtained from the Employer's authorized representative.

If an inclined chute is used for transporting concrete, it shall be of such slope as will ensure a continuous flow of concrete without the use of an excessive quantity of water and without segregation of the aggregates. The chute must be flushed out and properly cleaned before and after each working period. All waste from flushing shall be discharged outside the formwork.

In beams, each portion of a successive layer shall be placed as soon as the concrete below has been properly worked around reinforcement and against formwork. Concreting shall be carried forward in irregular steps, that is to say, one layer shall not be completed over the whole section before the succeeding layer is commenced. Concreting of slabs and beams shall, as far as possible, be carried forward in one operation. When concreting has to be interrupted the concrete shall be left with a level, rough top surface with ends vertical. The concrete shall not be merely sloped down.

On resuming concreting, the old surface shall be roughened and all laitance thoroughly and carefully removed before any new concrete is deposited. This must be carried out by brushing the surface of the concrete while it is still green. Great care must be taken to avoid any weakness at the junction of old and new concrete and the old surface shall be coated with a thin layer of cement and sand mortar, in the same proportions as that of the adjoining concrete.

While the concrete is setting, it shall not be disturbed or shaken by traffic, either on the concrete itself or upon adjoining formwork.

No holes in concrete elements shall be patched or filled in without inspection, instruction and approval of the Employer's authorized representative

No concreting shall be carried out when the air temperature is below 4°C when it is rising and 8°C when it is falling.

Before concreting is commenced The Contractor shall give the Employer's authorized representative 48 hours' notice of his intention to do so.

Concrete surface beds, excluding heavy industrial floors etc. shall be Class C concrete and shall be laid in suitable size panels not exceeding 20m^2 in area and with the length of any panel not exceeding 4.5m.

Where concrete beams are supported on concrete columns, the columns are to be concreted up to the underside of such concrete beams and then concreted up to the top of the beams, integral with the beams.

NOTA BENE: Any finish applied to the surface of concrete floors, is to be understood as being additional to the thickness of the concrete described or shown on the drawings.

PS4.2.31.16 CURING OF CONCRETE

After the concrete has been placed, all exposed surfaces shall be kept continuously damp for at least 10 days by methods as may be approved by the Employer's authorized representative, such as covering with approved building paper, or by means of wet canvas, wet sacks, wet sand, by continuous hosing or ponding with water.

PS4.2.31.17 CONCRETE LINTELS (CAST IN-SITU)

Concrete lintels cast in-situ shall be of Class E concrete, reinforced with steel reinforcement as well as of depths specified in the table hereunder. Each lintel shall be the full thickness of walls into which they are cast and 450mm longer than width of openings.

Clear or daylight span	**Depth in brick courses**	**Reinforcement**
< 1m	3	Nil
≥ 1m ≤ 1.5m	3	One 12mm diameter mild steel rod, 40mm up from bottom, for each half brick width of soffit.
> 1.5m ≤ 2m	4	One 16mm diameter mild steel rod, 40mm up from bottom, for each half brick width of soffit.
> 2m	To detail	To detail.

PS4.2.31.18 BUILDING ON CONCRETE FOOTINGS AND BEAMS

No brickwork, stone walling or other structure shall be built on concrete footings until at least 3 days after placement of the concrete in the case of mass concrete footings and after 7 days in the case of reinforced concrete footings or as may otherwise be directed by the Employer's authorized representative

No brickwork, stone walling or other structure shall be built on reinforced concrete beams or similar members until the formwork and all propping or supports have been removed.

PS4.2.31.19 SLIP JOINTS BETWEEN CONCRETE AND BRICKWORK

Slip joints shall be provided between brickwork and concrete slabs and beams by levelling up and troweling smooth the bearing surfaces of brickwork with 3:1 cement mortar and covering the bearings before the concrete is cast, with two layers of one side smooth tempered hardboard, with the smooth sides in contact.

The ends and sides of beams and edges of concrete slabs shall be separated from the brickwork with 13 mm thick bitumen impregnated soft board or expanded polyethylene strips placed vertically against the brickwork before the concrete is cast.

Similar slip joints shall be provided between brickwork and concrete lintels cast in situ, but without soft board or expanded polyethylene strips at ends.

PS4.2.31.20 MOVEMENT JOINTS

All movement joints are to be filled in with approved bitumen impregnated soft board or expanded polyethylene strip unless otherwise specified or detailed on drawings. Form similar movement joints where pathways adjoin structures externally.

PS4.2.31.21 CUTTING, PUNCHING OR HACKING CONCRETE

No reinforced concrete shall be cut or hacked without the approval of the Employer’s authorized representative

PS4.2.31.22 FORMING KEY TO CONCRETE FOR PLASTER AND OTHER FINISHES

Where rough formwork has been used, surfaces of concrete to receive plaster and other finishes, shall, immediately after the formwork has been removed, be well wetted and wire brushed whilst the concrete is still green and then slushed over with 2:1 cement grout to form a key for the finish, all to the approval of the Employer’s authorized representative The slushing is to be allowed to set hard before the finish is applied.

Where smooth formwork is used, surfaces of the concrete to receive plaster and other finishes shall be hacked, on the distinct understanding that hacking of concrete shall be at no extra cost.

Surfaces of concrete receiving plaster or other finishes shall not be plastered or finished until the Employer's authorized representative has signified his opinion that the surfaces are suitable to receive plaster or other finishes.

PS4.2.31.23 SLEEVES PIECES

Where it is necessary to leave plugs or holes in beams, slabs or any other reinforced concrete, all such plugs or holes must be situated in positions approved by the Employer's authorized representative before concreting. Where it is necessary to carry pipes, bolts, wires or any other fittings through reinforced concrete members, approved pipe sleeves must be provided and placed in position before concreting.

All necessary bolts, plugs, brackets, cramps, etc. shall be cast into the concrete as the work proceeds.

PS4.2.31.24 TIES

Where brickwork abuts against concrete, the brickwork is to be tied to the concrete with galvanized hoop-iron ties 1.6mm thick by 3mm wide and approximately 600mm long to every third course of brickwork with one end of each tie cast approximately 150mm deep into the concrete. Where such fixing is impossible, i.e. where steel formwork is used, the ties are to be gun-nailed against concrete with steel nails not less than 38mm long.

PS4.2.31.25 BAGGED FINISH TO CONCRETE

Concrete surfaces to receive bagged finish shall be prepared by removing sharp projections and making good defects with 3:1 cement mortar. Finish by rubbing over the whole area with wet rough sacking and cement grout to obtain an even surface.

PS4.2.31.26 POWER FLOATED FINISH

Power floated finish to floors or slabs means that surfaces shall be floated mechanically to a smooth and even finish before the concrete has set. Small areas inaccessible to the machine are to be floated by hand. Under no circumstances is cement mortar to be added while floating the concrete.

PS4.2.31.27 "NO-FINES" CONCRETE

"No-fines" concrete, for grading flat concrete roofs and the like to falls, shall be in the proportion of 12 parts 19 iron cubical stone to 1-part cement mixed with 20l water per bag of cement and be

laid to falls of not less than 15mm per linear metre for mastic asphalt and not less than 20mm per linear metre for sheet roof covering. For heavy load applications special mix designs may be required.

a) Fillets against upstands

Form triangular fillets, size 75 x 75mm, in corners with walls, kerbs, etc. neatly mitred at angles, stopped where necessary and finished smooth ready to receive waterproofing.

b) To raised floors, bases and other

"No-fines" concrete for raised floors, bases, etc. shall be in the proportions specified. Finish smooth with 3:1 sand/cement screed to receive waterproofing.

PS4.2.31.28 CELLULAR CONCRETE

Cellular concrete, for grading flat concrete roofs and the like to falls, shall be laid in situ in required layers; the bottom layer having a density of 400kg/m3, dressed to falls by varying the thickness, and a 20mm thick top layer having a density of 960kg/m3.

PS4.2.31.29 FORMWORK

Formwork shall include all shuttering, casing and centering of material required for the laying and forming of concrete floors, slabs, beams, lintels, walls, steps, columns, piers, pilasters and any other concrete work requiring moulds or forms and shall embrace all cleats, battens, fillets, wedges, struts, trestles, braces, props, shores and other requirements of material for keeping all in correct position. All materials used for formwork must be suitable and substantial and all joints must be tight enough to prevent leakage of liquid matrix.

All formwork must be designed by The Contractor and if requested to do so, he must submit fully detailed and dimensioned working drawings to the Employer’s authorized representative for checking purposes. Acceptance of the proposals shall not relieve The Contractor of his responsibility for the safety and stability thereof nor for any loss or damage arising out of defective design, materials and/or workmanship.

The formwork must be so constructed that its partial removal can be carried out to the satisfaction of the Employer’s authorized representative and in such stages as are required by the working conditions. As far as possible, wedges and clamps must be used in preference to nails. All formwork in its various sections for floors, beams, etc. must be so arranged that the whole may be raised or lowered either independently or together with other sections by means of wedges or other approved methods.

Immediately before concreting is begun, the formwork in contact with the concrete must be thoroughly cleaned, wetted and kept damp whilst the concrete is being placed.

Great care must be taken to keep the formwork wedged up to its correct height and this must be checked by taking levels immediately before concreting is commenced and immediately after it has been completed.

All beams shall have a camber of 6mm to every 3m of length.

The minimum periods that the formwork to the various parts of the structure is to remain in position after concreting shall be as stated in the following table:

Description	**Normal cement**		**Rapid hardening cement**	
	Weather		**Weather**	
	Normal	**Cold**	**Normal**	**Cold**
Beam sides, walls, unloaded columns	2 days	4 days	1 days	2 days
Slabs with props left under	4 days	7 days	2 days	4 days
Beam soffits with props left under including ribbed slabs	7 days	12 days	3 days	5 days
Removal of slab props	10 days	17 days	5 days	9 days
Removal of beam props	14 days	28 days	7 days	12 days

When determining the stripping time for formwork the weather shall be considered to be "normal" when the temperature is above 18°C and "cold" when the temperature is between 5°C and 10 °C, these being the average daily temperatures of the atmosphere adjacent to the concrete. When the average daily temperature lies between the above values for "normal" and "cold" weather the minimum period for stripping of formwork shall be determined by the Employer's authorized representative

Notwithstanding the above minimum periods, formwork may be struck immediately, once the concrete in the various parts of the concrete work has attained the crushing strengths required by the Employer's authorized representative the crushing strengths must be determined by proper tests, which shall be carried out by the Contractor .

No formwork of any nature shall be struck, either after the elapse of the minimum periods stated in the above table or on the attainment of the required crushing strengths of the concrete, without the prior consent of the Employer's authorized representative Such consent shall not absolve The Contractor of his responsibility for the safety of the works.

In structures having either in whole or in part, two or more reinforced concrete floors, props shall be provided under the soffits of any beam or slab of any floor which is being used to support the formwork and wet concrete of the floor above, all to the approval of the Employer's authorized representative The props shall not be removed until the formwork supporting the concrete of the floor above has been struck.

Under no circumstances shall steel formwork be oiled where concrete is to receive plaster.

PS4.2.31.30 SMOOTH FORMWORK

Smooth formwork shall be any material approved by the Employer's authorized representative which is to be used to leave concrete surfaces smooth when removed and where no other finish is to be applied.

PS4.2.31.31 REINFORCEMENT RODS

a) Mild steel

Mild steel shall comply with the requirements of SANS 920, Type A or B.

b) High tensile steel

High tensile steel shall comply with the requirements of SANS 920, Type C or D.

PS4.2.31.32 CONCRETE REINFORCEMENT

a) Rod reinforcement

Bending and hooking of rods shall be done in accordance with SANS 282. Rods shall be bent cold in an effective bending machine, or properly designed rod-bender using a steady pressure and not by hammering.

Diameters, lengths and positions of rods as shown on the drawings must be strictly adhered to. Joints in rods in beams, stairs, etc. will be permitted only where shown on drawings.

Before being placed in position, the rods shall be thoroughly cleaned of all grease, dirt, bituminous material, scale and loose rust.

All distribution rods shall be straight and shall extend at least 150mm into beams or other support. Unless otherwise shown on the drawings, all joints in reinforcing rods shall be lapped 40 times the

diameter of the rod. The laps shall be securely tied with 1.25mm diameter annealed mild steel binding wire.

Reinforcement for piles, column footings, columns and walls shall be tied at every intersection, or as directed or shown on drawings, with similar binding wire. Reinforcement in beams shall be tied at alternate intersections in a diamond pattern, unless circumstances demand every intersection.

Great care must be taken to retain the reinforcement in its correct position during the entire period of concreting. Blocks of fine concrete, size approximately 40 x 40mm, or plastic spacers, shall be provided on the formwork to soffits of beams to ensure than the rods are retained in position and that the correct concrete covering to the main reinforcing rods is provided. The blocks shall be of thickness required and shall be placed under the main reinforcing rods at approximately 600mm centres.

Reinforcement in the top of slabs and the like shall be retained in position by means of cradles (stools), formed of steel reinforcing rod as follows:

- R10 for height range 100-300mm and maximum width of 300mm.
- R12 for height range 310-500mm and maximum width of 45 mm.

Recommended spacing of supports for horizontal bars in slabs:

- not further than 600mm apart (cradles ±1000 mm c/c in both directions) for bar diameters up to 12mm.
- not further than 1,000mm apart (cradles ±1 500 mm c/c in both directions) for bar diameters of 16mm and over.

Stools are to be placed on the bottom layer of reinforcement, securely retained in position and with correct concrete cover as specified. Cradles are to be securely wired to the slab reinforcement with binding wire. Beam rods in different layers shall be separated by means of steel spacer bars of suitable diameters and lengths.

Double mats in concrete walls shall be kept in their respective positions by means of suitable steel clips.

Recommended spacing of supports for vertical bars in walls:

- 1,000mm centres in both directions for bars up to 12mm diameter; and
- 1,500mm centres in both directions for bars of 16mm diameter and over.

Supports can be spaced more closely by the design Engineer, depending upon the circumstances.

All stirrups shall be properly fastened to the rods so as to retain their relative positions during the entire period of concreting.

Welding of main rods will not be permitted unless approval has been given by the

Employer's authorized representative Spot welding in lieu of wiring may be used to secure rods and stirrups in position.

The concrete covering the main reinforcement, unless otherwise specified, shall not be less than that stated in the following table:

Position	**Amount of cover**
Soffit of slabs	**The diameter of the main rods, but never less than 15mm (mm)**
End of beams	40
Soffits of beams	40
Sides of beams	40
Sides of columns	40
Slab underground	40
Concrete walls	25
Walls exposed to ground	40
Ground beams	40
Foundations	75
Water retaining structures and within 1 km from coast	50

In cases not included in the above table the cover shall be not less than 25mm. Depending on the condition of exposure and fire resistance requirements, concrete cover can be varied by the Employer but in no case shall the concrete cover be less than the diameter of the rod to be covered.

The cover shall be measured from the face of the concrete to the outside of main reinforcement nearest the face of the concrete and shall exclude plaster and similar finishing materials.

Three samples of each diameter of reinforcing rods, each approximately 600mm long, must be taken from each consignment of rods of similar diameter, for testing. If any sample is found unsatisfactory, the whole consignment of rods from which the samples were taken shall be rejected.

Top reinforcement in cantilever slabs to be kept in position with a first row of stools or chairs

300mm from the beam or support, and thereafter at a maximum of 40 bar diameters under each bar.

The cover blocks, spacers, bars and stools or chairs are to be placed and/or wired in position by the steel fixer.

b) Welded steel fabric reinforcement

All welded steel fabric reinforcement shall comply with the requirements of SANS 1024. The preferred dimensions are as follows:

1	2	3	4	5	6
Fabric Reference number	**Nominal pitch of wires**	**Nominal diameter of wires**		**Nominal mass***	
	Longitudinal (mm)	**Cross (mm)**	**Longitudinal (mm)**	**Cross (mm)**	**kg/m2**
617	200	200	10.0	10.0	6.17
500	200	200	9.0	9.0	5.00
395	200	200	8.0	8.0.	3.95
311	200	200	7.1	7.1	3.11
245	200	200	6.3	6.3	2.45
193	200	200	5.6	5.6	1.93
100	200	200	4.0	4.0	1.00
772	100	200	10.0	7.1	7.72
655	100	200	9.0	7.1	6.55
517	100	200	8.0	6.3	5.17
433	100	200	7.1	6.3	4.33
341	100	200	6.3	5.6	3.41
289	100	200	5.6	5.6	2.89
278	100	300	6.3	4.0	2.78
226	100	300	5.6	4.0	2.26
133	100	300	4.0	4.0	1.33

*These mass values are based on the wires having mass of 0,00785 kg/mm2 per metre of length.

The actual mass of the fabric should not differ from the nominal value by more than 6%.

PS4.2.32 PRECAST CONCRETE

PS4.2.32.1 MATERIALS

Cement, water, aggregates and reinforcement shall be as described under the concrete section.

PS4.2.32.2 CONCRETE, FORMWORK AND REINFORCEMENT

PS4.2.32.3 CONCRETE

Concrete shall be as described under the applicable concrete section(s). Unless otherwise specified a Class E concrete shall be used but with coarse aggregate of an appropriate size.

PS4.2.32.4 MOULD UNITS

The whole of this work is to be carried out by a specialist, who has appropriately skilled workers in this class of work.

All materials and finishes are to be to the approval of the Employer's authorized representative

The moulds are to be properly constructed in the best and most up to date practice, made up in suitable sections with all necessary reinforcement, cramps, bands, bolts, etc. for fastening together and are to be constructed so that castings can be easily removed and the moulds re-used without distorting.

Those sections of the moulds which will produce the finished faces of the units are to be specially prepared, perfectly smooth, except where the finish is of exposed aggregate, true to shape and coated with a suitable solution which will prevent units adhering to the moulds, while not in any way discolouring the finished surfaces.

All cast units are to be properly cured and no units are to be fixed or built in until 28 days after casting.

Units are to be properly protected from the elements while curing and are to be kept wet for at least 10 days after casting by frequent spraying with clean water.

Form all necessary checking's, mortices, lugs, etc. for cramps and dowels when casting.

PS4.2.32.5 TERRAZZO BLOCKS

Precast terrazzo work shall be generally as prescribed for precast concrete above. The coarse aggregate of the mix of which blocks are to be formed shall be of 10mm stone. The finish to exposed faces shall be 10mm thick.

PS4.2.32.6 SMOOTH FINISH

Where described as "finished smooth from the mould" such surfaces shall have a layer composed of 1-part (volume) cement and 4 parts (volume) clean fine sand, packed against the faces of the mould before placing the concrete backing. The concrete backing shall be deposited into the moulds in a wet state (not dry pressed) whilst the facing is still wet.

Projections shall be rubbed off and faces shall be of even colour and free from blemishes, cracks and other imperfections. Salient angles shall be **arris rounded.**

PS4.2.32.7 SIZES

Sizes given are approximate; The Contractor shall be responsible for ascertaining the exact sizes based on actual measurements.

PS4.2.32.8 REINFORCEMENT

Unspecified reinforcement required for manufacturing, handling and erection purposes and for reinforcing projecting and other unwieldy portions of blocks shall be provided by The Contractor at his discretion, but such action shall be highlighted to the Employer.

PS4.2.32.9 BEDDING, JOINT AND POINTING

Blocks shall be bedded and jointed solidly in cement mortar composed of 3 parts (volume) of sand and 1 part (volume) of cement and shall be pointed with slightly keyed joints.

PS4.2.33 MASONRY

(Including brickwork and stone masonry)

NOTA BENE: Where sizes in descriptions are given in brick units, "one brick" shall represent the length and "half brick" the width of a brick

PS4.2.33.1 LIME

Lime shall be hydrated bedding mortar lime in accordance with the requirements of SANS 523.

PS4.2.33.2 CEMENT

Cement shall be as specified in the concrete section.

PS4.2.33.3 SAND

Sand shall comply with the requirements of SANS 1090, unless specialist advice is obtained. A sample of 25kg must be delivered to an approved laboratory for testing purposes.

PS4.2.33.4 BURNT CLAY BRICKS

a) Burnt clay bricks shall comply with the requirements of SANS 227 and shall be equal in all respects to the selected samples.

b) Clay bricks for foundations shall be as described in (a) above, but extra hard burnt.

c) Where bricks with holes are used, the holes in such bricks must only be filled in solid with mortar where specifically specified.

d) All bricks that do not carry the SABS Mark, must be tested by an approved laboratory.

PS4.2.33.5 FIREBRICKS

Firebricks shall be of well burnt refractory fireclay, resistant to spalling and cracking and of same size as ordinary bricks.

PS4.2.33.6 LOCAL STONE

Local stone shall be from an approved quarry, free from defects and to the satisfaction of the Employer or his duly authorized representative.

PS4.2.33.7 FREESTONE

All freestone shall be the best and most durable of its kind, free from vents, loose beds, oxide veins and other imperfections to the satisfaction of the Employer or his duly authorized representative and shall be set on its natural quarry bed.

PS4.2.33.8 **MORTAR TESTS**

a) Sampling

The frequency of sampling will be decided by the Representative/Agent. Sufficient mortar shall be taken from each of the points of laying to prepare a composite sample to make a set of three mortar cubes.

b) Moulding

Cube moulds with a nominal size of 100mm, that comply with SANS 5863 must be used.

Fill each mould with mortar in three equal layers and compact each layer by means of a tamper. The tamper must be made of hard wood with a flat tamping surface with nominal dimensions of 50 x 25mm and shaped to provide a round stem of approximately 25mm diameter and long enough to afford sufficient hand grip. Immerse the tamper in water for 15 minutes before use.

Each layer of mortar must be compacted by means of 8 evenly spaced pressing strokes of the tamper. After the final layer has been tamped, the excess mortar must be struck off level with the top edges of the moulds.

c) Curing

Cover the test cubes (in their moulds) with an impervious sheet followed by wet matting, sacks or similar material, and store them in a place free from vibration, excessive draughts and direct sunlight.

After 24 hours mark each cube so that it can be identified. After 48 hours the cubes shall be removed from their moulds and placed into water in a curing tank at 22 to 25 °C for a minimum period of 7 days before they are transferred to the approved testing laboratory. Ensure that loss of moisture is prevented during transportation and that they are well protected against damage.

d) Testing of cubes

The testing of all mortar cubes will be done by a laboratory approved by the Employer and in accordance with SANS 5863.

PS4.2.33.9 CEMENT MORTAR

Cement mortar shall be composed of 6 parts (by volume) of sand and 1 part (by volume) of cement. The material shall be mixed dry until of uniform colour and then water added, and the mixture turned over until the ingredients are thoroughly incorporated. Cement mortar shall be produced in such quantities as can be used before commencing to set as no cement mortar that has once commenced to set shall be used in any way.

Care shall be taken in mixing cement mortar to remove from the mixing machine or platform any old mortar that has already set as such mortar may not be incorporated into any new batch.

Mortar should achieve the minimum required strength (in MPa) for the classes of mortar as set out in the National Building Regulations.

PS4.2.33.10 COMPO MORTAR

Compo mortar shall be composed of 6 parts (by volume) of sand — depending on the quality of the sand available, 1 part of lime and 1 part of cement (by volume). The lime and sand shall be mixed dry, then mixed wet, before the cement is added, approximately ½ hour before using and the adding of the necessary additional water as required.

Compo mortar shall be produced in such quantities as can be used before commencing to set, as no compo mortar that has once commenced to set shall be used in any way.

Mortar should achieve the minimum required strength (in MPa) for the classes of mortar as set out in the National Building Regulations.

PS4.2.33.11 BRICKWORK

Brickwork shall be:

a) wherever practicable, built in English bond. No false headers shall be used and none but whole bricks employed, except where legitimately required to form bond.

b) built level and plumb with mortar as specified.

c) laid on a solid bed of mortar and all joints thoroughly grouted up solid throughout the whole width of each course.

d) carried up in a uniform manner, no one portion being raised more than 1.2m above another at any one time.

Clay bricks shall be well saturated with water, in the stack or dump, approximately 2 hours before being used. The tops of walls left unfinished shall be well wetted before work recommences.

NOTA BENE: Cement or concrete bricks shall not be wetted.

All rough and fair cutting, cutting of splays, skewbacks, chamfers, etc. shall be properly performed.

Form or leave all necessary openings for pipes etc. and make good after pipes etc. are fixed in position.

PS4.2.33.12 BRICKWORK IN CEMENT MORTAR

a) All brickwork below damp course level, all isolated piers three bricks wide and under, half brick thick walls and chimney stacks above ceiling level, shall be built in cement mortar as specified.

b) Brick arches and brick lintels shall be built in cement mortar as specified, but in the proportion of 3:1.

NOTA BENE: This clause is essential where compo mortar has been specified.

PS4.2.33.13 MORTAR JOINTS

Mortar joints to brickwork generally shall be 10mm in thickness with level bedding joints.

The joints in brickwork:

a) receiving plaster, tiling or similar finishes shall be raked out whilst the mortar is soft to form key for the plaster or mortar backing. The depth of the raking out shall depend on the condition of the bricks; i.e. the rougher the bricks on face the shallower the raking out and the smoother the bricks the deeper the raking out.

b) shall be flushed off where walls are to be bagged, in readiness for the bagging.

PS4.2.33.14 GROUT IN JOINTS IN BRICK FOUNDATION WALLS

All joints in brick foundation walls shall be grouted in solid with 3:1 liquid cement mortar to obviate any crevices for ant (termite) tracks.

PS4.2.33.15 BRICKWORK THICKNESSES

Walls built in two or three half brick thicknesses shall only be built where bonded brickwork (as specified) proves impractical or where required due to the prescribed bond of faced brickwork, all tied together with metal ties in accordance with SANS 28, of the Butterfly Types only, of sufficient length to allow not less than 75mm of each end to be built into brickwork. Ties shall be evenly spaced at not more than 1m apart to every third course and staggered.

PS4.2.33.16 BRICKWORK IN LININGS

Brick linings to concrete shall be tied thereto with 4mm diameter galvanized crimped wire ties bent at ends and of necessary length to allow 75mm to be cast into concrete and 75mm of the other end to be built into brickwork and evenly spaced at not more than 1m apart to every third course and staggered.

PS4.2.33.17 HALF BRICK THICK WALLS

Half brick thick walls shall be built in cement mortar (as specified) and reinforced with 75mm wide brick reinforcement (as specified), 1 row to every 8 course in height, and built 100mm into main connecting walls. The reinforcement shall be lapped 150mm at end joints, where these are necessary, and 75mm at angles.

Brickwork shall be built level and plumb.

PS4.2.33.18 BEAM FILLING

Beam filling shall be half brick thick, built up in mortar as used in the walls below, cut in between roof timbers and carried hard up to underside of roof covering and flushed up with mortar.

PS4.2.33.19 REINFORCED BRICK LINTELS

Reinforced brick lintels shall be built with sound machine-made bricks in 3:1 cement mortar with all vertical and horizontal joints filled solid with mortar throughout the required number of courses and to a distance of at least 330mm on either side of the clear opening.

The number of courses in lintels over the various size openings shall be as specified in the table hereunder and reinforcing steel wires or rods shall be built into the first horizontal joint over the bottom course to the number specified in the following table:

Clear or daylight span	**Number of courses**	**Reinforcement**
< 1m	4	One row 75mm wide brick reinforcement as described below, for each brick width of soffit.
≥ 1m ≥ 1.5m	6	Ditto
> 1.5m ≤ 2m	7	Three 6.3mm diameter mild steel rods for each half brick width of soffit.
> 2m ≤ 3m	8	Ditto

Brick reinforcement shall be of hard drawn mild steel comprising two 2.8mm diameter main wires spaced 75mm apart and 2.5mm diameter cross wires spaced at not exceeding 300mm apart, welded to main wires.

The reinforcing wires and rods shall be of length at least equal to the width of the clear opening plus 330mm at each end. The reinforcement shall be evenly spaced in the brick joints with the outer wires or rods having at least 20mm cover from face of brickwork.

Brick lintels in 270mm thick cavity walls shall be built with inner face of outer thickness, for a depth of three courses above soffit, covered with sheeting as for damp course, the full length of lintels, and space between the two thicknesses for the depth of the sheeting filled in solid with Class E concrete.

Where cavities continue above lintels, the sheeting shall be taken up and turned on to top of first course of brickwork to inner thickness of wall above the concrete filling in lintels. The sheeting is not required in lintels protected from the weather.

The lintels, except where built over pressed steel door frames and the like, shall be supported on temporary turning pieces of suitable and substantial construction left in position for at least 14 days for long spans (1 to 3m).

PS4.2.33.20 HOLLOW TILE LINTELS

Hollow tile lintels shall be formed with approved 300 x 220 x 110mm burnt clay hollow tiles each having not more than 3 cavities. The tiles shall be set end to end and the cavities filled up solid with Class E concrete.

Lintels shall have bearings of not less than 220mm on walls at ends.

The lintels over the various size openings shall be reinforced as specified in the following table:

Clear or daylight span	**Reinforcement**
≤ 1m	One12mm diameter mild steel rod in upper and lower cavities
> 1m ≥ 1.5m	One16mm diameter mild steel rod in upper and lower cavities

The reinforcing rods shall be placed 12mm from top and bottom edges of concrete filling to upper and lower cavities respectively.

Lintels over openings not exceeding 1m wide in 1 brick thick walls shall be on flat and in all other cases shall be on edge using 2 or more lintels in walls 1 brick thick and over, built side by side, to make up the thickness of walls.

Lintels in 270mm thick cavity walls shall be in two 110mm thicknesses with inner face of outer thickness covered with sheeting as for damp-course, the full length and depth of lintel, and the space between the two thicknesses filled in solid with Class E concrete. Where cavities continue above lintels the sheeting in lintels shall be taken up and turned on to top of first course of brickwork to inner thickness of wall.

Lintels shall be made not less than 21 days before building in and shall be cured for at least 14 days by being kept damp in a shaded position.

The lintels shall be hoisted into position and bedded and grouted in solid in cement mortar.

PS4.2.33.21 PRE-STRESSED LINTELS

Pre-stressed lintels shall be vibrated concrete reinforced with stressed high tensile steel wires, or of burnt clay blocks with similar reinforcing wires embedded in grooves in the blocks in 1:3, cement: sand mortar, or of other approved form of construction.

Concrete in lintels shall attain a crushing strength of at least 34MPa at 28 days for ordinary and at 7 days for rapid hardening cement.

The reinforcing wires shall be of ductile high tensile steel wire not less than 4mm diameter and of tensile strength of at least 1,350MPa and shall be stressed to not less than 850MPa.

The lintels may be in a single width to the thickness of wall or may be in two widths, placed side by side, and shall have a depth of not less than 60mm. Top surface of lintels shall be suitably roughened, indented or shaped to give a good bond between the lintels and the mortar for the first course of brickwork above,

Lintels shall have bearings of not less than 225mm on walls at each end.

The number of reinforcing wires in lintels for the various wall thicknesses and spans shall be not less than specified in the table hereunder, and brick courses over lintels of the number indicated in the table and for the full length of lintels shall be built in 3:1 cement mortar with all joints filled solid with mortar:

Nominal wall thickness (mm)	**Clear or daylight span**	**Number of wires (in total number of lintels used)**	**Number of brick courses over lintel**
90 - 110	≤ 1.8m	2	3
90 - 110	> 1.8m ≤ 3m	3	4
180 - 230	≤ 1.8m	6	4
180 - 230	> 1.8m ≤ 3m	6	5
270	≤ 1.8m	7	4
270	> 1.8m ≤ 3m	7	5
340	As described for 1 of 230mm plus 1 of 110 mm, or 3 of 110 mm		

Lintels in 270mm thick cavity walls shall be in 2 widths with joint between the two arranged directly over the window or frame below, and the brickwork above shall be built in 2 x ½ brick thickness with inner face of the outer thickness covered with sheeting as for damp-course, the full length and depth of lintels, and taken down between the 2 widths of pre-stressed lintels. The cavity to height of lintel courses shall be filled with Class E concrete, and where cavities continue above the lintel courses the sheeting shall be taken up and turned on to top of first course of brickwork to inner thickness of wall above the lintel course. The sheeting is not required in lintels protected from the weather.

PS4.2.33.22 BAGGED FINISH TO BRICKWORK

Bagging to walls is to be carried out after the mortar in joints has set. The wall surfaces shall be rubbed over with wet rough sacking until all joints and crevices are filled up and an even surface is obtained. Cement grout shall be added if necessary to fill up the joints and crevices.

PS4.2.33.23 RAKING OUT FOR AND POINTING FLASHINGS

Brick joints shall be raked out where required for fixing cover flashings and flashings, which shall be pointed in 3:1 cement mortar.

PS4.2.33.24 MASTIC POINTING

Where steel door and window frames are specified to be pointed with mastic compound they shall be pointed all round externally with an approved waterproofing compound of such composition that it will not stain surrounding surfaces and that it will adhere steadfastly, remain plastic without sagging or running, be capable of accommodating any normal movement of the joint sealed, and will receive paint without "bleeding". The pointing material shall be forced into the joints, which shall have been previously prepared to receive same, by means of a pressure gun or by other suitable method, all in accordance with the manufacturer's instructions.

PS4.2.33.25 BUILDING IN

Ends of timbers, holdfasts, cramps, gratings, air bricks, dowels, etc. shall be built-in in cement mortar.

Door and window frames lift door frames and the like shall be set up in position for building in and securely strutted to prevent distortion whilst the brickwork, lintels, etc. are being built.

Pressed steel door frames and lift door frames shall be grouted in solid at back with cement mortar as the work proceeds. Wood slips, fixing bricks, hoop iron roof ties, etc. shall be built in as the work proceeds.

PS4.2.33.26 SECURING OF ROOFS

Roof trusses shall be fixed at each support to walls with ties of 1.6mm thick galvanised hoop iron, 32mm wide, built 750mm deep into brickwork or embedded 300mm deep into concrete or wrapped around bottom layer of reinforcing in a reinforced concrete beam and wrapped over truss and fixed with four galvanised nails, 40mm long

PS4.2.33.27 BEDDING

All door, window and similar frames shall be bedded and pointed in 1:3 (cement: sand) cement mortar. All wall and floor plates shall be set true and level and bedded in 1:6 (cement: sand) cement mortar.

PS4.2.33.28 POINTING OF BRICKWORK

Clean and point at the end of each working day all exposed masonry work including nail holes, existing brickwork shall be pointed, thus Pointing, repairing eroded and cracked mortar joints, shall be executed on existing and new brick where and when shown by the Employer's authorized representative All disintegrated joints (erosions and/or cracks) shall be cleaned of all existing mortar for the full depth of the deterioration but not less than to a depth of 25mm. All joints shall be:

a) brushed and washed (under pressure) clean prior pointing;

b) kept wet during pointing; and

c) pointed to the full depth of the cut, tooled to match existing.

Steel door and window frames shall be carefully pointed all round and made perfectly watertight.

Joints greater than 25mm shall be stage-pointed.

PS4.2.33.29 FACED BRICKWORK

Faced brickwork shall be built fair and pointed with a keyed or recessed joint as specified. Keyed joint shall mean that the joints are to be pointed with a round jointing tool, well pressed into the joints as the work proceeds.

"Recessed joint" shall mean that the joints are to be square recessed to a depth of approximately 6mm formed with a rectangular jointing tool well pressed into the joints as the work proceeds.

Facing bricks shall be sorted by the brick manufacturer at his yard or by The Contractor on the site to ensure that proper mixing of the bricks within the colour range of each type of facing brick being used is obtained. Sudden changes in the general colour of face work in any 1 type of facing brick shall not be acceptable.

PS4.2.33.30 FIBRE CEMENT SILLS

Sills shall where in any way possible be in single lengths, cut between reveals, fitted with fixing lugs and solidly bedded in 1:3 (cement: sand) cement mortar with a slight projection beyond the finished wall face below.

Internal sills shall be level. External sills shall be set sloping on cut brickwork.

PS4.2.33.31 INSTALLATION OF ELECTRICAL SERVICE

The installation of electrical services, where such service is being provided, The Contractor shall embed in the concrete, as the work proceeds, all conduits, boxes, etc., which will be fixed in position by the electricians, and must reduce all required chases and holes in walls for conduits and form recesses in walls for distribution boards, all in the positions directed. Alternatively, distribution boards may be built into walls as the work proceeds, providing prior approval are obtained from the Employer. The Contractor shall afford every facility and shall render reasonable assistance to the electricians in carrying out their work and shall make good where necessary, in all trades, after installation has been completed.

Chases, holes and recesses required in walls shall be cut and formed as follows:

- vertical chase for single conduit.
- vertical chase for two conduits.
- vertical chase 150mm wide and 110mm deep for conduits.
- vertical chase 250mm wide and 110mm deep for conduits.
- vertical chase 380mm wide and 110mm deep for conduits.
- vertical chase 560mm wide and 110mm deep for conduits.
- horizontal chase for single conduit.
- Holes 25mm diameter or knocking out bricks and filling space and making good after a pipe has been fixed through a wall.

Recesses for distribution boards shall be:

Width (mm)	**Height (mm)**	**Depth (mm)**
330	330	110
455	330	110
635	330	110
610	660	110
610	910	110

PS4.2.33.32 CABLE SLEEVES

Provide under buildings where required 100mm diameter vitrified clay, pitch fibre or plastic pipes as sleeves for electric cable taken up to floor level in cable duct or switch cupboard with easy bends. The pipes shall be as specified for drainage including laying and jointing.

PS4.2.33.33 PATCHING BRICKWORK

Patching of existing walls and closing of openings shall be as shown. All brick shall be keyed to the existing or stepped every course with all surfaces flush with the existing surface and all joints kept online.

PS4.2.33.34 PROTECT FACE BRICKWORK

All face brickwork, stonework, tiling, etc. liable to damage shall be covered up and protected during the progress of the remaining work and any damage done shall be made good to the satisfaction of the Employer's authorized representative

All face brickwork, stonework, tiling, etc. shall be cleaned down as the work proceeds and shall be covered up with paper, pasted on, or by other approved means where necessary to prevent soiling of the surfaces during the progress of the remaining work. At completion of the works the coverings shall be removed and the surfaces again cleaned down to the satisfaction of the Employer's authorized representative

PS4.2.33.35 CLEANING

On completion of the work all masonry must be carefully cleaned down, removing all large particles of mortar with a putty knife or chisel. If acid is required for the removal of mortar stains (see note below), it shall be hydrochloric (muriatic) and not stronger than one volume of the commercial acid to nine volumes of water. Before the acid solution is applied, the surface should be thoroughly soaked with clear water; otherwise the mortar stain may be drawn into the pores causing a permanent dulling of the rich natural masonry colors. The acid solution should be applied with a long-handled stiff fiber brush, with proper precautions as to covering of clothing, hands and arms to prevent burns. It should not be placed over an area greater than 1.5 to 2.0m2 before the wall is again thoroughly washed down, or preferably hosed, with clear water immediately after cleaning. It is important to remove all trace of the acid before it attacks the mortar joint. All frames, trim, sills, or other installations adjacent to the masonry must be carefully protected against contact with the acid solution.

All paving shall be thoroughly cleaned off after laying to remove all traces of mortar and other substances, covered up and protected from damage during the progress of the works and again cleaned off at completion.

Any detergent or other materials used in the cleaning down of face brickwork etc. shall be of such nature that it will not harm adjoining paint and other finishings in any way.

NOTA BENE: Whenever possible, smooth, light colored units should be scrubbed with warm water and soap powder in lieu of acid cleaning.

PS4.2.34 PLASTERING

PS4.2.34.1 LIME

Lime shall be hydrated plaster lime complying with the requirements of SANS 523.

PS4.2.34.2 CEMENT

Cement shall be as specified.

PS4.2.34.3 SAND

Sand for plaster shall be as specified.

PS4.2.34.4 FORM KEY TO CONCRETE FOR PLASTER FINISH

All surfaces of concrete receiving plaster or similar finishes shall be well wetted, and wire brushed immediately after the formwork has been removed and slushed over with 2:1 cement grout to form key for the finish, all to the approval of the Employer's authorized representative the slushing shall be allowed to set hard before any finish is applied

Where smooth formwork has been used, particular care shall be taken in forming the key for plaster as described in applicable concrete specifications.

PS4.2.34.5 LIME PLASTER

a) One coat work on walls

Lime plaster for 1 coat work on walls shall be composed of 4 parts (volume) of sand and 1 part (volume) of lime. The material shall be mixed dry until of uniform colour, water shall then be added, and the mixture turned over until the ingredients are thoroughly mixed.

Lime plaster not used on the day it is mixed, shall be kept moist until required for use by covering with wet sacks or by other approved means.

b) Two coat work on walls

The rendering coat shall be of compo plaster well scratched over to form key for the setting coat. The setting coat shall be composed of 1 part hydrated putty plaster lime, complying with the requirements of SANS 523 and 1 part fine washed sand, to which retarded hemi-hydrate hard wall finishing gypsum plaster shall be added in the proportion of 1 part of gypsum plaster to 4 parts of sand, all proportioned by volume.

The gypsum plaster shall not be added to the mixture until the setting coat is to be applied and shall then be thoroughly incorporated into the mixture and used immediately.

c) Two coat work on metal lathing

The rendering coat shall be of compo plaster to which sisal shall be added in the proportion of 4kg of sisal to 1m3 of plaster. The rendering coat shall be well scratched over to form a key for the setting coat.

PS4.2.34.6 COMPO PLASTER

Compo plaster shall be composed of 10 parts (volume) of sand, depending on the quality of the sand available, 1-part (volume) lime and 1-part (volume) cement.

The lime and sand shall be mixed dry until of uniform colour and then mixed wet. Approximately ½ hour before use, add the cement and any additional water as may be required and remix until thoroughly mixed.

Compo plaster shall be produced in such quantities as can be used whilst remaining workable as no compo plaster that has become unworkable shall be used in any way.

PS4.2.34.7 CEMENT PLASTER, ONE COAT WORK ON BRICKWORK:

Cement plaster for 1 coat work on brickwork shall be composed of 4 parts of sand to 1 part of cement for internal work and 5 parts of sand to 1 part of cement for external work, all measured by volume, and mixed as described for cement mortar in sub-clause 4.2.19.9 (Cement mortar).

PS4.2.34.8 THICKNESS OF PLASTER

Plaster on walls shall be not less than 12mm or more than 20mm in thickness and plaster on concrete ceilings and beams shall not be less than 9mm or more than 16mm in thickness.

PS4.2.34.9 APPLICATION OF PLASTER

Walls shall be well wetted before plastering is commenced.

The surfaces of plastered walls internally shall be steel troweled to a smooth, even and true finish, unless otherwise specified.

All external plaster shall be finished to a true and even surface with a wood float, unless otherwise specified. All plaster surfaces shall be free from blemish.

Plaster shall be returned into reveals and soffits of openings and all angles shall be true and straight with salient angles slightly rounded.

The rendering coat of plaster in two coat work shall be approved by the Employer's authorized representative before the setting coat is applied and notice shall be given to him when the plaster is ready for inspection.

All cracks, blisters and other defects shall be cut out, made good and the whole left perfect at completion.

PS4.2.34.10 GRANOLITHIC FINISH

Granolithic finish to floors, treads of steps, thresholds and similar horizontal surfaces shall be not less than 25mm thick, composed of 2 parts (volume) granite, or other approved hard stone chippings, or approved hard coarse sharp washed granitic or quartzitic river sand, graded up to a maximum size of 5mm, 1/6 part clean pit sand screened through a 2.4mm mesh sieve and 1 part (volume) of cement, and hand or mechanically steel troweled to a true and smooth surface.

The material must test between 30 and 35MPa. No dry cement powder or grout shall be applied to the surface.

The granolithic shall be laid before the concrete subfloor has matured otherwise the exposed surface of the concrete shall be thoroughly cleaned with a wire brush and a coat of neat cement grout applied immediately before the granolithic is laid.

The granolithic shall be laid in panels not exceeding 20m^2 in area and joined to lines of panels with

V-joints as directed. The length of any panel shall not exceed 4.5m and wherever possible the joints between the panels shall coincide with any joints in the concrete sub-floor.

Where granolithic is to be tinted, it shall be laid in two thicknesses in one operation, the lower thickness being brought up to within 6mm of the finished level and the upper thickness, into which the requisite quantity of approved colouring material has been mixed, shall be laid. NO DUSTING OF COLOURING MATERIAL SHALL BE ALLOWED.

Granolithic finish to stair risers, sides of kerbs and other vertical surfaces shall be not less than 12mm thick.

Exposed salient angles of granolithic shall be neatly rounded to approximately 20mm radius.

All granolithic work shall be carried out by experienced workmen and shall be protected from injury caused by rain or other extremes of weather for 12 hours after being laid, and against drying out too rapidly whilst hardening by covering with wet sacks or other suitable material and shall be protected from other injury and discoloration during the progress of the remaining work.

Edges of granolithic floors adjoining other floor finishes, edges of margins, etc. shall be true and sharp, all protected by fixing temporary wood strips which shall remain in position until laying of the adjoining flooring material is commenced.

PS4.2.34.11 REEDINGS TO STEPS AND UPPER SURFACES

The treads of steps and upper surfaces of external thresholds finished with granolithic or sand-cement finish shall be rendered non-slip by reeding same near front edge for a width of 100mm and stopped 100mm from ends.

PS4.2.34.12 POLISHING OF GRANOLITHIC

All tinted granolithic finishes to floors, steps, thresholds, skirting, etc. shall at completion of all other work be twice polished with wax floor polish of an approved type.

PS4.2.34.13 SCREEDING TO FLOORS

Concrete sub-floors finished with wood mosaic, semi-flexible tiles and fully flexible vinyl sheeting and tiles and similar finishes shall be screeded with 1:3 (cement:sand) cement plaster of thickness required, but in no case less than 12mm, all steel trowelled to true and smooth surfaces. The sand used in the plaster shall be of such fineness as will allow for the screed being trowelled to a surface suitable to receive the finishes.

The Screeding shall be laid before the concrete sub-floors have matured, otherwise the exposed surfaces of the concrete shall be thoroughly cleaned with a wire brush and a coat of neat cement grout applied immediately before the Screeding is laid.

The screeding shall be laid in good time, but no finishes are to be laid if the screed exceeds 70% moisture content when measured with a hygrometer.

No traffic shall pass over nor shall any building operations take place on the screeding unless a proper protective covering is first provided.

NOTA BENE: A similar process shall be applicable where manholes or chambers are screeded.

PS4.2.34.14 SAND-CEMENT FINISH

Sand-cement finish to treads of steps, thresholds, etc. shall be of 1:2 (cement:sand) cement plaster not less than 20mm thick and steel trowelled to true and smooth surfaces. Finishes to risers of steps, sides of kerbs and other vertical surfaces shall be not less than 12mm thick. Exposed salient angles shall be neatly rounded to approximately 20mm radius.

PS4.2.34.15 NATURAL AGGREGATE CONCRETE FLOOR HARDENER

a) Definition

All-natural aggregate hardeners for concrete floors shall consist of a factory prepared blend of clean, properly graded and oven dried natural aggregate, Portland cement and chemical aids, all suitable for monolithic application to the surface of newly placed concrete. Where required the hardener may contain certain compatible pigments for tinted floors.

b) Quality testing

i) Sampling:

A minimum of 1% of every 5 tons of production shall be sampled and factory tested for water demand, compressive strength and proportioning.

ii) Compressive strength and water demand

Mix with sufficient water to give a slump of 20 to 25mm in a 35 x 90 x 75mm high slump cone filled in three layers; tamping each layer with 15 strokes of a 16mm diameter rod, shall give the following minimum compressive strengths when tested in a 70mm mortar cube vibrated for 3mm on a vibrating table and stored in a curing room or tank at 22 to 25°C and not less than 90% humidity:

- at 7 days : 50 MPa
- at 28 days : 70 MPa

iii) Test records:

Each quality test record shall be so referenced that the batch numbers on bags of the product may be traced back to the relevant quality control report. Such reports shall be available for inspection by the Employer’s authorized representative for up to 1 year after manufacture.

c) Curing

As an integral part of this hardener, a membrane curing compound, which must be both compatible with the floor hardener offered and comply with the ASTM C.309 Type 1 specification for moisture retention, shall be used.

