INVITATION TO BID
TENDER COVER PAGE

YOU ARE HEREBY INVITED TO BID FOR REQUIREMENTS OF JOHANNESBURG WATER

BID NUMBER: JW14322 **CLOSING DATE: 25 August 2022** **CLOSING TIME: 10:30**

DESCRIPTION: CONSTRUCTION OF A 26ML CONCRETE RESERVOIR AND 2ML WATER TOWER IN BRIXTON WITH ASSOCIATED PIPE AND PUMP WORKS

CIDB REQUIREMENTS: TENDERERS SHOULD HAVE A CIDB GRADING OF 9CE OR HIGHER.

A Compulsory Briefing Session will be held on 02 August 2022 at 12:00 to 13:00 at Brixton Primary School, Symons Rd & BarnesRd,Brixton,Johannesburg,2092:
https://www.google.com/maps/place/Brixton+Primary+School/@26.1931759,28.003842,17z/data=!3m1!4b1!4m5!3m4!1s0x1e950befccfaf1b9:0xe6676a3d56105f4b!8m2!3d-26.1931757!4d28.0060327

NOTE: HARD COPY TENDER DOCUMENTS ARE AVAILABLE AT A COST OF R350.00 PER SET. DOCUMENTS DOWNLOADED FROM THE ETENDER PORTAL IS AT NO COST BUT MUST COMPLY WITH SUBMISSION REQUIREMENTS.

BID DOCUMENTS MAY BE DEPOSITED IN THE BID BOX SITUATED AT GROUND FLOOR

TURBINE HALL
65 NTEMI PILISO STREET
NEWTOWN
JOHANNESBURG
2001

SUPPLIER INFORMATION				
NAME OF BIDDER				
POSTAL ADDRESS				
PHYSICAL ADDRESS				
CONTACT PERSON				
TELEPHONE NUMBER				
CELLPHONE NUMBER				
E-MAIL ADDRESS				
VAT REGISTRATION NUMBER				
CIDB CRS NUMBER				
TAX COMPLIANCE STATUS	TCS PIN		CSD No	

A B-BBEE STATUS LEVEL VERIFICATION CERTIFICATE MUST BE SUBMITTED IN ORDER TO QUALIFY FOR PREFERENCE POINTS FOR B-BBEE	
The 90/10-point scoring system will be applicable to this tender, i.e. 90 points for Price and 10 points for Preferential procurement (B-BBEE).	
TOTAL BID PRICE	R
TOTAL NUMBER OF DOCUMENTS SUBMITTED	

BIDDING PROCEDURE ENQUIRIES MAY BE DIRECTED TO:		TECHNICAL INFORMATION MAY BE DIRECTED TO:	
DEPARTMENT	Supply Chain Management	DEPARTMENT	CAPEX
CONTACT PERSON	Gcina Ndela	CONTACT PERSON	Nqobizitha Ndimande
TELEPHONE NUMBER	011 688 1796	TELEPHONE NUMBER	011 688 6573
E-MAIL ADDRESS	gcina.ndela@jwater.co.za	E-MAIL ADDRESS	nqobizitha.ndimande@jwater.co.za

Joburg
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Johannesburg Water

TERMS AND CONDITIONS FOR BIDDING

1. BID SUBMISSION:

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

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

1.3. **TENDERERS ARE REQUIRED TO SUBMIT ONE ORIGINAL HARD COPY PLUS A SOFT COPY IN A USB**

1.4. **THIS BID IS SUBJECT TO JOHANNESBURG WATER SCM POLICY VERSION 11, JOHANNESBURG WATER WILL NOT NECESSARILY ACCEPT THE LOWEST OR ANY TENDER AND RESERVES THE RIGHT TO WITHDRAW A TENDER WITHOUT FURNISHING REASONS.**

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

1.6. TENDERS WILL BE OPENED IN PUBLIC SOON AFTER CLOSING TIME AND RECORDING OF RECEIVED DOCUMENTS BUT NOT LATER THAN 11:00 AT THE TENDER OFFICE LOCATED AT TURBINE HALL, 65 NTEMI PILISO, NEWTOWN, 2001, GROUND FLOOR.TENDERERS NAMES AND TOTAL PRICES, WHERE PRACTICAL WILL BE, READ OUT.