PS4.2.34.16 FERROUS AGGREGATE CONCRETE FLOOR HARDENER

The ferrous aggregate hardener for concrete floors shall be a factory prepared blend of clean, properly graded ferrous metal aggregate, Portland cement and chemical aids for application and hardening, ready to apply as a dry shake to the surface of newly placed concrete before finishing.

The ferrous aggregate shall be guaranteed to be free of matter deleterious to concrete, such as oil and non-ferrous particles and shall be treated for rust inhibition. Where required it may contain compatible pigments for tinted floors.

PS4.2.35 GENERAL PRODUCT REQUIREMENTS

PS4.2.35.1 LOCAL CONTENT

Preference shall be given to materials fully manufactured in South Africa with South African raw materials.

PS4.2.35.2 SITE SERVICE

The manufacturer shall be expected to supply samples free of any other additional charge, and the services of a qualified technical representative on all of the building sites pertaining to the particular contract in order to train the placing team in the correct application methods of the product during initial placing upon 1 weeks' notice.

Circumstances may necessitate follow-up inspections.

PS4.2.35.3 SHELF LIFE

The shelf life of the offered product shall be stated, and the expiry date displayed on each bag. The Contractor shall ensure that the product supplied will survive the Contract Period or replace the product at his cost.

PS4.2.35.4 REFERENCES

The Contractor shall submit names and locations of projects in South Africa where the offered product has been in successful use for a period of at least 5 years under similar conditions and at similar rates. The Contractor shall:

i) make arrangements with the project owners for access for such visits, if the Employer's authorized representative wish to inspect such reference project sites.

ii) provide an acceptable alternative at the same accepted financial rate of the original proposed product, should the Employer's authorized representative find the product unacceptable.

PS4.2.35.5 APPROVED PRODUCTS

Only products that have been tested and which have been approved by the SABS shall qualify.

PS4.2.35.6 APPLICATION RATES

As specified by the manufacturer.

PS4.2.35.7 CONTROL TESTING

The Contractor shall be required to conduct control testing as and when requested by the Employer's authorized representative, proving the quality of the product used.

PS4.2.36 SPECIFIC WORK-RELATED INSTRUCTIONS

PS4.2.36.1 THE CONTRACTOR 'S RESPONSIBILITY

The Contractor shall be held responsible for damage to street or road surfaces, kerbing, stormwater drainage channels (gutters), existing utilities, etc. that result from his negligence during any survey. The Contractor shall repair, at his cost, any damage resulting there from, which shall be subject to approval by the owner of such asset and the Employer's authorized representative

PS4.2.36.2 NO DISTURBANCE

The Contractor shall be required to perform Works at all conduits with limited and approved disturbance to the existing service provision. Should the Contractor decide to use a stringing method to survey the conduit, the stringing lines shall not be left in the conduit for more than 5 days or without consent of the Employer's authorized representative

PS4.2.36.3 IMMEDIATE DANGER

All obstructions, cracks, irregularities must be fully surveyed and documented. The Contractor must inform the Employer immediately of any obstruction encountered, locations of hazardous atmosphere, or conduits that are in immediate danger of structural failure. Where possible:

a) the survey shall be done from the opposite side, whilst appropriate health and safety measures are adhered to, so that the extent of the danger can be assessed.

b) the position shall be clearly and accurately marked, to allow operations and maintenance to easily locate the position.

PS 4.3 WORKS AND MATERIALS

The Contractor is required to provide all WORKS and materials necessary to carry out the works as specified and required. No additional allowances other than those already specified in the Schedule of Rates shall be allowed for with respect to WORKS and materials.

PS 4.4 ENGAGEMENT OF LABOUR

PS 4.4.1 PROVISION OF A TEMPORARY WORKFORCE FOR THE CONTRACT

The Contractor shall have regard for the stipulation laid down for all Labour-Intensive projects that he employs labour from the local community through the Labour Desk that has been established for this purpose.

The Labour Desk shall assist in identifying available local labour and, where available, semi-skilled labour as well as local sub-The Contractor s. The Labour Desk shall also assist and advise regarding conditions of employment, minimum wages, disputes and disciplinary procedures.

The workforce that is employed on Site shall consist of local labour where applicable, except for approved key staff, to the extent that is compatible with the requirements of Clause 4.11 of the General Conditions of Contract 2010.

The Occupational Health and Safety Act must be adhered to with reference to the safety of any employee irrespective of whether such employee is employed by The Contractor or by a local sub-contractor and Contractor. Furthermore, a contract of employment must be signed between The Contractor and each of his employees and sub-The Contractor s and between such sub-The Contractor s, and each of the sub-The Contractor 's employees with clear reference to the following conditions:

- The minimum agreed wage rate per hour in respect of labourers;
- The agreed pay rate per unit of production where applicable;
- UIF and WCA payments;
- Minimum working hours per day;
- Start and end times of a daily shift;
- Lunch break times;

Company Policy regarding the following:

- Rain time
- No work no pay - sick, absent

- Disciplinary policy
- Grievance policy
- Method of payment
- Workers' clothing and safety equipment to be issued.
- The Contractor is required to show these items to the Employer for approval before construction commences.

PS 4.4.2 TRANSPORTATION OF LABOURERS

The labour employed on this contract shall be local labour from the nearest local community. Transportation should be arranged for the labourers from Site Offices to the site.

PS 4.4.3 MINIMUM WAGE FOR LOCAL LABOUR

Please take note that the minimum labour rate will be according to the latest Government Gazette: Basic Conditions of Employment Act 75 of 1997.

PS 4.4.4 TRAINING

The Contractor will be expected to provide formal training for the labourers. In this regard the labourers will be attending training for five days and the labourers should receive their full salary while on training. The Contractor is expected to have allowed for this in his rates.

PS 4.5 EXISTING SERVICES

PS 4.5.1 KNOWN SERVICES

Existing known services, both underground and overhead, are indicated on the drawings, but the positions of existing services on the drawings are not guaranteed nor does the Employer accept any liability in this regard.

PS 4.5.2 TREATMENT OF EXISTING SERVICES

The Contractor must liaise with all relevant local authorities to satisfy himself that all relevant services have been located. At the commencement of the contract, The Contractor must hand excavate a distance 0, 5 metre on each side of the located service to expose it. The exposed service shall be identified and recorded on a drawing.

A copy of the drawing with all known services shall be submitted to the Employer before construction can commence in any road reserve. Once the exposed service is identified and recorded the

excavation must immediately be backfilled. Re-excavation by hand at construction stage will not be measured in addition to normal trench excavation.

The Contractor shall retain full responsibility for establishing the exact positions of the numerous services in advance of any construction work. No allowance for delays or disruption shall be entertained unless The Contractor complies fully with the provisions of this clause regarding the establishment of the exact positions of the numerous services in advance of any construction work.

PS 4.5.3 USE OF DETECTION EQUIPMENT FOR THE LOCATION OF UNDERGROUND SERVICES

The Contractor is responsible to provide his own equipment to determine the location of existing services and shall locate and expose existing services by hand.

PS 4.5.4 DAMAGE TO EXISTING SERVICES

The Contractor:

must make provision for the possible existence of numerous services within and in close proximity to the work areas;

shall take necessary steps to protect any existing services whatsoever against damage which may arise as a result his operations on site. Adequacy in terms of protection of existing services shall be at the discretion of the Employer. The Contractor is to make good the protection of and any breakages to existing services;

must inform the relevant service provider immediately (within 2 hours of the incident) such that procedures for the re-instatement of the service can be effected, should he damage or break an existing service (whether known or unknown);

shall bear the cost of the repair of damages to any service, the possible existence of which could reasonably have been ascertained by him in appropriate time.

Under no circumstance is The Contractor to alter or in any way interfere with existing works or underground services unless authorized by the Employer.

***NOTA BENE*: Drawings indicating other existing services in the vicinity of the Works are not guaranteed as being accurate, as all other services may not have been recorded or properly recorded. It shall remain the responsibility of The Contractor to perform preoperational work, to locate existing services in advance of the commencement of the Works.**

PS 4.6 SITE ESTABLISHMENT, FACILITIES AVAILABLE AND REQUIRED

PS4.6.1 GENERAL

In order to facilitate compliance with the General Conditions of Contract and Conditions of Contract the Contractor shall be required to set-up an individual construction camp. The size and functionality of the site camp shall be in relation to the individual Blocks and Sections. It is, however, expected that The Contractor would have made themselves aware on whether one or multiple site camps are required for the execution of the complete Contract Works.

The Contractor shall price accordingly and state so in their proposal. For the camp/s, the following shall apply:

a) The Contractor shall make arrangements with the relevant authority for a suitable site to establish a construction camp, storage, works offices, workshop/s, kitchen, and shelters for security personnel.

b) The Contractor shall note that only security personnel shall be permitted to remain in the campsite overnight.

c) Ablution facilities shall be provided for men and women separately. One toilet per twenty workers shall be provided. Such facilities shall at all times be maintained in a clean and hygienic condition. Toilets shall be screened from public view and their use shall be enforced.

d) Covered accommodation shall be provided for perishable or corrodible materials, fittings and the like and shall be adequate and suitable for their purpose. In the case of cement stores, they shall be well ventilated, weatherproof and waterproof with appropriate floors to keep the materials dry and freely aerated.

e) All such accommodation shall be subject to the approval of the Employer who shall have free access thereto at all times.

f) Temporary buildings and fencing are to be safe, neat and presentable and the surrounding areas must at all times be kept in a neat, clean and orderly condition for the duration of the Works.

g) It shall be the Contractor 's responsibility to ensure that they are in compliance with all relevant laws and regulations as well as tribal requirements.

PS4.6.2 SITE FACILITIES REQUIRED FOR EMPLOYER

a) Source of water supply: It will be the responsibility of the Contractor to make his own arrangements for the supply of water. Potable water is available in the area and The Contractor is to make the necessary arrangements for the provision of a metered point of supply with the Municipality. The Employer does not guarantee the availability, sufficiency or continuity of any supply and no claims in this regard will be considered.

The Contractor is to be aware of the fact that this Contract is to be carried close to a built-up environment and that, as such, excessive dust creation will be considered unacceptable by the local residents. The Contractor is to make provision for regular watering of the works in order to alleviate

dust creation. During dry weather, or during periods when dust is created by the construction process, The Contractor will be required to water the works a minimum of twice a day, or as specified by the Employer. This is a requirement over and above the normal requirement for watering of the works.

b) Source of power supply: It will be the responsibility of The Contractor to make his own arrangements for the supply of electricity. The sum entered by The Contractor in the Bill of Quantities for the provision of P&Gs shall be deemed to include full compensation for the procurement and supply of powers to the works. The Employer does not guarantee the availability, sufficiency or continuity of any supply and no claims in this regard will be considered.

c) The Contractor 's camp: The Contractor is to make the necessary arrangements for the payment of services to the Municipality where applicable. The camp site shall be kept clean and tidy, and at the completion of the contract shall be restored to its original condition at the Contractor 's own cost, and to the satisfaction of the Employer. In order to facilitate compliance with the Conditions of Contract and the Specification, The Contractor may establish storage accommodation, works offices, workshops, mess-rooms, kitchens, shelters for watchmen, latrines, ablutions and the like in such positions and under such conditions as may be agreed by the Employer.

Temporary buildings and fencing are to be neat and presentable and the surrounding areas must at all times be kept in a neat, clean and orderly condition.

The Contractor shall not make any excavation without written permission of the Employer.

Covered accommodation for perishable or corrodible materials, fittings and the like shall be adequate and suitable for their purpose, and, particularly in the case of cement stores, shall be well ventilated, weatherproof and waterproof with floors raised off the ground, so as to keep the materials perfectly dry and freely aerated. All such accommodation shall be subject to the approval of the Employer who shall have free access there at all times.

In addition to the above, The Contractor shall provide one toilet per 20 workmen. Portable toilet facilities shall be made available to workers of both male and female genders, the number provided to be in proportion to the ratio of the sexes. The toilets shall be located in the vicinity of the work site, shall be screened from public view and the use thereof shall be enforced. The Contractor shall, where applicable, make the necessary arrangements for the regular removal of night soil.

The Contractor may not house members of his permanent staff except for a security guard at the site and is to make the necessary arrangements for the transport of his staff members to and from the site on a daily basis. As the Contractor 's Camp may be located in close proximity to a residential area, attention to noise levels, particularly after hours, will be essential.

d) Site facilities required for Employer's representative and others:

The Contractor shall provide the following office facilities at his main site camp for the Employer and others:

- One office for the Employer's Representative.
- Temporary office accommodation to suit his own requirements.
- Covered parking facilities for two (2) cars for the Employer's Representative.

A cell phone will be required for the sole use of the Employer's Representative. The Contractor shall be responsible for the payment of calls related to the Contract made by the Employer's Representative, on this mobile phone, during the course of the Contract. A Telkom ADSL line with modem facilities shall be provided on site and be available for the sole use of the Employer's Representative at all times.

PS 4.7 SITE USAGE

PS4.7.1 WORK ON PRIVATE OR STATE PROPERTY

The Contractor is to confine his activities strictly to the working area defined as being within 10m on either side of the pipelines, spoil sites and the direct access roads to these. He shall not encroach upon any roadway except with the prior approval of the Employer, in writing. The Contractor shall, throughout the Contract, take adequate precautions to protect all existing services from damage whether or not they have been pointed out to him.

Shallow sewer connections are to be found at the rear of the mid-block latrines. Particular care shall be exercised when excavating behind these structures. Underground electric cables are to be found on all erven at depths of between 75 and 1000 mm. Typically, these cables are at a distance of up to 1200 mm parallel to the erf boundaries and perpendicular to the common boundaries where they connect to the houses. Cables may also be encountered along the boundary behind the latrines. Particular care should be exercised when excavating in the vicinity of these cables.

The Contractor shall, as soon as is practically possible, inform the Employer of any damages to services and shall not repair any such damage unless instructed to do so. The Contractor shall be responsible for making good, at his own cost and to the satisfaction of the Employer, all damage caused by him to buildings and other improvements to properties.

Should the Contractor consider that damage to buildings and structures is unavoidable in the execution of any portion of the Works, he shall obtain the approval of the Employer before proceeding with the work. Where damage is noticed before commencement of work on that erf, this should be reported to the Employer in order to prevent a possible liability claim from the owner.

PS4.7.2 SITE SAFETY AND PRECAUTIONS AGAINST NUISANCE

The Works are to be conducted in an urban area where high volumes of pedestrian and vehicular traffic may prevail. The watching, barricading, lighting and traffic control on site shall be carried out in strict compliance with these specifications. The Contractor shall ensure that all safety measures are strictly adhered to. The Contractor shall ensure that excavations on sidewalks within the road reserves or within the erven, do not at any time present a safety hazard to pedestrians. All excavations that remain open overnight are to be adequately protected.

The Contractor shall provide all safety materials and equipment necessary for barricading and safeguarding the excavations. The safety of staff and labour involved with the Works and the security of installations, WORKS and equipment is of major concern and need special attention during the execution of the Works.

WORKS used on the Works shall be as efficiently silenced as possible and noisy operations will be permitted only between the hours of 07:00 and 17:00. Any work outside normal hours will be permitted only on the written authority of the Employer. Wherever excavations or loading of material is liable to form dust, an effective method of spraying water over the excavated area and loaded material shall be instilled. Any rock or debris falling from trucks on the roads shall be removed immediately. Precautions shall be taken to prevent fouling of public roads or private surfaces. The Employer may order The Contractor to broom off and clean roads or surfaces where debris may constitute a danger to the public or a nuisance to the owners.

PS4.7.3 WORK ON LIVE WATER MAINS

Every effort will be made by the Employer to furnish The Contractor with all available information regarding existing reticulation systems. Such information is given in good faith. Actual conditions in the field may, however, vary from the records upon which information is based. The Contractor must allow in his programme for delays when working on live mains and, as far as possible, such work should not be on the critical path of any programme and every effort must be made to have alternative work available.

PS4.7.4 FLUSHING AND CLEANING OF WATER MAINS

On satisfactory completion of work, the mains shall be flushed with potable water supplied by the Employer. The Contractor shall ensure that the water used for flushing is disposed of in an approved manner without damage, nuisance or injury to person or property. The Contractor shall allow in his rates for all costs associated with the flushing of water mains and communications pipes, save the cost of the water used. All water required for the flushing of water mains shall be supplied free of charge by the Council. If, in the opinion of the Engineer, foreign material has entered or remained in pipelines, The Contractor shall arrange for the water mains to be cleaned. The cost of cleaning including the cost of water used, shall be for the Contractor 's account.

PS4.7.5 WORK OUTSIDE NORMAL WORKING HOURS

In accordance with General Conditions of Contract Clause 5.8.1, certain work may only be done outside normal working hours. Such work shall be undertaken solely at the discretion of the Employer who shall, from time to time, issue advance orders in writing to The Contractor detailing the work to be undertaken. Work undertaken, as ordered, outside normal working hours shall be measured and paid for at the rates applicable to each and every item carried out as scheduled.

Normal working hours shall be defined as between 07:00 and 17:30 Mondays to Fridays and also 07:00 to 13:00 on Saturdays.

Where the Works are conducted within the road reserve of major arterial roads, the Contractor 's operations will be restricted to out-of-peak traffic periods (typically 09:00 to 15:30) or as determined by the Traffic Department. The Contractor shall co-ordinate his activities in such a manner that only minor operations that are non-disruptive to traffic are carried out during peak traffic periods. Should the Contractor choose to work outside normal working hours without having been ordered to do so by the Employer, permission will not be unreasonably withheld but all additional costs arising out of such work shall be entirely to the Contractor 's account.

PS 4.8 PERMITS AND WAYLEAVES

The Contractor will be required to obtain permits and wayleaves from all the applicable service providers.

The Employer will assist The Contractor to obtain clearance from the various departments with services that are likely to be affected by the Contract. It is, however, the Contractor ’s responsibility to obtain final permit and wayleave approval according to applicable procedures and specifications.

All associated costs to obtain permits and way-leaves as required for the execution of the works, where such affect other services, shall be deemed to have been included in the scheduled rates for SANS 1200A or SANS 1200AA or SANS 1200AB where pricing provision for such items have been allowed for in the pricing schedules, alternatively it shall be deemed to be included in the various scheduled activity rates or prices provided by the Contractor .

PS 4.9 ALTERATIONS, ADDITIONS, EXTENSIONS AND MODIFICATIONS TO EXISTING WORKS

The Contractor shall, within 20 working days or 10 % of the construction period after taking possession of the site (whichever is the lesser), satisfy himself that the dimensional accuracy, alignment, levels and setting out of existing structures or components thereof are compatible with the proposed works, and notify the Employer of any areas of dissatisfaction.

The Contractor shall, on becoming aware of a defect in existing works which will have an impact on the current works, notify the Employer of such a defect without delay.

The water mains of the existing network would have to be modified slightly to facilitate the connection of the new water main installation.

PS 4.10 INSPECTION OF ADJOINING STRUCTURES, SERVICES & ROPERTIES

The Contractor shall, before commencing with works which have the potential to damage surrounding structures, services, buildings or property, arrange an inspection with the owners of such structures, services, buildings and property and representatives of local or controlling authorities, as appropriate, to determine the condition of buildings, structures, services, paved surfaces, roads, kerbs, channels and the like, that the works could affect, and document their current condition in sufficient detail to enable disturbances or damage which might be caused by the works to be evaluated. The Contractor shall furnish the Employer with copies of all such documentation and shall be held responsible for any disturbance and damage to such structures, services, buildings and property arising from the performance of the contract as well as any costs involved in refuting or processing such claims.

PS 4.11 WATER, SANITATION AND ELECTRICITY FOR CONSTRUCTION PURPOSES

PS4.11.1 WATER

The Contractor shall make his own arrangements with the Employer to obtain a potable water metered standpipe connection for which at least 14 days' notice shall be given. The size of the connection provided will be as specified in the Water and Sanitation By-laws.

The Contractor may only draw water from fire hydrants through means of a legal, Employer owned, potable water metered standpipe. Failure to use such Employer owned potable water metered standpipes, or using illegal, non-Employer owned equipment for purposes of drawing water from fire hydrants, will result in The Contractor having to pay an account to the Employer, for an amount determined by the Employer

The potable water metered standpipe(s) must be made available to the Employer's water inspectors for purposes of reading and inspection, and failure to do so, will result in the immediate withdrawal of such potable water metered standpipe(s). The onus is on The Contractor to return such potable water metered standpipe(s) if they are found to be defective (not registering consumption). Failure to do so will result in an account being levied, payable to and determined by the Employer. Claims for delays caused where standpipe(s) are withdrawn and/or replaced will not be considered.

The current water tariffs applicable to the Contract are available from the Employer.

PS4.11.2 SEWER

The Contractor shall provide, maintain, move to positions as required and finally remove proper sanitary accommodation at each work front. Sanitary accommodation shall be properly screened, and its use strictly enforced. The Contractor shall comply with the Employer's Sanitation General By-Laws Section 19(1) and 19(3).

The situation of sanitary accommodation prescribed in terms of the Sanitary General By-Laws shall be approved by the Employer as being convenient for the person for whose use it is intended. The sanitary accommodation provided must be adequately ventilated, properly disinfected and kept in a thoroughly clean condition at all times.

The Contractor shall bear all costs associated with the provision of sanitary accommodation. Compensation for these costs will be made under the relevant item in the Schedule of Rates.

PS4.11.3 POWER

The Contractor shall make arrangements with the relevant authority for the supply and distribution of power for purposes of this Contract, the cost of which shall be deemed to be included in the rates inserted in the Schedule of Rates.

Power used for carrying out of the works in accordance with these Specifications will not be subject to measurement or payment.

PS 4.12 SURVEY CONTROL AND SETTING OUT OF THE WORKS

The Contractor is to confirm the levels and coordinates of all benchmarks prior to commencing with construction.

The Contractor shall, prior to the ordering of pipe fittings, set out the works strictly according to the Employer's construction drawings and/or site instructions.

The Contractor shall record the setting out of the works in an approved format and order all required pipe fittings accordingly.

PS5 MANAGEMENT OF THE WORKS

PS5.1 APPLICABLE SANS 1921 STANDARDS

SANS 1921-1:2004: Construction and management requirements for works contracts Part 1: General engineering and construction works shall be applicable to this Contract

PS5.2 PLANNING AND PROGRAMMING

PS5.2.1 WORK PLAN

Seven days prior to commencing with any part of the Works, the Contractor shall submit to the Engineer, for review and approval, a work plan detailing the procedure and schedule to be used to execute such works, detailing and substantiating any deviation from the originally proposed approach. Further, the work plan shall include a:

a) time frame;

b) description of all equipment and tools to be used;

c) list of personnel and their qualifications and experience (including back-up personnel in the event that an individual is unavailable);

d) list of sub-contractors, schedule of work activity;

e) safety plan (clearly highlighting any potentially hazardous substances to be used);

f) traffic control plan (if applicable);

g) an environmental protection plan; and

h) contingency plans for possible problems.

The approval given by the Engineer shall in no way relieve the Contractor of the ultimate responsibility for the satisfactory completion of the work as prescribed under this Contract

Work plan shall be comprehensive, realistic and based on actual working conditions. Further it shall form the various sub-sections of the overall Contract programme and plan

***NOTA BENE*: No works shall be allowed to commence without an approved work plan.**

PS5.2.2 PLANNING

The Contractor shall ensure that he:

a) is well informed with regard to the Employer's overall maintenance programme and avail resources as required to efficiently complete this Contract; and

b) delivers goods and services timeously to meet the Employer's prevalent performance standards and where applicable to not unnecessarily delay any other contractors, service providers and suppliers.

PS5.2.3 PROGRAMMING

In order to ensure a clear understanding, at the inception of the Contract, of the programming and documentation format requirements, the Contractor shall appoint a project programmer/ planner for liaison during the Contract. The Contractor shall for the Contract Period provide and regularly update (maximum monthly) a Contract Programme.
The programme shall at minimum contain:

a) Time Scale (minimum):

   i) Days, where the period does not exceed three months. Weeks, where the project period exceeds three months.

   ii) Months, where the period does not exceed one year.

   iii) Years, where the project period exceeds one year.

b) Tasks: Where phases or stages are anticipated, this shall be the highest level of division and all tasks related to the successful accomplishment of that phase of the area shall be grouped. Resources allocation and task dependency shall be indicated.

c) Start and Finish Dates: All tasks shall have specific start and finish dates.

d) Critical Path: All tasks forming the programme line that will establish any delays in the overall Contract Period shall be clearly indicated and an indication of their sensitivity characteristics shall be provided.

e) Progress Tracking: The Contractor shall be required to periodically indicate progress per task graphically and on a percentage basis.

f) Non-working Time: All South African public holidays, weekends and the local traditional annual builder's break shall be incorporated in the programme.

No deviation from the approved sequence of construction shall be accepted without prior written approval.

The programme shall not be in the form of a bar chart only but shall show clearly the anticipated quantities of work to be performed each month, together with the manner in which the listed WORKS is to be used, as well as the anticipated earnings for the various sections of work.

***NOTA BENE*: A Contract programme shall be submitted no later than 7 days after Contract Commencement Date.**

The Contractor shall provide the Engineer with a method statement indicating the manner and sequence in which he intends to construct the works, for each work area, with the program. In the method statement the Contractor must address at least the following items:

a) sequence of the works for the relevant works area;

b) target dates for the tasks identified in sequence of the works for the relevant works area;

c) materials requirements;

d) construction WORKS to be used;

e) services affecting construction; and

f) any factors that could affect construction progress after commencement.

The method statement must be approved by the Engineer before commencement of construction. In order to minimize the impact on traffic, pedestrians and business the Contractor will be required to segment the works in such a manner that no portion of the works is more than one day ahead of the following position. These segments of the works shall be clearly defined in the Contractor's method statement for each work area.

If, during the progress of the work, the quantities of work performed per month fall below those shown on the program or if the sequence of operations is altered, or if the program is deviated from in any other way, the Contractor shall, within one week after being notified by the Engineer, submit a revised program.

If the program is to be revised by reason of the Contractor falling behind his program, he shall produce a revised program showing the modifications to the original program necessary to ensure completion of the Works or any part thereof within the time for completion. Any proposal to increase the rate of work must be accompanied by positive steps to increase production by providing more labour and WORKS on the Site, or by using the available labour and WORKS in a more efficient manner.
Failure on the part of the Contractor to submit or to work according to the program or revised program shall be sufficient reason for the Employer to take steps as provided for in the GCC.

The approval by the Engineer of any program shall have no contractual significance other than that the Engineer would be satisfied if the work is carried out in accordance to such program and that the Contractor undertakes to carry out the work in accordance with the program. It shall not limit the right of the Engineer to instruct the Contractor to vary the program should circumstances make this necessary.

PS5.3 SEQUENCE OF THE WORKS

The sequence of works to be executed shall be agreed between the Engineer and the Contractor. It is envisaged that the visual stormwater drainage surveys shall be executed, and its findings shall determine the order of the other works. Also see 'Prioritising works' in the Contract Data section.

The Contractor shall address matters regarding the approval of his Health and Safety Plan, thereafter the works shall commence.

PS5.4 SOFTWARE APPLICATION FOR PROGRAMMING

The construction programme shall be completed in Microsoft ® Project Standard 2010 or compatible software. The construction programme and updated versions thereof shall be made electronically available to the Engineer.

PS5.5 METHODS AND PROCEDURES

The methods and procedures for the execution of the works shall be in accordance with the standard specifications and the variations and additions thereto.

PS5.6 QUALITY PLANS AND CONTROL

The Contractor shall be required to provide and maintain a quality plan to ensure that the quality of all work components is of a high standard.

PS5.6.1 CONTROL SAMPLE PHOTOGRAPHS AND/OR VIDEO PRINTS AND/OR RECORDINGS

If, in the opinion of the Engineer, any video prints and/or recordings fall significantly below the standard of the tender stage submitted samples, that part of the survey in question shall be re-surveyed, at the expense of the Contractor.

PS5.6.2 PIPE CONDITION ASSESSMENT

The accuracy of the pipe condition assessment coding system shall be highly reliant on the skill of the surveyor who conducts the survey and produces the report. Thus, the Contractor shall have a quality system that continuously monitors the standard of coding.

The procedure of this system shall be agreed with the Engineer, who shall specify the level of accuracy required prior to the Contract commencement.

The system shall measure the accuracy of reporting and in particular the:

a) number of defects/features not recorded (omissions)

b) correctness of the coding and classification of each defect/feature recorded.

PS5.7 ACCOMMODATION OF TRAFFIC ON PUBLIC ROADS

PS5.7.1 ACCOMMODATION OF TRAFFIC

The Contractor shall ensure the safe accommodation of traffic at all areas where the work may impact traffic and shall provide all delineators, watching, lighting, signs and barricades required by the road authorities, and in accordance with the South African Road Traffic Signs Manual.

PS5.7.2 ACCESS TO PROPERTIES

Adequate access shall at all times be maintained to public and private properties unless otherwise arranged and approved. Details of the proposed means of access shall be submitted before any such access is restricted. Claims arising from impeded access shall be the responsibility of the Contractor. At least 7 days before commencing any work affecting access to a property, the Engineer and the occupier/owner of each such property shall be notified of the Contractor's intention to commence work, the date of commencement, expected duration and arrangements which will be made regarding maintenance of access.

PS5.7.3 TRANSPORT DEPARTMENT REQUIREMENTS

The Contractor shall provide a structurally sound and safe bridge with side rails across dangerous excavations crossing sidewalks to allow pedestrians safe access to such sidewalk. Associated costs for the provision of pedestrian access to sidewalks shall be deemed to have been included under the various excavations or combined activity rates and/or prices in the pricing schedules.

PS5.8 OTHER CONTRACTORS ON SITE

There may be other contractors working within the same area. As such, the Contractor is required to make adequate allowances for such possibilities. No claims with respect to works being carried out by other contractors shall be entertained by the Employer.

PS5.9 TESTING, COMPLETION, COMMISSIONING AND CORRECTION OF DEFECTS

The onus is on the Contractor to produce goods and services which shall conform in quality and in accuracy of detail to the requirements hereinafter specified. The Contractor must clearly understand that it is not the duty of the Engineer or his representative to act as foreman or surveyor on the Works.

The Contractor shall, at his own expense, provide experienced engineers, foremen and surveyors together with all transport, instruments and equipment for supervising, checking and controlling the work.

The act of passing any completed work or accepting materials or goods for payment by the Engineer shall not be construed as signifying approval or acceptance thereof. Failure on the part of the Engineer to reject any defective work or material or goods shall not in any way relieve the Contractor of his obligations under the Contract, nor prevent later rejection when such work or material is discovered.

The Contractor shall, when submitting any work to the Engineer for examination, satisfy himself by testing, measurement and otherwise as may be necessary that the work does in fact meet with the requirements of the Specifications. This information shall be submitted with the Contractor's request for examination and the Engineer shall be authorised to decide on the number and type of tests, measurements, etc. required to enable him to judge the quality of the work. The submission of this information shall in no way diminish the authority of the Engineer to conduct such tests as he may consider necessary in order to determine the quality of the work performed by the Contractor, nor shall he be bound to take account of the Contractor's tests, measurements, etc. should he consider these to be either incorrect or not representative.

Quality control and completion tests shall be in accordance with the relevant standard and amended specifications and additional specifications.

PS5.10 RECORDING OF WEATHER AND ABNORMAL RAINFALL

If during the time for completion of the works or any extension thereof abnormal rainfall or wet conditions shall occur, then an extension of time in accordance with clause 45 hereof shall be granted by the Employer calculated in accordance with the formula given below for each calendar month or part thereof.

$V = (Nw - Nn) + ((Rw - Rn)/X)$

V	Extension of time in calendar days in respect of the calendar month under consideration.
Nw	Actual number of days during the calendar month on which a rainfall of Y mm or more has been recorded.
Nn	Average number of days, as derived from existing rainfall records, on which a rainfall of Y mm or more has been recorded for the calendar month.
Rw	Actual rainfall in mm recorded for the calendar month under consideration.
Rn	Average rainfall in mm for the calendar month as derived from existing rainfall records.

For purposes of the contract Nn, Rn, X and Y shall have those values assigned to them in the Appendix and/or the Specification.

The total extension of time shall be the algebraic sum of all monthly totals for the period under consideration, but if the total is negative the time for completion shall not be reduced due to subnormal rainfall. Extensions of time for part of a month to be calculated using pro rata values of Nn and Rn.

This formula does not take account of flood damage that could cause further or concurrent delays and will be treated separately as far as extension of time is concerned.

The factor (Nw-Nn) shall be considered to represent a fair allowance for variations from the average number of days during which rainfall exceeds Y mm. The factor (Rw-Rn)/X shall be considered to represent a fair allowance for variations from the average in the number of days during which the rainfall did not exceed Y mm, but wet conditions prevented or disrupted work.

The following average rainfall figures are applicable:

INFORMATION SOURCE: South African Weather Service Pretoria

Rainfall

STATISTICAL INFORMATION: Volksrust Weather Station: 2000-2020		
Month	**RAINFALL**	
	Nn = Actual number of days during the calendar months in which a rainfall of more than Y-mm has been received	**Rn Average monthly rainfall**
January	10.4	115.2
February	9.7	111.7
March	12.3	94.3
April	3.3	87.12
May	1.6	68.7
June	0.8	21.2
July	0.7	15.3
August	1.1	6.7
September	2.2	24.3
October	6.2	84.2
November	8.7	119.4
December	8.6	126.1
TOTAL	**64.8**	**786.3**

The Contractor shall be permitted to take his own rainfall measurements on site subject to the Engineer's approval, but access to the measuring gauge(s) shall be under the Engineer's control. The Contractor is to provide and install all the necessary equipment for accurately measuring the rainfall as well as to provide, erect and maintain a security fence plus gate, padlock and keys at each measuring station, all at his own cost.

PS5.11 FORMAT OF COMMUNICATIONS

All communication shall be in writing and any verbal agreements shall only be binding once confirmed and agreed to in writing. Communication via, registered post, email or facsimile is acceptable.

PS5.12 KEY PERSONNEL

PS5.12.1 GENERAL

The Contractor is to provide the Curriculum Vitae's of key personnel to be employed on the project as well as the person's position and responsibilities within the project team. The Contractor shall provide the following minimum key staff:

a) Contract manager;

b) Site Agent;

c) Quality Manager/Auditor/Controller;

d) CCTV camera Operators;

e) Health and Safety Officer/s; and

f) Foremen.

The Contractor shall ensure that at least one sufficiently experienced CIPP, horizontal directional drilling or pipe bursting supervisor is on-site full time while CIPP and pipe bursting operations are performed.

PS5.13 MANAGEMENT MEETINGS

Fortnightly site meetings shall be arranged and facilitated by the Engineer. Senior Contractor management staff attendance shall be compulsory.
The Contractor shall be required to provide reporting with regard to project progress, resources (human, WORKS and equipment), community issues, environmental and health and safety aspects.

PS5.14 FORMS FOR CONTRACT ADMINISTRATION

The Contractor shall maintain a file which shall contain project information related to project progress, resources (human, WORKS and equipment), community issues, environmental, health and safety aspects, penalties imposed, claims lodged and outcomes, disputes and resolutions, payment and variations.

PS5.15 DAILY RECORDS

The Contractor shall keep daily site records as required by the Employer or his representative and as specified herein. Daily records shall include, labour, WORKS, materials, rainfall, environmental issues, health and safety issues, daily diary and the like. Such records shall

be the property of the Employer and shall be made available to the Employer or his representative within 24 hours from being requested to do so.

PS5.16 BONDS AND GUARANTEES

In addition to GCC Clause 7, the Contractor shall provide the Form of Guarantee for the due and punctual fulfilment and completion of all the Contractor's obligations under the Contract. No extension of time of the Contract Period of Performance or any variation of the Contract nor the determination of the Contract by the Employer in terms of Clause 58 hereof shall in any way impair or diminish or terminate any liability to the Employer under and by virtue of such Guarantee.

Should the Contractor, when notified of the acceptance of his offer, fail to provide an approved Guarantee within the stated period, then the Employer may, at his sole discretion:
(a) Grant the Contractor a further reasonable period in which to provide the bond; or
(b) Withdraw his acceptance of the tender in which case the Contract shall be deemed to be void, but without prejudice to the Employer's rights to recover whatever damages he may have suffered by virtue of the Contractor's failure to fulfil his obligations.

PS5.17 PAYMENT CERTIFICATES

Payment certificates shall be submitted to the Engineer, in the format required, for approval and final submission to the Employer on a monthly basis.

PS5.18 PERMITS

Refer to PS 4.8

PS 6 FEATURES REQUIRING SPECIAL ATTENTION

PS6.1 SECURITY

The Contractor shall be responsible to provide security on site(s):

a) as he deems necessary. The Employer shall not be held responsible for any loss or damage(s) suffered by the Contractor , his WORKS, equipment, materials, Subcontractor (s) or employees because of a security incident of any nature.

b) which have been identified, by the Employer, as potential high-risk areas requiring security during site visits for the duration of the contract. The Contractor shall arrange that the security

meet with the Employer representative at a convenient and safe location and thereafter escort to the necessary areas.

PS6.2 OPERATION OF VALVES

Only employees of the Employer are permitted to operate primary and secondary water mains valves.

PS6.3 WORK OUTSIDE NORMAL WORKING HOURS

The Contractor is permitted to work outside of normal working hours only upon obtaining written permission from the Employer. It is anticipated that all switch-over work (tying new infrastructure into existing) will be completed during hours that will not affect the supply of water to affected communities.

PS6.4 SANITARY FACILITIES

The Contractor is required to supply adequate sanitary facilities for employees, visitors, and Employer.

PS6.5 COMMUNITY LIAISON AND COMMUNITY RELATIONS

For the purpose of this project a community liaison officer will be required; who shall be required to inform the community with regards to The Contractor 's activities in particular where such activities may affect the service provision to the affected community (See PS6.6).

PS6.6 NOTICES AND WARNING TO CONSUMERS

The Contractor shall ensure he maintains service (water and/or sanitation) provision at all times whilst executing the works where:

a) The maximum amount of time of no service shall be 8 hours for any property. Any service disruption longer than 8 hours shall be temporary bypassed by methodologies approved by the Employer's authorized representative

b) A Public Notification Program shall be implemented, requiring at minimum that The Contractor shall deliver written notices to each domestic and non-domestic customer affected by the works, 48 hours before commencement of the works, including providing:

i) a summary of work to be completed;

ii) the time and duration of service interruption; and

iii) a local telephone number to contact The Contractor for inquiries or complaints. All complaints received shall be addressed and resolved within the standard Employer response times and a summary of such complaints and associated actions shall be presented to the Employer's authorized representatives on a monthly basis.

PS6.7 CONTINUITY OF SERVICE SUPPLY TO CUSTOMERS

The activities of The Contractor shall not unreasonably interfere with the service supply to customer and be executed outside the agreed and notice time frames.

Where the Contractor cannot reasonably re-establish services within times agreed and notice time frames he shall proceed to contact the affected customer and make alternative arrangements that shall be acceptable to the customer and the Employer.

The associated costs of any customer claim arising from a lack of service provision due to the Contractor 's negligence or his disregard for the Employer's SOP or his disregard for the conditions of this Contract, whilst executing activities as per this Contract, shall be solely for his account. The Employer shall have the right to make equivalent monetary deductions from monies owed to The Contractor or from his Guarantee under this Contract and any other active contract(s) with the Employer.

PS6.8 CONDITIONS AND PROCEDURES FOR SERVICE AGENCIES

The Contractor shall comply with the conditions and procedures of the various affected service agencies, as mandated in their associated wayleaves.

PS6.9 REINSTATEMENT OF ASPHALT

The Provincial Roads shall be given first preference to provide and execute all the reinstatement of asphalt at places where excavation is within the roadway. The Contractor shall make other adequate arrangements where the SANRAL or Municipality:

a) indicated that it will not, for whatever reason, be able perform such asphalt resurfacing; and

b) is the cause of delays, where in particular The Contractor shall note that the Employer shall not be liable of any additional extension of time related cost obligations to the Contractor , as he shall be deemed have agreed adequate conditions with the Municipality and allowed delays on the part of the Employer.

PS6.10 GENERIC LABOUR INTENSIVE SPECIFICATIONS

EPWP guidelines shall not be applicable to this Contract, although it is expected that The Contractor execute the majority portion of the works utilizing unskilled labour and skilled labour.

PS6.11 CAUSES FOR REJECTION

Causes for rejection shall include, but not be limited to, not complying to the Employer's requirements and/or specifications and the intended purpose for this Contract, thus:

a) poor data (including photographs, recording, prints and reports) and data management;

b) inaccurate surveys, with regard to linear meterage of manhole length;

c) poor quality of survey information;

d) silt, grease, and debris remaining in conduits after cleaning; and

e) poor quality construction and remedial works:

i)Cracks in any concrete works or pre-cast units shall be cause for rejection.

ii)honeycombed or patched areas in any concrete works or pre-cast units in excess of 0.02m^2 shall be cause for rejection.

PS6.12 PROTECTION AGAINST WATER AND STORMS

The Contractor shall be responsible for the full adequate protection of the works against damage due to storms, rain, floods, stormwater, subsoil water and seepage from whatever source. The Contractor shall take over the site where the works has to be executed at the beginning of the Contract Period and the full risk and cost of dealing with all water shall be borne by the Contractor .

The Contractor shall also provide all necessary pipe work, pumps and other appliances necessary for adequate dewatering of all excavations and shall maintain these in good condition and provide adequate standby equipment to ensure that no disruption of work will ensue as a result of possible breakdown of equipment.

PS6.13 INFORMATION SUPPLIED BY THE EMPLOYER

Certain information included in this document or supplied separately is presented in good faith and no guarantees can be given regarding the accuracy or representativeness thereof. This pertains more specifically to all soil tests, material results and similar information that are necessarily subject to limitations in the test methods and sampling. Natural variations in materials and formations also influence the applicability of certain conclusions.

The Employer can therefore not accept any responsibility for the accuracy of any information or for any damage resulting from the fact that the information later proved wrong or not representative. If the Contractor chooses to rely on the information he does so at his own risk.

PS6.14 INDEMNITY CERTIFICATE

The Contractor must, on completion of the Works, obtain certificates from all authorities concerned stating that they are satisfied with the condition of all borrow pits, detours, access roads and spoil material on their properties. The certificates must be handed over to the Employer before the maintenance period starts. The certificates will not exempt The Contractor from any obligations concerning the backfill of trenches, finishing off of borrow pits, access roads, detours etc. This work must still be carried out to the satisfaction of the Employer.

PS6.15 RETURN OF MATERIALS

All old valves, valve covers, meter boxes and all pipework that can be reused shall be returned by The Contractor to the Municipality or as directed by the Employer. The Contractor shall obtain the signature of the Superintendent acknowledging receipt of materials returned. The Contractor shall determine the condition of the materials.

PS6.16 POLITICAL AND COMMUNITY UNREST

The Contractor shall make allowance for all costs which might arise due to the interruption of works and / or standing time in terms of political and / or community unrest on the Contract. Only if a situation gives rise to more than four (4) hours per day, for normal working hours only, of non-working progress on the Contract Area will such situation be considered an unrest situation payable to The Contractor under this item.

The Contractor shall notify the Employer or his duly Authorized Representative of any unrest situation and shall indicate all active Contract sites affected.

PS 7 HEALTH AND SAFETY SPECIFICATION FOR CONSTRUCTION WORK

The Occupational Health and Safety Specification of the Employer is bound in Volume 2 of these contract documents. Volume 2 forms an integral part of the Contract Specification and, in particular, shall be a part of the HEALTH AND SAFETY SPECIFICATION FOR CONSTRUCTION WORK.

In terms of Construction Regulations 4 (1) (a) of the Occupational Health and Safety Act, Act No 85 of 1993, the Employer is required to compile an occupational health and safety specification for any intended project and to provide the specification to prospective Contractors.

The objective of this specification is to ensure that the principal The Contractor entering into a contract with the Employer achieves and maintains an acceptable level of occupational health and safety performance.

The specification provides the requirements that the principal The Contractor and other The Contractor s shall comply with in order to reduce the risks associated with the contract work, and

that may lead to incidents causing injury and/or ill health, to a level as low as reasonably practicable and possible.

The Contractor , appointed by the Employer in terms of Regulation 4 (1) (c), is required to prepare an occupational health and safety plan.

This plan has to be prepared in terms of Regulation 5 (1) as well as the Employer's occupational health and safety specification. In terms of Regulation 4 (2), the Employer and the principle The Contractor are required to agree on the occupational health and safety plan before any work may commence.

The principal The Contractor 's health and safety plan have to follow the framework in Volume 2, as a minimum.

PS 7.1 SITE SPECIFIC HEALTH AND SAFETY ISSUES

Please refer to Volume 2 of The Occupational Health and Safety Specification of the Employer for site specific assessment of health and safety issues including a list of risk assessment headings that have been identified by the Employer as possibly applicable to the contract work for this project.

PS 7.2 BARRICADING OF TRENCHES

The Contractor shall ascertain himself of the nature, volume, stability, depth and possible safety risks of the excavations, before any decision with regards to the method of excavation is made.

Allowance for hand excavation has been made for the location of services. Extreme caution shall be taken when excavating along the route of the new pipe for existing services. Any damages and or repairs to the existing services will be for the Contractor 's account.

The length of open excavation must at all times not exceed 100m

Adequately protected by a barrier or fence comprising fluorescent orange plastic netting of height at least 1 000mm and as close to the excavation as practicable; and

- Provided with notice boards marked "CLOSED " at each end of closed or partially closed roads,
- The barrier or fence (at least 1m high) shall be suitably wrapped with reflective red and white danger tape or provided with flashing orange lights, placed at 15m intervals along the barricading at night.
- Where the depth of an excavation or the nature of the material excavated renders the sides of the excavation liable to movement that might endanger the works, or the workers engaged on the excavation,

- the sides of the excavation shall be supported by suitable timber or other sheeting adequately strutted and braced, all properly assembled and of sufficient strength and stiffness to prevent movement in the materials supported, or, alternatively,
- the slope of the excavated face or faces shall be reduced so that any danger to the works or workers is removed.

Any cavities formed by the fall of rock or earth due to rain, flooding, insufficient timbering or other causes, shall be adequately filled.

The Contractor shall so maintain borrow pits that they do not become a danger to persons or livestock.

Trenches may not be left open during the builder's holidays or for any shutdown period exceeding 5 calendar days. Should the Contractor not comply with this requirement without the written approval of the Employer; the Employer shall have the open trenches closed by others at the expense of the Contractor. Furthermore, all further opening-up of the backfilled excavation and dealing with the excavated material and subsequent making good will all be to the Contractor 's cost.

PS 7.3 PRECAUTION AGAINST POLLUTION AND CONTAMINATION

The Contractor shall take all necessary steps and precautions to prevent pollution of the surrounding area by his employees in any way. Any debris falling from construction vehicles and WORKS shall be removed immediately.

Every care is to be taken to avoid possible contamination of the mains during construction. Pipes are not to be stacked in the streets or gutters. On completion of a section, all loose material and foreign bodies are to be removed. The open ends of the new pipeline are to be protected by watertight caps, to the satisfaction of the Employer, to prevent the entrance of groundwater and foreign bodies until such time as these sections are connected to the live mains.

Sterilizing chemicals shall be supplied by The Contractor for sterilizing all new water mains. All new lines are to be thoroughly flushed. All sterilization shall be done at 10mg/ℓ free chlorine for 12 hours. The Contractor shall give due notice to The Employer of his intention.

PS 7.4 Operations under Live Conditions

Prior to the execution of any operation under live conditions, The Contractor shall liaise with the relevant Municipality at least 7 working days in advance, in this regard. At least one representative of the Municipality shall be present during the execution of such operation. These operations will include disconnection and reconnection to the existing Sewer/ Storm water main and Water storage tank at the works.