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

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

2.5 BIDDER MUST BE REGISTERED ON THE CENTRAL SUPPLIER DATABASE (CSD), A CSD NUMBER MUST BE PROVIDED.

3. QUESTIONNAIRE TO BIDDING FOREIGN SUPPLIERS

3.1. DOES THE ENTITY HAVE A BRANCH IN THE RSA? ☐ YES ☐ NO

3.2. DOES THE ENTITY HAVE A PERMANENT ESTABLISHMENT IN THE RSA? ☐ YES ☐ NO

3.3. DOES THE ENTITY HAVE ANY SOURCE OF INCOME IN THE RSA? ☐ YES ☐ NO

3.4. 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: NO BIDS WILL BE CONSIDERED FROM PERSONS IN THE SERVICE OF THE STATE.

SIGNATURE OF BIDDER: ……..

CAPACITY UNDER WHICH THIS BID IS SIGNED: ……

DATE: ……

CHECK-LIST FOR TENDER SUBMISSION

The Tenderer is to indicate in the check-boxes provided that they have completed the required section of the tender document. Completion of this check-list will assist the Tenderer in ensuring that they have attended to all the required items for submission with this tender. **Additionally, it is an absolute requirement that tenderers comply with National Treasury's CSD registration as well as SARS tax compliance requirements – refer T2.2.4 below**.

Ref	Description	Completed		For office use		
		Yes	No	Yes	No	Comments
Cover	Name of tenderer					
	Contact person					
	Telephone/Fax number					
	CIDB CRS Number					
T2.1	T2.2.2 Complete the Certificate of Authority					
	Submit Valid SARS Tax Compliance status Pin for Tenders					
	Confirm Proof of CSD Registration - submission of MA ---------- Number					
	Valid and certified copy of construction sector BBBEE certificate/ Affidavit for construction sector					
	Consortium / JV agreement with all signatories and breakdown of each members contribution / role					
	Complete and sign MBD 6.1 – Preference Points claim form					
T2.2.4	Complete and sign MBD 4- Declaration of any potential Conflict of Interest					
T2.2.4	Complete and sign MBD 8- past Supply Chain Management Practices Form					
	Complete and sign MBD 5 (Declaration for Procurement above R10m)*					
	Annual Financial statements for past 3 years (AFS) *					
T2.2.4	Complete and sign MBD 9- Certificate of Independent bid Determination					
	Complete and sign - Acknowledgement of JW Volume 3 OHS Specs					
C2.2	Complete the Schedule of Rates and the Summary. Sign the Summary					
C.1.1	Complete the Form of Offer. **Do not complete the Form of Acceptance**					
	Sign the Form of Offer with 2 witnesses. **Do not sign the Form of Acceptance**					
Qualifications	Is your tender subject to any qualifications. If Yes, reference to such qualification/s must be indicated below: ----------					

* for tenders with an estimated total value exceeding R10m (VAT included)
** for all tenders regardless of value

Signature:_____Date_____

CONTENTS:

Volumes	**Contents**		**Included (Yes / No)**	**To be returned (Yes / No)**
Number	**Number**	**Heading**		
Volume 1	**Part 1: Tender Procedures**		Yes	Yes
	T1.1	Tender Data	Yes	Yes
	Part 2: Returnable Documents		**Yes**	**Yes**
	T2.1	List of Returnable Documents	Yes	Yes
	T2.2	Returnable Schedules	Yes	Yes
	Part 1: Agreement and Contract Data		**Yes**	**Yes**
	C1.1	Form of Offer and Acceptance	Yes	Yes
	C1.2	Contract Data	Yes	Yes
	C1.3	Forms of Securities	Yes	Yes
	Part 2: Pricing Data		**Yes**	**Yes**
	C2.1	Pricing Instructions	Yes	Yes
	C2.2	Bill of Quantities	Yes	Yes
	Part 3: Scope of Work		**Yes**	**Yes**
	C3	Scope of Work	Yes	Yes
		Particular Specifications	Yes	Yes
	Part 4: Site Information		**Yes**	**Yes**
	C4	Site Information	Yes	Yes
Volume 2		Occupational Health and Safety Specification and Environmental Management Plan	Yes	No
Volume 3		Tender Drawings	Yes	No

Johannesburg Water (SOC) Ltd

CONTRACT JW14322

CONSTRUCTION OF A 26ML CONCRETE RESERVOIR AND 2ML CONCRETE WATER TOWER IN BRIXTON WITH ASSOCIATED PIPE AND PUMP WORKS

VOLUME 1

TENDER

T1.2 TENDER DATA

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T1.2 TENDER DATA

T1.2.1 Conditions of Tender

The conditions of tender are the Standard Conditions of Tender as contained in Annex C of the CIDB Standard for Uniformity in Construction Procurement (August 2019). (See www.cidb.org.za).

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

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

T1.2.2 Tender Data

The clause numbers in the Tender Data refer to the corresponding clause numbers in the Conditions of Tender.

The additional Conditions of Tender are:

Clause number	Tender Data
C.1.1	The Employer is, Johannesburg Water (SOC) Limited
C.1.2	The tender documents issued by the Employer comprise: **Volume 1A:** **Part 1: Tendering Procedures** T1.1 Tender Notice and Invitation to Tender T1.2 Tender Data **Part 2: Returnable Documents** T2.1 List of Returnable Documents T2.2 Returnable Schedules, including the Enterprise Declaration Affidavit which may be bound in a separate volume **Volume 1B:** **Part 1: Agreement and Contract Data** C1.1 Form of Offer and Acceptance C1.2 Contract Data C1.3 Forms of Securities **Part 2: Pricing Data** C2.1 Pricing Instructions C2.2 Schedule of Rates **Volume 2A:** **Part 3: Scope of Work** C3.1 Scope of Work C3.2 Particular Specifications **Part 4: Site Information** C4 Site Information **Volumes 2B:** Generic Specifications **Volume 3:** Occupational Health, Safety and Environmental Specification and Environmental Management Plan

Clause number	Tender Data
	Volume 4: Tender Drawings
C.1.4	The Employer's agent is: Company: Zutari (Pty) Ltd Contact Person: Chester Kan Telephone: 011 214 4500 E-mail address: chester.kan@zutari.com
C.2.1	**Eligibility criteria and requirements:** **CIDB registration and grading:** 1) Only tenderers who are registered with the CIDB, or are capable of being so prior to the evaluation of submissions, in a contractor grading designation equal to or higher than a contractor grading designation determined in accordance with the sum tendered for a **9CE** class of construction work, are eligible to submit tenders. 2) Joint ventures are eligible to submit tenders provided that: i) every member of the joint venture is registered with the CIDB; ii) the lead partner has a contractor grading designation in the **CE** class of construction work; and iii) the combined contractor grading designation calculated in accordance with the CIDB Regulations is equal to or higher than a contractor grading designation determined in accordance with the sum tendered for a **9CE** class of construction work.
C.2.7	The arrangements for a compulsory clarification meeting are as stated in the Tender Notice and Invitation to Tender. Tenderer's attendance and the name of the tendering entity will be recorded. Addenda will be issued to all of the meeting attendees and tenders will be received only from those tendering entities appearing on the attendance list.
C.2.8	Replace the contents of the clause with the following: "Request clarification of the tender documents, if necessary, by notifying the Employer's agent indicated in the Tender Notice and Invitation to Tender in writing at least seven working days before the closing time stated in the foregoing notice and clause F.2.15."
C.2.9	Add the following to the clause: "Be aware that the extent of insurance to be provided by the employer (if any) might not be for the full cover required in terms of the conditions of contract identified in the contract data. The tenderer is advised to seek qualified advice regarding insurance."
C.2.10.5	Add the following to the clause: "If no offer is made for an item, a line must be drawn through the item in pen. All prices and details must be legible/readable to ensure the tender will be considered for adjudication."