PS 8 ENVIRONMENTAL MANAGEMENT

The Contractor is to adhere to the mitigation measures listed in the EMP (refer to Volume 2: Occupational Health and Safety Specification and Environmental Management Plan. Environmental mitigation measures are actions needed to align a project implementation phase with environmental control principles, where potential impacts to the natural and social environment are prevented, minimised or remediated. Environmental safeguarding is governed by various sets of legislation, with the most noteworthy for this project constituting the National Environmental Management Act (No. 107 of 1998) and the National Water Act (No. 36 of 1998).

PS 9 VALVES

i. Wedge type gate valves: Shall be used for and valves from sizes 200 mm and above and the valves must be as per SANS 664. (All valves greater than and equal to 300 mm should be geared).

ii. Resilient seal gate valves: for valves sizes up to and including 150 mm;

iii. Air release valves: single chamber, double orifice with integral anti-shock device.

iv. Hytrol valves: can be piped as PRV's, pressure sustaining valves, level control valves, flow control valves etc. Other designs must be pre-approved;

v. Butterfly valves: may be used in restricted areas upon approval by the Employer. Strictly not allowed in the reticulation.

vi. Reflux valves: non-return valves must be approved by the Employer.

Types used:

Weighted type: used essentially in pump stations and on reservoirs and in town installations;

Double door dampered type: used on pumping mains;

vii. Above ground hydrants: All new installations to be above ground. Underground hydrants only to be used if approved by the Employer.

PORTION B: VARIATIONS AND ADDITIONS TO THE STANDARDISED SPECIFICATIONS

The following variations and additions to the SANS 1200 Standardized Specifications referred to in the last clause of Portion A apply to this Contract. The prefix PS indicates an amendment to SANS 1200. The letters and numbers following these prefixes respectively indicate the relevant Standardized Specification and clause numbers in SANS 1200.

PSA GENERAL

PSA 2 INTERPRETATIONS

PSA 2.3 DEFINITIONS

a) General

ADD THE FOLLOWING DEFINITIONS:

"General conditions: The General Conditions of Contract specified for use with this Contract and the special conditions of Contract as applicable.

Specified: As specified in the standardized specifications, the Drawings or the Project Specifications. Specifications shall have the corresponding meaning."

b) Measurement and payment

REPLACE THE DEFINITIONS FOR "fixed charge", "time-related charge" *AND* "value-related charge" *WITH THE FOLLOWING*:

"Fixed charge: A charge that is not subject to adjustment on account of variation in the value of the Contract amount or the Contract Time of Completion.

Time-related charge: A charge, the amount of which varies in accordance with the Time for Completion of the work, adjusted in accordance with the provisions of the Contract.

Value-related charge: A charge, the amount of which varies pro rata with the final value of the measured work executed and valued in accordance with the provisions of the Contract."

PSA 3 MATERIALS

SA 3.1 QUALITY

ADD THE FOLLOWING:

"All manufactured materials supplied shall be new materials unless the contrary is specified. All materials specified in accordance with SANS Specifications shall bear the SANS mark, whether so specified or not."

ADD THE FOLLOWING SUB-CLAUSE:

PSA 3.3 ORDERING OF MATERIALS

The quantities set out in the Schedule of Quantities have been carefully determined from calculations based on data available at the time and should therefore be considered to be approximate quantities only. Before ordering materials of any kind The Contractor shall check with the Employer whether or not the scope of the work for which the materials are required is likely to change substantially. No liability or responsibility whatsoever shall be attached to the Employer for materials ordered by The Contractor except when ordered in accordance with written confirmation issued by the Employer."

PSA 4 WORKS

PSA 4.1 SILENCING OF WORKS

REPLACE THE CONTENTS OF SUBCLAUSE 4.1 WITH THE FOLLOWING:

"The Contractor 's attention is drawn to the applicable regulations pertaining to noise and hearing conservation, framed under the Occupational Health and Safety Act, 1993 (Act No 85 of 1993) as amended.

The Contractor shall at all times and at his own cost, be responsible for implementing all necessary steps to ensure full compliance with such regulations, including but not restricted to the provision and use of suitable and effective silencing devices for pneumatic tools and other WORKS which would otherwise cause a noise level in excess of that specified in the said regulations.

Where appropriate, The Contractor shall further, by means of temporary barriers, effectively isolate the source of such noise in order to comply with the said regulations."

PSA 5 CONSTRUCTION

PSA 5.1 SURVEY

PSA 5.1.2 PRESERVATION AND REPLACEMENT OF SURVEY BEACONS AND PEGS SUBJECT TO THE LAND SURVEY ACT

*DELETE THE WORDS "*in the vicinity of boundaries*" IN THE SECOND SENTENCE OF SUBCLAUSE 5.1.2 AND REPLACE THE WORDS "*under the direction of*" IN THE SAME SENTENCE WITH* "in consultation and liaison with."

ADD THE FOLLOWING AFTER THE SECOND SENTENCE OF SUBCLAUSE 5.1.2:

"The Contractor and the Employer shall record on the said list, their concurrence or disagreement (as the case may be) regarding the completeness and accuracy of the details recorded therein."

REPLACE THE THIRD SENTENCE OF SUBCLAUSE 5.1.2 WITH THE FOLLOWING:

"At the completion of the Contract, The Contractor shall expose all pegs that were listed at the commencement of the construction as being in order and The Contractor shall arrange with a registered Land Surveyor for the checking of the positions of all such pegs and the replacement of those that the Land Surveyor's check reveals have become disturbed or damaged. The Contractor shall, as a precedent to the issue of the Certificate of Completion, provide to the Employer, a certificate from the registered Land Surveyor, certifying that all the pegs listed at the commencement of construction in accordance with the provisions of this clause, have been checked and that those found to have been disturbed, damaged or destroyed have been replaced in their correct positions, all in accordance with the provisions of the said Act.

The costs of all checking, replacement and certification as aforesaid shall be entirely for the Contractor 's account. This, with the provisions always that The Contractor shall not be held liable for the cost of replacement of pegs which:

(a) cannot reasonably be re-established in their original positions by reason of the finished dimensions of the permanent works, and

(b) The Contractor can prove beyond reasonable doubt to the satisfaction of the Employer, were disturbed, damaged or destroyed by others beyond his control."

PSA 5.3 PROTECTION OF EXISTING STRUCTURES

REPLACE "Machinery and Occupational Safety Act, 1983 (Act No 6 of 1983)*" WITH "*Occupational Health and Safety Act, 1993 (Act No 85 of 1993), as amended,*" AND INSERT THE FOLLOWING AFTER* "(Act No. 27 of 1956)": "as amended."

PSA 5.4 PROTECTION OF OVERHEAD AND UNDERGROUND SERVICES

REPLACE THE HEADING AND THE CONTENTS OF SUBCLAUSE 5.4 WITH THE FOLLOWING:

PSA 5.4 LOCATION AND PROTECTION OF EXISTING SERVICES

PSA 5.4.1 LOCATION OF EXISTING SERVICES

Before commencing with any work in an area, The Contractor shall ascertain the presence and actual position of all services which can reasonably be expected by an experienced and competent The Contractor to be present on, under, over or within the Site.

Without in any way limiting his liability in terms of the Conditions of Contract in relation to damage to property and interference with services, The Contractor shall, in collaboration with the Employer, obtain the most up-to-date plans as are available, showing the positions of services existing in the area where he intends to work. The Employer offers no warranty as to the accuracy or completeness of such plans and because services can often not be reliably located from plans, The Contractor shall ascertain the actual location of services depicted on such plans by means of careful inspection of the Site.

Thereafter, The Contractor shall, by the use of appropriate methodologies, carefully expose the services at such positions as are agreed to by the Employer, for the purposes of verifying the exact location and position of the services. Where the exposure of existing services involves excavation to expose underground services, the further requirements of sub Clauses 4.4 of GCC 2015 and 5.1.2.2 of SANS 1200 D (as amended) shall apply.

The aforesaid procedure shall also be followed in respect of services not shown on the plans, but which may reasonably be anticipated by an experienced The Contractor to be present or potentially present on the site.

All services, the positions of which have been determined as aforesaid at the critical points, shall henceforth be designated as 'known services' and their positions shall be indicated by The Contractor on a separate set of drawings, a copy of which shall be furnished to the Employer without delay.

As soon as any service which has not been identified and located as described above is encountered on, under, over or within the site, it shall henceforth be deemed to be a known service and the aforesaid provisions pertaining to locating, verifying and recording its position on the balance of the site shall apply. The Contractor shall notify the Employer immediately when any such service is encountered or discovered on the Site.

Whilst he is in possession of the Site, The Contractor shall be liable for all loss of or damage as may occur to

(a) known services, anywhere along the entire lengths of their routes, as may reasonably be deduced from the actual locations at which their positions were verified as aforesaid, due cognizance being taken of such deviations in line and level which may reasonably be anticipated, and

(b) any other service which ought reasonably to have been a known service in accordance with the provisions of this clause.

The Contractor shall also be liable for consequential damage in regard to (a) and (b), whether caused directly by the Contractor 's operations or by the lack of proper protection.

No separate payment will be made to The Contractor in respect of any costs incurred in preparing and submitting to the Employer the Drawings as aforesaid. These costs shall be deemed included in the Contractor 's other tendered rates and prices included in the Contract.

Payment to The Contractor in respect of exposing services at the positions agreed by the Employer and as described above will be made under the payment items (if any) as may be provided for in the respective sections of the specifications pertaining to the type of work involved.

PSA 5.4.2 PROTECTION DURING CONSTRUCTION

The Contractor shall take all reasonable precautions and arrange its operations in such a manner as to prevent damage occurring to all known services during the period which The Contractor has occupation and/or possession of the Site.

Services left exposed shall be suitably protected from damage and in such a manner as will eliminate any danger arising there from to the public and/or workmen, all in accordance with the requirements of the prevailing legislation and related regulations.

Unless otherwise instructed by the Employer, no services shall be left exposed after its exact position has been determined and all excavations carried out for the purpose of exposing underground services shall be promptly backfilled and compacted. In roadways, the requirements of Subclause 5.9 of SANS 1200 DB should be observed. In other areas compaction is to be to 90% modified AASHTO density.

PSA 5.4.3 ALTERATIONS AND REPAIRS TO EXISTING SERVICES

Unless the contrary is clearly specified in the Contract or ordered by the Employer, The Contractor shall not carry out alterations to existing services. When any such alterations become necessary, The Contractor shall promptly inform the Employer, who will either make arrangements for such work to be executed by the owner of the service or instruct The Contractor to make such arrangements himself.

Should damage occur to any existing services, The Contractor shall immediately inform the Employer, or when this is not possible, the relevant authority, and obtain instructions as to who should carry out repairs. In urgent cases, The Contractor shall take appropriate steps to minimize damage to and interruption of the service. No repairs of telecommunication cables or electric power lines and cables shall be attempted by the Contractor .

PSA 6 TOLERANCES

ADD THE FOLLOWING SUBCLAUSE TO CLUASE 6:

PSA 6.4 USE OF TOLERANCES

No guarantee is given that the full specified tolerances will be available independently of each other, and The Contractor is cautioned that the liberal or full use of any one or more of the tolerances may deprive him of the full or any use of tolerances relating to other aspects of the work.

Except where the contrary is specified, or when clearly not applicable, all quantities for measurement and payment shall be determined from the 'authorized' dimensions. These are specified dimensions or those shown on the drawings or, if changed, as finally prescribed by the Employer, without any allowance for the specified tolerances. Except if otherwise specified all measurements for determining quantities for payment will be based on the 'authorized' dimensions.

If work is constructed in accordance with the 'authorized' dimensions plus or minus the tolerances allowed, the calculation of quantities will be based on the 'authorized' dimensions, regardless of the actual dimensions to which the work has been constructed.

When the work is not constructed in accordance with the 'authorized' dimensions plus or minus the tolerances allowed, the Employer may nevertheless, at his sole discretion, accept the work for payment. In such cases no payment shall be made for quantities of work or material in excess of those calculated for the 'authorized' dimensions, and where the actual dimensions are less than the 'authorized' dimensions minus the tolerance allowed, quantities for payment shall be calculated based on the actual dimensions as constructed."

PSA 7 TESTING

PSA 7.2 APPROVED LABORATORIES

REPLACE THE CONTENTS OF SUBCLAUSE 7.2 WITH THE FOLLOWING:

"Unless otherwise specified in the relevant specification or elsewhere in the Project Specification, the following shall be deemed to be approved laboratories in which design work, or testing required in terms of a specification for the purposes of acceptance by the Employer of the quality of materials used and/or workmanship achieved, may be carried out:

(a) Any testing laboratory certified by the South African National Accreditation Systems (SANAS) in respect of the nature and type of testing to be undertaken for the purposes of the Contract;

(b) Any testing laboratory owned, managed or operated by the Employer;

(c) Any testing laboratory established and operated on the Site by or on behalf of the Employer;

(d) Any other laboratory that the Employer approves in his absolute discretion."

PSA 8 MEASUREMENT AND PAYMENT

PSA 8.1 MEASUREMENT

PSA 8.1.2 PRELIMINARY AND GENERAL ITEM OR SECTION

PSA 8.1.2.1 CONTENTS

REPLACE THE LAST SENTENCE OF SUBCLAUSE 8.1.2.1(b) WITH THE FOLLOWING:

"Separate items will be scheduled to cover the fixed, value-related and time-related components of the Contractor 's preliminary and general costs."

PSA 8.2 PAYMENT

PSA 8.2.1 FIXED-CHARGE AND VALUE-RELATED ITEMS

REPLACE THE CONTENTS OF SUBCLAUSE 8.2.1 WITH THE FOLLOWING:

PSA 8.2.1.1 FIXED-CHARGE ITEMS

Payment of fixed charges in respect of item 8.3.1 will be made as follows:

(a) EIGHTY PER CENT (80%) of the sum tendered will be paid when the facilities have been provided and approved;

(b) The remaining TWENTY PER CENT (20%) will be paid when the works have been completed, the facilities have been removed and the site of the Contractor 's establishment has been cleared and cleaned to the satisfaction of the Employer.

No adjustment will be made to the sum tendered in respect of item 8.3.1 should the value of the works finally executed or the time for completion vary in any way from that specified in the tender."

PSA 8.3 SCHEDULED FIXED-CHARGE AND VALUE-RELATED CHARGE

ADD THE FOLLOWING NEW SUBCLAUSES TO CLAUSE 8.3

PSA 8.3.5 ADDITIONAL CONTRACTUAL OBLIGATIONS

PSA 8.3.5.1 Notice and warning to consumers ……..…Unit : Sum

The sum shall cover the full compensation and cost of supply and delivery of the notices and warnings to customers at least 3 days before a shutdown is to take place in each section of work.

PSA 8.3.5.2 OHS Act Obligations ……...Unit: Sum

The sum shall cover the full compensation and fixed costs for the compliance with the Occupational Health and Safety Act, Construction Regulations 2003 and all the requirements stipulated in the Employer's Health and Safety Specifications."

PSA 8.3.5.3 EMP Obligations ……Unit: Sum

The sum shall cover the full compensation and all fixed costs for compliance with the requirements of The Employer's Environmental Management Plan.

PSA 8.4 SCHEDULED TIME-RELATED ITEMS

ADD THE FOLLOWING NEW SUBCLAUSES TO CLAUSE 8.4.

PSA 8.4.6 Additional Obligations

PSA 8.4.6.1 OHS Act Obligation……...Unit: Month

The sum shall cover the full compensation and all-time related costs for the duration of the contract, for the compliance with the Occupational Health and Safety Act, Construction Regulations 2003 and all the requirements stipulated in the Employer's Health and Safety Specifications. The cost shall include the salary for a full time OHS Officer for the project.

PSA 8.4.6.2 Security services costs…….……..Unit: Month

The sum shall cover the full compensation and all costs for a sufficient 24 hour guarded services for the duration of the contract.

PSA 8.4.6.3 Community Liaison Officer ……. Unit: Stated Sum

The stated sum shall cover full compensation and all costs payable monthly, to provide a full time qualified and suitable experienced Community Liaison Office for the duration of the contract. The stated sum shall also cover for the CLO cellphone airtime.

PSA 8.5 SUMS STATED PROVISIONALLY BY EMPLOYER

AMEND SUBCLAUSE 8.5.b)1 AND ADD THE FOLLOWING ITEMS:

i) Alteration to existing services by authorities……Unit: Stated Sum

ii) Control tests by independent laboratory …….. ….. Unit: Stated Sum

iii) Provision of photographic records ……Unit: Stated Sum

iv) CLO and CSO……. Unit: Stated Sum

v) Temporary protection of services……. Unit: Stated Sum

vi) Pipeline Cathodic Protection……. Unit: Stated Sum

vii) Reinstatement of asphalt ……... Unit: Stated Sum

The Contractor is responsible for both the cost of normal testing as described in the Project Specifications and for the cost of any additional test that indicates that the Specifications have not been complied with."

These sums will be paid to The Contractor in equal monthly amounts."

PSA 8.7 DAYWORKS

ADD THE FOLLOWING NEW CLAUSES:

PSA 8.7.1 SCOPE

This section covers the method of measurement and payment for work carried out on a day work basis.

PSA 8.7.1.1 GENERAL REQUIREMENTS

Work will be classified as day work only if the Employer considers no other rate in the Bill of Quantities appropriate for payment purposes.

An instruction regarding all work to be carried out under day work in terms of Clause 6.5 of the General Conditions of Contract 2010 will be issued at the discretion of the Employer. Some or all the items priced under day work in the Bill of Quantities may possibly not be required for this Contract.

Before ordering any material, The Contractor shall submit quotations to the Employer for his approval and shall submit such receipts or vouchers to the Employer as may be necessary for proving the amount claimed.

PSA 8.7.1.2 MEASUREMENT AND PAYMENT - DAY WORKS

The day work rates submitted for vehicles and construction equipment, in the Bill of Quantities shall be a hire charge for the use of the vehicle and driver or constructional WORKS/equipment and operator (excluding VAT) and shall apply only to vehicles and construction equipment approved in writing by the Employer. The rate shall include for maintenance, fuels and oils and other operating costs, establishment, insurance and other contingency costs relating to the running of the vehicle, WORKS or equipment.

Where there is ambiguity between the power developed at the flywheel and mass of a machine, the power shall govern the measurement category.

The Contractor and the Employer will agree on the method of recording the working hours prior to the commencement of the work. Any extended period of idling at any one time which in the opinion of the Employer or his representative is beyond that required for normal operating conditions will not be paid for as working time. Non-working hours for any reason shall not be measured for payment.

The ten percent allowed for overheads etc. as per Clause 6.5.1.2.3 of the General Conditions of Contract 2010 shall include full compensation for all administrative costs, supervision, overheads, liabilities and obligations related to the running of the vehicles, constructional WORKS and equipment. The tendered percentage shall also include for profit and shall be subject to the Contract Price Adjustment factor laid down in the Contract Data.

PSA 8.8 TEMPORARY WORKS

PSA 8.8.4 EXISTING SERVICES

AMEND THE SUB CLAUSE AS FOLLOWS:

PSA8.8.4 a) Supply or hire of specialist equipment ……. …. Unit: Sum

The sum shall cover the cost for the supply, operation and/or hire of specialist equipment for detection of underground services as ordered by the Employer.

PSA 8.8.4 b) Excavate by hand in soft material to expose existing services……. Unit: m^3

The rate shall cover the cost for removal of premix or other surfacing where necessary, excavating in all materials, shoring, backfilling, compaction and reinstatement of surfaces except for asphalt.

PSA 8.9 STANDING TIME……Unit: hour

Rate to include all costs The Contractor incurs on an hourly basis (labour, WORKSs, equipment, security, offices, supervisory staff and other time related costs). Standing time will be paid to The Contractor in a case where there are delays from the Employer in providing information or instruction and where The Contractor have no work to be undertaken during that period. The standing time rate for equipment will be taken as the dayworks rates less 10% for fuel.

PSAB EMPLOYER'S OFFICE

PSAB 3 MATERIALS

PSAB 3.1 NAMEBOARDS

DELETE THE ENTIRE CLAUSE AND REPLACE WITH:

"The name board shall be of either tempered hardboard at least 12mm thick or steel sheeting so braced on the reverse side as to prevent warping or buckling and shall be mounted on two or more firmly Worked poles as necessary. The quality of the paint shall conform to SANS Standard Specification CKS 193. The colour of the paint shall conform to SANS 1091-1975 colour F11, strong blue. The Employer's SOC Ltd logo shall be in colour. The height of the larger name board shall be 2400mm and the width 4800mm, whilst the height of the smaller name board shall be 800mm and the width 1600mm".

PSAB 3.2 OFFICE BUILDING(S)

Delete this sub-clause entirely and re-title the sub-clause "FACILITIES FOR THE EMPLOYER" Add the following sub-clause.

PSAB 3.2.1 OFFICE BUILDING(S)

The Contractor shall provide, furnish and equip one or more offices (as scheduled) for the use of the Employer.
The Contractor shall provide, furnish and equip one or more offices (as scheduled) for the use of the Employer.

The Contractor shall provide and furnish one office for the use of the Employer. Each office shall consist of one room with a floor area of at least 12 m^2 and a ceiling height of at least 2.5 m.

Each office shall be weatherproof, shall have a wooden boarded floor that is at least 150 mm above the ground, and shall be provided with a ceiling and a lining to the walls, or equivalent insulation, with an acceptable type of door with a secure lock, and two opening windows of glazed area at least 3 m^2. Each office shall be well ventilated and shall be so insulated as to provide comfortable working conditions.

Office building shall be painted with an approved paint after erection and the paintwork shall be maintained during the contract period.

Each door shall be provided with a lock and two keys.

The sitting of all offices shall be to the Employer's satisfaction and shall be decided upon in consultation with him/her and confirmed in writing before erection.
All accommodation shall include the provision of access roads where required, fresh clean portable water and sewerage, which will be considered as part and parcel of the accommodation provided and will not be paid for separately.
All accommodation shall meet with the approval of the Employer.

The offices shall comply with the following requirements.

Dimensions	Type 1 Office	Type 2 Office
Minimum floor area	20 m^2	12 m^2
Minimum window area	4.0 m^2	3.0 m^2
Minimum window area opening	2.4 m^2	1.5 m^2
Minimum clear height	2.5 m	2.5 m
Shaded parking for vehicles	2	2

Furniture and Equipment

Each office shall be equipped with the following:

i. Office desk with a surface area of at least 1.5m^2 with at least 3 drawers one of which can be locked.

ii. Two office chairs.

iii. a lockable upright steel cabinet with three shelves or a steel filing cabinet with four drawers

iv. Refrigerator

v. Printer

vi. Enough racks and hangers for hanging contract drawings. The hangers shall be of the "Bar hold" type, with one hanger to five drawings.

vii. Double 80-watt fluorescent light fittings complete with ballast and tubes (2 per Type 1 office, 1 per Type 2 office).

In addition to the above the Type 1 office shall be equipped with the following:

i. Conference table large enough to accommodate twelve people and have an area of at least 15m^2.

Fifteen office chairs

The Contractor shall also supply a toilet for the exclusive use of the Employer.
The Contractor must provide basic survey instruments: dumpy level, tripod stand and staff.

On completion of the Works, ownership of the buildings, furnishings and equipment shall revert to The Contractor who shall remove them from the Site.

PSAB 3.3 CARPORT

ADD THE FOLLOWING NEW CLAUSE:

The Contractor shall construct the number of carports specified in Portion A of the Project Specifications, for the sole use of the Employer and his staff. Each carport shall be constructed so that the vehicle parked under it is always protected against the direct rays of the sun. The carport area shall be at least 20 m² and the floor shall be covered with a layer of crushed stone to alleviate dusty and muddy conditions. The carport(s) shall be positioned to provide easy and convenient access to the Employer's office."

PSAB 4 WORKS

PSAB 4.1 TELEPHONE

REPLACE SUBCLAUSE 4.1 OF SANS 1200 AB WITH THE FOLLOWING:

"The Contractor shall arrange for the provision of an approved cellular phone and airtime and data bundles per month for the Employer's representative. The Contractor at the tendered rates under the relevant scheduled item shall recover the associated charges and telephone calls and data bundles associates with the contract.

PSAB 4.2 SURVEY EQUIPMENT

ADD THE FOLLOWING NEW CLAUSE:

The Contractor shall provide on-site and make available for the exclusive use of the Employer and his staff, the survey equipment listed in Portion A of the Project Specifications.

All survey equipment provided by The Contractor shall be in good condition, properly calibrated and fit for the purpose.

In addition to survey equipment provided by The Contractor for the exclusive use of the Employer and his staff, The Contractor shall make available for use by the Employer, the further survey equipment listed in Portion 1 of the Project Specifications, at all times when such is reasonably required by the Employer and his staff for the purposes of the Contract."

PSAB 4.3 COMPUTER FACILITIES

ADD THE FOLLOWING NEW CLAUSE:

The Contractor shall, for the duration of the Contract, provide the computer equipment complete with printer, modem and telephone connection including 3G connection together with the software specified hereunder, for the exclusive use of the Employer and his staff:

a) 1 laptop

b) 1 printer

The laptop shall comply with the following minimum specifications:
The laptop shall comply with the following minimum specifications:
Lenovo ThinkPad T540P Intel Core 17-4700MQ, 8GB, 1TB, DVD+-RW DL, 15.6FHD (1920X1080), NVIDIA 1GB, 3
WAR: 3 Year on-site Warranty upgrade
Mem: Lenovo 8GB DDR3L 1600 (PC3-1280D) 50 DIMM Memory
Dock: ThinkPad Pro Dock-65W-South Africa

Printers shall, unless otherwise approved by the Employer, be SamsungSCX-4600 Colour Laser Printer Series or equivalent compatible.

All computer hardware shall be provided complete with the requisite connecting cables and all interfacing devices and software necessary for its efficient operation as an integral system.

The following software shall be professionally installed on the computer, and the original license agreements and disks shall be provided to the Employer for safekeeping:

- Microsoft Windows 10
- MS-Office 2020
- MS Projects 2010

All computer equipment provided shall always be kept fully serviceable by the Contractor. The Contractor shall have any defective equipment repaired or replaced at his own cost within 12 hours after notification by the Employer's staff.

The Contractor shall further provide at his own cost, all paper and black ink cartridges and other consumables reasonably required by the Employer."

PSAB 5 CONSTRUCTION

ADD THE FOLLOWING NEW SUBCLAUSES TO CLAUSE 5 OF SANS 1200 AB:

PSAB 5.6 SURVEY EQUIPMENT

All survey equipment provided by The Contractor shall always be kept fully serviceable by the Contractor. The Contractor shall have any defective equipment repaired or replaced at his own cost within 12 hours after notification by the Employer's staff.

Where required by the Employer, The Contractor shall, at his own cost, promptly arrange for the recalibration of survey equipment provided."

PSC SITE CLEARANCE

PSC 3 MATERIALS

PSC 3.1 DISPOSAL OF MATERIALS

ADD THE FOLLOWING:

"The Contractor shall obtain his own dumping sites for the disposal of material and all transport costs shall be included in the rates tendered for site clearance."

PSC 5 CONSTRUCTION

PSC 5.1 AREAS TO BE CLEARED AND GRUBBED

ADD THE FOLLOWING:

"Small diameter pipeline routes shall be cleared to 1,0m on both sides of the pipeline Centre line and large diameter pipeline routes shall be cleared to 2,0m on both sides of the pipeline Centre line. Route pegs or markers shall not be destroyed or damaged during clearing operations."

PSC 5.2 CUTTING OF TREES

PSC 5.2.3 PRESERVATION OF TREES

PSC 5.2.3.2 INDIVIDUAL TREES

REPLACE THE LAST SENTENCE WITH THE FOLLOWING:

"An amount of R 1000.00 will be deducted from moneys due to The Contractor as a penalty for every tree that is damaged or removed unnecessarily."

PSC 8 MEASUREMENT AND PAYMENT

PSC 8.2 PAYMENT

PSC 8.2.1 CLEAR AND GRUB

REPLACE THE FIRST LINE WITH THE FOLLOWING:

"The area designated by the Employer to be cleared and grubbed will be measured in square metre to the nearest square metre or," otherwise specified.

PSC 8.2.5 TAKE DOWN EXISTING FENCES

REPLACE ITEM 8.2.5 WITH THE FOLLOWING:

PSC 8.2.5 TAKE DOWN EXISTING FENCES:

(a) Description of fence ……..……..... Unit: m or km

(b) Etc. for other items

The unit of measurement shall be the metre or kilometer of fence taken down and removed from the site.

The rate shall cover the cost of taking down the complete fence (fence height up to 2m) as scheduled and removing all fence material from the site, filling of holes, leveling ground surfaces and cleaning the site as well as providing temporary fence during construction."

PSC 8.2.8 DEMOLISH AND REMOVE STRUCTURES/BUILDINGS AND DISMANTLE STEELWORK, ETC.
REPLACE "Unit: sum" *WITH* "Unit: sum or number of m²".
REPLACE THE LAST SENTENCE WITH:

"The rate shall cover the cost of all such separate items as scheduled in the Schedule of Quantities."
ADD THE FOLLOWING ITEMS:

PSC 8.2.11A TEMPORARY FENCING OR HOARDING:

(a) Indicate temporary usage, description and type …… Unit: m

(b) Etc. for other usage and types.

The unit of measurement shall be the linear metre of fence or hoarding supplied and erected, and in the case of temporary fencing for maintaining and removing on completion of the works or part of the works.

The tendered rate shall include full compensation for the cost of supplying and erecting the complete fence as specified or scheduled and in the case of temporary fencing for taking down the fences, removing from the site, filling of holes, leveling ground surfaces and cleaning the site.

Seventy per cent (70%) of the tendered rate shall be payable on completion and approval of the temporary fences, and the remaining thirty per cent (30%) on completion of the removal of the fences.

PSC 8.2.11B REMOVAL OF MAN-MADE SURFACES

The rate shall cover all WORKS, labour, material, saw cutting (asphalt and concrete), breaking up, lifting, loading, transportation, off-loading surfacing and storing (where applicable).
Unit: m²
Roadways, Asphalt and other layers

i) Asphalt (≤ 50mm thick) and including base, sub-base and subgrades layers up to 800mm deep.

ii) Asphalt (> 50 ≤ 100mm thick) and including base, sub-base and subgrades layers up to 800mm deep.

a) Footways and driveways

Asphalt ≤ 50mm thickness
Asphalt > 50 ≤ 100mm thickness
Interlocking concrete segmental paving blocks (all colour)
Concrete slabs (450 x 450mm)
Brick paving
Unreinforced concrete ≤75mm thick
Reinforced concrete ≤75mm thick
Grassing
Kerbing (all types of kerbing) …….... (Unit: m)

PSC 8.2.12 BACKFILLING AND REINSTATEMENT OF MAN-MADE SURFACES

The rate shall cover the cost of all associated WORKS, labour, material, loading, transportation from storage, off-loading and placing (levelling and compacting where applicable) the following materials in roadways, footways and driveways in accordance with the COP:

PSC 8.2.12.1 BACKFILLING AND REINSTATEMENT OF ROADS

Unit:m²

a) Scenario A

i) 150mm base – G2 Graded crushed stone to 102% Mod AASHTO density

ii) 150mm subbase – G5 Graded crushed stone to 97% Mod AASHTO density

iii) 150mm Fill – G7 material compacted to 95% Mod AASHTO density

iv) 150mm selected subgrade – Insitu material compacted to 90% Mod AASHTO

b) Scenario B

i) 150mm base – G2 material compacted to 97% Mod AASHTO density

ii) 150mm subbase – C4 Stabilized gravel material to 95% Mod AASHTO density*

iii) 150mm selected subgrade - Insitu material compacted to 93% Mod AASHTO

*Rate shall include stabilization agent.

c) Scenario C (Foot paths)

i) 150mm base – Recovered material compacted to 93% Mod AASHTO

ii) 150mm selected subgrade – Insitu material compacted to 90% Mod AASHTO

d) Surfacing

i) 30mm Bitumen hot mix: Fine

ii) 70mm Bitumen hot mix: BTB

PSC 8.2.12.2 BACKFILLING AND REINSTATEMENT FOOTWAYS

Unit:m²

a) Using removed materials:

i) Interlocking concrete segmental paving blocks (all colour)

ii) Concrete slabs (450 x 450mm)

iii) Brick paving

iv) Grassing

v) Kerbing…….... (Unit: m)

b) Using new supplied materials: Unit:m²

i) 30mm Bitumen hot mix: Fine

ii) Interlocking concrete segmental paving blocks, including a 20mm river sand bedding layer, jointing sand (plaster sand) and mortar infill between edge restraint and blocks

1) Grey blocks

2) Coloured blocks

iii) Concrete slabs (450 x 450mm) including a 20mm river sand bedding layer, jointing mortar.

iv) Brick paving including a 20mm river sand bedding layer, jointing sand (plaster sand) and mortar infill between edge restraint and bricks.

v) Unreinforced concrete ≤ 75mm thick (15MPa)

vi) Reinforced (395 mesh) concrete ≤ 75mm thick (15MPa)

vii) Grassing

viii) Concrete channeling, including formwork, leveling and compacting 300 x 125mm cast in situ concrete of 15MPa.

ix) Kerbing, including a 50mm bedding (cement and river sand), jointing mortar and 15MPa concrete haunching at all joints. (Unit: m)

1) Figure 1

2) Figure 7

3) Figure 8

4) Figure 12

PSC 8.2.13 REINSTATEMENT OF EXISTING MASONRY WALLS AND STEEL PALISADE FENCES

The rate shall cover the cost of reinstating existing masonry walls, plastered or unplastered, and steel palisade fences (including any gates) including WORKS, labour, material, on-loading, transporting, off-loading and cleaning for the following:

Unit: m^2

a) Face brick

i) 110mm wall

ii) 220mm wall

iii) 330mm wall

b) Plastered

i) 110mm wall

ii) 220mm wall

iii) 330mm wall

c) Steel palisade fences (height = 2.1m)

PSD EARTHWORKS

PSD 2 INTERPRETATIONS

PSD 2.1 SUPPORTING SPECIFICATIONS

REPLACE SUBCLAUSE 2.1.2 WITH THE FOLLOWING:

"PSD 2.1.2: Any of the other SANS 1200 Specifications may form part of the Contract Documents."

PSD 2.3 DEFINITIONS

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 sources such as borrow pits or the authorized widening of excavations. "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, and including any borrow pit, provided by the Contractor.

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."

PSD 3 MATERIALS

PSD 3.1 CLASSIFICATION FOR EXCAVATION PURPOSES

PSD 3.1.1 METHOD OF CLASSIFYING

ADD THE FOLLOWING:

"The classification of material other than 'soft excavation' shall be agreed upon before excavation may commence.

The Contractor shall immediately inform the Employer when the nature of the material being excavated changes to such an extent that a new classification is warranted for further excavation. Failure on the part of The Contractor to advise the Employer in appropriate time shall entitle the Employer to reclassify, at his discretion, such excavated material."

ADD THE FOLLOWING NEW SUB CLAUSES:

PSD 3.1.3 CLASSIFICATION FOR HAND EXCAVATION

Classification of material for various types of hand excavation will be based on the results of a dynamic cone penetrometer. The category of material shall be determined by testing the material at regular intervals and at various depths along the centre line of the trench. A minimum of 5 tests shall be done at each location and the average number of blows of the tests shall be used to determine the category of material.

The interval between test locations shall be determined by the variation of material type but shall not exceed 50m. The depth of testing shall be determined by the variation of material type and can increase or decrease in hardness with increasing depth of excavation. Table PSD 3.1.3 indicates the categories:

TABLE PSD 3.1.3: Classification for Hand Excavation

Category of Material	**Consistency**		**DCP Blows to Penetrate 100mm**	
	Granular	**Cohesive**	**Granular**	**Cohesive**
<u>Soft</u> Soft excavation shall be excavation in material that can be efficiently removed from the trench using a pick and shovel but not requiring prior breaking using mechanical equipment such as pavement breakers	Up to medium dense	Firm to stiff	0-6	1-5
<u>Intermedite</u> Intermediate excavation shall be excavation in material that requires	Very dense		16-50	-15

prior breaking using mechanical equipment, such as pavement breakers with clay spades, before being removed from the trench.				
<u>Rock / Hard</u> Rock and Hard shall mean the same thing: - shall be excavation in material other than described above which by nature of the material requires blasting	-	-	>50	>15

PSD 3.2.3 MATERIAL SUITABLE FOR BACKFILL OR FILL AGAINST STRUCTURES

REPLACE THE CONTENTS OF THIS SUBCLAUSE WITH THE FOLLOWING:

"Material used for backfill behind structures shall generally be the material excavated, subject to the following conditions:

(a) The material shall not contain an excessive number of stones retained on a 50 mm sieve.

(b) The material shall not contain large clay lumps that do not break up under the action of the compaction equipment.

(c) The liquid limit of the material shall not exceed 40, neither shall the Pi exceed 18."

PSD 3.3 SELECTION

ADD THE FOLLOWING SUBCLAUSE:

PSD 3.3.3 SELECTION IN BORROW PITS AND EXCAVATIONS

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."

PSD 5 CONSTRUCTION

PSD 5.1 PRECAUTIONS

PSD 5.1.1 SAFETY

PSD 5.1.1.1 BARRICADING AND LIGHTING

REPLACE "Machinery and Occupational Safety Act, 1983 (Act 6 of 1983)" *WITH* "Occupational Health and Safety Act, 1993 (Act 85 of 1993)."

REPLACE SUB-PARAGRAPH (a) AND (b) WITH THE FOLLOWING AND ADD SUB-PARAGRAPH c):

a) adequately protected by a barrier or fence comprising fluorescent orange plastic netting of height at least 1 000mm and as close to the excavation as practicable; and

b) provided with notice boards marked "CLOSED – GESLUIT" at each end of closed or partially closed roads; and

c) provided with flashing orange lights, placed at 15m intervals along the barricading at night.

ADD THE FOLLOWING TO THIS SUBCLAUSE:

Should The Contractor fail to provide adequate lighting, signing and barricading, access to properties, or leave the site in a dangerous condition, the Employer shall be entitled to suspend all work under The Contractor until in the Employer's opinion the Contractor 's obligation in these respects have been fulfilled and/or arrange for any emergency work to be carried out by some other agency and to deduct the cost of this work from any monies due to the Contractor .

PSD 5.1.1.2 SAFEGUARDING OF EXCAVATIONS

REPLACE "Machinery and Occupational Safety Act" *IN SUB-PARAGRAPH* (a) *WITH* "Occupational Health and Safety Act, 1993 (Act 85 of 1993)."

ADD THE FOLLOWING TO SUB PARAGRAPH (d):

Loose ground, materials, tools and appliances shall be kept clear of the edge of the excavations and a pathway at least 0,30 m shall be left clear along the edge of the excavation.

PSD 5.1.1.3 EXPLOSIVES

REPLACE THE CONTENTS OF THIS SUBCLAUSE AS FOLLOWS:

Where blasting is resorted to, it shall be carried out strictly according to Explosives Act and Regulations 1956 (Act No. 26 of 1956, as amended). However, in no case will blasting be allowed if a reasonable possibility exists of injury to any foundation, wall, pipe, cable or any structure, complete or partly complete. Where the Employer considers blasting to be dangerous, the same shall not be permitted and his decision shall be final and binding.

Wherever blasting is permitted and resorted to in the vicinity or within the limits of existing townships, roads, etc., it shall only be executed under the cover of enough earth backfill, heavy wire mesh screens or rubber matting of adequate weight and area to prevent the blasted material from being ejected from the trench. If any damage should occur, The Contractor shall carry out remedial work arising from such damage and will be held to have allowed therefore in his price.

The Contractor shall undertake such blasting so that the Peak Particle Velocity (PPV) as measured at the closest point to the existing outfall sewer and or building structure shall not exceed 25mm/s. Each blast shall be monitored, and the findings recorded by an appropriately qualified explosives expert using a suitably calibrated apparatus. The Contractor shall also timeously inform the relevant inspectorate and obtain the required blasting permit from the South African Police Services, Division of Explosives before proceeding with any blasting on site. If in the opinion of the Employer, The Contractor makes careless use of explosives, he may forbid The Contractor the use of explosives.

It is a condition that should blasting result in the disturbing of material outside the trench, the Employer will require The Contractor to remove the disturbed material and backfill it to a compaction standard of the natural in-situ material. All this work for correcting areas of disturbed material will be done at the Contractor 's cost.

The schedule rate for hard rock excavation shall cover all costs incurred in connection with supply, transportation, storage and handling of explosives, the related blasting costs and any remedial work should this be required.

PSD 5.1.1.4 HARD ROCK EXCAVATION WITHOUT USING EXPLOSIVES

ADD THE FOLLOWING TO THIS CLAUSE:

It is a condition that should blasting result in the disturbing of structures outside the trench; the Employer will require The Contractor to remove the rock material by means of pneumatic or hydraulic breakers, e.g. jackhammers or woodpeckers.

The schedule rate for hard rock excavation without using explosives shall cover all costs incurred in connection with supply of specialist equipment, the transportation to and from the site as well as the removal and disposal of the hard material should this be required.

PSD 5.1.2 EXISTING SERVICES

PSD 5.1.2.2 DETECTION, LOCATION AND EXPOSURE

REPLACE THE CONTENTS OF SUBCLAUSE 5.1.2.2 WITH THE FOLLOWING:

"The exposure by The Contractor of underground services, as required in terms of subclause 5.4 of SANS 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 Employer.

Unless otherwise instructed or agreed by the Employer, 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 subclause 5.9 of SANS 1200 DB.

Payment in respect of exposing the services by means of hand excavation as described above, will be made in accordance with subclause PSA 8.8.4

Payment in respect of reinstating layer works in roadways will be made in accordance with subclause 8.3.6.1 of SANS 1200 DB."

PSD 5.1.2.3 PROTECTION OF CABLES

REPLACE SUBCLAUSE 5.1.2.3 WITH THE FOLLOWING:

PSD 5.1.2.3 PROTECTION DURING CONSTRUCTION

Further to the requirements of subclause 5.4.2 of SANS 1200 A (as amended), major excavating equipment and other WORKS shall not be operated dangerously close to known services. Where necessary, excavation near 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 subclause 5.4.2 of SANS 1200 A (as amended), immediately notify the Employer 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 minimize the occurrence of any further damage occurring."

PSD 5.1.2.4 NEGLIGENCE

DELETE SUB-CLAUSE 5.1.2.4

PSD 5.1.3 STORMWATER AND GROUNDWATER

ADD THE FOLLOWING TO THE SUB-CLAUSE:

"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."

PSD 5.1.4 NUISANCE

PSD 5.1.4.3 EXCAVATED MATERIAL NOT TO ENDANGER OR INTERFERE

AMEND THE CLAUSE AS FOLLOWS:

"A safe, clear path shall be kept open at all times for pedestrians. Equipment, materials and waste shall be stored, stockpiled or removed in such a manner that pedestrians are not endangered and that the nuisance level is kept to a minimum. If construction activities occupy the whole footway and verge area so that pedestrians are forced to walk in the traffic lane, adequate protection from traffic shall be provided.

Where instructed by the Employer or where the Works impose a danger to traffic or pedestrians, The Contractor shall at his own cost remove off Site excavated material to temporary stockpiles (approved by the Employer) and the return to Site, excavated material for use as backfill or bedding."

ADD THE FOLLOWING NEW SUBCLAUSE:

PSD 5.1.4.4 OPEN TRENCHES

Unless otherwise permitted and where relevant, not more than the 100 m of trench in one place shall be opened ahead of the completed and backfilled pipeline."

PSD 5.1.5 REINSTATEMENT AND MAINTENANCE OF ROADS

ADD THE FOLLOWING TO THE SUB-CLAUSE:

"Where crossings have been made, the roads shall be reinstated in accordance with the details specified in subclause 5.9 of SANS 1200 DB."

PSD 5.1.6 ROAD TRAFFIC CONTROL

DELETE THE SECOND SENTENCE OF SUBCLAUSE 5.1.6

PSD 5.2 METHODS AND PROCEDURES

PSD 5.2.2 EXCAVATION

PSD 5.2.2.1 EXCAVATION FOR GENERAL EARTHWORKS AND FOR STRUCTURES

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 rate tendered for item 8.3.5 will be deemed to include the cost of a working width of 600 mm, but The Contractor may excavate a greater working width at no additional cost to the Employer."

REPLACE THE CONTENT OF PARAGRAPH (e) WITH THE FOLLOWING:

"Where excavations have been carried below the authorized levels, The Contractor shall backfill such excavations to the correct level with approved gravel compacted to 90% of modified AASHTO density or to the density of the surrounding material.

Where excavations have been carried out in hard material, the Employer may direct the over-excavation to 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 retrim the excavations if necessary and, unless other remedial measures are agreed to by the Employer, shall cast the concrete for the structure, including the additional concrete that may be required because of the over-excavation or partial collapse. The cost of the additional concrete or remedial measures shall be for the Contractor 's account."

PSD 5.2.2.3 DISPOSAL

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.

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.

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 subclause PSD 8.3.14."

ADD THE FOLLOWING SUBCLAUSE IN SUBCLAUSE 5.2.2:

PSD 5.2.2.4 SELECTION AND STOCKPILING

Approval or designation of the material in a borrow pit or excavation for a 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 Employer's opinion, unsuitable for use in embankments or backfill as a result of contamination, shall be disposed of in a manner acceptable to the Employer and shall be replaced by The Contractor with materials acceptable to the Employer, all at the Contractor 's cost."

PSD 5.2.5 TRANSPORT FOR EARTHWORKS

REPLACE THE CONTENT OF SUBCLAUSE WITH THE FOLLOWING:

"The transport of all excavated materials, irrespective of the distance and source, shall be deemed to be free-haul, the cost of which is included in the Contractor 's tendered rates and prices for the excavation of the materials. No separate compensation shall apply for the transportation of excavated materials."

PSD 7 TESTING

PSD 7.2 TAKING AND TESTING OF SAMPLES

REPLACE THE CONTENT OF THIS SUBCLAUSE WITH THE FOLLOWING:

“The Contractor shall arrange with the approved independent laboratory by The Contractor to carry out sufficient tests on a regular basis as agreed between him and the Employer 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 Employer 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 percentage points below the specified value.”

PSD 8 MEASUREMENT AND PAYMENT

PSD 8.3 SCHEDULED ITEMS

PSD 8.3.1 SITE PREPARATION

REPLACE SUBCLAUSES 8.3.1.1 AND 8.3.1.2 WITH THE FOLLOWING:

"Where site preparation such as clearing, grubbing, the removal of large trees or the removal and stockpiling of topsoil is required, the provisions and scheduled items of SANS 1200 C shall apply."

PSDB 5 CONSTRUCTION

PSDB 5.1 PRECAUTIONS

PSDB 5.1.2 STORMWATER, SEEPAGE AND DEWATERING OF EXCAVATION

PSDB 5.1.2.3 SLOPING GROUND

ADD THE FOLLOWING SENTENCE AT THE END OF THE PARAGRAPH:

"All trench excavations on sloping embankments shall be backfilled in accordance with 5.6.2 over the full extent of the actual trench excavation and to the original embankment ground level."

PSDB 5.1.3 ACCOMMODATION OF TRAFFIC AND ACCESS TO PROPERTIES

REPLACE THE SEMICOLON AND THE WORD "and" AT THE END OF THE SUBCLAUSE 5.1.3 (a) WITH A FULL STOP AND REPLACE ITEM (b) WITH THE FOLLOWING:

"(b) Where necessary to achieve compliance by The Contractor with his obligations to provide and maintain pedestrian and vehicular access to properties affected by the works, The Contractor shall construct and maintain to the satisfaction of the Employer, such temporary access roads around, and/or steel or timber bridges over excavations in roads, pavements, entrances or accesses to properties.

The Contractor shall make available on site at all times a sufficient number of steel plates at least 2.0m x 2.0m x 8mm thick to be laid across open trenches to provide access to private properties. The cost of providing, placing and removing the steel plates shall be included in the rates for trench excavation.