Clause number	Tender Data
C.2.11	The evaluation on price alteration will be conducted as follows: • Where the tender award strategy is to evaluate and award per item or category, the following must apply: ▪ If there is an alteration on the rate but no alteration on the total for the item or category, the bidder will not be disqualified ▪ If there is an alteration on the total for the item/s without authentication, bidders will only be disqualified for alteration per item or category. • Where the tender award strategy is to evaluate and award total bid offer, the following must apply: ▪ If there is an alteration on the rate, total for the line item, sub-total/ sum brought/carried forward for the section but no alteration on the total bid offer, the bidder will not be disqualified. ▪ If there is an alteration on the total bid offer on form of offer then the amount in words must be considered or vice-versa. ▪ If there is an alteration on the total bid offer and the amount in words without authentication, the bidders will be disqualified for the entire tender Corrections may not be made using correction fluid, correction tape or the like.
C.2.12	Replace Contents Alternative offers will not be permitted.
C.2.13.3	Each tender offer shall be submitted as an original. Tenderers are also requested to submit a soft copy in a USB (Tenderers who do not submit a soft copy will not be disqualified)
C.2.13.5	The Employer's address for delivery of tender offers and identification details to be shown on the Tenderer's offer package are: **Location of tender box:** Turbine Hall Ground Floor **Physical address:** Johannesburg Water (SOC) Ltd Turbine Hall 65 Ntemi Piliso Street Newtown Johannesburg 2001 **Identification details:** Tender reference number, Title of Tender and the closing date and time of the tender, *as well as the Tenderer's name, his Authorised Representative's name, postal address and telephonic contact numbers*.
C.2.13.6 & C.3.5	A two-envelope procedure will not be followed.
C.2.15.1	The closing time for submission of tender offers is as stated in the Tender Notice and Invitation to Tender.

Clause number	Tender Data
C.2.16	The tender offer validity period is 90 days.
C.2.16.1	Add the following to the clause: "If the tender validity expires on a Saturday, Sunday or public holiday, the Tender Offer shall remain valid and open for acceptance until the closure of business on the following working day."
C.2.19	The Tenderer must provide access during working hours to his premises for inspections on request.
C.2.23	The Tenderer is required to submit with his tender: 1) Valid SARS Compliance status Pin for Tenders issued by the South African Revenue Services. 2) Proof of CSD registration i.e. MA xxxxxxxx number 3) a Certificate of Contractor Registration issued by the CIDB. 4) where the tendered amount inclusive of VAT exceeds R 10 million: i) audited annual financial statement for 3 years, or for the period since establishment if established during the last 3 years, if required by law to prepare annual financial statements for auditing; ii) a certificate certifying that the tenderer has no undisputed commitments for iii) municipal services towards a municipality or other service provider in respect of which payment is overdue for more than 30 days; iv) particulars of any contracts awarded to the tenderer by an organ of state during the past five years, including particulars of any material non-compliance or dispute concerning the execution of such contract; v) a statement indicating whether any portion of the goods or services are expected to be sourced from outside the Republic, and, if so, what portion and whether any portion of payment from the municipality or municipal entity is expected to be transferred out of the Republic. Where a tenderer satisfies CIDB contractor grading designation requirements through joint venture formation, such tenderers must submit the Certificates of Contractor Registration in respect of each partner.
C.2.24	Add the following new clause: **Canvassing and obtaining of additional information by tenderers.** Accept that no Tenderer shall make any attempt either directly or indirectly to canvass any of the Employers officials or the Employer's agent in respect of his tender, after the opening of the tenders but prior to the Employer arriving at a decision thereon. No Tenderer shall make any attempt to obtain particulars of any relevant information, other than that disclosed at the opening of tenders."
C.2.25	Add the following new clause: **Prohibitions on awards to persons in service of the state.** Accept that the Employer is prohibited to award a tender to a person - a) who is in the service of the state; or b) if that person is not a natural person, of which any director, manager, principal shareholder or stakeholder is a person in the service of the state; or c) a person who is an advisor or consultant contracted with the municipality or municipal entity. "In the service of the state" means to be -