On completion of the work, The Contractor shall dismantle and remove all such temporary constructions and reinstate these areas to their former condition.

Except only where the Employer has included in the Schedule of Quantities, particular payment items specifically therefore, The Contractor will not be paid directly for the construction and maintenance of temporary access roads and/or the provision and maintenance of bridges as aforementioned, and the costs thereof shall be deemed included in the Contractor 's tendered rates for excavation."

ADD THE FOLLOWING NEW SUBCLAUSE TO SUBCLAUSE 5.1:

PSDB 5.1.5 REMOVAL OF EXISTING PIPELINES

Where existing pipes have to be removed, they shall be carefully opened up by machine excavation to 300 mm above the pipes after which the whole pipe shall be fully exposed by means of hand excavation. The excavation width shall comply with subclause 8.2.3.

The pipes shall be removed from the trench in a manner approved by the Employer and brought to the surface for inspection by the Employer.

Pipes that are declared suitable for reuse and pipes declared unfit for reuse shall be dealt with in an applicable manner described in the specifications, or on the Drawings or on the Employer's instructions, as relevant."

PSDB 5.2 MINIMUM BASE WIDTHS

ADD THE FOLLOWING SUB PARAGRAPH TO:

c) Should the excavated trench width exceed the specified side allowance on each side of the pipe of 300mm by a value greater than 300mm, remedial measures shall be as directed and shall be provided at the Contractor 's cost unless it can be shown that such excess width is due to factors beyond the Contractor 's control.

Trench widths should be as near vertical as possible in order to minimize the quantity of selected fill material to be provided."

PSDB 5.4 EXCAVATION

ADD THE FOLLOWING SUB CLAUSES:

PSDB 5.4.1 PRINCIPLES

"a) The cost of trimming excavations by hand or machine shall not be paid for separately but shall be included in the rates tendered for excavation.

b) All excavated material shall be kept within defined limits and shall, wherever possible, be deposited alongside the trench. The material shall be deposited so as to leave a clear strip of at least one metre between the edge of the trench and the excavated material and shall not cause undue inconvenience to traffic and property owners. The material shall be placed and kept well clear of all manhole covers, culvert in- and outlets, fire hydrants, benchmarks, stand pegs, fences, etc.

c) To prevent vertical trench walls from collapsing, excavated material shall, wherever possible, not be stacked on the side of any underlying strata sloping down towards the trench and in this regard, attention is specifically drawn to the shales sloping south to north in the Pretoria area.

d) Excavations more than 1,5 m deep shall be adequately shored or braced to support the overhanging material and other loads which may occur. If the Contractor is of the opinion that shoring or bracing for an excavation of depth of more than 1,5 m is not necessary, he shall notify the Employer accordingly in writing, including a report from a professional Employer or a professional technologist competent in excavations. The report shall include the relevant laboratory tests.

e) The Contractor shall provide all the open and close timbering, strutting and shoring required for the safety of the excavations and structures adjacent to the trenches and shall be solely and wholly responsible for ensuring the adequacy of these measures for this purpose.

Without in any way affecting or detracting from the Contractor 's responsibility, the Employer shall have the right to instruct The Contractor to provide additional or improved timbering, shoring or strutting where he considers this to be necessary. The Contractor shall have no claim for additional payment on this account.

The shoring method adopted shall be compatible with the soil type and the excavating, backfilling and pipe-laying methods adopted and shall not place any undue restrictions on the laying of the pipes.

Timbering and shoring shall be left in position until the Employer has authorized their removal.

f) Shoring and bracing may not be necessary where The Contractor elects to slope the sides of the excavation to at least the maximum angle of repose measured relative to the horizontal plane, as determined by laboratory tests. Sloping of the sides could be combined with steps. The Contractor will submit the proposed excavation profile to the Employer for approval.

g) The cost for shoring, bracing and sloping of the sides will be included in the rates tendered for excavation. The cost for the services of a professional engineer or a professional technologist, including the relevant laboratory costs, shall be included in the tendered rates.

h) The Safety officer, or another competent person appointed by The Contractor in writing, shall inspect every excavation, including bracing and shoring:

(i) daily, prior to each shift;

(ii) after every blasting operation;

(iii) after an unexpected fall of ground;

(iv) after substantial damage to supports; and

(v) after rain,

in order to pronounce the safety of the excavation to ensure the safety of persons, and those results are to be recorded in a register kept on site and made available to an inspector, the Employer, Employer's agent, The Contractor or employee upon request;

i) Each excavation which is accessible to the public or which is adjacent to public roads or thoroughfares, or whereby the safety of persons may be endangered, shall be

(i) adequately protected by a barrier or fence of at least one metre in height and as close to the excavation as is practicable; and

(ii) provided with warning illuminants or any other clearly visible boundary indicators at night or when visibility is poor."

PSDB 5.4.2 HAND EXCAVATABILITY

PSDB 5.4.3 EXCAVATION OF ASPHALT SURFACES

The existing asphalt road surfacing shall be saw-cut prior to excavation commencing for the full width of the trench as specified on the construction drawings so as to ensure a neat finish to the reinstated surfacing.

PSDB 5.6 BACKFILLING

PSDB 5.6.3 DISPOSAL OF SOFT EXCAVATION MATERIAL

DELETE THE EXISTING CLAUSE AND REPLACE WITH:

"The Contractor shall locate and negotiate for tipping sites for the disposal of surplus material and bear all costs in connection therewith. Arrangements for the consent of the owner of a property to deposit spoil and or temporary spoil thereon shall be confirmed in writing. Such arrangements shall be approved before being implemented. All spoil sites shall be neatly finished off and compacted to 90% of MOD.AASHTO density."

PSDB 5.6.6 COMPLETION OF BACKFILLING

ADD THE FOLLOWING:

Backfilling should not lag more than 50m behind the laying operation.

PSDB 5.7 COMPACTION

ADD THE FOLLOWING:

"Where pipelines cross existing gravel roads, backfilling shall be carried out as specified in Subclause 5.7.2 and payment therefore will be made under sub item 8.3.3.3."

PSDB 5.9 REINSTATEMENT OF SURFACES

ADD THE FOLLOWING TO THIS SUB CLAUSE:

PSDB 5.9.2 PRIVATE PROPERTY AND COMMONAGE

The ground and paved surface of servitudes, parks, driveways, roadways and sidewalks shall be reinstated to at least the standard and conditions as existed previously.

Grass sods shall be cut out from the grassed areas to be excavated and shall be set aside, preserved and kept damp until used for reinstatement. All other material to be used for reinstatement shall be suitably stored for such purpose.

The rate for reinstatement of block paved surfacing shall include all costs for the supplying and laying of the surfacing. The rate shall also cover for taking brick paving out carefully, stockpiling and replacement with new if bricks are broken or damaged. The rate must furthermore provide for all WORKS, labour and material costs associated with the work.

The rate for reinstatement of asphalt or concrete paved surfacing shall include all costs for the saw cutting, supplying and laying of the surfacing. The rate shall also cover for removal and spoiling of the material. The rate must furthermore provide for all WORKS, labour and material costs associated with the work.

The width of any trench through an area paved with bricks or precast concrete units shall be the minimum practicable width that, in the opinion of the Employer, can be removed without cutting bricks or precast units.

PSDB 5.9.4 BITUMEN ROADS: SUB-BASE AND BASE

DELETE THIS SUB CLAUSE AND REPLACE WITH THE FOLLOWING:

Johannesburg Roads Agency will reinstate all asphalt surfaces. Refer to PS 6.7.

ADD THE FOLLOWING NEW SUB CLAUSES:

PSDB 5.9.7 CONSTRUCTION OF LAYERS FOR FOOTWAYS

The reinstatement of the paving blocks shall be the responsibility of the Contractor. The reinstatement and backfilling of pavement layers shall be done in accordance with PS 6.7

ADD THE FOLLOWING NEW SUB CLAUSES:

PSDB 5.9.8 EXISTING KERBS AND CHANNELS

"Where excavations have to cross existing kerbs and channels, then:

a) In the case of a precast kerb and channel the kerb, segmented paving blocks and channel shall be carefully removed and stored so as to avoid any damage to or theft of the kerb and channel and replaced after the excavation has been backfilled. Any damage to or theft of the kerb and channel shall be made good by The Contractor at his expense.

b) In the case of cast insitu or extruded insitu kerb and channel the kerb and channel shall be cut with a diamond tipped saw and carefully removed so as to avoid any damage to the remaining kerbs and channels. After the excavation has been backfilled the portion of kerb and channel removed shall be replaced with a cast insitu kerb and channel of the same profile as the existing kerb and channel."

ADD THE FOLLOWING NEW SUB-CLAUSE:

PSDB 5.11 LOCATION OF EXISTING SERVICES

Positions and details of known existing services as received from the various Departments are indicated on the Construction Drawings. Exact positions cannot be guaranteed by The Employers who will not be held responsible for any damages to any services. The Contractor shall excavate by hand to locate any such services and ensure that care is taken not to damage these services.

ADD THE FOLLOWING NEW SUB-CLAUSE:

PSDB 5.12 DEALING AND PROTECTING EXISTING SERVICES

All existing services, underground as well as above ground level, shall be protected by The Contractor in an appropriate manner, for the duration of the construction or as deemed necessary by the Employer, such that no damage to or interruption of the services shall occur.

ADD THE FOLLOWING NEW SUB-CLAUSE:

PSDB 5.13 GAS MAIN, ELECTRICITY AND TELECOMMUNICATION POLES

Gas mains, electricity and telecommunication poles along the pipe route are to be stabilized and protected prior to excavation and for the duration of construction.

ADD THE FOLLOWING NEW CLAUSE:

PSDB 5.14 TREES IN CONSTRUCTION PATH

Whenever possible any trees that lie within the construction path, shall not be removed and care shall be exercised to avoid damaging them. If the Contractor considers the removal of any tree unavoidable he/she shall obtain in writing the approval of the Employer and the Environmental Consultant prior to removal of any trees. Rates to cover removal and replacement where practical are provided in the schedule of quantities. A penalty of R1, 000.00 will be applied for any unauthorized or unnecessary damage to any tree which in the opinion of the Employer could have been avoided.

ADD THE FOLLOWING NEW SUBCLAUSE 5:

PSDB 7 TESTING

ADD THE FOLLOWING NEW SUBCLAUSE:

PSDB 7.2 INSPECTION AT INTERMEDIATE STAGES OF CONSTRUCTION

The Contractor shall call the Employer, giving him reasonable notice, to inspect the works at the following intermediate stages of construction:

a) After completion of the trench excavation and preparation of the trench bottom and before any pipe is laid.

b) After the selected backfill material has been placed around the pipe and before the remainder of the trench is backfilled.

c) Before placing of premix on roads or any final surfacing on constructed footways. Work shall not progress through the specified stages without the approval of the Employer or his representative on site.

Failure to comply with the provision of this clause shall result in the suspension of the backfilling work until the testing has been approved by the Employer."

PSDB 8 MEASUREMENT AND PAYMENT

PSDB 8.1 BASIC PRINCIPLES

ADD THE FOLLOWING PRARGRAPH:

"The basic principle of measurement and payment for earthworks for a pipe trench is that the rates tendered for excavation shall also cover the cost of trimming, handling and shoring or bracing as specified in clause PSDB 5.4".

PSDB 8.3 SCHEDULED ITEMS

PSDB 8.3.2 EXCAVATION

a) Excavate in all materials, for trenches, backfill compact and dispose of surplus material

ADD THE FOLLOWING SUB-ITEM:

The rate shall also cover the cost of excavating for trenches using labour intensive construction methods. The rate shall exclude the cost of removal of grass sods and compaction but shall include for the disposal of surplus/unsuitable material. The rate shall, in addition, cover the costs for compliance with the requirements of PSDB 5.4.1.

b) Extra over item (a) above for:

ADD THE FOLLOWING AT THE END OF THE EXISTING SUB-ITEM 2:

"No payments will be made under sub items (1) and (2) in respect of any materials measured and paid for under sub item 3 below."

AND ADD THE FOLLOWING NEW SUBITEMS IN 8.3.2(b):

"(3) Hand excavation and backfill where ordered by the Employer ……Unit: m^3

The unit of measurement shall be the cubic metre of material, measured in place according to the authorized dimensions, which was excavated by the hand on the specific prior written instructions of the Employer; provided always that the Employer's said instruction shall have stated that measurement and payment for such hand excavation will be in accordance with this item.

The tendered rate shall include full compensation for the additional cost, effort and time resulting from excavating in the respective materials using hand methods only.

The Employer shall not be obliged to authorize payment under this item in respect of any hand excavation carried out (whether ordered in writing or otherwise), which hand excavation was in any case necessary to achieve compliance by The Contractor with his obligations under the Contract to

(i) utilize construction appropriate to the nature of the specific parts of the works; and/or

(ii) protect existing structures and/or services; and/or

(iii) comply with all prevailing legislation and regulations.

(4) Cutting of premix and concrete surfaces……..….Unit: m^2

The cutting of premix and concrete surfaces shall be measured per square metre of cut as scheduled. Cutting of premix and concrete surfaces shall be done with a diamond tipped saw or by some other approved method. The depth of the cut shall be such that the adjoining premix and concrete surfaces are not disturbed when excavation takes place. The cutting of surfaces shall be done 100mm on either side of the trench.

(5) Backfill stabilized with 5% cement where directed by the Employer…… Unit: m^3

The unit of measurement shall be the cubic metre of backfill material, measured in place after compaction according to the authorized dimensions, which was stabilized on the Employer's instructions in accordance with subclause PSDB 3.5(c).

The tendered rate shall include full compensation for supplying the cement and for selecting, mixing, backfilling and compacting the stabilized material to 90% of modified AASHTO density.

(6) Soil-crete backfill where directed by the Employer ……. Unit: m^3

The unit of measurement shall be the cubic metre of soil-crete placed on the Employer's instructions in accordance with subclause PSDB 3.5(d), measured in place according to the authorized dimensions.

The tendered rate shall include full compensation for supplying the cement and for selecting, mixing and placing the soilcrete as well as for the cost of shuttering if required."

PSDB 8.3.3 EXCAVATION ANCILLARIES

PSDB 8.3.3.3 COMPACTION IN ROAD RESERVES

REPLACE THE HEADING OF THIS SUBITEM WITH THE FOLLOWING:

"PSDB 8.3.3.3.3 Compaction in road crossings"

REPLACE THE SENTENCE, "The volume will be measured as specified in 8.2.2, 8.2.3 and 8.3.3.1", WITH THE FOLLOWING:

"To determine the volume in the case of gravel roads, the depth will be measured from the underside of the gravel wearing course to the top of the fill blanket, and in the case of bitumen roads, from the underside of the subbase to the top of the fill blanket.

The rest of the trench shall be backfilled as specified in clauses 5.9.3, 5.9.4 and 5.9.5, as applicable, and payment will be made under item 8.3.6.1."

PSDB 8.3.3.4 OVERHAUL

REPLACE THE CONTENTS OF THIS ITEM WITH THE FOLLOWING:

"Measurement and payment shall be in accordance with subclause PSD 5.2.5."

PSDB 8.3.4 PARTICULAR ITEMS

PSDB 8.3.4(A) SHORE TRENCH OPPOSITE STRUCTURE OR SERVICE

REPLACE THE HEADING OF THIS SUBITEM WITH THE FOLLOWING:

PSDB 8.3.4(A) SHORE TRENCH OPPOSITE STRUCTURE OR SERVICE FOR DEPTHS:"

ADD THE FOLLOWING AFTER THE LAST SENTENCE:

"Separate items will be measured for depths of trenches in increments of 1 m. The rate for each stated category shall cover the cost of shoring from ground level up to the full depth of the stated category. Payment for this item will only be made if written instructions were issued by the Employer over and above the Standard Specifications for safety of excavations as specified in SANS 1200 DB, subclause 5.1."

PSDB 8.3.4(b) Temporary works: Control water inflow from ……. to …….

REPLACE THIS SUBITEM WITH THE FOLLOWING:

PSDB 8.3.4(b) Accommodation of existing flows for temporary or permanent connections or construction of new structures or pipe trenches:

1) (Description of item stated) …… Unit: Sum

2) Etc. for other structures

The tendered sums shall include full compensation for any inconvenience suffered, for normal and exceptional risks, for unforeseen eventualities and for maintaining the accommodated flow as long as necessary and shall include for the design and construction of all necessary temporary measures such as additional clearing, grubbing, earthworks, culverts, structures, pipework, pumping, cleaning up and any other associated work that may be required as specified in Clause PS1.5. Where a temporary structure for the accommodation of an existing flow has been designed by the engineer and is to be constructed by the Contractor, payment for such structure shall, unless otherwise stated in the scheduled item, be made under the applicable sub items in this payment item."

PSDB 8.3.5 EXISTING SERVICES THAT INTERSECT OR ADJOIN A PIPE TRENCH

PSDB 8.3.5 A) SERVICES THAT INTERSECT A TRENCH

ADD TO THE FIRST SENTENCE OF THIS SUB CLAUSE AS FOLLOWS:

After "Except where water pipes are to be recovered" add "*and water leads for erf connections need to be renewed*"

ADD THD NEW SUBCLAUSE PSDB 8.3.5 c) TO CLAUSE 8.3.5 AS FOLLOWS:

PSDB 8.3.5 C) SERVICES THAT REQUIRE SPECIAL CARE

1) Description of service……Unit: No

2) Etc. for other items……Unit: No

The Unit of measurement shall be the number of each service described. Electricity, telecommunication poles and water mains along the pipe route are to be stabilized and protected prior to excavation and for the duration of construction. The rate shall cover the temporary stabilization and protection of electricity and telecommunication poles.

ADD THD NEW SUBCLAUSE PSDB 8.3.6.2 TO CLAUSE 8.3.6 AS FOLLOWS:

PSDB 8.3.6.2 REINSTATEMENT OF SURFACING FOR FOOTWAYS

a) Brick paving …… Unit: m²

b) Concrete paving …… Unit: m²

c) Concrete slabs …… Unit: m²

The Unit of measurement shall be square metre of a reinstated. The rate for reinstatement of footway surfacing shall include all costs for careful removal, replacement of damaged sections and laying of the surfacing using labour intensive construction methods. The rates shall include for the lifting, stockpiling and replacement of broken or damaged bricks, blocks or slabs and shall provide for all WORKS, labour and material costs associated with the work.

The width of any trench through an area paved with bricks or precast concrete units shall be the minimum practicable width which, in the opinion of the Employer, can be removed without cutting bricks or precast units.

ADD THE NEW SUBCLAUSE PSDB 8.3.6.3 TO CLAUSE 8.3.6 AS FOLLOWS:

PSDB 8.3.6.3 Reinstatement of kerbs and channels……Unit: m^2

The unit of measurement shall be square metre of area reinstated. The rate shall cover the cost of all labour, WORKS and material required and shall also include for the disposal of all unsuitable materials.

ADD THD NEW SUBCLAUSE PSDB 8.3.6.3 TO CLAUSE 8.3.6 AS FOLLOWS:

PSDB 8.3.6.4 Reinstatement of grassed surfaces……Unit: m^2

The unit of measurement shall be square metre of area reinstated. The rate shall cover the cost of careful removal of grass sods to a minimum depth to a minimum depth of 100mm, stockpiling, maintenance for later re-use and reinstatement thereof."

DELETE THIS SUBCLAUSE AND REPLACE WITH THE FOLLOWING:

PSDB 8.3.6.5 REINSTATEMENT OF FENCE

a) Description of fence……Unit: m

b) Etc. for other items

The unit of measurement shall be the metre of fence reinstated complete. The rate shall cover the full compensation, labour, material and ancillary works for the reinstatement.

PSDK GABIONS AND PITCHING

PSDK 3 MATERIALS

PSDK 3.2 PITCHING

PSDK 3.2.1 STONE

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

PSDK 5 CONSTRUCTION

PSDK 5.3.3 GROUTED PITCHING

REPLACE THE WORDS "(Table 4)" IN THE SECOND LINE OF THE FIRST PARAGRAPH WITH "(Table 2)"

PSG CONCRETE STRUCTURAL

PSG 3 MATERIALS

PSG 3.2 CEMENT

PSG 3.2.3 STORAGE OF CEMENT

ADD THE FOLLOWING:

“Cement shall not be store for longer than 12 weeks without the Employers permission”.

PSG 3.4 AGGREGATES

ADD THE FOLLOWING SUBCLUASE:

PSG 3.4.4 AGGREGATE OF DOLOMATIC ORIGIN

All aggregates for structural concrete, manholes, pipe encasement, pipe bedding cradles, mass filling, etc. shall be of dolomatic origin. The quantity of insoluble matter in respect of concrete made with aggregates of dolomatic origin, determined according to the method described in SANS 677, Appendix C, shall not be more than 15%.

PSG 4 WORKS

PSG 4.1 GENERAL

ADD THE FOLLOWING SUBCLAUSE

PSG 4.1.1 MINIMUM WORKS

The Contractor shall have the following minimum WORKS available and in sound working order:

(a) Two concrete mixers, each of sufficient capacity to complete a section off the wall between horizontal construction joints within 4 hours and without interruption;

(b) Two concrete vibrators, at least one of which shall be powered by an internal combustion engine;

(c) One air compressor;

(d) Storage tanks at the water carts or trucks are adequate capacity to ensure that sufficient water will be available before commencement of every major concrete-placing operation.

If the WORKS used for placing concrete for the structure of electrically or mechanically powered, the Contractor s shall also provide some other approved, non- electrically powered standby means for placing concrete at an adequate rate in the event of a power or mechanical failure of the main WORKS.

When the Contractor elects to place a crane inside the walls of the structure during the construction period, shall communicate with the Employer in good time to ensure that the design and layout of the panels that form the roof slabs and floor allow for such positioning of the crane. When sections of the roof and floor have to be redesigned to accommodate the crane, the redesigned cost shall be borne by the Contractor.

PSG 4.5 FORMWORK

PSG 4.5.1 DESIGN

ADD THE FOLLOWING:

All form work with scaffolding required for any part the works shall be designed by the Contractor, and before commencing with the erection of any formwork or scaffolding, The Contractor shall submit the methods he proposes to use to the Employer for approval. The Employer has the authority to order alterations to the design or the sizes of any part of the formwork or scaffolding. The Contractor shall check the safety and suitability of all such alterations. The fact of the Employer has approved or altered any part of the formwork of scaffolding shall not be construed as relieving The Contractor of his responsibility with regard to the strength and stability of the formwork or scaffolding.

PSG 4.5.3 TIES

ADD THE FOLLOWING:

“No plugs, bolts, ties or clamps of any description used to hold formwork will be allowed into the project or through the concrete unless expressly approved by the Employer.

Only approved tie-rods consisting of solid rods (that remain embedded in the concrete) and with removable ends shall be used to hold the formwork of the walls. The removable tie-rod ends shall facilitate removal without damage to the concrete, and no permanently embedded parts of such tie-rods shall have less than 50mm of cover to the finished concrete surface.

The cavities left in the concrete when the tie-rod end cones are removed shall soundly caulked with a cement mortar to which an approved shrinkage-reducing agent has been added and shall be neatly to finished to a smooth surface uniform with that of the surrounding concrete.

The cost of supplying special tie-rods as well as the filling of the cavities left by the tie-rod cones shall be included in the rates tendered for formwork under the appropriate pay items.

On no account shall formwork be secured to reinforcing bars".

PSG 5 CONSTRUCTION

PSG 5.1 REINFORCEMENT

PSG 5.1.2 FIXING

ADD THE FOLLOWING:

"The Employer 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".

PSG 5.1.3 COVER

ADD THE FOLLOWING:

"The distance between pipes in the reinforcing steel shall nowhere be less than:

(a) 40 mm or

(b) 5 mm plus the maximum size of the coarse aggregate, whichever is the largest

PSG 5.2 FORMWORK

PSG 5.2.5 REMOVAL OF FORMWORK

ADD THE FOLLOWING SUBCLAUSE:

PSG 5.2.5.6 The Contractor shall make provision for the continued support of beams and slabs while the formwork is being removed and/or for that propping of beams and slabs".

PSG 5.3 HOLES, CHASES AND FIXING BLOCKS

ADD THE FOLLOWING:

"Cover blocks for reinforcing and fixtures may be placed into the concrete provided that neither the strength nor any other desirable characteristics (such as the appearance) of the concrete section is affected or impaired in the opinion of the Employer.

The holes or cavities left by the ferrule heads in the concrete of water-retaining structures shall be filled with an approved non-shrink grout applied strictly in accordance with the manufacturer's specifications."

PSG 5.4 PIPES AND CONDUITS

ADD THE FLLOWING:

"All pipes passing through to concrete floors, walls or slabs shall be cast into a concrete member simultaneously with the casting of the member. Openings for pipes shall only be left in concrete members when so directed by the Employer or when shown on the drawings. Pipes shall be installed in such openings according to the details shown on the drawings.

If water tightness is a requirement where pipes are cast into walls, floors and slabs, The Contractor shall ensure water tightness where smooth-surfaced pipes are used by using an approved method such as tape wrapping the pipes prior to casting in. The cost of such method will be deemed to be included in the rates tendered for item PSG 8.10".

PSG 5.5 CONCRETE

PSG 5.5.1 QUALITY

PSG 5.5.1.5 DURABILITY

The exposure conditions of the concrete are classified as "severe".

PSG 5.5.1.7 Strength concrete

ADD THE FOLLOWING:

"The concrete mixes for sulphate resistant cement shall be designed by an approved laboratory for approval by the Employer before commencement of any concrete work".

PSG 5.5.3 MIXING

PSG 5.5.3.2 READY-MIXED CONCRETE

ADD THE FOLLOWING:

"Ready-mixed concrete may be used on the Site. The Contractor shall take samples for testing from every load delivered to the Site".

PSG 5.5 5 PLACING

ADD THE FOLLOWING SUBCLAUSE:

PSG 5.5.5.10 "Concreting of the wall between horizontal construction joints shall be carried out in both directions from a point on the wall in order to close the gap with fresh concrete".

PSG 5.5.7 CONSTRUCTION JOINTS

ADD THE FOLLOWING:

"Horizontal construction joints are permitted in structure walls in positions indicated on the drawings or approved by the Employer. Vertical construction joints in the wall are subject to the written approval of the Employer and the cost of all such vertical or horizontal construction joints will be deemed to be included in the rates for cast-in-situ concrete. This also applies to the preparation of concrete to form construction joints in the flume walls as specified on the drawings.

The construction joints in water-retaining structure shall be made strictly in accordance with the details shown on the drawings. The joints between screeds and concrete floors shall be regards as construction joints and the surface of the floor shall be prepared as described for construction joints.

Should the Contractor 's method of construction necessitates the placing of construction or other joint in a position not shown on the drawings, such method of construction and position of the joint shall be approved by the Employer in writing. The cost of such joint shall be included in the tendered rates and shall include scrabbling of the concrete where steel reinforcement is continuous.

The walls shall be cast in lifts of height that permits each lift to be poured without interruption in one continuous operation during working hours.

It is the Contractor 's responsibility to ensure that construction joints are watertight. The Contractor 's proposed method for ensuring the water tightness of such joints shall be submitted to the Employer for his approval.

For construction joints at kickers all additional costs for concrete, preparation, etc. will be deemed to be included in the rates tendered for concrete in walls or sides and kicker joints or construction joints will not be measured separately".

PSG 5.5.8 CURING AND PROTECTION

ADD THE FOLLOWING:

"Curing by retaining the formwork in place or by covering with a waterproof membrane are the curing methods strongly recommended. Concrete will not be paid for unless properly cured and proof of curing is continuously visible on the Site".

PSG 5.5.11 WATERTIGHT CONCRETE

ADD THE FOLLOWING:

"The minimum cement content in water-retaining structures shall be 325 kg/m³, and the maximum cement content shall be 450 kg/m³ in reinforced concrete."

The maximum water cement ratio for water-retaining structures shall be more 0, 50".

ADD THE FOLLOWING SUBCLAUSE:

PSG 5.5.16 SOILCRETE

Where soilcrete is specified for filling under floor slabs the soilcrete shall comply with the requirements of subclause PSDB 3.5 (d) of section 1200 DP as amended and shall be placed as specified in this subclause.

PSG 6 TOLERANCES

PSG 6.2 PERMISSIBLE DEVIATIONS

PSG 6.2.3 SPECIFIED PERMISSIBLE DEVIATIONS

ADD THE FOLLOWING:

"Degree of accuracy II is applicable

Every specified permissible deviation is binding in itself. The cumulative effect of permissible deviations will not be considered. The maximum permissible vertical deviation is subject to the other permissible deviations".

REPLACE SUBCLAUSE 6.2.3 (D)(5) WITH THE FOLLOWING:

	Permissible deviation		
	Degree of accuracy		
	III	II	I
	mm	mm	mm
"Vertically, per metre of height	5	3	2

Subject to a maximum	50	30	10

PSG 7 TESTS

PSG 7.1 FACILITIES & FREQUENCY OF SAMPLING

PSG 7.1.1. FACILITIES

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 all testing, including the cost of sampling, storage and transporting samples should be included in the rates tendered for concrete work".

PSG 7.3 ACCEPTANCE CRITERIA FOR STRENGTH CONCRETE

ADD THE FOLLOWING:

"Test results obtained from the supplier of ready-mix concrete will not be accepted for evaluation in terms of subclause 7.3, but samples for testing shall be taken off such concrete at the point of placing ".

ADD THE FOLLOWING SUBCLAUSE:

PSG 7.3.6 TESTING FOR WATER TIGHTNESS

Water for testing shall be provided by The Contractor and shall be responsible for providing all necessary equipment that may be required for filling the structures.

The structure shall be filled with water at a uniform rate not exceeding 2.0 m in 24 hours until the top water level been reached. The water level will then be carefully noted and recorded by the Employer in relation to a fixed benchmark and shall be contained by the addition of further water for a sterilizing period to permit complete absorption of water by the concrete.

The sterilizing period may be 7 days for a maximum design crack width of 0.1mm or 21 days for 0.2mm or larger. After the sterilizing period, the level of the liquid surface shall be recorded at 24-hour intervals for a test period of 7 days. During the 7-day test period the total permissible drop in level, after allowing for evaporation shall not exceed 1/500 the one of the average water depth of the full tank, or 10 mm.

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.

In the event of appreciable leakage being evident at any of the stages of the filling or testing or the event of the Employer considering the final degree of water tightness to be unsatisfactory, The Contractor when ordered by the Employer shall discontinue such filling or testing and shall, at his own expense, take approved steps immediately to rectify the leakage, until a satisfactory test is obtained, which shall prove to the Employer that a sufficient degree of water tightness has been obtained.

The cost of emptying a water-retaining structure which cannot be drained shall be borne by the Contractor. The water shall be discharged in a manner approved by the Employer and shall be such that the employer can utilise the water is he so desires.

The water shall not be used as a medium for additives to affect remedial work or to stop leaks.

The cost of retesting the structure for water tightness shall be borne by the Contractor".

PSG 8 MEASUREMENT AND PAYMENT

PSG 8.1 MEASUREMENT AND RATES

PSG 8.1.1 FORMWORK

DELEAT "or splays over 20 mm x 20 mm" FROM THE FIRST LINE OF PARAGRAPH 8.1.1.2

ADD THE FOLLOWING 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 (joint F), 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 width.

8.1.1.8.1 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.

8.1.1.8.2 Back-shuttering or formwork to top revealed surfaces of sloping - or conical formwork will only be measured to surfaces over 40° and 85° to the horizontal.

8.1.1.8.3 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".

PSG 8.1.2 REINFORCEMENT

REPLACE THE CONTENTS OF THIS SUBCLAUSE WITH THE FOLLOWING:

"The unit of measurement for steel bars shall be the ton of reinforcement in place, in accordance with the Drawings or as authorized by the Employer.

The unit of measurement for welded steel fabric shall be the kilogram of fabric reinforcement in place, and the quantity shall be calculated from the net area covered by mesh, excluding overlaps.

Clips, ties, separators, stools and other steel used for positioning reinforcement will not be measured, unless these are shown on the bending schedules.

The tendered rate shall include full compensation for the supply, delivery, cutting, bending, welding, placing and fixing of the steel reinforcement, including all tying wire, stools, supports and waste".

PSG 8.1.3 CONCRETE

Delete "or the plank size of the excavation where additional excavation is provided to facilitate erection of forms" from the second line of paragraph 8.1.3.1(c).

PSL 3.9 CORROSION PROTECTION

PSL 3.9.2 STEEL PIPE

ADD THE FOLLOWING TO THE EXISTING CLAUSE:

"All coating and linings shall be completed strictly to the publication "Corrosion Protection for Civil, Mechanical and Electrical Engineer 2000 Edition.

Pipes and fitting shall be externally coated with fusion bonded medium density polyethylene (sintakote) or polyclad 777 and internally with liquid epoxy lining or similar approved.

The thickness of the lining material shall not be less than 250 micron and test certificates of the lining thickness must be furnished to the Employer for his approval."

PSL 3.9.2.3 REPAIRS TO EPOXY COATINGS

ADD THE FOLLOWING TO THE EXISTING CLAUSE:

PSL 3.9.2.3.1 GENERAL

(a) Where the damage is extensive the remedial procedures shall be agreed in writing with the Employer.

(b) All repairs shall comply with the requirements of the repair-product manufacturer's data sheet. The Employer may at his discretion request that repaired coating areas undergo adhesion tests.

(c) The Contractor shall repair any damage occurring during transport, on site during handling, assembly, storage, and erection.

(d) The repaired area shall be tested in accordance with Sub-Clauses 8.4 and 8.12 of SANS 1217 for compliance with the relevant requirements for thickness and electrical insulation defects respectively.

(e) Any item showing electrical insulation defects exceeding an average of five per square metre (a cluster of pinholes within a radius of 25 mm being regarded as a single defective area), or flaking or other signs of loss of adhesion, shall not be repaired. The item shall be blast cleaned and re-coated in accordance with the relevant requirements of the Clause PSL 3.9.2.3.3.

PSL 3.9.2.3.2 REPAIR METHODS FOR MINOR DEFECTS

The repair of areas showing electrical insulation defects or low film thickness shall, if approved by the Employer, be carried out as follows:

(a) Degrease in accordance with Clause PSL 3.9.2.3.4.

(b) Thoroughly abrade the damaged area, including an adjacent surrounding area of at least 25 mm wide, with a medium grade 220 abrasive paper;

(c) Vacuum-clean the surface to remove dust and debris in accordance with SANS 5769.

(d) Wipe the abraded paint surface with methyl ethyl ketone and allow to dry, and

(e) Apply as many coats of the following repair material as necessary to achieve the specified thickness and finish.

(i) Solvent free epoxy; or
(ii) Fusion-bonded epoxy powder repair kit.

NOTE: Apply a final topcoat over the repaired area to achieve a pleasing, uniform finish of the item.

PSL 3.9.2.3.3 REPAIR METHODS FOR MAJOR DEFECTS

The total un-coated areas for renovation by the applicator shall not exceed 0.5% of the total surface area of a component. Each un-coated area for renovation shall not exceed 2 500 mm². If damaged areas are larger, the items containing such areas shall be re-coated.

The repair of areas showing damage down to the steel surface shall, if approved by the Employer, be carried out as follows:

(a) Degrease in accordance with Clause PSL 3.9.2.3.4

(b) Blast-clean all damaged areas to Sa 3 (ISO 8501-1).

(c) Feather the surrounding paint for a distance of 25 mm beyond the damaged areas with a medium grade 220 abrasive paper.

(d) Vacuum-clean the surface to remove dust and debris in accordance with SANS 5769.

(e) Wipe only the abraded paint surface with methyl ethyl ketone and allow drying.

(f) Apply as many coats of the following repair material as necessary to achieve the specified thickness and finish.

(i) Solvent free epoxy or

(ii) Fusion-bonded epoxy powder repair kit.

NOTE: Apply a final topcoat over the repaired area to achieve a pleasing, uniform finish of the item.

PSL 3.9.2.3.4 DEGREASING

(a) All surfaces to be coated shall be tested for oil and grease contamination by the water break free test.

(b) Oil and grease contamination shall be removed by:

- Steam-cleaning;
- An emulsifiable or aqueous detergent applied in accordance with SANS 1344; and
- An alkaline cleaning solution.

(b) Allow to react, and then rinse off with clean, potable water to remove all residues prior to surface preparation, all in accordance with Clauses 3.3 and 3.4 of SANS 10064.

(c) The surfaces shall be tested after degreasing and show no oil, grease and chemical contamination after degreasing.

(d) Care shall be taken to avoid entrapment of cleaning agents in recesses or other retention areas.

ADD THE FOLLOWING NEW SUBCLAUSE:

PSL 3.9.2.4 REPAIR OF DAMAGED SINTAKOTE

PSL 3.9.2.4.1 GENERAL

Damaged Sintakote shall be repaired in accordance with the procedures detailed in the Tyco Handling and Installation Manual for steel pipeline systems for the repair of Sintakote or in accordance with clause 3.2 or clause3.3

PSL 3.9.2.4.2 REPAIR OF SMALL PINHOLE TYPE DEFECTS

PSL 3.9.2.4.2.1 SURFACE PREPARATION

- Clean and dry the area to be repaired including the removal of dirt, dust and other contaminants. Slightly roughen the area around the repair for a minimum distance of 50 millimeters using a coarse file or abrasive paper.
- Wipe the surface with a clean dry rag.

PSL 3.9.2.4.2.2 PRIMING

- Stir the primer to ensure complete mixing prior to application. Apply a thin even coat of Densopol Primer D around the area of repair using a paint brush or roller
- Allow the primer to tack dry (approximately 10 to 20 minutes)

PSL 3.9.2.4.2.3 TAPE WRAPPING

- Apply Deponsole 60 tape to the repair area ensuring a minimum of 50 mm overlap onto sound coating around the defect area.
- Apply Denso MP/HD P.V.C self-adhesive over wrap tape around the full pipe circumference to completely cover the repaired patch.

PSL 3.9.2.4.3 REPAIR OF LARGE AREA OF DAMAGE WHERE STEEL IS EXPOSED

PSL 3.9.2.4.3.1 SURFACE PREPARATION

Cut out the area of Sinkakote and clean the steel surface in accordance with AS1627.2. Clean and dry the area to be repaired. Slightly roughen the area around the repaired using a course file or abrasive paper. Wipe the surface clean with a dry clean rag.

PSL 3.9.2.4.3.2 PRIMING

- Stir the primer to ensure complete mixing prior to application. Apply a thin, even coat of Densopol Primer D onto the steel surface and around the periphery of the Sintakote.
- Allow the primer to track dry (Approximately 10 to 20 minutes)

PSL 3.9.2.4.3.3 FILLING/PRIMING

- Cut out a piece of Bitumen Mastic Strip to fit into the bare steel area prior to applying the primer.
- Insert the cut-out piece of Bitumen Mastic Strip into the repair area.

- Re-apply a thin even coat of Densopol Primer D over the patch and adjacent area of Sintakote.
- Allow the primer to track dry (Approximately 10 to 20 minutes)

PSL 3.9.2.4.3.4 Tape Wrapping

- Apply Densopol 60 tape to the repair area ensuring a 50mm overlap over the fitted patch.
- Apply Denso MP/HD P.V.C self-adhesive over wrap tape around the full pipe circumference to completely cover the repaired patch.

PSL 3.9.2.4.4 SURFACE PREPARATION

All joints shall be fully welded and sealed, and all sharp edges and corners ground off to a radius of not less than 1.5 mm. All weld spatter and irregularities shall be removed. Any unsound or damaged edges of sintakote shall be cut back into the sound coating and the edges chamfered.

The surface shall be cleaned by means of power tools to achieve a minimum surface preparation in accordance with AS1627.2 TO CLASS St. 2. All dust, dirt, moisture and grease shall be removed. Slightly roughen the sintakote 100 millimeters both sides of the joint, using a coarse file or abrasive paper. Wipe the surface clean with a dry rag.

PSL 3.9.2.4.5 PRIMING

- Stir the primer to ensure complete mixing prior to application, apply a thin even coat of Densopol Primer D to the steel and roughened sintakote surfaces using a paintbrush or roller.
- Allow the primer to touch dry (approximately 10 to 20 minutes)

PSL 3.9.2.4.6 MASTIC FILLING

To improve the contours for wrapping the tape, fillet welds, sharp edges of sintakote, test plugs or welding lid holes shall be filled and profiled with Bitumen Mastic Strip. The mastic filling shall be molded such that the Densopol 60 tape can be applied with no sharp edges protruding or air entrapment.

PSL 3.9.2.4.7 TAPE WRAPPING

Commencing at least 100 milliliters back onto the primed sintakote one complete turn of 150 milliliter wide Densopol 60 tapes shall be applied. Release film shall be removed before application. While

holding the tape under tension, the pipe shall be spirally wrapped using a 55 percent overlap and finished 100 mm onto the primed sintakote with one complete circumferential wrap around the pipe. The tape shall be cut off in the downward direction of wrapping. New roles of tape shall have the ends overlapped at least 75 mm.

During wrapping the tape shall be smoothed out by hand to exclude any air bubbles or wrinkles and to seal overlaps.

Care shall be taken to prevent any folds or misplacement of the tape, especially under the pipe, and to prevent the tape becoming contaminated during wrapping.

The butt-welds in segmental (lobster bends) are to have the tape applied partial layer by partial layer with a 55 percent overlap until a full spiral wrap can be made (refer sketch in appendix A) continue wrapping onto the primed sintakote for at least 100mm with one complete circumferential wrap around the pipe.

Straight steel pipes shall also be wrapped with Densopol 60 with a 55 percent overlap in accordance with the above clauses.

PSL 3.9.2.4.8 STEEL FITTINGS AND FLANGES

PSL 3.9.2.4.8.1 GENERAL

Procedures for the protection of steel fittings applies to both main pipeline fittings and branch pipe work. Fittings manufactured and coated by Tyco shall be factory coated with Sintakote. Difficult fittings such as valves may be protected using a more conformable petrolatum system in accordance with TS29 only with the approval of a SA Water representative.

PSL 3.9.2.4.8.2 SURFACE PREPARATION

Still surfaces shall be prepared in accordance with clause 4.1.

PSL 3.9.2.4.8.3 TAPE WRAPPING

Prepare and wrap all straight sections leading up to the fitting and flange in accordance with section 4.

PSL 3.9.2.4.8.4 PRIMING

- Stir the primer to ensure complete mixing prior to application. Apply a thin even coat of Densopol Primer D to the prepared steel surfaces and a minimum of 50mm onto the Densopol 60 wrapped areas using a paint brush.

- Allow the primer to touch dry (approximately 10 to 20 minutes).

PSL3.9.2.4.8.5 MASTIC WRAPPING

Unavoidable sharp edges such as bolts, nuts and collars shall have mastic strip molded over the positions or edges. Strip with a 55 percent overlap onto itself and minimum 50mm overlap onto the Densopol 60 or Sintakote coated pipe work. Press the Bitumen Mastic Strip firmly into place ensuring no air voids are beneath the Bitumen Mastic Strip.

Note: The Bitumen Mastic Strip provides corrosion protection to the steel work and is similar in composition to Densopol 60, but it does not have a woven carrier.

PSL3.9.2.8.6 OVER WRAPPING

150 or 100mm wide Denso MP/HD tape (self-adhesive PVC) shall be spirally wrapped over the Bitumen Mastic Strip with a 55percent overlap. While wrapping, the Denso MP/HD tape shall be pulled firmly and the lapse properly sealed.

PSL3.9.2.8.7 TESTING

All repairs and wrapping shall be tested using a high voltage “spark” tester in accordance with AS3894.1 at an operating voltage of 15 KV.

PSL3.9.3 PROTECTION AGAINST ELECTROLYTIC CORROSION

OMIT THE EXISTING CLAUSE AND INSERT THE FOLLOWING:

"All joints and fittings shall be fully wrapped with approved protective tapes. Protective tape shall comply with either Specification A or Specification B as ordered by the Employer.

SPECIFICATION A

This tape shall be made up of pre-bonded components to form a composite single wrap tape. The adhesive inner protective tape must provide complete protection to steel piping against electrolytic corrosion. It shall be impermeable to water, chemically inert and physically stable and must provide a perfect seal at the overlap on a spiral-winding pattern.

The adhesive outer protective tapes shall be tough and impact resistant, providing suitable protection of the inner protective tape against mechanical damage. It shall be stable and not crack or deteriorate when buried. The tapes shall be chemically resistant to all common acids and alkalis normally encountered in the soils at the construction site.

The tapes shall be suitable for both machine and hand application.

The Combination electrical characteristics of the inner and outer wrap together must exceed:

Dielectric strength = 25kV/mm

Insulation = 10 0hm metre

The following minimum criteria shall be satisfied:

	Inner Tape	Outer Wrap
Thickness (mm)	0,3	0,3
Tensile strength (kg/cm width)	3,3	5,0
Elongation at break (%)	200%	50%
Adhesion to primed steel (gm/cm width)	220	220

SPECIFICATION B

This tape shall be made up of a non-woven synthetic fibre carrier impregnated and coated on both sides with a compound incorporating high melting point bitumen (Densotherm or similar approval). During application the tape shall be correctly heated, and laps adequately sealed all in accordance with the instructions and recommendations of the supplier.

Before the application of any protective material, the surface of the pipe shall be thoroughly cleaned, and all loose or damaged pipe coating removed. All ridges, depressions and steps in the surface shall be filled with an approved filler so as to present a smooth uniform surface. After the filler has hardened, the entire surface to be wrapped shall be primed with a primer or otherwise treated as recommended by the supplier of the tape.

The protective tape shall be applied as a spiral wrap with not less than 50% overlap. The width of the tape shall be appropriate for the section to be wrapped."

PSL3.9.5 JOINTS, NUTS, BOLTS AND WASHERS

DELETE AND REPLACE WITH THE FOLLOWING:

"All bolts and nuts shall comply with the requirements of the relevant sections of SANS 1700 and shall be of Grade 4.6 steel. Washers shall be provided at each nut and shall be of the same material (or coating where applicable to match the bolt and nut. Nuts and bolts subject to vibration shall be machined finished fitted with plain washers and treated with "Loctite" or equivalent.

Bolts other than jacking bolts shall project not less than 3mm and not more than 10mm from the heads of the nuts after tightening.

All bolts to be built into concrete work as well as bolts to be installed above ground level (outside buildings), directly above and under water shall all be of stainless-steel grade 304. Bolts for flexible couplings and flanges for underground installation shall be hot dip galvanized. Bolts to be installed inside buildings shall be hot dip galvanized. Galvanizing shall be in accordance with the Standard Corrosion Protection Specification (Heavy coating).

Suitable plastic sleeves and/or washers shall be used for protection against corrosion by bi-metallic action".

PSL3.9.6 CORROSIVE SOIL

ADD THE FOLLOWING TO THE EXISTING CLAUSE:

"Steel pipes, pipe fittings and steel flanges in contact with soil shall over and above the protection as described above be protected as specified in Clause 3.9.3 with "DENSO" tape and/or mastic or approved similar. Application shall be strictly in accordance with the manufacturer's instructions. A polyethylene tape of 300 microns minimum shall be spirally wrapped over the petrolatum tape and fixed to the clean pipe ends with pressure sensitive tape."

PSL3.11 VALVES

PSL 3.11.1 VALVE TYPES

PSL3.11.1.1 Valves shall spheroidal graphite iron resilient seal gate valves, double flanged, non-rising spindle, manually operated, class 16 to SABS 664 and 665 and be corrosion protected.

PSL3.11.2 FLANGES

Flanges shall be Class 16 cast iron flanges and shall conform to the requirements of SANS 1123 (table 1600/3).

PSL3.11.3 INSPECTION AND TESTING

PSL3.11.3.1 Any inspection or test at the manufacturer's works will not exempt the Supplier from any obligation under this specification.

PSL3.11.3.2 A copy of the durability test as specified in SANS 664-1999 should be supplied with the sample valve (If available) which will be a strong recommendation.

PSL3.11.4 TESTING OF VALVES

PSL3.11.4.1 All assembled valves shall be so constructed that there is no leakage of water when subjected to an internal hydraulic test pressure of 3 200 kPa for a period of not less than five minutes.

PSL3.11.5 IDENTIFICATION AND MARKING

PSL3.11.5.1 The following information must be legibly and indelibly cast or embossed on each valve body.

(i) Manufacturer's name or trade name or trademark.
(ii) Valve size
(iii) Class of valve e.g. Class 16, PN 16....

PSL3.11.5.2 A metal identification plate must be permanently fixed to each valve. The plate must bear the following information:

(i) Date of manufacture
(ii) Type of trim, where applicable.
(iii) Mass in kg

PSL 3.11.6 FINISH

PSL3.11.6.1 All parts must be smooth and free from fins and burrs.

3.11.6.2 All surfaces must, after they have been cleaned in a manner appropriate to the type of primer used, be coated with a primer that complies with the requirements of SANS 723 or SANS 1345 and having a dry film thickness of 10-25 microns.

PSL 3.11.7 END CONNECTIONS

PSL 3.11.7.1 Valves must be flanged to SANS 1123 table 1600 with the bolt holes drilled off centre. Flange stud bolts must be supplied and fitted if required by the valve design.

PSL3.11.7.2 Body ends must be sealed during delivery and storage to prevent entry of foreign matter. The front faces of flanges shall be flat faced, fully machined, parallel to one another, with appropriate bolt holes.

PSL 3.11.8 BOLTS

PSL3.11.8.1 Bolts and nuts must comply with the requirements of SANS 135 or SANS 136. Body gaskets in contact with water must be non-hydroscopic.

PSL 3.12 SUBMERSIBLE PUMPS

The duty point for the Pump Station No.1 is H = 23.5m; Q = 192m³/hour and static head equal to 17.13m. Minimum suction 150NB and minimum discharge (100NB-150NB) connected to 250mm diameter UPVC class 16 pumping mains and shall be of the non-clog type and corrosion protected. Pump curves shall be supplied with pumps. Performance curves shall be based on a reproducible and certified test carried out in an approved testing facility, such as the SABS.

The duty point for the Pump Station No.2 is H = 13m; Q = 430m³/hour and static head equal to 11.1m. Minimum suction 200NB & minimum discharge (200NB – 250NB) connected to 315mm diameter UPVC class 16 pumping mains and shall be of the non-clog type and corrosion protected. Pump curves shall be supplied with pumps. Performance curves shall be based on a reproducible and certified test carried out in an approved testing facility, such as the SABS.

NB: Important to note;

- All pumps must be fitted with motor and cooling mechanism or jacket.
- Pumps function as one on duty and the other on standby.
- All pumps are normal submersible and should be supplied with 10m power cable and hanger bar.
- Pumping is being done for raw sewers and pumpstations are fitted with screening chambers.

PSL 3.13 ELETRICAL INSTALLATION

Item No.	Reference Specification	Description
PSL3.13.1	SABS 1065-2	CONDUITS
		All plain end metal conduits must be galvanised to ensure electrical continuity through the push-on connectors and adaptors.
	SABS IEC 60614-2-5	Conduit and conduit accessories must bear the mark of approval of the South African Bureau of Standards.
PSL3.13.2	SANS 10142	DISTRIBUTION BOARDS
	SABS 1765	Specification for distribution boards with rated frequency not exceeding 50 Hz, and rated voltage not exceeding 1000 V a.c. or 1500 V d.c. and with a short-circuit withstand current rating of less than 10 kA. Type: Mark specification for safety.
	SABS IEC 60439-5	Specification for cable distribution cabinets intended for stationary outdoor installations exposed to the public, but where only skilled personnel have access for their use.
		Kiosks must be of ample size to accommodate the specified equipment and have 25% free space for future equipment.
		The colour must be "FLAG GREEN", colour E08 or "LIGHT STONE", colour C37 of SABS 1091.
		A tin of matching touch-up paint (not smaller than 500ml) must be provided with each consignment.
		All equipment must be labelled, and accurate descriptions must be given in English on legend cards.
		Labels must be trafolite with black letters engraved on a white background.

The kiosk label must be riveted to the kiosk.

The kiosk label must be in a prominent position on the front of the kiosk and must give the kiosk name and/or number. (KIOSK B6)

The lettering must be at least 10 mm high.

Equipment labels must give a clear description of the equipment or the equipment number if there is not enough space to give a full description.

The lettering must be at least 5 mm high. Provide one label directly below each item of equipment.

Where equipment is labelled with numbers only, provide a legend card with detailed descriptions of the numbered equipment.

Install the legend card on the inside of the door behind a durable, transparent plastic cover.

The legend card holder must be spot-welded to the cubicle door before painting. In the case of outdoor cubicles, the legend card must slide into the legend card holder from the side instead of from the top to protect it against rainwater damage.

PSL3.13.3 SANS 1507 CONDUCTORS

High conductivity annealed stranded copper.

Shall be supplied and installed in one length.

No joints allowed where the installed length is less than the standard supplied length.

Insulation (where required) shall be general purposed PVC 600/1000V grade.

PSL3.13.4 SABS IEC 60884-1 SWITCHED SOCKET OUTLETS

Specification for plugs and fixed or portable socket-outlets for a.c. only, with and without earthing contact, with a rated voltage above 50 V but not exceeding 440 V and a rated current not exceeding 32 A, intended

for household and similar purposes, either indoors or outdoors.

PSL3.13.5 SANS10400-S:2011

SWITCHES

Switches must be of the rocker operated micro-gap type rated at 16A, 220/250V.

Switches must have protected terminals for safe wiring.

Switches must have silver contacts.

It must be possible to individually change any switch of multi-lever switches.

The yoke strap must be slotted to allow for easy alignment.

PSL3.13.6 SABS152& SABS IEC 60947-3.

ISOLATORS

The switch-disconnectors must have a high-speed closing and opening mechanism.

The switch-disconnectors must be suitably rated for the continuous carrying, making and breaking of the rated current specified as well as the through-fault current capacity as specified.

To distinguish the switch-disconnectors or isolators from circuit breakers the operating handles must have a distinctive colour and/or the switch must be clearly and indelibly labelled "ISOLATOR".

Three pole switch-disconnectors must be mechanically interlocked to disconnect all three poles simultaneously.

Four pole switch-disconnectors must be supplied with late making or breaking contacts for the neutral pole as specified.

PSL3.13.7 SABS 1464-1

LUMINAIRES

Specification for the safety of general-purpose fixed luminaires for use with tungsten filament, tubular fluorescent and other discharge lamps that operate at supply voltages not exceeding 1000 V. Type: Mark specification for safety. *

	SABS 1464-2	Specification for the safety of recessed luminaires for use with tungsten filament, tubular fluorescent and other discharge lamps that operate at supply voltages not exceeding 1000 V. Does not apply to air-handling or liquid cooled luminaires. Type: Mark specification for safety. *
PSL3.13.8	IEEE-C57.12.80-2010	TRANSFORMERS
		Pole mounted.
		Oil cooled.
	D-DT-1860	Supplied complete with surge arrestors.
PSL3.13.9	SABS 1411-1	CABLES & CONDUCTORS – GENERAL
	SABS 1411-2	Materials used in the manufacturing of insulated electric cables, cords and conductors must comply with the relevant standards below: Specification for copper used in insulated electric cables. Covers solid, stranded and flexible circular conductors, and solid and stranded shaped conductors.
	SABS 1411-3	Specification for PVC insulating and protective cover materials in electric cables and flexible cords. S Specification for elastomer components of electric cables and flexible cords.
	SABS 1411-5	Specification for non-metal components of electric cables and flexible cords that do not contain halogen in their chemical composition and have reduced flame propagation properties.
	SABS 1411-6	Specification for three types of metal armour materials that are components of electrical cables and that provide protection against mechanical damage.
PSL3.13.10	SABS 1507	PVC INSULATED CABLES (300/500V to 1,9/3,3kV)
		Insulation grade to be 300/500 V to 1,9/3,3 kV.
		Intended for use in fixed installations.

Armouring (where required) is to be Steel Wire Armouring.

Conductors to be Annealed Stranded Copper.

All cables must be new when delivered to site.

No joints will be allowed for cable lengths of less than 300m.

Cables are to be labeled at all terminations with punched metallic bands or labels or tags (Refer also to SABS 0142 for identification of cable cores and phases).

Identification labels must indicate the size of the cable and where it feeds to or from.

PVC tape with punched characters is not an acceptable label.

Indicate the identification numbers of cables on the "as built" drawings of the installation.

Only fully competent personnel may install, bend, join and/or terminate cables. These personnel must acquaint themselves with the instructions, requirements and recommendations of the manufacturer for the installation of the particular cables.

PSL3.13.11 SABS 1213 GLANDS

Glands for terminating PVC/PVC/SWA/PVC cables must be adjustable. Glands must be suitable for general purpose 600/1000 V Grade cable with steel armouring.

PSL3.13.12 (Profile to be approved by the Engineer) CABLE MARKERS

Allow for the manufacture, supply and installation of approved cable route and cable joint markers in positions as shown on drawings or indicated on site.

The cable marker must be made of concrete with a capping at the upper horizontal surface of a fine mixture.

After removal from the mould, the cable marker must be cured in the

approved manner by wetting or immersion.

The capping at the upper horizontal surface of the marker must be about 30mm deep and be of a 1:3 cement and sand mixture.

This fine mixture is for providing a suitable base for forming the recessed lettering and directional double-headed arrow.

The remaining portion of the marker must consist of an adequately compacted concrete mixture of 1:3:4 cement, sand, and crushed stone.

The lettering and double-headed directional arrow of the upper horizontal surface of the marker must be recessed to a depth of at least 5 mm.

Install cable route markers along all underground cable routes.

Install cable markers at the beginning and end of a cable run (e.g. where a cable enters a substation or building), at all changes of direction, above cable sleeve entries and exits and at intervals not exceeding 50 m along the cable route.

Cable markers show the actual route of a buried cable, therefore, locate the cable markers at such intervals that the deviation of the actual buried position of the cable from a straight line between any two adjacent cable markers does not exceed 500 mm horizontally.

The cable joint marker is located above the joint of a buried cable. Indicate the position of cable markers on the "as built" drawings.

First delivery will not be considered until the cable markers are installed neatly in their positions.

PSL3.13.13 SANS 3:2015 1507- <u>CABLE SLEEVES & PIPES</u>

Where cables cross under roads, railway tracks, other service areas, etc. and where cables enter buildings, install the cables in ribbed and reinforced PVC pipes.

Asbestos cement or earthenware sleeves are also acceptable, but pitch-fibre sleeves are not allowed.

Join the pipes in accordance with the manufacturer's instructions.

Install sleeves to crossroads and railway tracks at right angles.

Sleeves must have a minimum diameter of 100 mm, except at road crossings; the minimum diameter must be 150 mm.

Sleeves must extend at least 2 m beyond the tracks of a railway line or of the outermost tracks where there is more than one line. In the case of roads, the sleeves must extend at least 1 m beyond the road edge or kerb on both sides of the road.

Install sleeves with a 1:400 fall for water drainage.

Seal the ends of all sleeves with a non-hardening watertight compound after the installation of cables. Seal all sleeves intended for future use in the same manner.

Backfill trenches at least 300 mm on top of sleeves before compacting to avoid damage to the sleeves.

Complete the backfilling and compacting as presented elsewhere (in this specification).

PSL3.13.14 TRENCHING & EXCAVATIONS

The electrical contractor must determine the position of all the existing services such as water, storm water, sewer, gas, telephone cables, etc. before commencing with excavations.

The Electrical Contractor must furthermore employ a metal detecting apparatus over the entire planned cable route to determine the exact position of existing services crossing the planned cable route or running parallel to it.

If existing services are parallel and close to the planned cable route, or cross the planned cable route, excavate and expose the existing service carefully by hand.

In the event of damage to other services or structures during trenching

operations, notify the Engineer and institute repairs without delay.
The Electrical Contractor will be held responsible for any damage to existing services resulting from his failure to take the precautionary measures described above.

Inspect the site conditions and confirm all cable routes before trenching commences. Preferably follow established cable routes or use cable servitudes.

Provide cable trenches in such a manner as to follow a rectangular route in relation with the boundary's and buildings on site.

Plan and provide excavations for cable trenches as servitude areas running along sidewalk ways or as close as possible to buildings in such a way as to ensure that as many cables as possible will follow the same route in the most economical manner. Avoid open spaces where future buildings might be erected.

Excavate trenches in straight lines between the starting point and end point and any turning points in-between.

Deviations from the routes indicated on the drawings due to obstructions or existing services must be approved by the Engineer beforehand.
The Engineer reserves the right to alter any cable route or portion thereof before the cable is laid.

Payment for any additional or fruitless work shall be calculated on the tendered rates.

The removal of obstructions along the cable routes is subject to approval from the Engineer.

Take extreme care not to disturb surveyor's pegs.

Do not cover the surveyor’s pegs with excavated material.

If the surveyor's pegs are disturbed, a qualified surveyor must replace them.

The bottom of the trench must have an even contour without any sharp dips or rises that may cause mechanical tension in the cable during

backfilling or thereafter.

Inspect the trenches thoroughly and remove all objects likely to cause damage to the cables before laying the cables.

Place the excavated material next to each trench in such a manner as to prevent nuisance, interference or damage to adjacent drains, gateways, trenches, water furrows, other works, properties or traffic.

Where this is not possible, remove the excavated material from site and return it for backfilling after laying the cable.

The Contractor must remove and dispose of surplus material at his own expense.

PSL3.13.15 MOTOR CONTROL CENTER PANEL

Enclosure to be made of 1,6mm mild steel powder coated electrical orange. Complete with pad lockable handles

Stainless steel enclosures will be stipulated where necessary

Contactors shall consist of the following makes:-
Allen Bradley or ABB

- Overloads to be matched to the contactors selected.

- All circuit breakers shall be either :-Merlin Gerin or ABB

- No mixtures of circuit breakers are allowed in a panel.

- Contactors are to be rated higher than the motor rating (see any attached quotation for required rating).

- All panels must contain phase failure / phase rotation protection. All power monitors, timers, and process controllers, motor system protection relays, electronic counters must be of the same manufacture and to be so stipulated in any quotation.

- ABB, UMC100-FPB will be used when stipulated

- Timers for use with star/delta systems must be of the modular electronic type and not plug in timers

- When using a UMC100, star delta and phase failure/rotation can be programmed in this unit.

- Any panel built for use with an ABS submersible pump, (which will be stipulated in the quotation). The protection for the sealing and temperature, must be the ABS TDM relay, item No 61245042.

- All panels circuits to accommodate remote emergency stop facility.

- All panels circuits to accommodate remote start/stop facility.

- Running Hour Meters to be fitted.

- Spillage meters to be fitted if requested.

- Stop buttons to be latch type.

- All indication lights must be of a L.E.D type and of the same make as the pushbuttons.

- Pushbuttons are to be the same make as contactors quoted.

- Earth connecting strip of good design to be at the bottom of the panel to facilitate the motor cable earth wire.

Provide shoring in locations where the sides of the trenches are in danger of collapsing due to water logging or other ground conditions. Refer to the Occupational Health and Safety Act.

The shoring must be suitable for the prevailing site conditions and must be braced across the trench.

Provide pumps and equipment required to remove accumulated water from trenches.

Dispose of water or any other liquid removed from the trenches without causing any nuisance or hazard.

PSL3.13.17 DIMENSIONS OF CABLE TRENCHES

Cable trenches for one or two cables must not be less than 300 mm wide and need not be more than 500 mm wide.

Maintain the specified width for the total trench length.

The trench depth should be 800 mm.

Where trenches change direction or where cable slack must be accommodated, ensure that the requirements of the manufacturer regarding the bending radii of cables are met when determining trench widths.

Payment is calculated using the running meter rate or the volumetric excavation rate (whichever is specified in the bill of quantities) and the specified maximum dimensions or the actual dimensions, whichever is the lesser.

PSL3.13.18 BEDDING

Fill the bottom of the trench across the full width with a 75 mm thick layer of sandy soil sifted through a 6 mm mesh and level it off.

Use only sandy clay or loam soil with a satisfactory thermal resistivity (not exceeding 1,5°C m/W) for this purpose. Do not use sea sand, ash, chalk, peat, clinker or clayey soil.

Crusher sand and river sand are acceptable.

Where no suitable soil is available on site, import fill from elsewhere.
Include the cost of importing soil for bedding in the unit rates for excavations.

Provide a further layer of bedding that extends to 75 mm above the cables after laying the cables.

In the case of HV cables, provide an additional 200 mm cover of sifted soil from the backfill material on top of the 75 mm bedding above the cable to lay the protective concrete slabs on.

PSL3.13.19 BACKFILLING

Install a coloured plastic marking tape 300 mm beneath the final ground level directly above the cables.

Backfill trenches with suitable soil to ensure settling without voids.
The maximum allowable diameter of stones present in the backfill material is 75 mm.

Allow in the tender rates for importing suitable backfill material if required.
Compact the backfill in 150 mm thick layers.

Backfill the first layer by hand. Allow for final settlement when backfilling.
Compact the excavations at paved areas to the original density of the surrounding material before reinstating the surface finish.

The refilled trench must be maintained at the Contractor's expense for the duration of the contract.

Remove and dispose of all surplus backfill material.

Restore damage to concrete walkways, tarred surfaces, lawns and flowerbeds, to their original finish after installation of cables.

Remove lawns in sods and carefully replace the sods after installation of the cable.

Ram the sods down and neatly level it off with sifted soil.

Properly water the restored area of the lawn.

In the case of roadways or paved areas, compact the excavations to the original density of the surrounding material before reinstating the surface finish.

PSL3.13.20 WARNING TAPE

The tape must be yellow and marked with the words "ELECTRIC CABLE BELOW".

These markings must not be more than 1 m apart from centre to centre.

PSL 3.14 PUMP OPERATION AND MAINTENANCE MANUAL

All equipment must have corrosion resistant metal tags attached to it, giving the most important technical details. Three copies of the operating and maintenance manuals must be supplied giving the following information:

- A flow diagram of the pump station showing all the components as well as the working pressure flow rates.
- Operation of the pump station. Maintenance of the pump station. Complete list of emergency spares to be kept in store
- A list of spares with specifications, names and addresses of suppliers of all components used in the pump station, pipework and rising main.
- A complete set of the as-built drawings Electrical panel drawings

PSL3.14.1 ELECTRO-MECHANICAL SPECIFICATION COMPLIANCE CHECKLISTS.

PSL3.14.1.1 PUMP STATIONS

A…. PS1& PS2: MOTOR CONTROL CENTER (MCC) - OPERATOR PANEL

Item No.	**Compliance Requirement**	**Yes / No.** (*In the event of a "No", state an equivalent or better capability*)
1	Indoor type panel.	
2	Star/Delta Motor Starters.	
3	Motor Controller for **two** x 21kW / 380V Pump motors.	
4	The following operator interface pilot lamps or indicators are to be installed / provided:	
4.1	❖ Pump **A** "Stopped" RED indication.	
4.2	❖ Pump **B** "Stopped" RED indication.	
4.3	❖ Pump **A** "Running" GREEN indication.	
4.4	❖ Pump **B** "Running" GREEN indication.	

4.5	❖ Pump **A** "Tripped" RED indication	
4.6	❖ Pump **B** "Tripped" RED indication	
4.7	❖ Pump **A** "Failure to Start" RED indication.	
4.8	❖ Pump **B** "Failure to Start" RED indication.	
4.9	❖ "Sump level low low" CLEAR or WHITE indication.	
4.10	❖ "Sump level low" CLEAR or WHITE indication.	
4.11	❖ "Sump level high" CLEAR or WHITE indication.	
4.12	❖ "Sump overflow" RED indication.	
4.13	❖ "Power On" GREEN indication.	
5	The following selector switches are to be installed / provided:	
5.1	❖ Power ON/OFF selector switch.	
5.2	❖ Manual/Automatic Mode selector switch.	
5.3	❖ Pump **A** /Pump **B** "Duty/Standby" selector switch.	
5.4	❖ Voltage selector switch.	
6	The following operator push buttons are to be installed / provided:	
6.1	❖ Pump **A** "Start" GREEN push button.	
6.2	❖ Pump **B** "Start" GREEN push button.	
6.3	❖ Pump **A** "Stop" RED push button.	
6.4	❖ Pump **B** "Stop" RED push button.	
6.5	❖ "Lamp Test" BLUE or GREY push button.	
7	Includes "Pump **A** Running Hours" meter.	
8	Includes "Pump **B** Running Hours" meter.	
9	Includes "Pump **A** Current" analogue meter.	
10	Includes "Pump **B** Current" analogue meter.	
11	Includes "Voltage" analogue meter.	
12	Includes a digital indication of sump wastewater level in mm or meters.	
13	Supplied complete with a single-phase welding socket.	
14	Supplied complete with a 16A switched socket outlet.	
15	Details of the MCC-Operator Panel to be are communicated to the Engineer for prior approval.	
16	Functionality to be configured as per the Engineer compiled Motor Controller operating philosophy.	
17	**Note:** To be factory tested and witnessed by the Engineer prior to shipping to site.	
18	**Three copies** of Operating and Maintenance documentation to be supplied.	
19	As-built installation details / drawings to be supplied.	
20	Critical spares list to be provided.	

A. *PS1& PS2: SEWER PUMPS CONTROL PHILOSOPHY*

B. PS1: OPERATOR PILOT LAMPS INDICATIONS (FUNCTIONAL SPEC COMPLIANCE)

C. PS2: OPERATOR PILOT LAMPS INDICATIONS (FUNCTIONAL SPEC COMPLIANCE)

D. PS1 & PS2: ULTRASONIC WW LEVEL SENSOR- TRANSMITTER (SPEC COMPLIANCE)

Item No.	**Compliance Requirement**	**Yes / No.** **(***In the event of a "No" state an equivalent or better capability***)**
1	Waterproof type.	
2	For waste water level sensing.	
3	Transmitter & Receiver (Dual use type)	
4	Ambient temperature compensated (for at least the range of -40^{o}C to +60^{o}C).	
5	Directivity of 80^{o} to process medium level (i.e. capable of acceptable operation when mounted perpendicular to the process medium surface level).	
6	Detection range of 200mm-to-5000mm or better.	
7	No objects/obstructions between the sensor (signal cone) and the level to be measured.	
8	Has means of generating a "need for sensor cleaning" alarm function in the event of the sensor being dirt coated.	
9	To be mounted on vendor-supplied mounting hardware.	
10	No hard-conduit-wiring for the sensor wiring.	
11	Is "foam tolerant" in detecting the true level of the process medium.	
12	**Note:** Details of selected level sensor-transmitter are to be communicated to the Engineer for prior approval before procurement.	
13	**Three copies** of Operating and Maintenance documentation to be supplied.	
14	Redlined as-built installation details / drawings to be supplied.	
15	Critical spares list to be provided.	

PSL 7 TESTING

PSL 7.2 INITIAL TESTS ON WELDED STEEL PIPES

PSL 7.2.2 RADIOGRAPHIC EXAMINATION

Fifteen percent of all welded joints, or when ordered by the Engineer, shall be examined radiographically.

ADD THE FOLLOWING NEW CLAUSE:

PSL 7.2.3 HYDROSTATIC TEST

(a) All pipes and fittings shall be subject to an approved hydrostatic test and to a test pressure determined as follows:

$$P = \frac{2000\ t\ f}{D}$$

Where

P = test pressure in kPa

F = 85 percent of the guaranteed minimum yield strength in MPa for steel plate

D = outside diameter of the pipe in mm

T = wall thickness in mm.

(b) Hydrostatic testing shall not be carried out until all aspects of fabrication have been completed.

(c) The pressure shall be applied steadily by approved means and maintained without variation sufficiently long for proof and inspection.

(d) Should water sweat or ooze from any part or any defects of any nature be discovered the pipe shall be emptied and the defects made good. The pipe shall then be tested again. Should a pipe, after repair, fail to pass the second hydraulic test the Employer may order its rejection.

(e) The fact that any pipe may have passed the hydraulic test at the works shall not exempt The Contractor from his liability under Clause 7 of the General Conditions of Contract 2010.

(f) If a pipe fails to pass any of the above tests in Clauses PSL 7.2.1, PSL 7.2.2 or PSL 7.2.3, it shall be rejected, but the Employer may permit repairs or alterations to be made to enable the pipe to pass the test.

(g) The Employer may require one or more pipes to be tested to destruction. If practicable the Employer may require The Contractor to repair the pipes and retest them. The cost of repairs will be paid by the Employer as an extra to the Contract."

PSL 8 MEASUREMENT AND PAYMENT

PSL 8.2 SCHEDULED ITEMS

ADD THE FOLLOWING NEW SUBCLAUSE:

PSL 8.2.16 c) DEMOLISH STRUCTURE

a) Description of connection, types and diameters involved……...Unit: No

b) Etc. for the other items

The unit of measurement shall be sum for several types of connection into existing line mains

The rate shall cover the cost of excavation, WORKS and labour required, demolishing the existing chambers, safeguarding the existing valves and specials from damage and safely disposing of the rubble material.

ADD THE FOLLOWING NEW SUBCLAUSE:

PSL 8.2.17 CONNECT TO EXISTING MAINS

a) Description of connection, types and diameters involved……...Unit: No

b) Etc. for the other items

The rate shall cover the cost of isolating, cutting, excavation (up to 2 m deep), bedding, dewatering and exposing the existing main at the connection point, supply necessary fittings for under pressure connections for the section of the mains as required, temporary support, safety precaution backfilling and the removal of surplus and unsuitable material. The supply and installation of fittings and couplings shall be measured separately.

ADD THE FOLLOWING NEW SUBCLAUSE

PSL 8.2.18 RECOVER VALVES, FITTINGS, SPECIALS, ETC

a) Description of item……Unit: No.

b) Etc. for another item

The unit of measurement shall be number of described items to be recovered

The rate for the recovery of the above shall cover the cost of the excavation, breaking out existing brick or precast concrete, and removal of the valves, fittings and specials removal of debris and spoil to The Contractor 's dump site and importing suitable backfill material, the plugging with concrete of the open ends of the abandoned water mains, the removal of the surface boxes, backfilling to required density, the handling and transporting of the recovered materials to the Responsible Depot, the listing of the salvaged materials and the backfilling and compaction of the chambers and reinstatement of surface covering.

PSL 8.2.19 SUPPLY AND INSTALL VALVES…….....Unit: No

a) Gate Valves

All gate valves shall be flanged Resilient seal or wedge type isolation valves to SABS 664, Class 16, anti-clockwise closing. All valves 400 mm and bigger are to be supplied with an approved **open gear box assembly** as follows:

1. For the 600mm Valve:
   Multi-Stage Spur gearing with 6:1 minimum ratio, having operating spindles on the input spindle and at a stage where the valve can be stroked without exceeding the maximum input torque of 275Nm if no differential pressure is applied to the valve.

   1.1 For the 450mm Valve:

   Single-Stage spur gearing with 4:1 ratio having one spindle to operate with a 1:1 ratio and a second spindle to operate with a 4:1 ratio. A maximum input torque of 240Nm is recommended.

2. The gears shall be robust, and machine cut, and their mounting shall be of substantial design.

3. Each pinion gear spindle shall be supported between two bearings or alternatively one bearing of enough depth to prevent misalignment of the opinion gear and spindle. The bearings shall be fitted with bronze bushes and shall be provided with grease nipple lubricating points and shall be lubricated prior to delivery. All points to be lubricated shall be fitted with 1/8-inch BSP straight nipples for grease-gun lubrication. Adequate lubrication shall be provided for all gear and indicator bushes.

4. All valves shall open by anti-clockwise rotation of the main spindle and gearboxes shall be fitted with an intermediate idler where necessary.

5. In the case of Type, A and Type B gearing a shear pin or other safety device shall be incorporated between the high and low gears to prevent damage to the valve if excessive force is applied. Two spare pins shall be attached to each valve.

6. Shear pins shall be easily replaced in the field. Hard-driven pins will not be accepted as shear pins.
   b) Air Valves

Air valves must be double acting air valves of compact single chamber design with both small and large air release orifices inside the chamber. The valve must also act as a vacuum breaker, with intake capacities of 60 % of discharge rates given.

The unit measurement for valves shall be number of each described assembly

The rate shall include supply installation and testing including for all corrosion protection, bolts, gaskets, and any other contingency work.

PSL 8.2.21 SUPPLY AND INSTALL FITTINGS ASSEMBLY…….....Unit: No

The unit of measurement shall be number of a described item to be installed. The applicable specification contained herein on various clauses will apply to the various pieces, for example **PSL 8.2.19** will be applicable to any valve and air valve in the assembly.

The rate shall include supply installation and testing including for all corrosion protection, bolts, gaskets, and any other contingency work to enable the proper operation of the fittings assembly.

PSLC CABLE DUCTS

PSLC 3 MATERIALS

PSLC 3.1 DUCTS

ADD THE FOLLOWING:

PSLC 3.1.1 SPLIT UPVC PIPES

Split pipes shall only be used to provide ducts for existing services that cannot be severed and threaded through the ducts. The pipes shall be cut accurately in the middle, and opposite halves shall be matched as sawn. Split pipes shall be placed around the service, firmly bound by steel straps, and encased in concrete."

PSLC 3.4 CABLE DUCT MARKERS

ADD THE FOLLOWING:

"A cable duct marker shall consist of a 300 mm x 300 mm x 100 mm deep, class 20 MPa/19 mm concrete block, connected by means of a non-ferrous metal strip to a temporary plug to seal the end of the duct. The plug shall prevent moisture or soil from entering the duct. The metal strip shall be firmly connected to both the plug and the concrete block. The concrete block shall be positioned not further than 0,5 m horizontally from the end of the cable duct. The face of the concrete block shall be clearly marked "E" to indicate electricity cables."

PSLC 8 MEASUREMENT AND PAYMENT

PSLC 8.2 SCHEDULED ITEMS

PSLC 8.2.5 SUPPLY, LAY, BED AND PROVE DUCT

REPLACE THE PAYMENT PARAGRAPH WITH THE FOLLOWING:

"Separate items are scheduled for each diameter of duct.

The rates shall cover the cost of providing all the materials and the cost of laying the ducts, installing the draw wire, jointing, bedding and providing all as specified."

PSLD SEWERS

PSLD 1 MATERIALS

PSLD 1.1 PIPES, FITTINGS AND PIPE JOINTS (SUBCLAUSE 3.1)

Sewer pipes used in this contract shall be uPVC class 34 (Heavy Duty) to SABS 791 as amended with a minimun wall stiffness of 300 kPa

PSLD 1.2 MANHOLES, CHAMBERS ETC. (SUBCLAUSE 3.5)

Manholes shall be pre-cast concrete rings with pre-cast concrete lid and frame, Heavy Duty, SABS 566 approved, as in typical details drawing, 12214-C-S-STD-xxx.

Sewer manholes that consist of precast concrete sections shall comply with SABS 1294 (1993) with step irons located on the downstream side, and are to be of dolomitic concrete.

For all manholes channeling shall be clay channels. Alternative offers can be done separately by the contractor for plain concrete finish steel trowelled smooth, but no PVC channels will be allowed

PSLD 1.3 CONCRETE (SUBCLAUSE 3.5.4)

Concrete shall be made with ordinary Portland cement complying with SABS 471. The minimum cement content shall be 420 kg/m^3 and a minimum cement: water ratio of 2,2. Only dolomitic aggregates shall be used.

PSLD 1.4 MORTAR (SUBCLAUSE 3.5.6)

Mortar shall be composed of one part of ordinary Port-land cement to 3 parts of sand by volume.

PSLD 1.5 MANHOLE COVERS AND FRAMES (SUBCLAUSE 3.5.8)

All manhole covers and frames shall comply with SABS 558 and shall be dolomitic concrete with a steel rim to the cover. Covers shall be either heavy duty or medium duty capable of test loading of 135 kN and 40 kN respectively.

PSHC CORROSION PROTECTION OF STRUCTURAL STEELWORK

PSHC 5 MATERIALS

PSHC 5.7 COATING SYSTEM

PSHC 5.7.1 Structural Steelwork

The coating system for the structural steelwork shall be as follows:

a) Within four hours of cleaning in accordance with the requirements of Clause 5.4.3. apply one coat of Plascon UC 182 zinc phosphate primer to a minimum dry film thickness of 35 microns.

b) After erection of the steelwork apply a touch up coating of primer as above to all areas of the steelwork where the shop coat of primer has been damaged.

c) After allowing a minimum of 18 hours drying time for areas that have received touch up coatings, apply one coat of Plascon white Merit universal undercoat Code UC1 to a minimum dry film thickness of 30 microns. Prior to application the undercoat shall be tinted to a shade lighter than the final finishing colour using Plascon liquid stainers.

d) After allowing the undercoat to dry for a minimum of 18 hours, apply finishing coat of Plascon Alkyd enamel to a minimum dry film thickness of 30 microns. The non-volatile vehicle of the finishing coat shall contain at least 24% phithalic anhydride.

The colour of the finishing coat shall be selected and approved by the Engineer.

All proprietary coatings specified above may be replaced by paints from another manufacturer subject to approval by the Engineer. In order to obtain such approval, the Contractor must submit detailed specifications of the proposed coatings to the Engineer.

PZ FENCING AND GATES

GENERAL

The Engineer will be responsible for indicating the exact positions of all gates, fencing lines and corner posts. The Contractor shall be responsible for setting out the fencing in accordance with the prescribed alignment.

All bushes, trees, debris, rocks and other obstructions shall be removed from the fencing line to produce a clear even strip a minimum of 500mm wide on either side of the fencing line.

PZ 1 MATERIALS & CONSTRUCTION

PZ 1.1 STRAINING POSTS

Straining posts shall be erected at ends and corners and intermediately at not exceeding 45m centres with standards or intermediate posts at not exceeding 3m centres.

PZ 1.2 CHAIN LINK WIRE MESH

Fencing and wire shall comply with SABS specifications 675 and 1373 and shall be Type 1 fully galvanized to Class A. Chain link fencing shall have a mesh size of 50mm and be of the height and type specified, woven from 2.5mm diameter wire. The edges of wire mesh rolls shall be clinched and shall have a durable label attached indicating the manufacturer's name, type and description of fencing, nominal diameter of wire, nominal width and length of roll ad size of mesh. Wire for the lacing of wire mesh to posts, gate framing etc. must be identical to the wire forming the fencing. The wire mesh fencing shall be tied at 450mm centres to straining wires with binding or tie wire.

PZ 1.3 STRAINING WIRE

Straining wire shall be Type 1 galvanised wire or 3.15mm diameter. The bottom straining wire shall be fixed 50mm above the levelled ground and each straining wire shall be strained between posts and tied to same by turning each wire twice round the post and tying off by twisting it a minimum of three turns around the straining wire.

PZ 1.4 FLAT WRAP RAZOR WIRE

Flat wrap razor wire shall be 500mm roll diameter and fully galvanised, installed in accordance with the manufacturer's instructions.

PZ 1.5 BINDING OR TIE WIRE

Binding or tie wire shall be Type 1 galvanised wire of 2mm diameter.

PZ 1.6 GALVANISING

Galvanising shall comply with SABS 763 and all posts, stays, gate framing etc. shall be hot dipped galvanized after fabrication with Class A galvanizing with all interior and exterior surfaces fully coated.

PZ 1.7 MILD STEEL TUBULAR STRAINING, GATE AND INTERMEDIATE POSTS

Mild steel tubular straining, gate and intermediate posts shall comply with CKS 32. Posts and stays shall be fitted with base plates welded on with each base plate holed 25mm in the centre to permit intrusion of galvanizing. Tubular posts not exceeding 51mm diameter shall fitted at the top with a machined steel plug pressed or welded into the end of the post. The top end of posts exceeding 51mm diameter are to be capped with 1.60mm thick pressed mild steel domed cap welded on. Gate posts are to be drilled and fitted with mild steel ferrules welded into position to receive 20mm diameter mild steel hinges. Stays shall have the top end flattened, bent as required and holed 12mm for bolting to the post. Threaded 12mm diameter studs or approved stay collars are to be welded to the posts to locate and secure the top ends of stays.

a) Single and double gates shall be of the sizes shown on the drawings formed with mild steel tubular framing all round, covered with chain link wire mesh fencing and flat wrap razor wire of the same type used for the fencing laced to the framing. Tubular framing shall be mitred and welded at the corners and at all other intersections the tubular framing shall be scribed and welded together with all welds ground smooth.

   Gates shall be hung on 20mm diameter adjustable eye bolt hinges wrapped around the gate framing with a collar welded on to the gate framing above the eye bolt hinge. Each hinge shall be fitted with two nuts and two washers.

   Each single gate and one leaf of a double gate shall be fitted with a gate latch formed of 25mm x 6mm mild steel bracket, 550mm girth, twice bent to U-shape with centre section 150mm high and with ends scribed and welded to the tubular stile of the gate. A locking bar of 25mm x 6mm mild steel plate, 100mm long, twice holed 13mm diameter for a shackle of a padlock and for a padbolt, shall welded to the inside of the bracket. The sliding pad bolt shall be formed of 12mm mild steel rod 220mm long with 25mm x 6mm mild steel flat bar 60mm long welded on at one end and holed 13mm diameter for shackle of the padlock. The style of the gate and the locking post or locking stile of the double gate shall be holed for and fitted with a mild steel ferrule welded in to receive the padbolt. In addition fittings to each leaf of the double gate shall comprise 50mm x 6mm mild steel locking bar 80mm long holed 20mm diameter for the shackle of the padlock and welded to the locking stile of the gate, and a drop bolt formed of 16mm diameter mild steel rod, 575mm girth once bent L-shape, fitted through and including 20mm internal diameter sleeve welded to the gate at the bottom corner with a 12mm diameter mild steel peg stay 25mm long welded on to the gate frame. A concrete gate stop lock 230mm x

230mm x 230mm deep with two 20mm internal diameter mild steel sockets each 75mm long cast into the top shall be embedded into the access way surface between each pair of double gates in the closed position, and a similar stop block with one socket for each leaf of the double gate in the open position.

Each gate shall be provided with an approved 51mm brass padlock with hard steel shackle and two keys.

PZ 1.9 PRECAST PRESTRESSED CONCRETE POST AND PALE FENCING

Concrete palisade heights shall be 2.4m(8-foot-high) and should have extended posts (500mm) between which flat razor wire to ensure it is secured.

- Installation of concrete palisade
  Each post is embedded to a full depth in concrete in a foundation of at least 400 X 400 X 600mm. Foundations are 19/25MPa. Strong mixtures are available depending on the specifications required. A full method statement is available on request.
- The strength of concrete palisade
  Only the highest quality raw materials are used. Our standard concrete strength is between 25 MPa. We supply (and guarantee) stronger strengths of 25, 30 and 35 MPa. All reinforcing steel wires are free of rust, loose scale, flux, grease or oil substances.
- Main Anchor Posts

  2.4-meter fence (Size: Post 3000 X 220 X 150 tapered to 80mm). Reinforced with 4 X 6mm spring steel wires. Weight: 144kg. Extended post weighs 181kg. The posts are not pre-stressed.

  Distance between posts are 2.0-meter centre to centre. The top of the posts are angled at 45 degrees. Posts are spaced 20. meter centre to centre. The posts are slotted to take the horizontal load bearing rails.
- Pales (Intermediate Uprights)

  2.4-meter fence (Size: 2400 X 80 X 110 tapered to 80mm). Reinforced with 4 X 4mm spring steel wires. Weight: 35kg.

  Distance between pales are 200mm c/c. Gap between pales are 100mm. Nine pales installed per section of 2 meters. The top of the pales are angled at 45 degrees. Pales are not pre-stressed.
- Horizontal Rails (Cross Bars)

Size: 1980 X 75 X 150mm with 9 x 10mm diameter holes. Reinforced with 4 X 4mm spring steel wires. Weight: 49kg. Cross bars are not pre-stressed

- Nuts, Bolts & Washers

18 of 160mm long 8mm diameter high tensile steel carriage bolts are used per 2-meter section. Galvanised and electro-galvanised fixing bolts are available optionally extra. All bolts used for the erection have their ends burred over.

PZ 2 PAINTING

All applications and colour shall be coded to SABS1091

Outside walls of building	Micatex or Equivalent (Clifton) BBO308
Inside walls of building	Gloss Enamel (Tapioca) or equivalent G377
Window and door frames	Gloss Enamel (Brilliant white) NY1
Pipe work	Colour code to SABS1091
Pumps	Colour code to SABS1091
Lifting Beam	Gloss Enamel (Golden Yellow) B49
Stanchions	Gloss Enamel (Black) G2
Handrail uprights	Gloss Enamel (Black) G2
Handrail bottom horizontal	Gloss Enamel (Black) G2
Handrail top horizontal	Gloss Enamel (Golden Yellow) B49
Electrical equipment	
Pipes and guards	Gloss Enamel (Light orange) B26
Sump pump drainage pipe	Gloss Enamel (Black) G2
Access steps	Gloss Enamel (Black) (Golden yellow edge)
Entrance Door	Gloss Enamel (Light Brown) G397
Drainpipes	Gloss Enamel (Light Brown) G397
Ventilation ducting	Gloss Enamel (Mines gray) G15
Direction arrows	Gloss Enamel Black on white, white on any other colour
Floors Green floor paint	
Danger Areas	Gloss Enamel (Signal red) A11 (G7)
Demarcation lines	Gloss Enamel (Golden Yellow) B49

1. Paint Selection.

a) Paint Quality: Paint shall be of the best quality, of approved manufacture and brand and comply with the relevant SABS or BS specifications.

b) Compatibility: To avoid incompatibility between paint coats due to variations in formulation, the different coats in any one paint system shall be provided by the same manufacturer.

c) Confirmation of suitability: Contractors shall obtain confirmation from their suppliers that, when using their paints, the systems specified are technically correct and suitable for the application and material being coated.

2. Paint Application

a) Surface Preparation: Between coats or with previously painted surfaces in good condition (Any surface cracks and missing plaster to be made good.) All traces of oils greases, soluble salts and corrosive air borne contaminants shall be thoroughly washed from the surfaces to be painted using a detergent type cleaning agent, rinsed and dried. The previous coat shall then be immediately be lightly sanded or otherwise prepared as recommended by the paint manufacturer, wipe clean, dried and painted. Solvents are not acceptable as a surface cleaning agent.

b) Galvanised Surfaces: Galvanised surfaces to be painted shall be free from white rust, shall be cleaned to a drop free surface with an approved water based galvanising cleaner, scrubbed with a bristle brush, washed with water and dried immediately prior to painting. Where necessary to obtain adhesion a light sanding with a fine abrasive paper on the surface shall be done after cleaning.

c) Painting: Paints shall be applied strictly in accordance with the manufacturer's instructions by a tradesman skilled in this class of work. Thinning of paint shall only be allowed for spray painting and the manufacturer's thinners shall be used.

d) Coating of hidden areas: Areas which will be inaccessible after erection and surfaces resting on floors shall receive the full paint system prior to erection. Mating or contact surfaces shall be prepared and primed and brought together while the paint is still wet.

e) Crevices: Crevices will not be permitted. Where unavoidable crevices are accepted by the Engineer, such crevices shall be filled with compatible filler after application of the priming coat.

f) Protection of machined surfaces: Where painting of machined surfaces is not possible or advisable, these surfaces shall be coated with an approved proprietary anti-corrosion compound giving 12 months protection under normal operating conditions. Shaft ends and machined mating or mounting surfaces or pads shall be so coated and shall not be painted.

g) Protection on site: Proper and adequate use of cover sheets and other means shall be made to protect the existing paint work from damage and from metal dust and sparks when welding, grinding and wire brushing on site. Similarly, effective steps shall be taken to prevent spillage or splashing of other damage to floors, walls and equipment when painting on site and any damage or mess caused shall be corrected at the Contractors cost.

h) Final coat: The final external coat/s shall always be applied on site after installation. A professional smooth finish with uniform colour is required.

i) Floors: All floors to be degreased made good if necessary and paint with a reputable floor-cote type paint.

j) Danger Areas: Areas in front of or around distribution boards, MCC panels and fire points shall be so painted in gloss enamel on top of the floor paint to identify such areas. The area painted will be of such size as to allow sufficient access space to the danger area for authorised personnel. The area shall be so identified by the use of demarcation lines

k) Demarcation Lines: All demarcation lines on the premises shall be uniform in colour and shall be a solid yellow line 10 cm wide.

l) Gate posts, straining posts, intermediate posts, stays, standards and gate framing shall be painted before erection with two coats of approved bituminous aluminium paint. After erection any bared or damaged surfaces are to be made good to the approval of the Engineer.

PZ 3 MEASUREMENT AND PAYMENT

Measurement and payment shall be per linear metre of fencing supplied and erected complete with razor wire, straining posts, stays and standards, and for each gate supplied and erected complete, all in accordance with the specifications.

(a) 2.4m concrete palisade fencing complete…… Unit: m

(b) Sliding gate 2.4m high …… …….. Unit: No

(c) Single leaf gate 2.1m high …… …. Unit

DR PIXLEY KA ISAKA SEME LOCAL MUNICIPALITY

VOLKSRUST WATER TREATMENT WORKS
60KVA GENERATOR SET TECHNICAL SPECIFICATION

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ANNEXURE B: GENERATOR TECHNICAL SPECIFICATION

SECTION 1 – GENERAL

1. Intent of Document

The specification is intended to cover the complete installation of the standby generator The minimum equipment requirements are outlined, but do not cover all the details of design and construction. Such details are recognised as being the exclusive responsibility of the contractor.

In all cases where a device or part of the equipment is referred to in the singular, it is intended that such reference shall apply to as many devices as are required to complete the installation.

2. Scope of Work

2.1 **1x 60KVA** open set generators with changeover panel.
2.2 The existing generators change over including controllers to be upgraded.
2.3 Distribution boards.
2.4 LV cabling.
2.5 LV terminations.
2.6 Earthing.
2.7 Cable ladders.
2.8 Dummy load for on-site testing for all generators
2.9 As built drawings.
2.10 Trenching
2.11 Minor Building works

3. Maintenance and Guarantee

The installation and equipment supplied under this contract shall be guaranteed and maintained for a period of twelve months (12-month guarantee) from the date of acceptance by SABC in all respects and commissioned for continuous service. The bid price shall include the above, which will entail call outs during and after hours.
A separate five-year maintenance and service contract shall be priced separate in the bill and shall commence after the warranty period expires.

4. Relevant Standards and Specifications

4.1 General

4.1.1 All material and equipment supplied and / or installed under this Contract shall be new and of good quality and shall comply with the requirements laid down in the latest editions of the relevant SABS, BS or IEC Specifications and their amendments (if any) and the requirements of this specification. The workmanship and finish of work shall be of high standard throughout and to the satisfaction of the Engineer/SABC.

4.1.2 Before the commencement of manufacture a full set of drawings showing all details of equipment, wiring (single line diagram) and layouts shall be submitted to the Engineer for approval.

4.1.3 All calculations, designs, documentation and drawings shall be submitted to the Engineer prior to the procurement, manufacture or construction of any part of the plant

5. Laws, Regulations and Standards

The work shall be carried out strictly in accordance with the specifications and all material and equipment supplied shall comply with the following laws and regulations where applicable:

The cost of complying with the requirements of this clause shall be deemed to be included in the rates.

5.1 The latest version of the "Code of Practice for the wiring of Premises" SANS 10142-1: 2003 as amended.
5.2 The Occupational Health and Safety Act (No 85 of 1993) as amended.
5.3 The general safety regulations of 1986.
5.4 The construction regulations of 2003.
5.5 The "Electrical Supply By-Laws and Regulations" of the Supply Authority.
5.6 The local Fire Office Regulations.
5.7 The regulations of Telkom.
5.8 Specifications indicated in the detailed generator specification.