Clause number	Tender Data
	i) a member of:- • any municipal council; • any provincial legislature; or • the National Assembly or the National Council of Provinces; ii) a member of the board of directors of any municipal entity; iii) an official of any municipality or municipal entity; iv) an employee of any national or provincial department; v) provincial public entity or constitutional institution within the meaning of the Public Finance Management Act, 1999 (Act No.1 of 1999); vi) a member of the accounting authority of any national or provincial public entity; or vii) an employee of Parliament or a provincial legislature." In order to give effect to the above, the questionnaire for the declaration of interests in the tender of persons in service of state in Section T2.1 must be completed.
C.2.26	Add the following new clause: **Awards to close family members of persons in the service of the state.** "Accept that the notes to the Employer's annual financial statements must disclose particulars of any award of more than R 2 000 to a person who is a spouse, child or parent of a person in the service of the state (defined in clause C.2.25), or has been in the service of the state in the previous twelve months, including a) the name of that person; b) the capacity in which that person is in the service of the state; and c) the amount of the award. In order to give effect to the above, the questionnaire for the declaration of interests in the tender of persons in service of state in part T2 – Returnable Documents must be completed in full and signed."
C.2.27	Add the following new clause: **Tax Compliance.** In the case of a Joint Venture/Consortium the tax Compliance status Pin must be submitted for each member of the Joint Venture/Consortium."
C.2.28	Add the following new clause: Tenderers will be afforded a period of three (3) days to complete the following returnable documents (MBD 6.1, MBD 4, MBD 5, MBD 8, MBD 9) in instances where such forms are incomplete.
C.3.1.1	Replace the contents of the clause with the following: 1. Bidders may seek clarification regarding any aspect of the tender or bid documents in writing. 2. The written request for clarification must be sent to and reach the responsible Supply Chain Specialist at least 7 calendar days before the closing date.

Clause number	Tender Data
C.3.4.2	There will be no opening of tenders in public instead the list of tenderers that have submitted will be published on JW Website
C.3.11	Replace Contents with Returnable Schedule MBD 6.1 for evaluation criteria

C 3.9	Replace Existing Clause Arithmetic Errors 3.9.1 **Construction related tenders** JW undertakes to check the highest scoring bid for arithmetical errors and correcting them as follows: 3.9.1.1 JW shall check for arithmetic errors using the following sequence: i. Check the amount in words against the amount in figures on the *Form of Offer*, ii. Check the Form of Offer against the Summary Schedule Total, iii. Check the Section Sub-Totals per section against the Summary Total for summation errors, iv. Check the Section Sub-Totals in the Summary Schedule against Section Sub-Totals in the *Bill of Quantities*. v. Check the Section Sub-Totals against the Item Totals for summation errors. vi. Check the Item Totals against the product of the Item Rate and the Quantity Provided. 3.9.1.2 If a bill of quantities or price schedule applies JW will request the bidder to correct the arithmetic errors as follows: i. In respect of the Form of Offer, where there is a discrepancy between the amounts in figures and the amount in words, the amount in words shall govern. The bidder must be requested to adjust the amount in figures to correspond with the amount in words. 3.9.2 JW will notify the tenderer of all errors or omissions that are identified in the tender offer and either request the tenderer to confirm the offer as tendered or JW will accept the corrected total of prices. Where the tenderer elects to confirm the tender offer as tendered, correct the errors as follows: i. If bills of quantities or pricing schedules apply and there is an error in the line item total resulting from the product of the unit rate and the quantity, the line item total shall govern, and the rate shall be corrected. Where there is an obviously gross misplacement of the decimal point in the unit rate, the line item total as quoted shall govern, and the unit rate shall be corrected. ii. Where there is an error in the total of the prices either as a result of other corrections required by this checking process or in the tenderer's addition of prices, the total of the prices shall govern and the tenderer will be requested to revise selected item prices (and their rates if bills of quantities apply) to achieve the tendered total of the prices 3.9.3 Clarification session(s) shall be held with Tenderer where there is pricing discrepancies, errors are highlighted and identified corrections are explained. 3.9.3.1 Tenderer is afforded an opportunity to provide clarification, accept or reject identified corrections in writing.

i. In the event that the Tenderer accepts identified corrections, JW will proceed with evaluation.

ii. In the event that the Tenderer rejects the identified correction(s), JW must review the Tenderer's motivation and risks associated with the proposed change.

This is not an opportunity for Tenderers to change the bid offer. A bidder that does not agree to the above will be disqualified.

3.9.3.2 Risk related to the Arithmetic Corrections shall be assessed. Where risks are identified, tenderers shall provide JW with any other material or information that has a bearing on the tender offer, the tenderer's commercial position (including joint venture agreements), quotations preferencing arrangements or samples of materials considered necessary by JW for the purpose of a full and fair risk assessment.

3.9.3.3 Should the tenderer not provide the material, or a satisfactory reason as to why it cannot be provided, by the time for submission stated in the JW request, or fails to attend any meeting in which it has been formally invited to clarify any issue, the tender offer will be regarded as non-responsive.

1.1 TECHNICAL EVALUATION CRITERIA:

Part A

Pre-qualification

Description	**Remark (Yes or No)**
Has the tenderer met the local content threshold as stipulated in MBD 6.2 and Annexure C. **Note: Tenderers who fail to meet the local content threshold as stipulated in MBD 6.2 and Annexure C will be disqualified immediately. Tenderers who meet the local content threshold as stipulated in MBD 6.2 and Annexure C will be evaluated further.**	
Has the Tenderer completed and signed the Special Condition Schedule JW6.1? *Tenderers who FAIL to complete and sign schedule Special Conditions form will not be evaluated further.*	

Part B

Functionality

Part B1
1. Contracts Manager – Qualifications and Experience. Has minimum requirements been met for both
2. Site agent – Qualifications and Experience. Has minimum requirements been met for both
3. OHS Officer – Qualifications and Experience. Has minimum requirements been met for both
Part B2
1. Tenderer's experience with respect to Steel Pipelines. Has minimum requirements been met.?
2. Tenderer's experience with respect to Ground Reservoir. Has minimum requirements been met?
3. Tenderer's experience with respect to Concrete Water Tower. Has minimum requirements been met?
4. Tenderer's experience with respect to Pump Station. Has minimum requirements been met?

Number	Criteria	Description	Documentary Evidence
1	Experience of the key staff (assigned personnel) in relation to the scope of work	Contracts Manager	CVs of Key personnel detailing their work experience in relation for all key personnel See **T2.1.9**.
		Site Agent	
		Safety Officer	
2	Qualifications of the key staff (assigned personnel) in relation to the scope of work	Contracts Manager	Copies of certified qualifications of key personnel. See **T2.1.9**.
		Site Agent	
		Safety Officer	
3	Experience of tenderer with respect to specific aspects of the project /	Steel pipelines (field-welded) with valves and chambers ≥ DN600	Record of completed steel pipeline projects as per format given on section **T2.1.6 7**completed by the client **or in the client 'letterhead containing all the information requested in the contactable reference format** accompanied with take-over certificate/completion certificate / final approval certificate.