5.9 Additional Standardized Specifications

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

NO	DESCRIPTION	DETAILS
11	Safety of distribution boards	SABS 1765
12	Earthing of low-voltage (LV) distribution systems	SABS 0292 :2001
13	Cable standard	SANS 1507 (Part 1-3) Electric cables with extruded solid dielectric insulation
14	Low voltage switchgear and control gear assemblies Part 1: Type-tested and partially type-tested assemblies	SABS IEC 60439-1 :
15	The design and installation of an earth electrode	SABS 0199 :1985
16	Earth rods and couplers	SABS 1063 :1998
17	Low voltage switchgear and control gear assemblies Part 2: Particular requirements for busbar trunking systems (busways)	SABS IEC 60439-2:
18	Low Voltage Switchgear and Control Gear Part 1: General Rules	SABS IEC 60947-1
19	Low Voltage Switchgear and Control Gear Part 2: Circuit Breakers	SABS IEC 60947-2
20	Low Voltage Switchgear and Control Gear Part3:Switches,disconnectorsswitch- disconnectors and fuse-combination units	SABS IEC 60947-3
21	Low Voltage Switchgear and Control Gear Part 4: Contactors and motor-starters Section 1: Electromechanical contactors and motor- starters	SABS IEC 60947-4-1
22	Steel, cast iron and copper alloy flanges, tables 10/3, 25/3 or 64/3	BS 4505-1969
23	Specification General requirements for rotating electrical machines. Part 133	BS 4999
24	Specification for Acceptance tests for centrifugal, mixed flow and axial pumps – Part 2. Class B tests	BS 5316
25	Classification of insulating materials	IEC 60085
26	Occupational Health & Safety Act (Act 85 of 1993)	OHS Act

6. Drawings and Documents

6.1 Drawings and Information Provided:

The Engineer shall produce cable schedules and such drawings necessary to adequately document the installation for the Contractor.
Three prints of each drawing shall be issued to the Contractor.

6.2 As Built Drawings

The Contractor shall be required to mark up these schedules and drawings with the "as built" information and return one print to the Engineer with all "as built" information entered thereon.

6.3 Information to be submitted by the successful bidder in respect of Control Panels

The successful bidder shall submit three paper prints of each of the following drawings, in respect of the Control Panels to the Engineer for approval prior to manufacture:

6.3.1 Outline and general arrangement drawings, showing main overall dimensions and construction details.
6.3.2 Wiring diagrams.
6.3.3 Schematic line diagrams.

Prints of the following shall be supplied by the successful Bidder in respect of each of the final As Built layouts of the Control Panels:

6.3.4 Outline and general arrangement drawings of the DB's.
6.3.5 Wiring diagrams
6.3.6 Schematic line diagrams.

Note: Where contradiction occurs between the Detailed Technical Specification and the General Technical Specification, preference shall be given to the Detailed Technical Specification.

SECTION 2 – TECHNICAL INFORMATION

1. Conduit

Galvanised conduit bearing the SANS mark of approval must be used for surface mounting on concrete slab and soffits walling.

2. Cables Specification

2.1 All cables shall have stranded copper conductors and shall be of the PVC/PVC/SWA/PVC type, 600/1000V grade. Cables with aluminium conductors are unacceptable.
2.2 The cables shall be armoured with a single layer of galvanised steel wire.
2.3 All cables shall bear the SANS mark of approval and shall have colour coded PVC insulated conductors.

3. Numbering

The contractor shall fit a cable number at each cable gland. The cable number shall be in accordance with the cable number indicated on the respective cable schedules. The cable numbers shall be equal to the type manufactured by Bowthorpe Hellerman or similar approved.

4. Glands

All cable glands shall be suitable for use in highly corrosive locations and equal or similar to the CCG Posi guard and Posi seal types.

5. Trenches

Cables installed in trenches shall be installed in accordance with the General Technical Requirements. The electrical contractor shall carry out the excavation and backfilling of cable trenches. Cable trenches shall have a minimum depth of 600m.

6. Measurement

Cable quantities given in the Schedule of Quantities and Cable Schedules have been measured against scaled drawings. It is the contractor's responsibility to measure the exact cable lengths before purchasing / installing cables. All cables will be subject to re-measure by the engineer once installed.

7. Installation

All LV cables shall be installed as specified. The installation shall be carefully planned to reduce the number of cable crossings to a minimum.
The following different types of installations shall be employed:

7.1 On cable trays and ladders
7.2 Inside sleeves in excavated cable trenches

8. Laying of cables in trenches

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

8.1 Before laying the cables all rocks, stones, etc shall be removed from the bottom of the trench. The floor of the trench shall be evenly covered with a layer of sifted backfill or sand to a level which is 75mm above the highest unevenness of the trench. The cost of this work shall be included in the contractor's price. The laying of cables shall not be commenced until the trenches have been inspected and approved. The cable shall be removed from the drum in such a way that no twisting, tension or mechanical damage is caused, and must be adequately supported at short intervals during the entire operation. Particular care must be exercised where it is necessary to draw cables through pipes and ducts to avoid abrasion, elongation or distortion of any kind. The ends of such pipes and ducts shall be sealed in an approved manner after drawing in of cables.

8.2 The cable shall be covered with a 150mm layer of sifted backfill of sand. All trenches shall be backfilled with damp soil, in layers not more than 150mm thick. Each layer shall be individually compacted in order to obtain the same degree of permeability as that of the surrounding undisturbed soil.

8.3 A distance of 300mm shall exist between instrumentation and power cable.

*Tenderers are to note that **Pickable Material** shall mean: -*
ground or rock that can be loosened by handpick and includes hard shale, compact ouklip and boulders from 75mm in diameter up to 0.03m² in volume.

9. Laying of cables into existing concrete cable trenches.

New cables installed in concrete cable trenches must be secured to existing cable ladders, and metal covers must be reinstated after cables have been installed.

10. Cable Ladder

10.1 Cable ladders shall be OL76 (2mm thick) Cable Ladder as supplied by O- Line or similar approved. All nuts and bolts must be galvanised.

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

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

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

10.5 Cables on cable trays and ladders shall be neatly laid on the ladders and strapped to the ladders/trays at 1200mm intervals. A minimum of a half cable diameter space shall be allowed between cables.

11. 400v Circuit Breakers

CB's indicated on drawings must be ABB or similar approved.

12. Existing Electrical Installation

Bidder must note that the existing installation in Volkstrat WTP is in operation 24 hours a day. Before any equipment is disconnected and new equipment connected, the contractor will have to obtain acceptable time slots from the Engineer.

13. Remote Monitoring System

13.1 The new generator must be equipped with remote monitoring system.
13.2 The system must be able to support multi-set generator system
13.3 The system must provide real time instrumentation & control, event log and automatic system alerts. These must be sent to different users via email and SMS. The system should be viewed on smart phone, tablet or computer.
13.4 Each device can be set to view only or able to control the system remotely.
13.5 The controller should be able to log all the event or changes done by each user.

14. Earthing

The complete Electrical Installation shall be earthed and bonded as required by the Code of Practice

15. Generator Change over Panel

The contractor will be responsible for liaison with the supplier regarding programme, submission of workshop drawings, inspections at the factory, taking delivery, unpacking, placing in position and assembling, where required. Final connections to all Control Panels, testing, preparation of legend cards and commissioning shall be carried out by the contractor.

The fault levels are indicated on the schematic diagram. It is the responsibility of the distribution board manufacturer to select current limiting type circuit breakers and select suitable downstream switchgear to ensure that the fault levels indicated will be achieved.

The Control Panels manufacturers shall ensure that distribution boards are correctly sized in order that they may be fitted within the allocated spaces as indicated on the drawings.

15.1 Battery Charger

15.1.1 The changeover panel shall contain battery charger for charging each of the 24V DC Engine Starting batteries.

15.1.2 Each of the Engine Starting batteries will consist of 2 x 12V DC 200Ah batteries in parallel.

15.1.3 The 24V battery chargers shall be of the fully automatic type and shall consist of an air-cooled transformer, silicon bridge rectifier, fuses and switching arrangement. All equipment shall be suitably rated and designed to automatically deliver a trickle or boost charge as determined by the battery voltage. The boost charge in amps shall not exceed 20% of the rated battery capacity but must not be less than 10Amps.

15.1.4 A constant trickle charge facility is not acceptable. The charger shall switch off automatically when the battery is fully charged.

15.1.5 The charger must be provided with a Voltmeter indicating the battery voltage. This instrument must be mounted on the control panel door.

15.2 Battery Charger

15.2.1 The changeover panel shall contain battery charger for charging each of the 24V DC Engine Starting batteries.

15.2.2 Each of the Engine Starting batteries will consist of 2 x 12V DC 200Ah batteries in parallel.

15.2.3 The 24V battery chargers shall be of the fully automatic type and shall consist of an air-cooled transformer, silicon bridge rectifier, fuses and switching arrangement. All equipment shall be suitably rated and designed to automatically deliver a trickle or boost charge as determined by the battery voltage. The boost charge in amps shall not exceed 20% of the rated battery capacity but must not be less than 10Amps.

15.2.4 A constant trickle charge facility is not acceptable. The charger shall switch off automatically when the battery is fully charged.

15.2.5 The charger must be provided with a Voltmeter indicating the battery voltage. This instrument must be mounted on the control panel door.

15.3 Change Over Panel

15.3.1 The switchboard / control panel must provide for the control, metering and switching of the diesel alternator sets. The switchboard will incorporate all the switchgear, control equipment and load busbars specified.

15.3.2 This section covers the design, manufacture and works testing of a switchboard/control panel for the automatic change over and control of the 400/230V 50Hz diesel generating sets.

15.3.3 Control equipment must provide advanced synchronizing functionality for diesel generating sets that include non-electronic and electronic engines.

15.3.4 Control of the sets will be undertaken by means of Programmable Deep-Sea series 8610 Controllers or similar approved, and the

control system must offer the end user maximum flexibility, reliability and ease of operation.

15.3.5 The hardware of the controllers must comprise inputs and outputs which are galvanically isolated from the C.P.U. (Central Processing Unit) input and output circuits.

15.3.6 The switchboard will consist of a section for each generator, arranged with a Common Control section in the centre of the switchboard and the generator switching and control panels on either side of the Common Control section

15.3.7 The switchboard will be manufactured from 2mm cold rolled sheet steel and will be of folded construction. Each section of the switchboard will be physically separated from adjacent sections and suitable barriers will be provided between control and switchgear sections of each panel.

15.3.8 Prior to epoxy painting, all sheet steel must be thoroughly de- rusted and primed with two coats of zinc chromate etching primer.

15.3.9 All internal chassis plates must be galvanised steel

15.3.10 The panel shall be fully labelled, and a wiring diagram shall be installed in each plant room, mounted on the wall in a wooden frame with removable Perspex protective cover.

16. Sections of the Switchboard

Generator Control and Switching	Control selectors and LCD Display	Control Functions and Equipment
Instrumentation	Front STOP/RESET, MANUAL, AUTO and START push buttons	Monitor under/over generator volts, over current, under/over generator frequency, under speed, over speed, charge fail, emergency stop, low oil pressure, high engine temperature, fail to start, low/high DC battery volts, fail to stop, generator short circuit protection
Generator Volts L1- N, L2-N, L3-N	Electronic engine capability	ROCOF & vector shift
Generator Volts L1- L2, L2-L3, L3-L1	RS485 remote communications	Automatic hours run balancing of generator sets
Generator Amps L1, L2, L3	Back-lit LCD 4-line text display	Dead bus sensing
Generator Frequency Hz	Voltage measurement	Direct communication from the module to the governor and AVR
Generator kVA L1, L2, L3, Total	Configurable inputs number of ports (9)	Volts & frequency matching.
Generator kW L1, L2, L3, Total	Configurable outputs number of ports (5)	Alarm message with SMS.
Generator pf L1, L2, L3, Average	Automatic start	If first generator failed on start-up or during operation the second generator shall start automatically.
Generator kVAr L1, L2, L3, Total	Manual start	KW and KVAr load sharing with multiple generators.
Generator KWh	Audible alarm	Refuel day tank automatically when at 50%, when at 30% send low fuel

Generator Control and Switching	Control selectors and LCD Display	Control Functions and Equipment
		alarm. When level reach 90% refueling must stop and when at 100% a second stop signal must be sent including full fuel alarm. Day tank fuel gauge to be calibrated on site and tested.
Generator KVAh	LED indicators	
Generator KVArh	Engine history event log	
Generator Phase Sequence	Engine protection	
Synchroscope Display	Configurable alarm timers	
Engine Speed RPM	Configurable start & stop timers	
Engine Oil Pressure	Automatic load transfer	
Engine Temperature	Magnetic pick-up	
Plant Battery Volts	LCD display scroll, lamp test, mute functionality, and breaker control	
Engine Hours Run		
Number of Start Attempts		
Maintenance Display		
Engine ECU diagnostics information via industry standard CAN interface		
Enhanced metering via CAN when connected to an electronic engine		

17. Switchgear

The following switchgear for switching and protection of each generator must be provided:

17.1 Triple-pole draw out type air circuit breaker complete with electronic overload and short circuit protection. This breaker will be suitable for remote electrical operation and will be equipped with a spring charging motor as well as closing and tripping coils.
17.2 Suitable ratio five-amp current transformers.
17.3 Set copper busbars rated for 115A per millimetre square operation. The busbars will be identified in phase colours.

The following ABB switchgear for switching and protection of the main incomer must be provided:

17.4 Three-pole draw out type air circuit breaker complete with electronic overload and short circuit protection. This breaker will be suitable for remote electrical operation and will be equipped with a spring charging motor as well as closing and tripping coils.
17.5 Suitable ratio five-amp current transformers.
17.6 Set copper busbars rated for 115A per millimetre square operation. The busbars will be painted in phase colours.
17.7 Programmable power meter (KVA, KWH, Kvar, V, I,pf, etc).

The following switchgear for switching and protection of the feeders must be provided:

17.8 Triple-pole draw out type air circuit breaker complete with electronic overload and short circuit protection. This breaker will be suitable for remote electrical operation and will be equipped with a spring charging motor as well as closing and tripping coils.
17.9 Suitable ratio five-amp current transformers.
17.10 Set copper busbars rated for 115A per millimetre square operation. The busbars will be painted in phase colours.
17.11 Programmable power meter (KVA, KWH, Kvar, V, I,pf, etc).

17.12 Testing

The control panels must be fully tested and the following control conditions must be simulated:

17.12.1 Automatic Starting and Stopping of the Generators as described in clause 5.
17.12.2 Manual Control of the Generators.
17.12.3 These tests must be witnessed by an Engineer/ representative.

17.13 Standards

The switchboard/control panel will be built to the following standards:

17.13.1 Control Circuit Wiring and Terminals

a. All control wiring will be undertaken in stranded copper conductor having a minimum cross-sectional area of 1,0mm².
b. All control wiring will present a neat appearance and will be suitably braced, placed in trunking, clipped to prevent vibration. Connections to equipment on swing doors will be so arranged to give a twisting motion and not a bending motion to the conductor.
c. All panel and equipment terminals, labels etc., will be completely accessible after the wiring and cabling has been completed.
d. All wires will be marked at both ends with an approved type of marking device identifying the conductor which corresponds to the circuit diagrams. Interlocking type ferrules with permanent

black letters impressed on a white or yellow background will be used.

e. All auxiliary terminals will be accessible from the front of the control board and all terminals will be mounted at a minimum height of 200mm above the gland plate.

f. All terminals will be suitable for use with crimped lugs.

g. Terminal blocks will be made from non-tracking insulating material and have a minimum clearance of 13mm between the connection point and earthed metal. Terminals where pressure is applied to the insulating moulding when tightening the connections will not be used.

h. After completion, the wiring will be tested to withstand a test voltage of 1000V for two minutes.

i. All busbars and cable connections will be pressure tested to withstand a test voltage of 2500V for two minutes.

17.13.2 Fuses

a. All fuses will be of the high breaking capacity type in accordance with IEC/EN60269-1.

b. All fuses will be so connected that the live wire terminal is at the top.

c. Each set of fuses will be provided with an engraved label, fixed to the panel adjacent to the fuses, inscribed with the fuse number and rating.

17.13.3 Instruments

All instruments will comply with the following standard unless otherwise stated.

Instruments	BS89
Instrument scales	BS3693
Indicating electrical instruments	I.E.C.51

17.13.4 Contactors: All contactors will comply with the requirements of I.E.C.947-4-1.

17.13.5 Control Switches

Control switches will be of the rotary action air break type, suitable for controlling alternating or direct current loads.

17.13.6 Control Relays

Control relays will be of the totally enclosed plug-in type with contacts suitable for the current making, carrying and breaking conditions of the associated equipment.

17.13.7 Busbars and Busbar assemblies

In accordance with SABS IEC 60439 and SABS 1473 Part 1, all bus-bar assemblies and mountings must have been tested by the NETFA test facility and the switchboard manufacturer must be approved to manufacture switchboards in accordance with this standard.

Fault Level - The board and its equipment shall be rated to operate on a 400V 3phase 4 wire system having an asymmetrical prospective fault level of 50 kA or as contained in the detailed specification of the Electrical Installation.

18. Generators

18.1 Engines

18.1.1 General

The engine must comply with the requirements as laid down in BS 5514 (ISO 3046), and must be of the atomised injection, compression ignition type, running at a speed not exceeding 1500 r.p.m. The engine must be amply rated for the required electrical output of the set, when running under the site conditions. 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. This must be guaranteed by the Bidder.

18.1.2 Rating

The set shall be capable of delivering the specified output continuously under the site conditions, without overheating. The engine shall be capable of delivering an output of 110 % of the specified output for one hour in any period of 12 hours consecutive running in accordance with BS 5514.

18.1.3 De-Rating

The engine must be de-rated for the site conditions as set out in the Specification 1500 metres above sea level.

The de-rating of the engine for site conditions shall be strictly in accordance with BS 5514 of 1977 as amended to date. Any other methods of de-rating must have the approval of the SABC and must be motivated in detail. Such de-rating must be guaranteed in writing and proved by the successful Bidder at the site test.

18.1.4 Starting and Stopping

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.

The engine must be fitted with electrical heater to keep the engine warm. The electrical circuit for such heaters shall be taken from the control panel, and must be protected by a suitable circuit breaker.

18.1.5 Starter Battery

The set must be supplied with a fully charged lead-acid type battery, complete with necessary electrolyte. The battery must have sufficient capacity to provide the starting torque stipulated by the engine makers. The battery capacity shall not be less

than 120 Ah and shall be capable of providing five consecutive start attempts from cold and thereafter a six attempt under manual control of not less than 20 seconds duration each. The battery must be of the heavy duty “low maintenance” type, housed in a suitable battery box. An automatic battery charger to be supplied to keep in a fully charged state. The electrical circuit for the battery charger shall be taken from the control panel, and must be protected by a suitable circuit breaker.

18.1.6 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 must be fitted.

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 low water cut-out and low water warning switches, 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 cowling/radiator face to air outlet louvers in the plant room wall.

18.1.7 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.

18.1.8 Fuel Pump

The fuel injection equipment must be suitable for operation with the commercial brands of diesel fuel normally available in South Africa.

18.1.9 Fuel Tank

A 250L < stainless steel fuel tank shall be installed at plant rooms link to the existing underground tank with approved seamless steel pipes from the bulk tank.

Supply and install main pipe from the bulk tank to each day tank including electric solenoid valve and pump for each tank. The piping & pump shall be sized to replenish the day tank while the generator is running at full load.

A water trap shall be fitted in the fuel pipeline from the day tank to the engine.

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.

An automatic electrically operated pump to refuel the day tank from the main tank shall be fitted.

The fuel lines should not be made of copper as there is a risk of oxidation due to condensation.
The sulphur content in the fuel can also have a negative effect on the copper.

The interconnection fuel piping shall consist of seamless steel pipe and the connection to vibrating components shall be in flexible tubing with armoured covering.

18.1.10 Governor

The speed of the engine shall be controlled by a governor in accordance with class A2 of BS 5514 of 1977 if not otherwise specified in the Technical Specification.

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 ± 5% at all loads zero and rated load.

18.1.11 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 limit laid down in BS 5514 of 1977.

18.1.12 Exhaust 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.

The exhaust pipe shall be installed in such a way that the expulsed exhaust fumes will not cause discomfort to the public/employees. The exhaust pipe must be flexibly connected to the engine to take up vibrations transmitted from the engine, which may cause breakage. 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.

18.1.13 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.

The engine shall be capable of starting from cold in winter conditions, and should be provided with a dual pre-heating system, separately wired, supplied from both normal and

backup supplies (not smaller than 2kW each), acceptable to the Engineer.

An electronic speed governor of class A1 as stipulated by BS 5514 shall be provided.

The engines shall be rated (prime capacity) to operate at 1,500 metres above sea level (Mahikeng), capable of driving the alternators to the capacity as specified.

18.1.14 Alternators

The alternators shall comply with the requirements of BS 5000, Part 3.

The alternators shall be of the self-excited brushless (Stamford/Leroy) type, capable of supplying the specified output continuously with a temperature rise not exceeding the limits laid down in BS 5000 for rotor and starter windings.

The alternator shall be capable of delivering an output of 110% of the specified output, for one hour in any period of 12 hours consecutive running

The alternators shall be self-regulated, the inherent voltage regulation not exceeding ± 2,5% of the nominal voltage at all loads with the power factor between unity and 0,8, and within the driving speed variations of 4, 5% between no load and full load.

The alternator shall be designed for rapid voltage recovery following sudden application of full load or motor starting currents. The voltage shall recover to within 2,5% of the steady state within 300 Ms following the application of full rated load, with the transient voltage dip not exceeding 18%.

The engine and alternator must be directly coupled by means of a high-quality flexible coupling, equal and similar to the “HOLSET” type.

18.1.15 Plant Ratings

The Standby Plant ratings shall apply under the following load/site conditions:

Power factor	0,8
Altitude above sea level	1500m above sea level
Maximum ambient temperature	30□C averages
Relative humidity at maximum	80% Average

18.1.16 Protection Equipment and Indicators

Provide a start attempt limit, limiting the number of start cycles to six attempts, thereby avoiding the batteries from being run down, should the engine fail to start or should the alternator fail to generate power for any reason.

Provide a speed sensing switch to isolate the starters after the engine has attained speed during the start cycle. In series with the speed sensing switch, provide an oil pressure switch, again

to isolate the starter when the engine oil reaches operational pressure during the starting of the plant.

While the plant is in its stop cycle, the oil pressure switch shall delay engaging of the starters, until the engine has come to rest and the oil pressure has dropped completely. The above switches shall prevent the starters engaging while the engine is still rotating.

Provide engine over and under speed protection with short delay before shutting down the plant.

Provide low and high (adjustable) alternator voltage protection. Other protective devices shall include:

a. Set not in "auto" mode
b. Single Common Alarm Output but shall have individual potential free contacts for
c. High engine temperature
d. Low battery voltage
e. Start sequence failure alarm
f. Over-speed
g. Under-speed
h. Low fuel level
i. Battery earth fault
j. Generator "Run"
k. Mains failure

The above devices shall operate indicator lamps, sound the alarm and shut down the plant, except as otherwise indicated.

SECTION 3 – SCHEDULES OF TECHNICAL INFORMATION

1. GENERATOR PARAMETERS

The following information shall be supplied in full and in all respects for each plant and shall be submitted together with the bid

1.1 Engine 60 KVA

NO	ITEM	REMARKS
1.	Manufacturer's Name	
2.	Manufacturer's model No. and year of manufacture	
3.	Continuous sea level rating after allowing for ancillary equipment in kW	
4.	Percentage de-rating for site conditions, in accordance with BS 551.4 a) For altitude b) For temperature c) For humidity d) Total de-rating	
5.	Net output on site in kW	
6.	Nominal speed in r.p.m.	
7.	Number of cylinders	
8.	Fuel consumption of the complete generating set on site in l/h of alternator output at : a) Full load b) ¾ load c) ½ load NOTE : A tolerance of 5% shall be allowed above the stated value of fuel consumption.	
9.	Make of fuel injection system.	
10.	Capacity of fuel tank in litres	
11.	Is gauge glass fitted to tank?	
12.	Is electric pump for filling the fuel tank included?	
13.	Method of starting	
14.	Voltage of starting system	
15.	Method of cooling	
16.	Type of radiator if water-cooled	
17.	Type of heater for warming cylinder heads	

NO	ITEM	REMARKS
18.	Capacity of heater in kW	
19.	Method of protection against high temperature	
20.	Method of protection against low oil pressure	
21.	Type of governor	
22.	Speed variation in % a. Temporary b. Permanent	
23.	Minimum time required for as assumption of full load in seconds	
24.	Recommended interval in running hours for : a. Lubricating oil change b. Oil filter element change c. Decarbonising	
25.	Type of base	
26.	Can plant be placed on solid concrete floor?	
27.	Are all accessories and ducts included?	
28.	Is engine naturally aspirated?	
29.	Are performance curves attached?	
30.	Diameter of exhaust pipe	
31.	Noise level at tail of exhaust pipe in dBA	
32.	BMEP (4 stroke) at continuous rating (kPa)	
33.	% Load acceptance to BS 5514, Part 4, with 10% transient speed drop	

1.2 Alternator (1250KVA)

NO	ITEM	REMARKS
1.	Maker's name and model no.	
2.	Country of Origin and year of manufacture	
3.	Type of enclosure	
4.	Nominal speed in r.p.m.	
5.	Number of bearings	
6.	Terminal voltage	
7.	Sea level rating kVA at 0,8 power factor	
8.	De-rating for site conditions	
9.	Input required in kW	

NO	ITEM	REMARKS
10.	Method of excitation	
11.	Efficiency at 0,8 power factor and: a) Full load b) ¾ load c) ½ load	
12.	Maximum permanent voltage variation in %	
13.	Transient voltage dip on full load	
14.	Voltage recovery on full load application in milli-seconds	
15.	Is alternator brushless?	
16.	Class of insulation of windings	
17.	Is alternator tropicalized?	
18.	Symmetrical short circuit current at terminals in Ampere	
19.	Type of Coupling	

1.3 Switchboard

NO	ITEM	REMARKS
1.	Maker's Name	
2.	Country of Origin	
3.	Is board floor mounted?	
4.	Finish of board	
5.	Make of volt, amp, and frequency meters	
6.	Dial size of meters in mm	
7.	Scale range of voltmeter	
8.	Scale range of ammeters	
9.	Ratio of current transformers	
10.	Make of hour meter	
11.	Range of cyclometer counter	
12.	Smallest unit shown on counter (Item 11)	
13.	Make/ Manufacturer of circuit breaker	
14.	Type of circuit breaker	
15.	Rating of circuit breaker in Amp and fault level in kA	
16.	Setting range of overload trips	
17.	Setting range of instantaneous trips	
18.	Make of change-over equipment	
19.	Make of voltage relay	

NO	ITEM	REMARKS
20.	Is control and protection equipment mounted on a small removable panel?	
21.	Type of control equipment	
22.	Make of mains isolator	
23.	Type of indicators for protective devices	
24.	Is battery charging	
25.	Are volt- and ammeters provided for charging circuit?	
26.	Is the alarm hooter of the continuous duty type?	
27.	Rating in Amps of : a. Change-over equipment b. Mains on load isolator c. By-pass switch d. Circuit breaker to outgoing feed	
28.	Is manufacture of switchboard/control panel to be sub-let?	
29.	If yes, state name and address of specialist manufacturer	

1.4 Battery

NO	ITEM	REMARKS
1.	Maker's Name	
2.	Country of Origin	
3.	Type of battery	
4.	Voltage of battery	
5.	Number of cells	
6.	Capacity in cold crank amp	

1.5 Dimensions 60KVA Generator set

NO	ITEM	REMARKS
1.	Overall dimensions of set in mm	
2.	Overall mass	
3.	Is the generator room adequate for the installation of the set?	

1.6 Spare Parts and Maintenance Facilities

NO	ITEM	REMARKS
1	Approximate value of spares carried in stock for this particular diesel engine and alternator	

2	Where are these spares held in stock	
3	What facilities exist for the servicing of the equipment offered	
4	Where are these facilities available	

1.7 Warranty

NO	ITEM	REMARKS
1	12 months warranty on delivery of generator set.	
2	12 months warranty after commissioning and acceptance of generator set by client.	
3	Any other warranties please state.	

1.8 Delivery

NO	ITEM	REMARKS
1	Delivery period in weeks	

DR PIXLEY KA ISAKA SEME LOCAL MUNICIPALITY

VOLKSRUST WATER TREATMENT WORKS
SCADA & HMI CONTROL SYSTEM SPECIFICATION

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C3.7.2.3 SUPERVISOR CONTROL AND DATA ACQUISITION (SCADA)

GENERAL

The new SCADA system shall be provided under this Contract and located in the Centralised Control Room (CCR) with the main Administration building. The primary function shall be to provide a graphical real-time representation of the works and to provide data capture, control and monitoring of plant unit process, alarming, data logging and trending of the PLC information within the Water

Treatment Works. Information will be gathered from the various PLC's located in various MCC and RIO stations within the plant.
The SCADA package shall interface with the "off-site" remote locations to provide monitoring and trending functionality via Radio Telemetry.
The SCADA system offered shall comprise the latest version of the reputable SCADA package in use within a Water and Waste Water Industries as preferred by Volksrust WTW . The SCADA system shall be provided with a suitable tag count license commensurate with the tag count.
A new, centralised Historian, long term reporting package and centralised Alarm Management Software shall be installed at the CCR. The reporting and alarm management shall be of the same brand as the SCADA package being offered.
Hot standby SCADA servers with provisions for a separate data storage server shall also be included. RAID Level 5 is required for the data storage server.
The SCADA system shall be provided to satisfy the requirements of the Standard Specification and the following qualifying statements. The Tenderer shall include the provision of a control system Functional Design Specification for the SCADA in his offer.

INDUSTRIAL SERVER HARDWARE

Three brand reputable industrial servers with a minimum 3 year warranty shall be supplied in 19" rack mount format complete with all peripherals. The equipment shall have the following minimum specification:

MODULE	DESCRIPTION
Type	Intel®
Processor type	4th Generation Intel® Xeon® Scalable Processors
Processor family	Gen 11 or latest equivalent
Processor number	1 or 2
Processor core available	16 to 60 core, depending on processor
Processor cache	22.5 MB to 112.5 MB L3, depending on processor
Processor speed	3.1 GHz maximum, depending on processor
Power supply type	800W, 1000W, or 1600W Dual hot-plug redundant 1+1 HPE Flexible Slot Power Supplies, depending on model
Expansion slots	Up to 8 PCIe Gen5, and 2 OCP 3.0, for detailed descriptions reference the QuickSpecs
Maximum memory	8 TB with 256 GB DDR5
Memory slots	32
Memory type	HPE DDR5 Smart Memory
Memory protection features	RAS – Advanced ECC, online spare, mirroring, combined channel (lockstep) functionality, and HPE Fast Fault Tolerant Memory (ADDDC) Intel Optane Persistent Memory
Optical drive type	Optional DVD-ROM Optional via Universal Media Bay External support only
System fan features	Hot-plug redundant fans, Standard Fan Kit or High Performance Fan Kit, depending on model
Network controller	1 Gb, 10 Gb, 10/25 Gb, 100 Gb, or 200 Gb, in PCIe adapter or OCP 3.0 form factor, for detailed descriptions reference the Quick Specs
Storage controller	HPE SR932i-p and/or HPE MR216i-o and/or HPE MR416i-o and/or HPE MR216i-p and/or HPE MR416i-p and/or HPE MR408i-o, for detailed descriptions reference the Quick Specs
DIMM capacity	16 GB to 256 GB
Infrastructure management	HPE iLO Standard with intelligent provisioning (embedded), HPE OneView Standard (requires download) (standard) HPE iLO Advanced, HPE OneView Advanced (optional, requires licenses), and HPE Green Lake COM
Warranty	3/3/3: Server Warranty includes three years of parts, three years of labor, and three years of onsite support coverage. Additional information regarding worldwide limited warranty and technical support is available at: https://h20564.www2.hpe.com/hpsc/wc/public/home. Additional HPE support and service coverage, to supplement the product warranty, is available. For more information, visit https://www.hpe.com/support.

MODULE	DESCRIPTION
Drive supported	8 or 12 LFF SAS/SATA/SSD 8, 16, or 24 SFF SAS/SATA/SSD, depending on configuration. 6 SFF rear drive optional or or 2 SFF rear-drive optional, 20 SFF NVMe optional, NVMe support via Express Bay will limit maximum drive capacity, depending on model.
Warranty & Service	3 Year Next Business Day Onsite Support and Service

SCADA ENGINEERING (IPC) WORKSTATION

One branded reputable industrial workstations with a minimum 2 year warranty shall be supplied in Minitower format complete with all peripherals. The equipment shall have the following minimum specification:

MODULE	DESCRIPTION
Type	Industrial Panel PC IP66
Make	IPC-
Model	CMSA-23-Pro-6 series
Processor	Intel® Core™ i7-6600U 2.6Ghz
Operating System	Microsoft 10 Pro Windows X64 Bit
Memory	Memory DDR4-16Gig
Keyboard and Mouse	Keyboard and Optical Mouse, USB, Black, English
Monitor	22" Multitouch HD Resolution 1980X1080Intel@HD Graphics 520
Video Card	Intel® HD Graphics-520
Select Network Adapter	Network port: 2 Network interfaces 1GB
Hard Drive	SSD 256 GB
Mouse	USB Optical Mouse MS111
	HDMI*1; USB*4 COM*1 RS232; COM*1
	RS485, SIMATIC S7 via PROFIBUS or MPI. WIFI*1
Brightness	**350 CD/m (TYP)**
Display Colour	16.7M (6-BIT-HI-FBC)
Response Time	¼ (TYP)(TR)
Hardware Support Services	3 Year NBD Onsite Service after Remote Diagnosis
Warranty & Service	3 Year Next Business Day Onsite Support and Service

INDUSTRIAL NETWORK SWITCH

A single SCADA server network switch with a minimum 2 year warranty shall be supplied. The equipment shall have the following minimum specification:

Attribute:	Specification:
Power Supply	24VDC /5.2 A (typical)
IP Rating	IP30
Mounting	19" Rack Mounting
Standards	IEEE802.3, 802.3u, 802.3x, 802.1D, 802.1W, 802.1Q, 802.1p , 802.1X, 802.3ad
Flow Control	IEEE802.3x flow control, back pressure flow control
Interface speed	24 UTP PORT 10/100/1000BaseT(X) auto negotiation speed, F/H duplex mode, and auto MDI/MDI-X connection WITH 4 SFP PORTS 10/100/1000/10000BaseT(X) auto negotiation speed
Interface connection	RJ45, Fibre Optic
No. of ports	24 10/100/1000 Cu, 4 SFP 10/100/1000/10000 PORT

SYSTEM PERFORMANCE

The CPU and memory per server and workstation shall be suitably sized such that the CPU usage never exceeds 100% for longer than 60 seconds at any time and memory usage (Page file bytes) never exceeds 90% of allocated memory at any time.
In the event that the above performance cannot be met with the proposed conceptual architecture or as per qualifying statements in this Detailed Electronic Specification, a separate Database Server for alarm management and reporting shall be offered.

SERVER AND PC SOFTWARE

The servers and workstations shall be configured with the latest version of OEM recommended, reputable multitasking, multi-user operating system as well as all relevant, up to date device drivers for peripherals, networks and printers.

The operating systems shall provide robust system and user security, system monitoring and event logging functionality as well as application monitoring and failure recovery functionality. The operating system shall be plug_and_play compliant and shall include a remote update and maintenance facility. Diagnostic and regular self-maintenance functionality shall be configured and enabled on the system.

The operating systems auxiliary applications and games shall be un-installed to prevent misuse of the Engineering WorkStation Computer.

The latest virus protection package from a reputable vendor shall be installed and shall be supplied with an annual update option unless otherwise stated.

All software shall be supplied complete with the latest service packs, valid license certificates and media discs.

SCADA SOFTWARE

The package shall be sized for the required number of Tags including 20% spare. The SCADA package shall be upgradable without having to replace the existing SCADA configurations.

The SCADA software offered shall comprise the latest version of the reputable SCADA package in use within a Water and/or Waste Water Industry as preferred by Mhlathuze Water.
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The license for the SCADA software to be provided shall include licencing of the reporting package and alarm management software.

The Contractor shall provide OEM System Integrator certificate for the SCADA package being offered.

The architecture of the SCADA package shall be robust and modular and shall make maximum use of the operating systems multitasking and system services capabilities. All status and error events shall be written to the operating systems event log.

A design and a run-time version of the SCADA package shall be provided such that the client can make changes to the SCADA mimics, face-plates and Tag database and download these to the live system without having to restart the computers (so called on-the-fly changes).

The SCADA software shall be client-server capable such that one or more SCADA server(s) can be configured with all mimics, graphics, alarms and events that can then be accessed and displayed on one or more client workstation(s) as per statements in the Project Specification.

The SCADA shall communicate with the PLCs throughout the works via a high speed, Ethernet based network. Serial communications protocols with the PLC's and other devices will not be acceptable.

The SCADA system shall support OPC (OLE for Process Control).

SCADA MODE OF OPERATION

The SCADA modes of control shall comply with the relevant clauses of the Standard Specification for SCADA.

The SCADA system shall be provided to include the full control, monitoring, dynamic-animated mimics displays, trending of all motors, valves and instrument measured values, alarming and event logging of all actions, failures, run time and down time recording together with full data logging and reporting functionality of all equipment associated with the municipal water and waste water automation infrastructure.

The configuration of the SCADA system shall provide the modes of operation as described in the Standard Specification for SCADA F251.

The configuration of the SCADA system shall provide the modes of operation described in the Standard Specification F251 however with the following refinements:

For "Automatic" read "SCADA Auto"
For "Manual" read "SCADA Manual"
For "Local" read "MCC Manual"

Note: When a piece of equipment has been selected to “Auto” this will allow control by the PLC effectively from either the SCADA commands to the PLC (i.e. SCADA Manual) or from internal logic in the PLC.

SCADA GRAPHICS

SCADA graphics shall be based on the flow of material through the Plant as opposed to mechanical arrangement of the equipment.

There shall be an overview mimic, which depicts all functions or processes on the plant in block form with hyperlinks that when selected will navigate down to individual plant area mimics.

A mimic shall furthermore depict a common segment of the process or operational area.

All mimics shall have a “title” bar at the top or bottom which displays:

- Left; the menu button
- Left of Centre, an indication of unacknowledged alarms.
- Centre; The name of the mimic, which describes the process area depicted by the mimic.
- Right; Date and Time in the format YYYY/MM/DD HH:MM:SS
- When an analogue signal is out of range the mimic shall replace the value with “transmitter fail”
- When communications to a PLC is lost all dynamic symbols representing equipment controlled by that PLC will revert to “outlines”.

Navigation between mimics shall be as follows:

- A system of progressive exposure and hot spots shall be implemented.
- On the overview mimic the menu button, once “pressed”, shall pop up a navigation mimic displaying buttons to navigate to all process mimics on the system, general alarms and events.
- On all other mimics, the menu button once “pressed” shall pop up a navigation mimic displaying buttons to navigate to all related mimics and the overview mimic.
- From the navigation pop up mimic “pressing” the desired mimic button shall display a further pop up mimic to select the mimic, related alarm window or one related trend windows.
- On the pop up navigation mimic each mimic button shall indicate a current alarm condition for that mimic.
- Where applicable clicking on a device, such as a motor, shall pop up a mimic displaying relevant data and any control functions associated with the device.
- Hot spots (or “hyperlinks”) should be available on process mimics to navigate to the upstream or downstream process mimic.

Tenderers shall allow for three re-iterations of graphical displays and mimics presented in the FDS during execution of the Contract to suite the operational personnel’s preferences as well as any process changes that may occur.

Faceplates shall be provided for all instruments, valves, motors, package plant equipment, PID control loops and Start-up/Shut-down sequences that have control signals or more than one status signal associated with them.

SCADA ALARMS

A comprehensive Alarm and Event system shall be provided by the SCADA system. Alarms and Events shall be viewable from a separate screen and the last 5 alarms or events shall be visible at the bottom of every mimic as shown in the mimic typical layout.

State changes from any Motor, Valve, Actuator, Measured Value, Controller or individual status bit shall be configurable for alarming and / or event logging.

Alarms shall be associated with process mimics. The alarm philosophy to be used shall be documented in the SCADA FDS document and shall comply with the alarm rate thresholds are specified in the ISA-18.2 and EEMUA-191 documents.

The general alarms window, accessible from the overview mimic, shall only contain alarms NOT displayed in other alarm windows.

The Alarm window shall display:

Date (YYYY/MM/DD),
Time (HH:MM:SS) 24 hour format,
Description (from the agent);
Alarm type (from the agent),
Reported Data (from the agent).

Measured value alarms shall be time and date stamped at source.

SCADA REPORTS

Standard on-demand and scheduled SCADA reports shall be provided as part of the integral function of the SCADA software. Reports should be configurable in the same manner as display mimics and should be printable on demand, event triggered or at scheduled intervals.

The standard report printing functionality shall be adequately threaded and multitasked such that it does not interfere with or hold up the regular updates of mimic dynamic elements and/ or SCADA to PLC data communications. A list of reports to be provided under this contract is provided in Appendix G

SCADA TRENDS

All measured values and control loops shall be logged and trended based on real time or historical (logged) data.

A list of proposed measured values for logging and trending is provided in Appendix G.

Data logging shall be provided on the SCADA and measured values logged on an hourly basis and shall be stored over a period of 3 years in the database. Provision shall be made for three 8-hour shifts a day. Measured Values to be Trended and Recorded (logged) are as follows:

(a) All Inlet flow readings
(b) All outlet flow readings
(c) On/Off periods of all Electromechanical equipment
(d) All data from analytical instrumentation
(e) All process data from field instrumentation

Historical Data shall be kept on file for a period of at least 3 years and disk space as well as back-up storage capacity shall be adequately sized for this purpose. Backup and archiving shall be to CD/DVD.

SCADA INSTALLATION

The SCADA servers and Engineering Workstation shall be installed in the SCADA equipment room provided for this purpose within the existing Administration building.

The SCADA Servers, Engineering Work Station and Firewall shall be installed in a floor standing standard 42U 19" rack cabinet and shall be placed adjacent to the Main PLC panel. The cabinet shall be suitably ventilated with filtered, conditioned air.

All power, peripheral and network cabling shall be neatly arranged and tied back with cable ties, where cabling has to run along floors, walls or ceilings, adequately sized PVC ducting shall be provided. All power supplied from the UPS shall be via Red Flat top earth 15A plugs and sockets.

The SCADA computers and peripherals shall also be suitable protected from electromagnetic radiation that could typically radiate from two-way radios used by the operators in the control room.

Complete wiring and network diagrams shall be provided for the SCADA installation.

All SCADA hardware shall be inspected by the in the factory before dispatch to site. A SCADA thin slice test shall be configured and inspected by the Engineer prior to full SCADA configuration. The full SCADA configuration shall be simulation tested as described in the Standard Specification F251.

SCADA INSPECTION AND METHOD OF TESTING

The SCADA shall be inspected by the Engineer and tested by the Contractor (which tests shall be witnessed by the Engineer) prior to delivery, installation and switch on at site.

The Tenderer shall allow in his tender price for all costs that shall be incurred by himself and/ or the Engineer to perform these inspections and tests.

The Contractor shall have all equipment available to do all tests. Any additional equipment required for the tests shall be obtained by the Contractor and remains the Contractor's property.

The Quality Control Plan shall detail exactly which tests will be made, and how they will be performed. After testing at the Contractor's offices, one original and one copy of the official test report shall be submitted to the Engineer.

Should the Engineer, when called upon to witness tests and inspections and find that the Contractor has not made reasonably certain that the tests will be successful, he may cancel such tests and postpone them to a future date so that the Contractor can ascertain by pre-testing that the equipment to be tested will be of acceptable standards.

Any such re-test expenses incurred by the Contractor and/or the Engineer shall be borne by the Contractor.

Any equipment or workmanship found by the Engineer to be of inferior quality during construction, erection, commissioning, or during the guarantee periods, shall be replaced promptly to an acceptable quality and standard, at the Contractor's expense.

The final acceptance tests shall be undertaken after completion of the full installation on site.

The minimum inspection of the SCADA shall include the following:

(a) Correct choice of PCs CPU, motherboard and all components.
(b) Correct and neat assembly of all components.
(c) Correct configuration of the PCs BIOS.
(d) Correct installation and configuration of the Operating System.
(e) Review of all SCADA software configuration.

The minimum testing of the SCADA shall include the following:

(a) Correct operation of all Mimics and Dynamic Elements.
(b) Correct operation of all Modes of Operation.
(c) Correct detection and annunciation of simulated Faults/ Alarms.
(d) Correct scaling, trending and logging of measured values.
(e) Correct PLC/ SCADA data communication.
(f) SCADA command and load time response measurements.
(g) PLC/ SCADA data communications response time measurement.

The method of testing shall be by using the actual SCADA connected to a PLC's that will ultimately be delivered to site, set up in a simulated environment. Simulation of the process to be controlled shall be as simple and as cost effective as possible.

C3.7.2.4 HUMAN MACHINE INTERFACE (HMI)

GENERAL

Three Industrial Panel Mount Computer(IPC), 1920x1080 21" FHD colour graphical, touch IPC to act as a Human Machine Interface (HMI) shall be provided in the following plant areas i.e.

1. Filter Gallery Remote I/O Panel to act as Filter Console control Station.
2. Chemical House Remote I/O Control Panel
3. Central Control Room (IPC) for the Main Plant Operator Workstation (LAB Room to monitor and Control the plant from the central Control Room(CCR)

All these control station communicates to the Main Plant SCADA Server which then connects to the Main Plant PLC and Remote I/O.

Ref: Plant Control System Network.

There will be no special HMI Software required since the SCADA Server shall have three Operator Client Licenses for the entire Plant.

DETAILED SPECIFICATION

The IPC(HMI) units shall comply with the following minimum specifications:

Attribute:	Specification:
Type	21" Full HD 1920x1080 Resolution, Advanced Touchscreen Panel
Backlight	CFL (50000hrs at 25deg C and 24hr operation)
Resolution (Pixels)	TFT LCD Display – 1024 x 768
Touch Panel/Screen	Minimum 1024x768 resolution
Memory	32 Mb flash EEPROM
Control Bus network	Industrial Ethernet
Programming Communication Link	RS232C/RS 422/485 COM1, RS485 Industrial Ethernet
Interface Port	SUB-DP, RJ45 respectively
Data Transfer	CF Card, USB Memory Stick
Power supply	24VDC
Real time clock	Built-in
Degree of protection	IP 65

The IPC(HMI) shall be configured with detailed graphical displays (mimics) showing all pertinent equipment contained within the connected PLC's "Island", their status (running, tripped or stopped) and instantaneous Field instrument readings.
The HMI is intended to be used for operation of equipment from the unit process control panel in all modes of operation.
A navigation screen shall be provided per HMI from where the Operator can intuitively navigate from the overview screen to detailed process screens.

Equipment status shall be indicated by different state colours such as white for ready, green for running, amber for tripped and red for e-stop or other fault states.

Trend pages shall be provided showing all measured value readings over time. Trend pages shall show live and historical data (which shall be logged to the HMI memory in a first in first out rolling log file). Trends shall be configured to show the full range of data in memory.

An Alarm page shall be provided showing all active and acknowledged alarms. Alarms shall also be stored in a first in first out file stored in the HMI memory. It shall be possible to scroll backward and forward in the alarm history list.

IPC(HMI) INSTALLATION, INSPECTION AND TESTING

The IPC(HMI) shall be installed on the Door of the PLC Panel in the field to suitable height that can be easily accessed by the Operator or on a telescopic Stand mount on the Desk equipped with versa mount accessories facing the Operator. The telescopic stand shall be adjustable to suit the Operator height and sitting arrangement of the operator's ergonomics.
n the associated unit process control panel at

The IPC(HMI} shall be will be inspected and tested as part of the SCADA Client Server Architecture in the factory together with the PLC.

Tenderers shall allow for at least three iterations of inspections and testing of the configuration before the PLC / (IPC)HMI and SCADA Server combination is released to site.

Simulation testing shall include communications with the PLC's through the SCADA Server and IPC Clients and other associated IED's, the switching of all states, testing of all alarms, setting of all parameters and correct layouts, colours and functionality of all mimics.

The Contractor shall also prove the logging and successful data export of all measured values, historical trends and related log files to usable formats.

C3.7.2.5 UNINTERRUPTABLE POWER SUPPLIES

GENERAL

A, Industrial type Uninterruptable Power Supply shall be provided at each of the Two New MCCs i.e. Main Plant and Chemical House MCC Panels) and new UPS unit for the SCADA Control room. The IPC HMI shall be 24VDC for get powered from the same Power Supply for the PLC and Remote I/O Panels.

The UPS shall provide power to the PLC components, network equipment, IPC(HMI), and to analytical field instrumentation. Power shall be provided to the UPS from the respective Plant LV MCC board.

The SCADA Control room UPS shall be provided at the SCADA control room to provide backup power to all electronic systems including the SCADA servers, engineering work station and network switch.

The complete UPS systems shall be tested in the factory and on site. The Contractor shall ensure that, following a power failure, the PLC and SCADA components shutdown and restart automatically without losing any information or requiring operator intervention should the UPS standby period expire for any reason.

All Pneumatic and Electric valve actuators which require to 'close' during fail-safe conditions shall be fitted with an internal battery pack, suitably sized to close the valve in a controlled manner following a power failure.

DETAILED UPS SPECIFICATION

The PLC compartment UPS shall comply with SANS 62040-3 as varied by this Detailed Specification for high availability, high stability under varying supply and loads. The following minimum specifications shall be met:

Attribute:	Specification:
Type of configuration	UPS with bypass and isolation transformer
Bypass to	Primary power
Standby power generator	Yes
Nominal input voltage	230V ± 15%
No. of phases	Single
Nominal input frequency	50 Hz ± 5%
Harmonics compatibility levels	Normal service conditions in SANS 62040-3
Load type	PLC, HMI, Fibre Switches , and Instrumentation
Rated output power	To suit load plus 30% (minimum 1 kVA)
No of output phases	Single
Output voltage	230V ac ± 0.5%
Nominal output frequency	50 Hz
Rated stored energy time	Standard in 10-300 minutes range
Interfaces required	Ethernet
	LCD status display / alarm panel
Battery life	Minimum 10 years
Battery type	Sealed, maintenance free, lead acid contained in UPS
Corrosion protection	As required for site conditions
System fault level	As per single line diagram
UPS type	19" rack mount in PLC compartment or Floor standalone installation adjacent to the control panel in SCADA room

UPS INSTALLATION, INSPECTION AND TESTING

Adequate provision shall be made for ventilation of the UPS systems when installed within the MCC panel.

The UPS system shall be tested off site AND on site and the Contractor shall ensure that the associated SCADA components, PLC's and HMI's shutdown and restart automatically without losing any information or requiring operator intervention should the UPS standby period expire.

C3.7.2.5 CONTROL SYSTEM NETWORK

GENERAL

The Plant consists of four network point that is connected in a ring or start topology. i.e.

1. Main Plant PLC is hosted in the Central Plant LAN Cabinet at the Central Control Room.

2. Main SCADA and Client IPC computer equipment hosted in the Central Control Room.
3. Main Plant MCC Remote I/O Panel starting and stopping all the Pump House equipment Switchgear
4. Filtration Remote I/O controlling all the Filtration Valves during the Filtration and the Backwash mode.
5. Chemical House Remote I/O starting and stopping all the Equipment and signal around the chemical house.

Detailed Specification

The plant control system network is a Industrial Ring network connecting all the PLC Remote I/O, SCADA Server, Field Client IPC and the control Room PLC together on fibre network

The fibre installation route starts from the Server Equipment Cabinet in the Central Control Room, to Main Plant MCC Panel Remote I/O, Filter 1-7 Remote I/O, Filter Gallery IPC Panel, Chemical House Remote I/O and back to the Server Equipment Cabinet in the Central Control Room.

All the field instrumentation is connected from the field Junction Boxes to the Local Remote I/O panel. The Main and Chemical House MCC Panel is hardwired to the local Remote I/O Panel to control all the field equipment.

Installation and testing
The Contractor shall have shall install 24VDC Power Supply for the PLC and the field instrumentation to all PLC and Remote I/O Panels.

All PLC and Field 24VDC Power supply shall be connected to UPS to keep the PLC, Remote I/O and all Field instrumentation ON during power failure for a minimum power backup time of 8 hours.

The Contractor shall demonstrate the viability of his design by means of data transfer cycle time calculation. In addition the Engineer shall witness the network simulation before final commissioning of network on site.

Any additional equipment required for the tests shall be obtained by the Contractor and remains the Contractor's property. Contractor can ascertain by pre-testing that the equipment to be tested will be of acceptable standards.

C3.7.2.6 FIBRE OPTIC

GENERAL

The fibre optic cables shall comply with SABS IEC 60794.The cables shall be of the SINGLE MODE type, suitable for direct burial in the ground.

The plant wide fibre optic network cables shall comply with the following minimum specification

Attribute:	Specification:
Compliance	ITU-T G651.1, SANS 10340-1 and 2, SANS 60794 Part 1 and 2
Cable type	8 Core – Single Mode, SWA, suitable for installation within sleeves in trenches and direct burial in ground.
Core/Cladding diameter	50/125 microns

Category	A2
Wavelength	805 nm
Attenuation	3db/km maximum
Bandwidth	400 – 600 MHz/km
Test procedures	As per SANS 60794, Part 1-2
Crush resistance (with 100mm plates)	5000N
Impact resistance (25mm anvil/10 blows)	4 Nm Blows
Water penetration	No leakage (IEC 60794-1-5B)
Drip test	No leakage ((IEC 60794-1-14)

The fibre optic cables shall be constructed to the following specification:

- Tubes shall not be filled with water blocking compound
- The cable core shall be filled with water blocking compound
- The cable shall be designed with sufficient strength members to meet installation and service conditions so that the fibres are not subjected to strain of more than the limits specified by the manufacturer
- A moisture barrier shall be provided by a metallic tape applied over the cable core with a longitudinal overlap and bonded to the sheath
- The inner sheath shall be made of polyethylene
- The cable shall be armored with galvanised steel wire or corrugated tape.
- the outer sheath shall be a seamless sheath made of UV-stabilised weather-resistant polyethylene in accordance with Clause 22 of SABS IEC 60708-1
- the outer sheath shall be marked with the manufacturer's name and "Optical Fibre Cable" as a single line of marking at intervals not exceeding 1 00 mm
- Optical elements and each fibre within a cable element shall be uniquely identified by colours.

Fibre optic Cables shall be subjected to the following tests in accordance with SABS IEC 60794-1-2:

- Tensile performance
- Cable bend
- Crush
- Temperature cycling
- Water penetration

In addition, compatibility with the particular installation conditions shall be demonstrated through the following tests:

- impact
- kink
- torsion
- sheath abrasion resistance

INSTALLATION TERMINATIONS AND TESTS

The fibre optic cables shall be installed in accordance with SABS IEC 60794-1-1.

- Where trenches are excavated specifically for the optical fibre cable, these shall be to a depth of 600 mm below final ground level
- Where 600 mm deep trenches link up with 1000 mm deep trenches, the trench floor shall slope gently to take up the step in depth
- Where Fibre Optic cable is to be recovered and re-installed, the contractor shall ensure that no additional joints are made, unless unavoidable

All Sleeved road crossings shall be constructed under this Contract. PVC warning tape shall be laid 300 mm above the cable.

The contractor shall be responsible for the termination of the fibre optic Cable in each device location.

Pigtails with ST connectors shall be spliced onto the individual fibre of the cable and connected to patch panels housed in the fibre optic distribution box. All termination sundries required shall be provided by the contractor.

Test certificates shall be provided after the terminations have been done. The normal losses shall not be more than 0.5 dB and return losses not more than 20dB.

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DCS, PLC AND TELEMETRY SYSTEM SPECIFICATION

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1. OVERVIEW

This specification covers the minimum technical requirements for the design, supply, manufacture, installation, documenting and testing of programmable control (PLC) systems. The PLC system will be in compliance with IEC requirements. This specification is not intended to specify the complete details of design and construction which are the responsibility of the contractor. All components and subsystems required for a complete and fully operable system shall be included whether or not specifically called for. For a specific PLC system, this specification shall be used in conjunction with the project technical requirements. Any exceptions to the requirements of this specification shall be submitted in writing to UW.

This PLC specification requires that a flexible open approach to the system design be applied. Apart from any other rights the Project Engineer may have in terms of the contract, he shall have the right to set the standard and to accept or reject part of the supplied equipment depending on the quality of workmanship and materials offered.

2. PLC HARDWARE CHARACTERISTICS

2.1 PLC CENTRAL PROCESSING UNIT.

The PLC shall act as an interface between the process components (e.g. Motors, Valves, Measuring instruments, etc.) and the Scada system and as such shall perform the following main tasks and have the following features:

2.1.1 Process signal acquisition, Process signal output, and Process automation task,

Transfer of collected data to the monitoring and supervisory system.

2.1.2 The Process signal acquisition and output shall be by means of suitable signal

formation modules for both digital and analogue values.

2.1.3 The process signal acquisition function shall include the measurement of operational variables such as level, flows, temperatures, pressures etc. as analogue values (4¬20mA proportional signals). Primary signals such as contact, limits, disturbances and plant statuses (usually potential-free contacts) and counter values such as counter contents, impulse count, time integrals of operational process variables (e.g. totalized flow over time period).

2.1.4 The process signal output function shall include the setting of analogue control values and limit selection and issuing of binary 'commands such as the actual starting and stopping of drives.

2.1.5 The process automation tasks shall include the required closed loop control (e.g. speed control of variable speed drives, flow control by means of valve throttling, etc.), plant interlocking and any required sequence control (e.g. first start lubrication pump before main pump and if lubricant pump fails stop main pump, etc.) .

2.1.6 The PLC shall facilitate the transfer of collected data to the central monitoring and supervisory system. If the data is to be transferred on a cyclic basis, the maximum cycle time shall be a second, else if the data is transferred uncyclically, every data change shall be transmitted. The **PLC** should be able to accommodate both modes of data transmission to the Scada and should be configurable for each data point.

2.1.7 All data shall be time stamped locally at the PLC.

2.1.8 The CPU within the system shall perform internal diagnostic checking and give visual indication to the user by illuminating indicators when no fault is detected and a different indicator when a fault is detected.

2.1.9 The CPU shall be a modular type.

2.1.10 The CPU shall contain adequate program memory for the application as well as spare capacity capable future expansion of at least 30% of the installed capacity. The CPU shall contain a real time calendar/clock(Y2K compliant) that can be accessed by the user program.

2.1.11 The Volatile Memory (RAM) of the PLC shall not require an external battery to support ,it during a power failure, but shall be supplied with an internal battery providing back-up for minimum of 4 months.

2.1.12 All channels shall be updated on every PLC scan.

2.2 INPUT AND OUTPUT MODULES

6. 2.2.1 Digital input specification

2.2.1.1 All Voltage signals to the module shall be obtained from the DC Power Source on the PLC Power Supply.

2.2.1.2 Each limit switch, pushbutton, or other input devices shall be connected to only one individual input point.

2.2.1.3 All digital input modules shall be 24VDC.

2.2.1.4 Discrete output modules shall be of the type capable of switching 2 Amps per output.

2.2.1.5 Each output device shall be connected to only one individual output point.

7. 2.2.2 Analog input specification

2.2.2.1 All analog input modules shall be 4-20 mA and 0-10V configurable type unless indicated to the contrary.

2.2.2.2 The analog input modules shall be capable of converting inputs in the range 4-20 mA.

2.2.2.3 All analog output modules shall be 4-20 mA and must be configurable to accept 010V type unless indicated to the contrary.

2.2.2.4 Resolution of the converted input analog output signal shall not be less than 16 bits.

2.2.2.5 All input channels shall be updated on every PLC scan.

8. 2.2.3 Analog output specification

2.2.3.1 All analog output modules shall be 4-20 mA and 0-10V configurable type unless indicated to the contrary.

2.2.3.2 The analog output modules shall be configured to default to a specified mode in the event of the CPU failure.

2.2.3.4 Resolution of the converted input and output analog output signal shall not be less than 16 bits.

2.2.3.5 All output channels shall be updated on every PLC scan.

9. 2.2.4 **Input / Output (I/O) general requirements**

2.2.4.1 A PLC system Vendor shall be capable of providing a full range of compatible programmable controller hardware from a minimum of 32 I/O up. Programming and I/O modules shall be compatible across the Vendor's entire line.

2.2.4.2 I/O termination assemblies, I/O modules, and I/O communication cables shall be monitored and cause a CPU fault if a malfunction occurs. The CPU fault shall alarm and stop execution of a user program and place all outputs in the failure mode.

2.2.4.2 I/O modules shall come equipped with integral light emitting diode (LED) indicators to indicate whether a signal is off or on.

2.2.4.3 The PLC inputs and outputs shall be completely wired to field connection terminal strips.

2.2.4.4 Each input or output module shall be self-contained unit housed within an I/O rack assembly.

2.2.4.5 The Input/Output enclosure (rack) with its respective modules shall be of the universal type and compatible with any programmable controller manufactured by the supplier.

2.2.4.6 During normal operation, a malfunction in any remote Input/Output channel shall affect the operation of only that channel and not the operation of the CPU or any other channel.

2.2.4.7 Any remote Input/Output channel shall be field selectable to shut down the CPU upon failure of that channel.

2.2.4.8 Upon remote channel shutdown, the CPU shall see all inputs on the malfunctioning channel as the inputs were when the shutdown occurred and all outputs shall deenergize on the channel.

2.2.4.9 It shall be possible to replace any input or output module without disturbing field wiring or shutting down the processor or other I/O modules in the rack. Outputs shall be selected so that the output fails safe on loss of power.

2.2.4.10 A minimum of 25 percent spare I/O modules shall be provided for each type of I/O (discrete, analog, single-ended, differential, etc.), or at least one of each module type, whichever is greater.

2.2.4.11 Inputs and outputs shall conform to the following ranges :

Discrete : 24 VDC or 220 VAC

Analog : 4-20mA and 0-10VDC

Dry Contacts : 5 amps @ 24 VDC and 2,5 amps @ 220 VAC

2.3 I/O POWER SUPPLY MODULE.

2.3.1 The power supply shall be suitable for connection to the mains supply yoltage as per VOLKSRUST WTP 's Standard Electrical and Instrumentation Specification.

2.3.2 The power supply shall contain isolated, internal power sources suitable for I/O modules requiring external power.

2.3.3 The power supply shall be compatible with the main CPU Racks as well as the expansion racks.

2.3.4 The power supply shall contain integral thermal overload and short circuit protection. Once activated, this condition shall only be manually resetable.

2.3.5 The Power supply to each PLC and I/O module shall be protected against lightning and power surges.

2.3.6 A single main power supply shall have the capability of supplying power to the CPU and local input/output modules and auxiliary power supplies shall provide power to remotely located racks.

2.3.7 At the time of power-up the power supply shall inhibit operation of the processor and I/O modules until the DC voltages are within specifications.

2.3.8 The power supply shall be fitted with an integral fuse protection.

2.3.9 At the time of power-up, the power supply shall inhibit the processor and I/O modules until the DC voltages are within specifications.

2.3.10 A visual indication shall be provided to indicate the operating status of the memory back up battery.

2.3.11 An indication that normal power has been restored after a power failure shall be provided by either software or hardware.

2.3.12 Program reloading shall not be required when normal power is restored.

2.3.13 The switching to the backup power source shall be annunciated in the control room.

2.3.14 The user program shall be capable of overriding the automatic restart feature.

3 SYSTEM FUNCTIONAL AND OPERATIONAL DESIGN REQUIREMENTS

3.1 All system modules, main and expansion chassis shall be designed to provide for free air flow convection cooling. No internal fans or other means of cooling except heat sinks shall be permitted.

3.2 All hardware shall be purposefully designed for industrial use. Standard office or home type equipment shall not be acceptable.

3.3 All modules within the system shall be mechanically interlocked to prevent insertion or removal of modules under power which in turn helps to prevent damage to the modules and/or system e.g. 24V modules should not fit the 220V slots.

3.4 The supplier shall wire all Programmable Logic Controller inputs and outputs to the customer-specified terminal blocks.

3.5 In a single chassis system all system and signal power to the CPU, support modules shall be distributed on a single motherboard or backplane .No interconnecting wiring between these modules via plug terminated jumpers shall be acceptable .

3.6 The Programmable Logic Controller shall provide a means for mounting the chassis in a standard cabinet or 19 inch rack.

3.7 Within the enclosure all I/O racks, processor racks, and power supplies shall be grounded to meet the manufacturer's specifications.

3.8 Output Relays associated with digital signals shall be considered part of I/O function and therefore all output modules should have relay contacts.

3.9 Terminal blocks shall be removable, and common to all discrete and analog I/O to allow to allow for convenience pre-wiring of field devices.

3.10 All external field devices shall be terminated to a common terminal strip within the PLC enclosure.

3.11 The system provided shall be fully workable and operational system complete with racks, power supplies, processors, I/O modules, communication interfaces and all necessary cables, etc.

3.12 Output relays associated with digital signals shall be considered part of the I/O function and therefore all output modules shall have relay contacts.

3.13 Terminals shall be clearly identified by terminal block number and wire numbers.

3.14 The terminals for all incoming and outgoing 4-20 mA signals shall comply with the surge protection units. This will be specified by the Project Engineer during the start of installation

3.15 Each input and output loop will be fitted with loop isolators. This will be specified by the Project Engineer during the start of installation.

3.16 The terminal strips shall have at least 30% spare space after all incoming and outgoing cables (including spare cores) have been terminated.

3.17 All field connection to the computer equipment shall be adequately protected against the effects of EMI (Electromagnetic Interference)/RF/(Radio frequency interference) and power surges with loop isolators and surge arrestors.

3.18 The Contractor will be responsible for ensuring electromagnetic compatibility of the control system components with one another and with the overall electrical and mechanical installation in the whole plant. This includes ensuring proper and adequate earthing and any other necessary measures to prevent malfunctioning.

3.19 Each processor or I/O module shall not occupy more than one slot.

3.20 The system shall make use of prefix wiring. Wiring directly to I/O modules shall not be allowed to ensure easy removal and inserting of modules without disturbing the Wiring.

3.21 The design shall be such that the minimum number-of function cards is used to support binary input/output and analogue input/output e.g. 4x16 digital input cards should be replaced by 1x64 digital input cards.

3.22 All function cards shall be interchangeable without the necessity to set the jumpers, dip switches or reconfiguring the affected PLC address configuration in all slots.

3.23 Modules are defined herein as devices which plug into a chassis and are keyed to allow installation in only one direction. The design must prohibit upside down insertion of the modules as well as safeguard against the insertion of a module in the wrong slot.

3.24 The Programmable Logic Controller shall have downward compatibility whereby all new module designs can be interchanged with all installed modules in an effort to reduce obsolescence.

3.25 Once the address of an I/O module has been allocated no address displacements shall occur within that particular PLC installation if I/O modules are interchanged or when gaps are left between modules e.g. the CPU must be able to identify any module regardless of its position.

3.26 The I/O modules shall be installed in any available slot and shall not require any special tools for removal or replacement.

3.27 The I/O modules shall have removable termination faceplate.

3.28 The labels, symbols, comments and annotations must be resident in the CPU memory.

4 PERFORMANCE

4.1 The PLC shall be capable of handling the following discrete Input/Output (I/O) levels, as per the existing infrastructure :

- 5 VDC
- 12 VDC
- 24 VDC
- 220 VAC

4.2 The PLC shall be capable of handling the following analog input and output ranges, as per the existing infrastructure:

- -10 to 10 VDC
- 0 to 10 VDC
- 1 to 5 VDC
- 4 to 20 mA DC

4.3 The PLC shall be capable of receiving or transmitting 4-digit, binary coded decimal (BCD) numbers and 16-Bit binary numbers.

4.4 Resolution of the converted analog input signal shall not be less than 16 bits.

5 RADIO FREQUENCY INTERFERENCE

5.1 PLC equipment shall not be affected by radio frequency interference from standard, commercial ultra high frequency (UHF) and very high frequency (VHF) hand-held, personal transceivers of 5 watts nominal output power, which will be operated within two feet of the logic controller system including remote I/O units. The RF emissions of the PLC equipment shall not exceed those allowed by current (1990) FCC rules.

6 POWER SUPPLY

6.1 The PLC shall be capable of operating on the following power supply(ies) as required by the project specifications or data sheets :

- 220 VAC (plus or minus 15 percent), 50 Hertz
- 24 DC V (plus or minus 10 percent)

7 RELIABILITY

7.1 Failure of one critical system component shall be equivalent to total system failure. A critical component is defined as a component that is required for the system to operate.

7.2 PLC equipment associated with an emergency shutdown (ESD) subsystem shall have a reliability greater than 0.99%. These figures shall take into account all components individual MTBF's (e.g. I/O cards, power supplies, etc).

7.3 PLC equipment associates with process monitoring and control shall have a minimum reliability of 0.95.

7.4 If required in project data sheets of specifications, the PLC system shall be configured in a hot-standby setup where two processors run simultaneously. The setup must allow on-line program changes and total failure, removal, and reinstallation of either of the processors with no disturbance to the process.

7.5 Reliability calculations shall be provided for the entire PLC system (processor, power supply, I/Os etc.). Use ISA document S84.01 as a basis for calculation methodology.

8 PLC INTERFACING AND PERIPHERALS

8.1 Flexible open system design is a fundamental requirement under this specification.

8.2 Both the hardware and the software shall incorporate open system architectures, providing a system that fulfills both current and future requirements.

8.3 The system provided shall be capable of interfacing with existing architectures and performing as a stand-alone system or integrated part in the distributed control system.

8.4 The PLC shall be capable of communicating with other equipment via communication network as specified by the suppliers.

8.5 The programming means shall be an IBM or compatible, laptop or desktop industrial quality programming terminal.

8.6 The Programmable Controller system shall be able to interface with human machine interfaces via an industrial standard serial communication protocol.

8.7 The system shall have the capability to interface to electronic media for loading a user program into, or recording the contents of, the processor's memory. It shall be possible to load or record the entire contents or selected portions of memory.

8.8 It shall be possible to communicate with remote I/O racks or other PLCs via fibre optic cable by inserting fibre optic modems into the twin-axial links. The fibre links must support distances between modems of up to 6500 cable feet. Redundant fibre optic cabling shall be an option.

8.9 The Programmable Controller shall have the ability to support multiple communication links without requiring additional hardware.

9 MAINTAINABIITY

9.1 PLC equipment shall be highly modular in design so that the equipment can be repaired by unplugging a faulty module or board and plugging in a replacement without disassembling the equipment or disconnecting wiring terminations.

9.2 Any module shall be replaceable by trained service personnel in less than one hour.

9.3 Components shall be arranged to facilitate identification for testing and maintenance.

10 AVAILABILITY OF SPARE PARTS, MODULES AND COMPONENTS

10.1 The supplier is expected to give a proposal as to how they assure availability of spares at an optimum cost to VOLKSRUST WTP . This should also indicate the availability of technical support and the cost of such support. Please indicate clearly where these services will be available (i.e. where are the spares kept) and which technical expertise is available and where.

10.2 The supplier shall product application assistance by trained experienced engineer to assist the customer with program and system development through telephonic consultation and on site check-outs or callout for assistance.

10.3 The supplier shall provide customer training program designed to teach the customer's personnel in the understanding and application of the programmable controller. The training shall include training manuals and "hands-on" programming experience on a Programmable Controller of a type similar to that provided by the supplier.

10.4 The supplier shall have the capability to conduct on provided by the customer. -site training programs at a location

10.5 The supplier must provide troubleshooting software.

10.6 Spare parts, system expansion components or modules, and support service shall be available for a minimum of 10 years after system acceptance.

10.7 Spare parts, components, and modules shall be available at the Vendor's plant within 4 hours of requesting an item during the warranty period .

11 ENVIRONMENTAL CONDITIONS

11.1 The PLC shall perform reliably and shall be suitable for the environment in which they will be installed. It is the contractors responsibility to identify all potential hazards that could affect the functionality of the equipment.

11.2 The PLC shall be designed for installation in a controlled environment and capable of operating in the following environmental conditions without decrease in accuracy :

- Operating ambient temperature range of 0ºC - 60ºC with an ambient temperature rating of storage range 40ºC - 85ºC
- Relative humidity range of 5 to 95 percent with no condensation.

11.3 The Programmable Logic Controller system shall be designed and tested to operate in the high electrical noise environment of an industrial plant.

12 EQUIPMENT CONSTRUCTION REQUIREMENTS

12.1 All circuitry design shall be based on worst-case design criteria. PLC Components shall be derated for the applicable ambient temperature, current, and voltage extremes, including heat-buildup in non ventilated enclosures.

12.2 As a minimum, each PLC system shall consist of one central processing unit (CPU) and I/O termination assemblies sufficient to accommodate the process system requirements.

12.3 Each power supply and major module shall be protected by a suitable fuse or circuit breaker and voltage limit to prevent damage to internal or external equipment or wiring from short circuits, voltage surges, or other unexpected operating conditions.

12.4 Equipment shall be designed to be self-protecting against status and/or alarm contact bounce and induced noise and voltage transients.

12.5 PLC equipment shall be suitable for surface mounting on a cabinet mounting plane.

12.6 Equipment design shall provide adequate heat-sinks and ventilation.

12.7 The CPU and each I/O termination assembly shall be individually fused.

12.8 Within the enclosure all I/O racks, processor racks, and power supplies shall be grounded to meet manufacturer's specifications.

12.9 All push buttons, switches, and other operator devices shall be sufficiently large and durable to provide dependable long life operation.

12.10 Modules are defined in this specification as devices that plug into the electronic chassis and are keyed such that they can be installed in only one direction, thus preventing the insertion of module into the wrong slot.

12.11 All programming and network port shall have a rugged design and be sealed and constructed so that no dust or other foreign matter from a harsh operating environment can reach critical parts.

13 EQUIPMENT VENTILATION

13.1 It is the contractor’s responsibility to install ventilation systems to ensure compliance with the PLC system operating requirements.

14 TERMINATION ASSEMBLIES

14.1 The I/O termination assemblies shall be modular with individual, replaceable plugin modules for each particular I/O requirement.

14.1 I/O termination assembly loading shall not exceed 75 percent.

14.2 The I/O modules shall come equipped with blown fuse indicators. The fuses shall be replaceable from the front of the panel without removing the protected device from the panel.

14.3 I/O terminations shall be provided for all I/Os, including spares.

15 I/O COMPATIBILITY

15.1 The PLC shall be capable of handling either analog inputs and outputs or discrete digital inputs and outputs. Analog inputs shall be able to accept both single-ended and differential signals.

15.2 I/O modules shall be optically/galvanically isolated from the process signal input.

15.3 If required, such as when contacts are provided for annunciator points, discrete inputs shall be totally isolated from discrete outputs.

16 PROTECTION

16.1 All signal loops must be protected by loop isolators. The make and model to be approved by the Project Engineer.

17 PROGRAMMING DEVICE AND THIRD PARTY INTERFACE COMMUNICATION INTERFACES

10.

11. 17. Programming Device and Third Party Interface communication interfaces

17.1 The PLC programming device shall be of industry standard specification, Windowsbased laptop computer or UW-approved equivalent. All cabling required shall be supplied.

17.2 Programming software shall be the suppliers standard offering to run on the computer. Any other software required to run the programming system is the responsibility of the Contractor, but shall include as a minimum requirement the Windows Operating System software and utilities for file manipulation and backup.

17.3 The PLC shall be capable of communicating with a host computer using vendor's standard equipment or, as an option, using RS-422, RS-232, or modem communications link.

17.4 The PLC shall be capable of a communications speed up to 56,000 baud.

17.5 The PLC system shall allow the SCADA computer to monitor and alter all discrete and data registers of the PLC.

17.6 The PLC programming device shall be capable of loading and recording the user PLC program.

18 EXTERNAL POWER SUPPLIES

18.1 The power supplies shall automatically shut down the programmable controller system whenever over-voltage under-voltage, and / or over-current conditions are detected at the output.

18.2 The power supplies shall monitor the incoming AC line voltage for proper levels. When the power supplies are wired to utilise 220 VAC power, the system shall function properly as long as the voltage remains within the manufacturer's specifications.

18.3 In cases where the AC line is especially unstable or subject to unusual variations, it shall be fitted with a UPS.

18.4 The power supply shall provide terminals for customer use, and external functions such as an alarm to signify a power supply shutdown.

18.5 At the time of power-up, the power supply shall inhibit the processor and I/O modules until the DC voltages are within specifications.

18.6 A visual indication shall be provided to indicate the operating status of the battery.

18.7 An indication that normal power has been restored after a power failure shall be provided by either software or hardware.

18.8 Program reloading shall not be required when normal power is restored.

18.9 The switching to the backup power source shall be annunciated in the control room.

18.10 The user program shall be capable of overriding the automatic restart feature.

18.11 An Uninterruptible power supply unit will provide power in the event of the mains failure

19 DATA MANIPULATION

19.1 The PLC shall be capable of manipulating numeric data. The Vendor's low-end PLC system shall do math on a minimum 16-bit basis. The process PLCs shall do floating-point math.

19.2 The following data handling, timing and other capabilities shall be provided as a minimum :

- Addition
- Subtraction
- Multiplication
- Division
- Comparison Functions (>,<,=)
- Totalizing
- Square Root Calculations
- Timing Functions
- Logical Comparisons
- On-line Data Up- and Down-loads from Remote Terminal Units
- Self-diagnostics Generation
- Data reads and writes to and from supervisory computer

19.3 The PLC shall provide three term, proportional, integral and derivative control where required.

19.4 PLC shall have the capability of an automatic loop tuning feature. The following minimum tuning and setting capabilities shall be available:

- Anti windup protection.
- Direct or Reverse acting
- Output value to control 0 to 100%
- Set point
- Proportional gain
- Integral gain
- Derivative gain
- Variable sampling time
- Alarm features (e.g. dead band, rate of change, etc).

19.5 The PLC shall be capable of performing analog control algorithms. Proportional (P) proportional-integral (PI), and proportional-integral-derivative (PID) modes of control shall be available. The allowable settings for the control modes shall be as follows :

- Proportional : 0.1 to 1000 percent
- Integral : 0.0 to 100 repeats per minute
- Derivative : 0.0 to 100 minutes

19.6 Analog inputs shall be scanned at least every four (4) seconds. Each PLC with analog I/O ports shall be furnished with spare I/O ports equal to at least 30% of the total analog I/O count.

19.7 The PLC shall be capable of accepting program changes while in the process of executing a program (on-line).

19.8 Software shall be provided to display and alter the status of all inputs, outputs, internal relays, and data registers on the Windows-based PC as described above. (Software and hardware shall be provided to alert operating personnel if an input or output has been programmed to stay off or on).

19.9 Software or hardware shall be provided to inhibit all outputs to allow for system testing.

19.10 A PLC shall have the capability to alter such program details as changing a contact from normally open to normally closed, adding extra contacts, and changing addresses without deleting and reprogramming the entire rung or ladder.

19.11 A single programming command or instruction shall suffice to delete an individual ladder diagram rung from memory. It shall not be necessary to delete the rung contact by contact.

19.12 It shall be possible to insert relay ladder diagram rungs or program changes anywhere in the program, even between existing rungs, insofar as there is sufficient memory to accommodate these additions.

19.13 On the relay ladder rung display it shall be possible to show the on-line running open/closed status of inputs and energise / de-energise status of outputs.

19.14 If contacts or entire rungs are intentionally deleted from an existing program, the remaining program shall be automatically repositioned to fill this void. Whenever contacts or entire rungs are intentionally inserted into an existing program, the original program shall automatically be repositioned to accommodate the enlarged program.

19.15 PLC memory size shall be selected, such that there is a minimum of 25% spare programming memory and data register space left after all programming has been completed.

20 FAILURE MODE

If any PLC module malfunction occurs, the system design shall programmable to halt the relevant module in a fail to safe condition. Details of fault to be indicated as per fault diagnostics signal requirements.

21 FAULT DIAGNOSTICS

21.1 The following status signal must be available and indicated by an individual LED indicators on the CPU: • Status of low or dead battery

- Status on Processor RUN
- Status of Processor STOP
- Status of Processor FAULT
- Status of communication
- Status of a Forced on the system
- Status of I/O fault(e.g. analogue loop break)

21.2 Internal register status bits shall be provided to indicate the following information :

- Power on
- CPU Run
- CPU failure
- RAM battery backup available
- Battery status
- Operating on backup power
- Output card status
- Input card status
- Network status
- I/O Drop failure
- Network status
- HMI status
- Multi vendor interface status
- Communication Status(SCADA and other third part devices)

This information must be available on the SCADA system on a common diagnostic screen. The CPU shall be capable of recording a fault causing I/O error and display the location of the fault to the operator and generating an alarm of the message. The CPU shall be able to record any internal CPU error or communication error.

22 PROGRAM/CODE STRUCTURE AND TECHNIQUES

22.1 The supplier must produce and submit a comprehensive for the PLC programming structure that must be approved by the Project Engineer.

22.2 The programming standard shall be I EC 61131-3 compliant incorporating the Ladder Logic when required and if suits the program, Sequential Function Charts ,or Function Blocks ,and Structured Text.

22.3 The code will be annotated and labeled using the tag naming convention. All functional blocks will be labeled with detailed descriptions of the process control stage.

22.4 The program should be structured in a logic manner to have ease of troubleshooting and the programmer must have a written format of how the program is structured e.g. Communication addresses at the top of the program, followed by all block moves, then program inputs, decision making, and last program output.

22.5 Programming shall be done through a user friendly software package running on the latest Microsoft Windows platform that is compatible with UW's systems.

22.6 The Programming package shall provide the capability of reading, writing and verifying the configuration and program as well as facility to backup with an external storage device e.g., compact diskette, flash disk.

22.7 The software shall be capable of generating printout of the application program for documentation purposes.

22.7 The Contractor shall write, adjust, tune, debug and commission all software and hardware to ensure a proper and fully functional installation.

23 MEMORY

23.1 The program storage medium shall be of a static RAM type.

23.2 Non-volatile memory shall store the operating system information to protect against loss in the case of power loss or system shutdown. Only at the time of a hardware change shall the original configuration status be altered or re-entered.

23.3 Memory shall contain battery back-up capable of retaining all stored program data through a continuous outage for 4 months under worst case conditions. The capability shall exist to remove all batteries from the system without removing system power. A low battery condition must be detected in ladder logic, but shall not automatically generate a major fault.

23.4 A clock/calendar feature shall be included within the CPU. Access to the time and date shall be from the programming terminal, user program, or message generation.

23.5 The Programmable Logic Controller shall have support for integer and floating points, signed math functions consisting of addition, subtraction multiplication, division, square root, and trigonometric functions.

23.6 The program standard shall display all instructions on a screen with appropriate mnemonics to define all data entered by the programmer. The system shall be capable of providing a "HELP" instruction which when called by the programmer will display a list of instructions and all data and keystrokes required to enter an instruction into the system memory.

23.7 The system shall have the capability to enter rung comments above ladder logic rungs and these comments may be entered at the same time the ladder logic is entered.

23.8 The system shall have the capability to enter address comments and symbols. These entries may be entered at the same time the ladder logic is entered.

23.9 The capability shall exist for adding, removing, or modifying ladder logic rungs during program execution. When changes to ladder logic are made or new logic rungs are added it shall be possible to test the edits of such rungs before removal of the prior logic rung is executed.

23.10 It shall be possible to manually set (force) either on or off all hardwired input or output points from the programming terminal with the forced I/O displayed clearly on the programming terminal.

24 COMMUNICATIONS

24.1 A communication interface device shall be Supplied with the PLC to allow the PLC to communicate data with other PLC devices as weII as SCADA computer equipment on a central Ethernet Network as specified.

24.2 The PLC shall-control all plant Operations local to its environment and shall operate independently of the other connected equipment.

24.3 Transmission shall be of a digital format with a speed not less that 9600 baud.

25 PLC NETWORK AND BUSINESS NETWORK

25.1 The PLC network must be of a star topology using the Ethernet communication protocol.

25.2 The supplier is to design the PLC network architecture that will operate independently from the local area network (business network).

25.3 Each PLC will be configured using IP addresses allocated to by the Engineer.

25.4 An interface between the PLC & SCADA Systems shall be to the equipment supplier's standard and compatible with the other supplier's communications protocol.

25.5 The installed PLC communication network media shall be of a industrial grade optical fibre comprising of fibre patch panels, fibre signal converters, switches and hubs.

25.6 The PLC standard communication protocol shall be compatible with Fieldbus standards. e.g. Profibus, Devicenet, etc.

25.7 The PLC Control Systems and Supervisory Control Systems and shall be routed to the Business LAN/WAN via a industrial grade switch.

26 IDENTIFICATION AND MARKING

26.1 The following items shall be identified with laminated, engraved nameplates :

- Relay Sockets
- Plugs and Receptacles
- Terminal Groupings
- Power Connections
- Fuse Holders
- Interconnecting Cables of Central System Equipment (at both ends and traceable to the system drawings) • Major Equipment Components

26.2 System components such as component modules, circuit boards, terminal points, and interconnecting wires shall be individually identified and traceable to the system drawings.

26.3 Cable cores shall be permanently identified at each cable ends.

26.4 The general wiring and interconnection wiring shall be tagged at each end with the number of the terminal to which the wiring is connected. Wire markers shall be embossed and of the slip-on sleeve type. PLC I/O shall be labeled with both tag number and PLC address.

26.5 Terminal references shall be provided on the terminals. A centre strip with tag numbers on the I/O terminal is acceptable. Each row shall be sequentially numbered. I/O module inputs and outputs shall be labeled on the module itself, with tag number and PLC address.

26.6 Nameplates and labels shall be permanent, waterproof, and machine engraved.

26.7 Nameplates and labels shall be securely attached. Self-adhesive labels are not acceptable.

26.8 No company logos, other than the logo of the equipment component manufacturer, shall be displayed on equipment enclosures.

27 VENDOR REQUIREMENTS

27.1 The Vendor shall conform to the Company-approved schedule of delivery. Any deviation or proposed deviated from the schedule shall be reported immediately to the Company.

28 PERSONNEL TRAINING

28.1 The Vendor shall provide formal, comprehensive training programs for Company designated personnel if required.

28.2 Training programs must include the operations, configuration, and maintenance of the system.

29 TESTING AND COMMISSIONING

29.1 Apart from any other rights the Project Engineer may have in terms of the contract, he shall have the right to set the standard and to accept or reject part of the supplied equipment depending on the quality of workmanship and materials offered.

29.2 The Contractor shall provide all equipment, instrumentation and supplies necessary to perform site testing and commissioning. Original copies of all data produced including results of each test procedure shall be submitted to the Project Engineer at the conclusion of each phase of testing.

29.3 Once the installation has been completed, The contractor shall test, adjust and commission each control loop system and shall verify proper operation of each item in the sequences of operation ,including hardware, software, and all communication links and this is subject to the approval by the Project Engineer before the system is placed online.

29.4 During the testing and commissioning period, the contractor shall identify failures, determine causes of failures and deliver a written report to the Project Engineer and Maintenance Engineer or their representative detailing the nature of each failure, the correction action taken, results of tests performed and shall recommend when testing should resume.

29.5 Software must be tested offline in the presence of VOLKSRUST WTP maintenance representative and an acceptance certificate issued for each PLC tested. The supplier must provide all necessary simulation facilities for testing.

29.6 The contractor will perform detailed testing on the PLC system in accordance with IEC 62381. All equipment integrated with the system as follows:

- Internal testing(IT),
- Factory testing (FAT)
- Site Acceptance Testing(SAT)

29 The format of the Internal Testing(IT) will be carried out on the hardware, software and communication with other interfacing devices (ie SCADA, HMI, other PLCs) as defined by the system architecture. The results of all tests will be submitted to the PM by the contractor for approval.

30 Factory Acceptance Tests FAT will be conducted by the contractor, Project Engineer and other representatives from UW.

31 The SAT shall be conducted after the PLC has been installed on site and the tests carried out at FAT be repeated as SAT.

32 Apart from the process control system testing carried during SAT, testing shall also consist of seven consecutive days of on-line system operation during which the system shall meet the following requirements:

- No unexplainable logic component failures

- No unexplainable shutdowns
- A percent reliability factor of at least the factor required by 2.4
- No known, uncorrected hardware or software deficiencies.

29.11 A record shall be kept and witnessed by the Vendor's commissioning engineer of all hardware and software errors and failures observed during the system installation, checkout, and functional test. The record shall show the cause of the failure and the corrective action taken.

30 QUALITY ASSURANCE

30.1 Contractor must provide inspection visits for quality assurance and specification conformance.

30.2 The contractor must produce all quality assurance certificates for the supply, installation, testing, commissioning and handover of each PLC.

30.3 Copies of all test/inspection reports and meeting minutes must be transmitted to the PE.

30.4 The contracting parties shall be notified at least one week prior to attend any meetings, inspections, or testing unless the situation warrants it or agreed to .

31 DOCUMENTATION REQUIREMENTS

31.1 The contractor must comply with the requirements of the Operation and Maintenance O&M manuals specifications.

31.2 Written software and PLC programs showing the proposed control shall be submitted to the Project Engineer for review prior to system start up.

31.3 The Contractor shall be responsible to provide schematics showing the architecture, wiring, ladder diagrams and I/O layout referred to in the I/O list etc. as part of the Operation and Maintenance O&M manuals.

31.4 All drawings shall include page, sheet and line numbers.

31.5 The supplier shall provide documentation detailing the mounting of the processor, I/O racks, terminal and wireways, etc .AII materials shall be labeled to provide easy cross reference to the Bill of Materials listing.

31.6 The operation and maintenance manuals must comply with UW's standard specification.

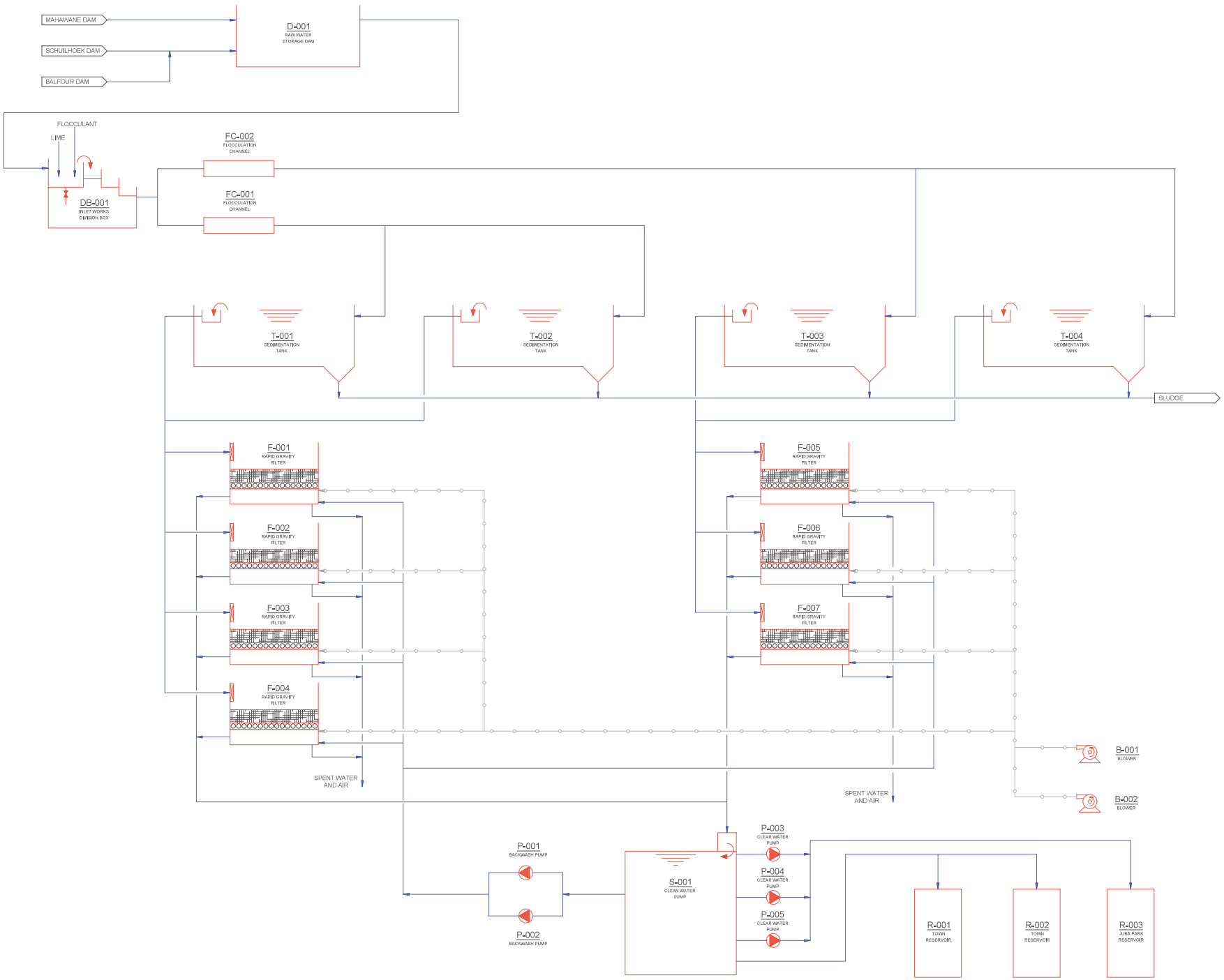
31.7 The operation and maintenance manuals (OM&M) draft to be delivered 2 weeks before cold commissioning. Final manuals to be delivered within 4 weeks after hot commissioning.

31.8 All changes done should be initiated by the change control procedure which must be approved by the engineer.

31.9 The Project Engineer will provide a standard VOLKSRUST WTP drawing template as a soft and electronic copy (AUTOCAD) to effect drawings that are new or ones that need changing.

31.10 The contractor is to comply with the operation required to produce two hardcopy copies of all documentation as well an electronic copy in the format approved by the engineer. The file description must be dated.

DRAWINGS



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ACE
Aguatech Consulting Engineers

NOTES

1.

DRAWING REVISIONS				
REV	DATE	DRAWN	CHECKED	DESCRIPTION

PROJECT NAME:

REFURBISHMENT OF VOLKSRUST
WASTE WATER TREATMENT WORKS

DRAWING TITLE:

PROCESS FLOW DIAGRAM

RESPONSIBLE PERSONNEL		SIGNATURE	DATE
DESIGNED	FJMHLANGA		
DRAWN	CLAWRENCE		
CHECKED	FJMHLANGA		
APPROVED	MGUNI		
SCALE	AS SHOWN		

APPROVED : CLIENT

SIGNATURE _____ DATE _____

PROJECT NUMBER	DRAWING NUMBER		
ACE-2023-143	ACE-2023-PFD-143/001		
STAGE	SHEET SIZE	SHEET No.	REVISION
TENDER	A0	1 OF 1	A

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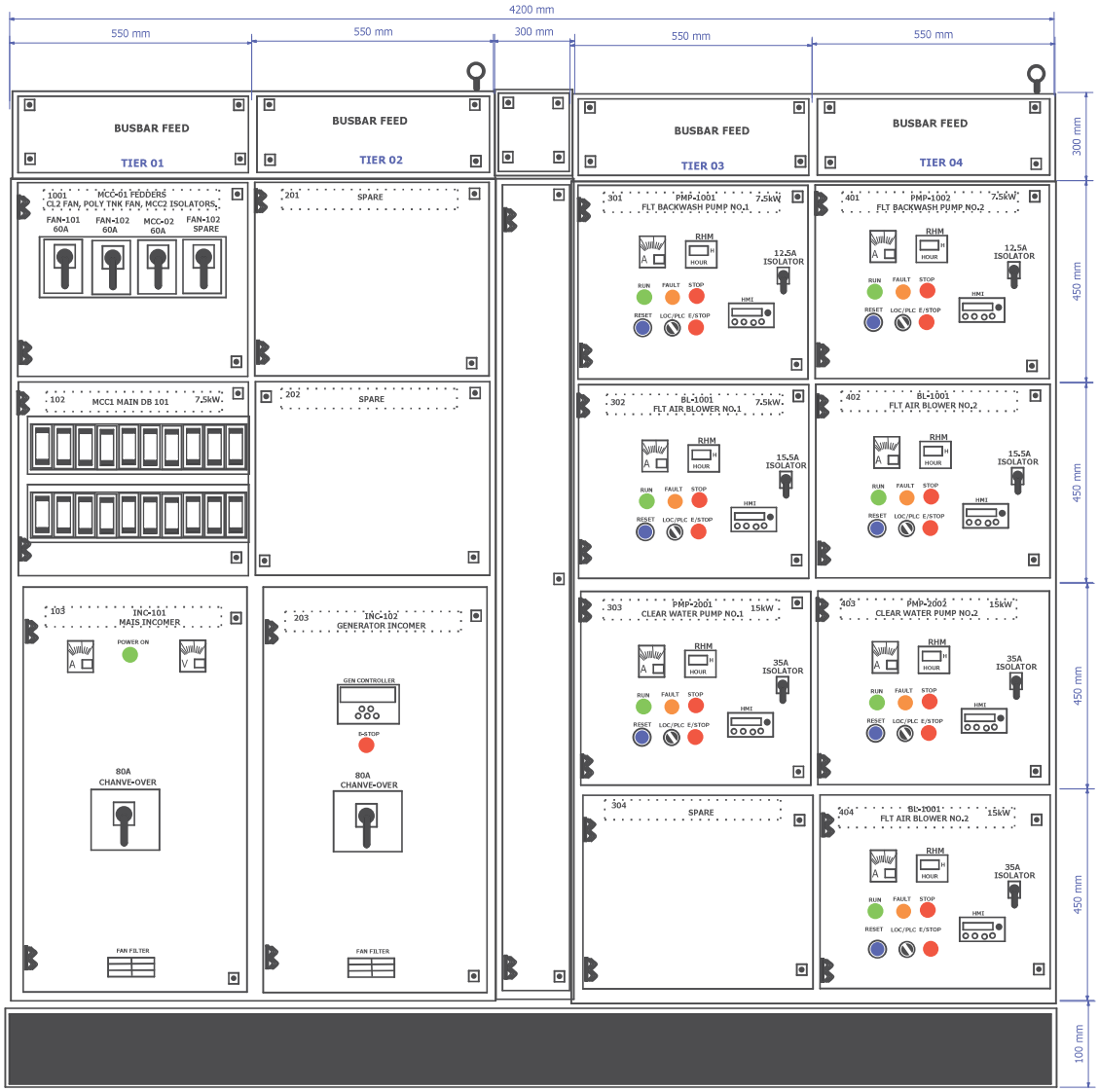
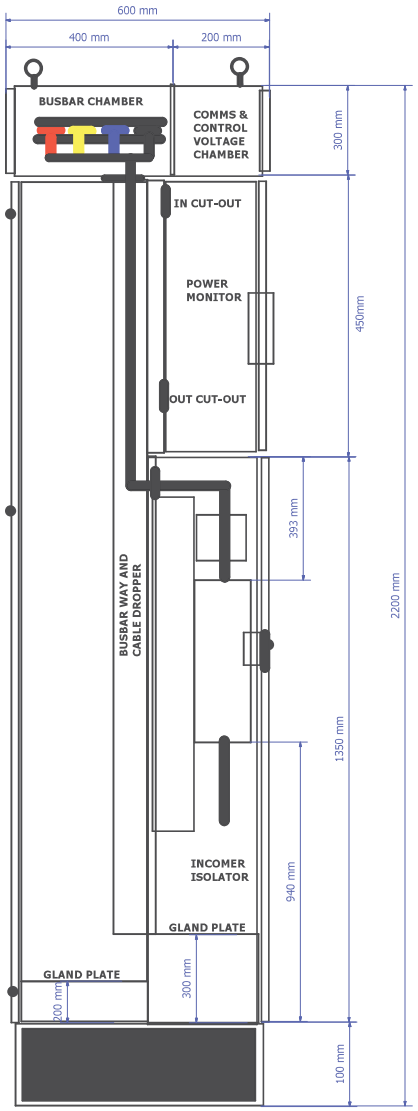


FRONT VIEW



SIDE VIEW

REFERENCE DRAWINGS

DRAWING No.	TITLE/DESCRIPTION	SOURCE

NOTES:

REV	DATE	DESCRIPTION	NAME	SIGNATURE APPROVED

VENDOR APPROVAL

VENDOR DRAWING No.	VWT-GA-MCC01-DRW001		
DESIGNED	M.MNTUNGWA	DRAWN	S.MEMELA
CHECKED	F.MHLANGA	CIVIL ENGINEER	
STRUCTURAL ENGINEER		MECHANICAL ENGINEER	
ELECTRICAL ENGINEER		H & S PROFESSIONAL	
APPROVED	F.MHLANGA PROJECT ENGINEER	SIGNATURE	

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07 Fairhaven
04 Coronation Road
Pietermaritzburg
3210

Aguatech Consulting Engineers
Unit 214 The Quartz
Umhlanga Ridge
Durban 4319

VOLKRUST WATER TREATMENT PLANT APPROVAL

ENGINEERING SERVICES

	NAME	SIGNATURE	DATE
DESIGN ENGINEERS			
MAINTENANCE ENGINEERS			

OPERATIONS

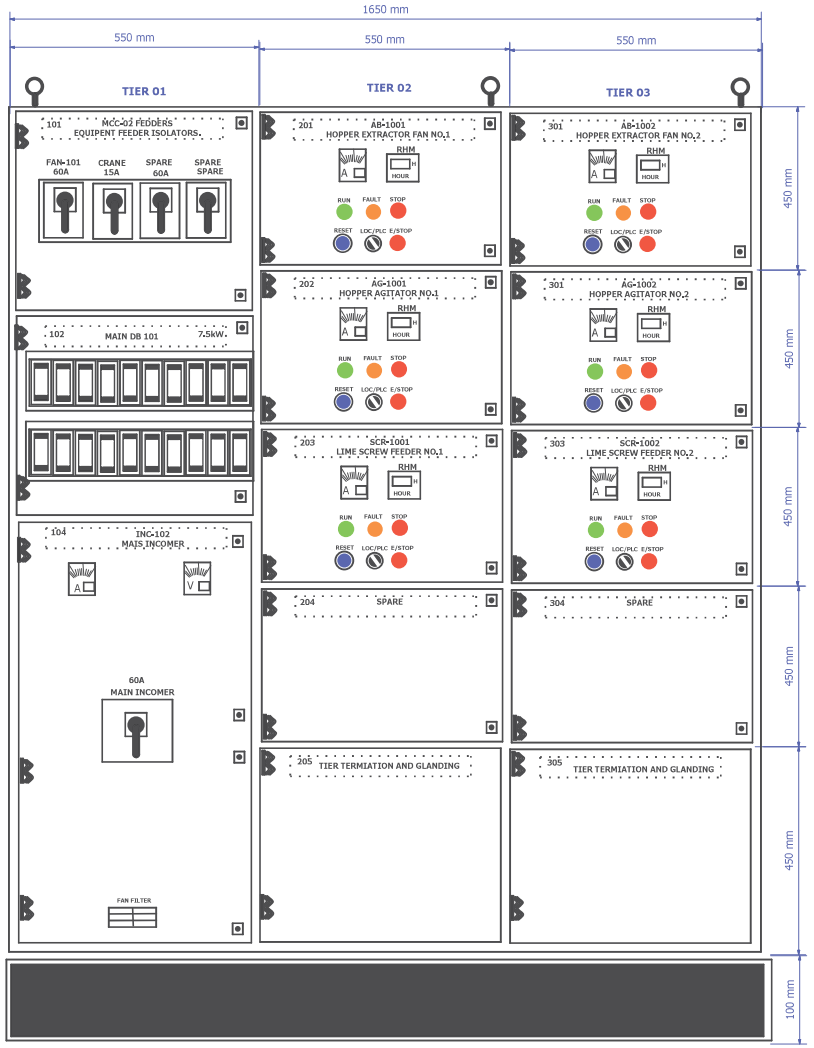
	NAME	SIGNATURE	DATE
MAINTENANCE ENGINEERS			
AREA MANAGER			
ASSET MANAGER			
REGIONAL MANAGER			

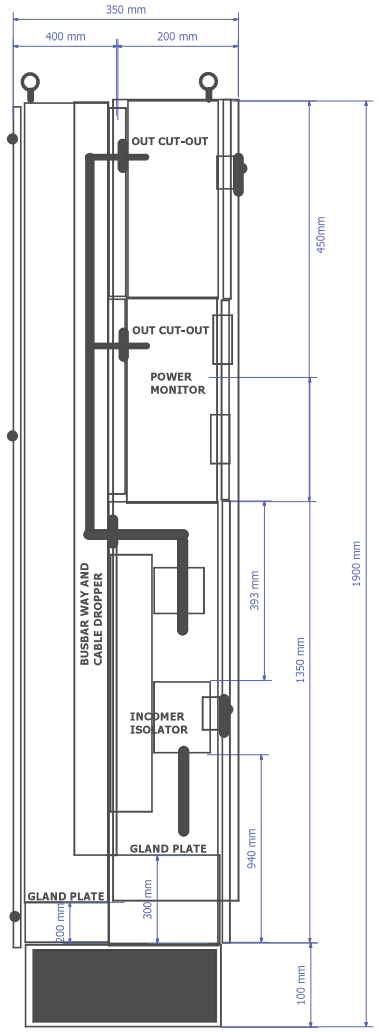
Dr Pixley Ka Seme Local Municipality
Volkrust Water Treatment Works

VOLKRUST-WTP MAIN MCC GENERAL ARRANGEMENT TIER 1-4 LAYOUT

VOLKRUST-WTP MCC AND PLC PROJECT

FILE No.	SCALE	NTS	SHEET SIZE	SHEET OF
			A3	7/31
CONTRACT No.	DRAWING No.			REVISION
2023/022	I/A08/ELE/U10665A/123B			1





SIDE VIEW

REFERENCE DRAWINGS

DRAWING No.	TITLE/DESCRIPTION	SOURCE

NOTES:

REV	DATE	DESCRIPTION	NAME	SIGNATURE APPROVED

VENDOR APPROVAL

VENDOR DRAWING No.	DVL-GA-MCC19-DRW002		
DESIGNED	M.MNTUNGWA	DRAWN	S.MEMELA
CHECKED	F.MHLANGA	CIVIL ENGINEER	
STRUCTURAL ENGINEER		MECHANICAL ENGINEER	
ELECTRICAL ENGINEER		H & S ENGINEER	
APPROVED	F.MHLANGA PROJECT ENGINEER	SIGNATURE	

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Pietermaritzburg
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Umhlanga Ridge
Durban 4319

VOLKRUST WATER TREATMENT PLANT APPROVAL

ENGINEERING SERVICES	NAME	SIGNATURE	DATE
DESIGN ENGINEERS			
MAINTENANCE MANAGERS			

OPERATIONS	NAME	SIGNATURE	DATE
MAINTENANCE ENGINEERS			
AREA MANAGERS			
ASSET MANAGERS			
REGIONAL MANAGERS			

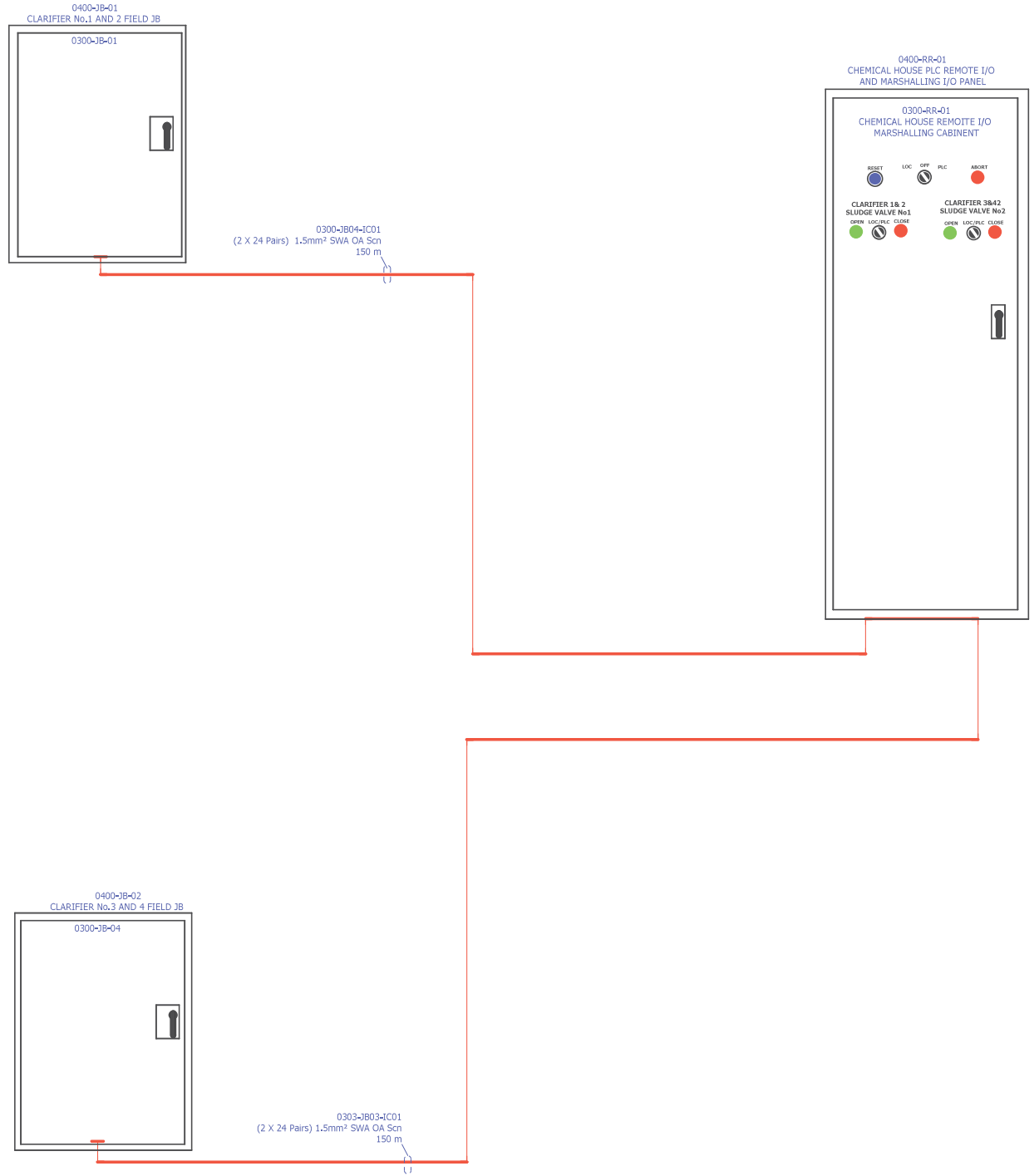
Dr Prixie Ka Seme Local Municipality
Volkrust Water Treatment Works

VOLKRUST-WTP CHEMICAL HOUSE MCC-2
GENERAL ARRANGEMENT
TIER 1-3 LAYOUT

VOLKRUST-WTP MCC AND PLC PROJECT

A3

FILE No.	SCALE	SHEET SIZE	SHEET
	NTS	A3	7/31
CONTRACT No. 2023/022	DRAWING No. I/A08/ELE/U10665A/1238		REVISION 1



REFERENCE DRAWINGS

DRAWING No.	TITLE/DESCRIPTION	SOURCE

NOTES:

1. CLARIFIER SLUDGE CONTRLLED FROM THE CHEMICAL HOUSE REMOTE /O PANEL IN LOCAL MODE. DEFAUL POSITION IS PLC SELECTION

REV	DATE	DESCRIPTION	NAME	SIGNATURE
				APPROVED

VENDOR APPROVAL

VENDOR DRAWING No.	DVL-ILS-MCC19-DRW020		
DESIGNED	M.MNTUNGWA	DRAWN	S.MEMELA
CHECKED	F.MHLANGA	CIVIL ENGINEER	
STRUCTURAL ENGINEER		MECHANICAL ENGINEER	
ELECTRICAL ENGINEER		P & PC ENGINEER	
APPROVED	PROJECT ENGINEER	SIGNATURE	

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Aguatech Consulting Engineers
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Umhlanga Ridge
Durban 4319

VOLKRUST WATER TREATMENT PLANT APPROVAL

ENGINEERING SERVICES	NAME	SIGNATURE	DATE
DESIGN ENGINEERS			
MAINTENANCE MANAGERS			

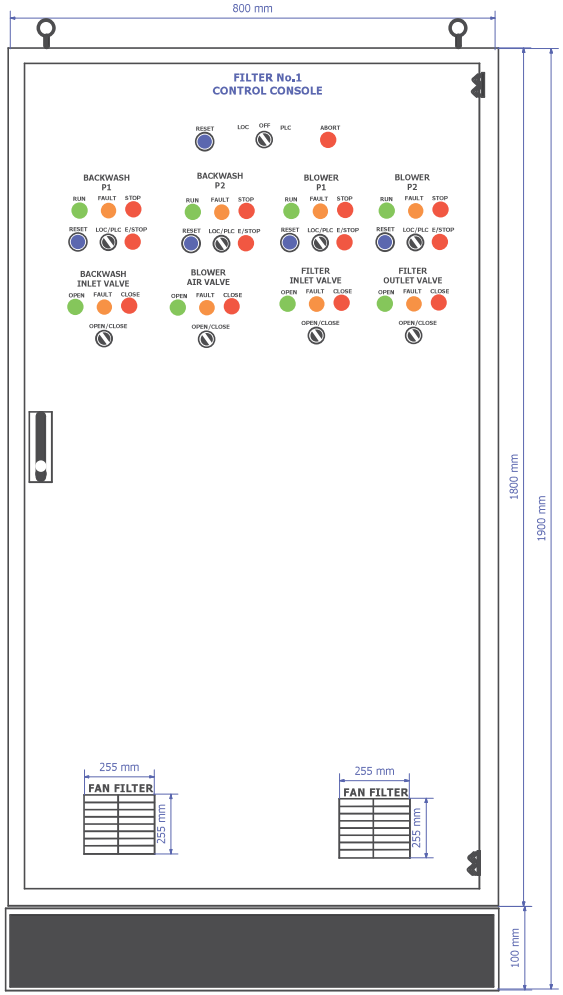
OPERATIONS	NAME	SIGNATURE	DATE
MAINTENANCE ENGINEERS			
AREA MANAGERS			
ASSET MANAGERS			
REGIONAL MANAGER			

Dr Prixie Ka Seme Local Municipality
Volkrust Water Treatment Works

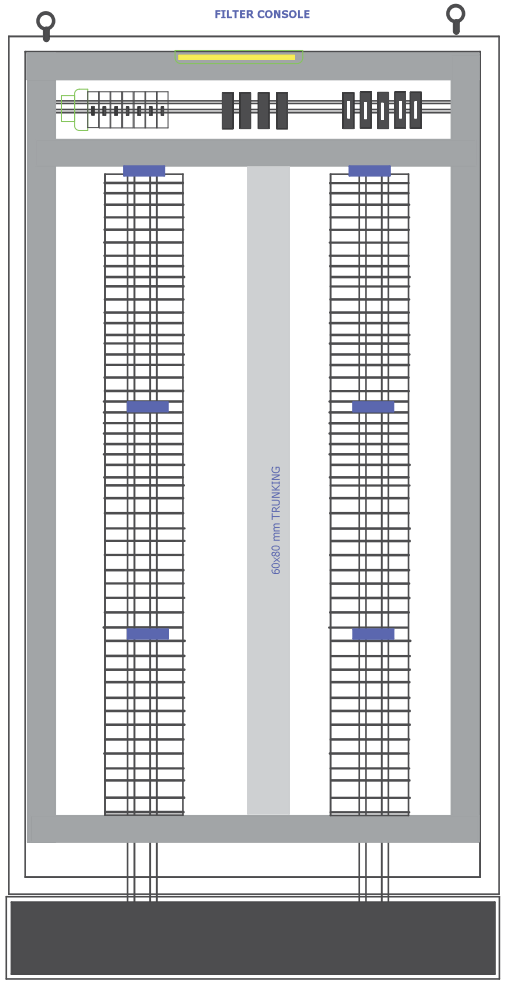
VOLKRUST-WTW CHEMICAL PLANT REMOTE I/O LAYOUT

VOLKRUST-WTP MCC AND PLC PROJECT

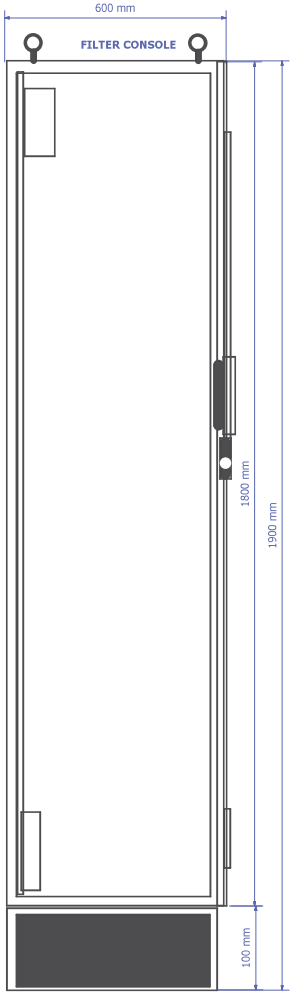
FILE No.	SCALE	SHEET SIZE	SHEET OF
	NTS	A3	
CONTRACT No.	DRAWING No.		REVISION
2023/022	1/A08/ELE/U10665A/1256		1



FRONT VIEW



INTERNAL VIEW



SIDE VIEW

REFERENCE DRAWINGS

DRAWING No.	TITLE/DESCRIPTION	SOURCE

NOTES:

FILTER FIELD CONSOLE
LOCAL START/STOP STATION
FILTER IS TURNED TO LOCAL
a) NO OTHER FILTER COULD BACKWASH
b) START FILTER BACHWASH ON SEMI-AUTO
c) LOCAL OPERATOR START THE BACKWASH ON LOCAL MODE WHERE HE RUNS ALL DEVICES ON MANUAL TO BACKWASH WITHOUT THE PLC

THE FILTER CONSO;E IS ALWAYS LEFT ON AUTO IN ORDER BACKWASH ON AUTO MODE

REV	DATE	DESCRIPTION	NAME	SIGNATURE APPROVED

VENDOR APPROVAL

VENDOR DRAWING No.	DVL-GA-MCC19-DRW005		
DESIGNED	M.MNTUNGWA	DRAWN	S.MEMELA
CHECKED	F.MHLANGA	CIVIL ENGINEER	
STRUCTURAL ENGINEER		MECHANICAL ENGINEER	
ELECTRICAL ENGINEER		P & PC ENGINEER	
APPROVED	F.MHLANGA PROJECT ENGINEER		SIGNATURE

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VOLKRUST WATER TREATMENT PLANT APPROVAL

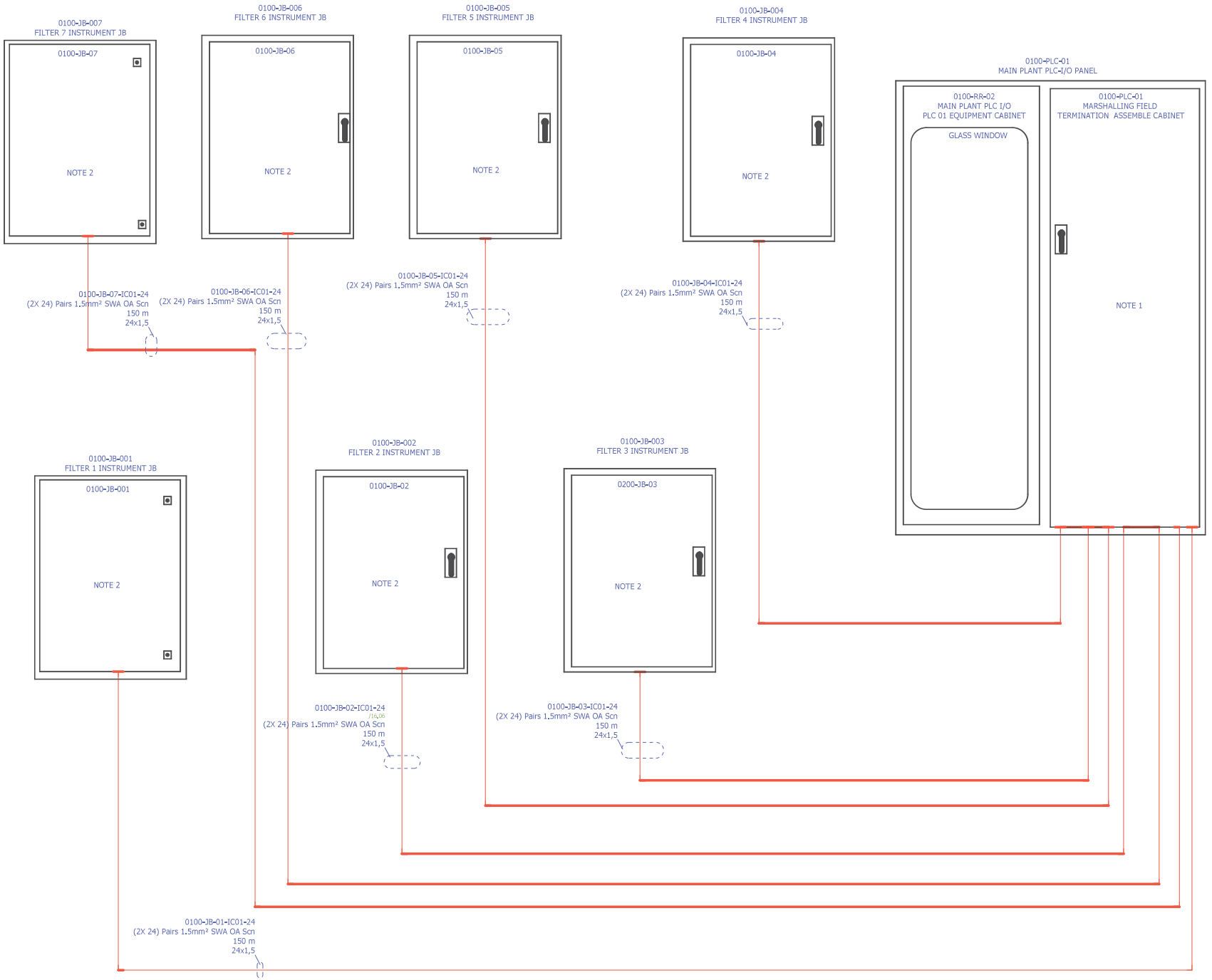
ENGINEERING SERVICES	NAME	SIGNATURE	DATE
DESIGN ENGINEERS			
MAINTENANCE ENGINEERS			
OPERATIONS	NAME	SIGNATURE	DATE
MAINTENANCE ENGINEERS			
AREA MANAGERS			
ASSET MANAGERS			
REGIONAL MANAGER			

Dr Pixley Ka Seme Local Municipality
Volkrust Water Treatment Works

VOLKRUST-WTW FILTER JB GENERAL ARRANGEMENT FILTER CONSOLE LAYOUT

VOLKRUST-WTP MCC AND PLC PROJECT

FILE No.	SCALE	SHEET SIZE	SHEET OF
	NTS	A3	
JOB NUMBER	DRAWING No.		REVISION
2023/022	I/A08/ELE/U10665A/1241		1



REFERENCE DRAWINGS

DRAWING No.	TITLE/DESCRIPTION	SOURCE
DVL-GA-MCC 19-01		GA-MCC 19

NOTES:

1. PLANT RGF FILTER AND CHEMICAL HOUSE MAIN PLC PANEL
2. NB! REF TO DETAIL DRAWING FOR FILTER 1-7 JB PANEL

REV	DATE	DESCRIPTION	NAME	SIGNATURE
1.00	10/04/2021	GA DRAWINGS		
1.01	21/05/2021	GA DRAWINGS		

VENDOR APPROVAL

VENDOR DRAWING No.

DESIGNED	M.MNTUNGWA	DRAWN	S.MEMELA
CHECKED	F.MHLANGA	CIVIL ENGINEER	
STRUCTURAL ENGINEER		MECHANICAL ENGINEER	
ELECTRICAL ENGINEER		H & PC ENGINEER	
APPROVED	F.MHLANGA PROJECT ENGINEER	SIGNATURE	

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Durban 4319

B MDHLULI 04/05/2021

VOLKRUST WATER TREATMENT PLANT APPROVAL

	NAME	SIGNATURE	DATE
ENGINEERING SERVICES	G.SEEKOE		10/05/2021
DESIGN ENGINEERS			
MAINTENANCE ENGINEERS			
OPERATIONS			
MAINTENANCE ENGINEERS			
AREA MANAGERS			
ASSET MANAGERS			
REGIONAL MANAGER			

Dr Pixley Ka Seme Local Municipality
Volkrust Water Treatment Works

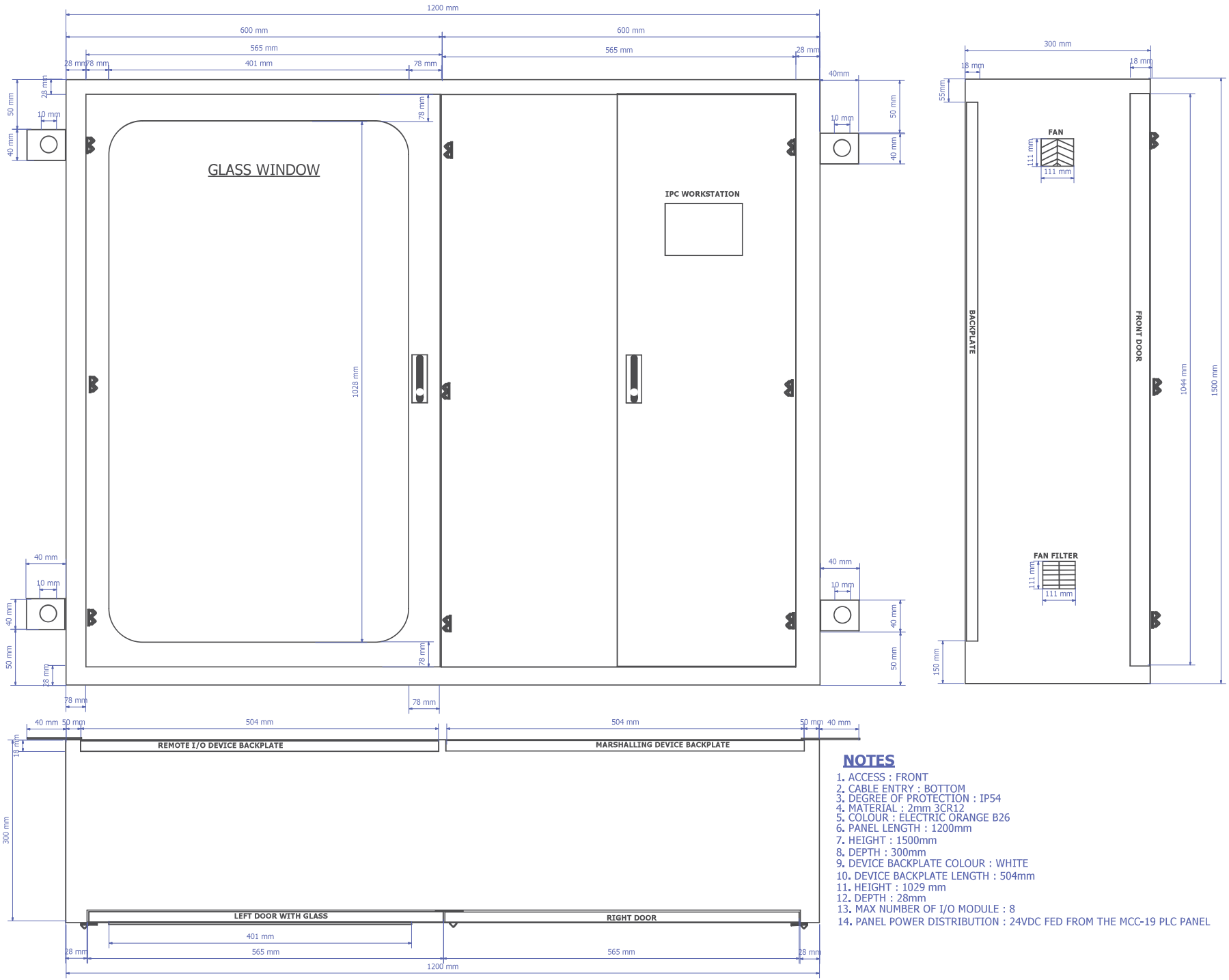
VOLKRUST MAIN PLANT PLC AND REMOTE JB IO LAYOUT

VOLKRUST-WTP MCC AND PLC PROJECT

NTS

A3 16/31

FILE No.	SCALE	SHEET SIZE	SHEET OF
CONTRACT No. 2023/022	DRAWING No. DVL-ILS-MCC19-DRW011 I/A08/ELE/U10665A/1247	A3	REVISION 1



NOTES

1. ACCESS : FRONT
2. CABLE ENTRY : BOTTOM
3. DEGREE OF PROTECTION : IP54
4. MATERIAL : 2mm 3CR12
5. COLOUR : ELECTRIC ORANGE B26
6. PANEL LENGTH : 1200mm
7. HEIGHT : 1500mm
8. DEPTH : 300mm
9. DEVICE BACKPLATE COLOUR : WHITE
10. DEVICE BACKPLATE LENGTH : 504mm
11. HEIGHT : 1029 mm
12. DEPTH : 28mm
13. MAX NUMBER OF I/O MODULE : 8
14. PANEL POWER DISTRIBUTION : 24VDC FED FROM THE MCC-19 PLC PANEL

REFERENCE DRAWINGS

DRAWING No.	TITLE/DESCRIPTION	SOURCE

NOTES:

ALL PLC AND MARSHALLING PANELS 24V IS FROM AN EXTERNAL SOURCE, NO MIXING OF VOLTAGES.

MAIN PLC RUNS THE ETNIRE FILTRATION PROCESS ON BACKWASH AND FILTRATION MODE. ALL FILTERS CONNECTS BACK USINSG MULTI PAIR CABLES TO CONTROL VALVE, BACKWASH PUMP AND AIR BLOWER

MAIN PLC RUNS THE ETNIRE CHEMICAL DOSING SYSTEM AND THE CLARIFIER DISLUDGING PROCESS

REV	DATE	DESCRIPTION	NAME	SIGNATURE / APPROVED

VENDOR APPROVAL

VENDOR DRAWING No.	DVL-GA-MCC19-DRW021		
DESIGNED	M.MNTUNGWA	DRAWN	S.MEMELA
CHECKED	F.MHLANGA	CIVIL ENGINEER	
STRUCTURAL ENGINEER		MECHANICAL ENGINEER	
ELECTRICAL ENGINEER		P & I'S ENGINEER	
APPROVED	F.MHLANGA PROJECT ENGINEER	SIGNATURE	

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Umhlanga Ridge
Durban 4319

VOLKRUST WATER TREATMENT PLANT APPROVAL

ENGINEERING SERVICES

	NAME	SIGNATURE	DATE
DESIGN ENGINEERS			
MAINTENANCE ENGINEERS			

OPERATIONS

	NAME	SIGNATURE	DATE
MAINTENANCE ENGINEERS			
AREA MANAGERS			
ASSET MANAGERS			
REGIONAL MANAGERS			

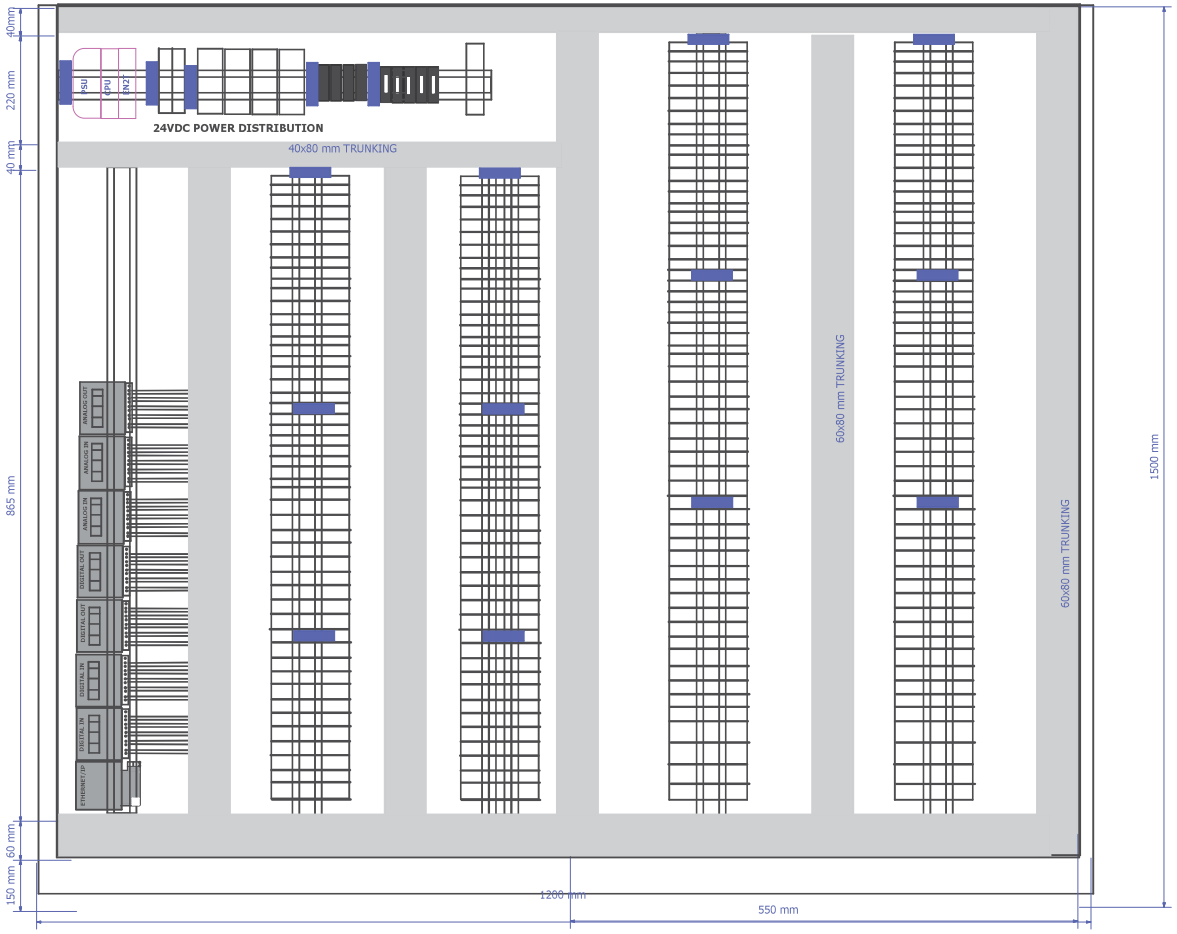
Dr Pixley Ka Seme Local Municipality
Volkrust Water Treatment Works

VOLKRUST -WTW MAIN PLC AND MARSHALLING PANEL LAYOUT

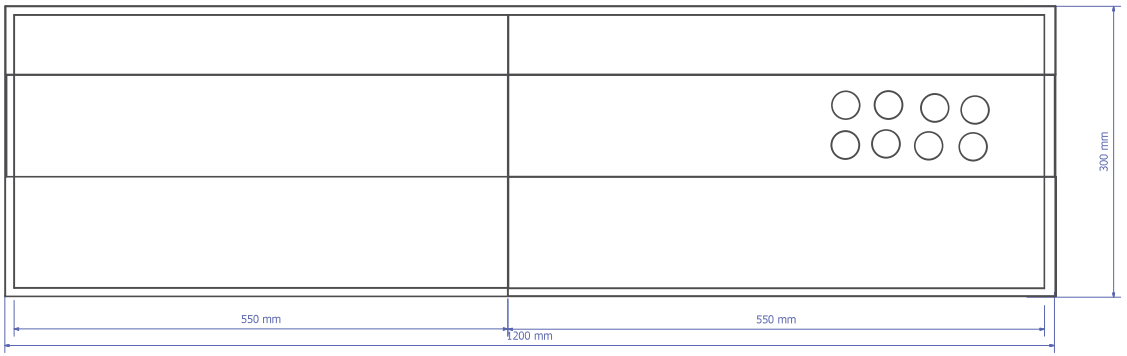
VOLKRUST-WTP MCC AND PLC PROJECT

PLOT No.	SCALE	SHEET SIZE	SHEET
	NTS	A3	26 OF 31
DOCUMENT No.	DRAWING No.		REVISION
2023/022	I/A08/ELE/U10665A/1257		1

BACK PLATE



BOTTOM OF FILTER PANEL



REFERENCE DRAWINGS

DRAWING No.	TITLE/DESCRIPTION	SOURCE

NOTES:

REV	DATE	DESCRIPTION	NAME	SIGNATURE APPROVED

VENDOR APPROVAL

VENDOR DRAWING No.	DVL-GA-MCC19-DRW022		
DESIGNED	M.MNTUNGWA	DRAWN	S.MEMELA
CHECKED	F.MHLANGA	CIVIL ENGINEER	
STRUCTURAL ENGINEER		MECHANICAL ENGINEER	
ELECTRICAL ENGINEER		P & I'S ENGINEER	
APPROVED	F.MHLANGA PROJECT ENGINEER	SIGNATURE	

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Unit 214 The Quartz
Umhlanga Ridge
Durban 4319

VOLKRUST WATER TREATMENT PLANT APPROVAL

ENGINEERING SERVICES

	NAME	SIGNATURE	DATE
DESIGN ENGINEER			
MAINTENANCE MANAGER			

OPERATIONS

	NAME	SIGNATURE	DATE
MAINTENANCE ENGINEER			
AREA MANAGER			
ASSET MANAGER			
REGIONAL MANAGER			

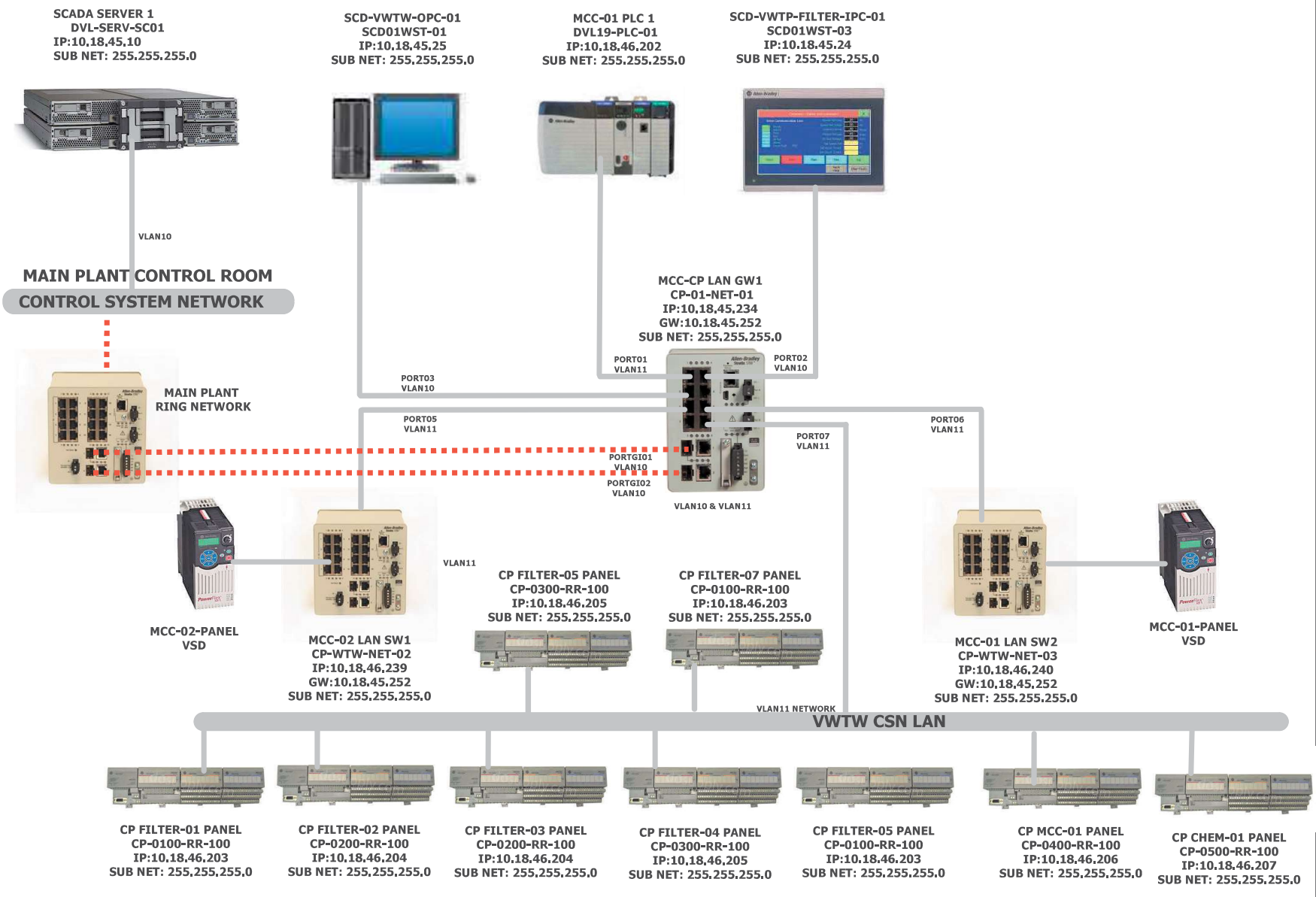
Dr Pixley Ka Seme Local Municipality
Volkrust Water Treatment Works

VOLKRUST-WTW DETAILED MAIN PLC AND MARSHALLING PANEL I/O BACK PLATE VIEW

VOLKRUST-WTP MCC AND PLC PROJECT

PLOT No.	SCALE	SHEET SIZE	SHEET
	NTS	A3	27 OF 31
DOCUMENT No. 2023/022	DRAWING No. I/A08/ELE/U10665A/1258		REVISION 1

VOLKRUST WTP MCC-01 SCADA , PLC AND VSD NETWORK ARCHITECTURE



REFERENCE DRAWINGS

DRAWING No.	TITLE/DESCRIPTION	SOURCE

NOTES:

REV	DATE	DESCRIPTION	NAME	SIGNATURE

VENDOR APPROVAL

VENDOR DRAWING No.	CP-CSN-MCC01-DRW001		
DESIGNED	M.MNTUNGWA	DRAWN	S.MEMELA
CHECKED	F.MHLANGA	CIVIL ENGINEER	
STRUCTURAL ENGINEER		MECHANICAL ENGINEER	
ELECTRICAL ENGINEER		H & S PROFESSIONAL	
APPROVED	F.MHLANGA	SIGNATURE	

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3210

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Umhlanga Ridge
Durban 4319

VOLKRUST WATER TREATMENT PLANT APPROVAL

ENGINEERING SERVICES	NAME	SIGNATURE	DATE
DESIGN ENGINEER			
MAINTENANCE ENGINEER			

OPERATIONS	NAME	SIGNATURE	DATE
MAINTENANCE ENGINEER			
AREA MANAGER			
ASSET MANAGER			
REGIONAL MANAGER			

Dr Pixley Ka Seme Local Municipality
Volkrust Water Treatment Works

VOLKRUST WTW CONTROL SYSTEM Network Layout

VOLKRUST-WTP MCC AND PLC PROJECT

FILE No.	SCALE	SHEET SIZE	SHEET
	NTS	A3	27 OF 31
DOCUMENT No. 2023/022	DRAWING No. I/A08/ELE/U10665A/1260		REVISION 1