	comparable projects	Experience with respect to Concrete Reservoir. (25ML)	Record of completed reinforced concrete projects as per format given on section **T2.1.6 7**completed by the client **or in the client 'letterhead containing all the information requested in the contactable reference format** accompanied with take-over certificate/completion certificate / final approval certificate.
		Pump Station with flow rate ≥ 400 ℓ/s and pump station with pumping head ≥ 40m	Record of completed pump station projects as per format given on section **T2.1.6 7**completed by the client **or in the client 'letterhead containing all the information requested in the contactable reference format** accompanied with take-over certificate/completion certificate / final approval certificate.
		Experience with respect to Concrete Water Tower. (1.2ML)	Record of completed reinforced concrete projects as per format given on section **T2.1.6 7**completed by the client **or in the client 'letterhead containing all the information requested in the contactable reference format** accompanied with take-over certificate/completion certificate / final approval certificate.

Part B1

EXPERIENCE AND QUALIFICATIONS OF KEY PERSONNEL

General Qualifications

Tenderer must submit CVs and Certified Certificates of the key personnel who will be assigned to this contract.:

The respective minimum qualification and experience of the Key Personnel are:

Designation	Minimum Qualification	Registration	Minimum Experience
Contracts Manager	BSc/BEng/B.Tech (Civil Engineering /Quantity Survey/ Construction Management)	Pr Eng/Pr Tech/ /Pr QS / PrCPM / PrCM	10 Years (All Projects) after obtaining minimum qualification.
Site Agent	National Diploma (Civil) Engineering	N/A	2 projects (reinforced concrete Water retaining structures), Steel Welded Pipeline with a min diameter of 600mm and 1 pump station project with

			min flow rate of 400l/s as a Site Agent.
Safety Officer	National Diploma (Safety/Environmental Science),	SACPCMP	3 Years (All Projects) as a Safety Office.
	OR		
	SAMTRAC/SHEOMTRAC/ SHEMTRAC/ MESHTRAC / NEBOSH / Safety Officers Course	SACPCMP	4 Years (All Projects) as a Safety Office.

ACRONYMS

SACPCMP: South African Council for the Project and Construction Management Professions.

SAMTRAC: Safety Management Training Course.

NEBOSH: National Examination Board in Occupational Safety and Health.

SHEOMTRAC: Safety Health Environmental Occupational Management Training Course.

SHEMTRAC: Safety Health Environmental Management Training Course.

MESHTRAC: Management Environmental Safety Health Training Course

FIDIC: International Federation of Consulting Engineers

GCC: General Conditions of Contract

NEC: New Engineering Contract

Tenderers who fail to meet the minimum requirements outlined in Part B1 will not be evaluated further.

Part B2

TENDERER'S EXPERIENCE

Welded Steel Pipeline Construction Experience

Tenderer has provided references and completion certificates as follows

- FIDIC Contract - Take-Over Certificate /Completion Certificate.

or

- NEC Contract - Take-Over Certificate /Completion Certificate.

or

- GCC Contract – Completion Certificate / Final Approval Certificate.

The above is confirming that the Service Provider has successfully completed one (1). project of a steel pipeline (field-welded) with valves and chambers ≥ DN600mm.

Ground Reservoir Construction Experience

Tenderer has provided references and completion certificates as follows

- FIDIC Contract - Take-Over Certificate /Completion Certificate.

or

- NEC Contract - Take-Over Certificate /Completion Certificate.

or

- GCC Contract – Completion Certificate / Final Approval Certificate.

The above is confirming that the Service Provider has successfully completed one (1) 25ML or bigger concrete reservoir.

Water Tower Construction Experience

Tenderer has provided references and completion certificates as follows

- FIDIC Contract - Take-Over Certificate /Completion Certificate.

or

- NEC Contract - Take-Over Certificate /Completion Certificate.

or

- GCC Contract – Completion Certificate / Final Approval Certificate.

The above is confirming that the Service Provider has successfully completed one (1) 2 ML or bigger Concrete Water Tower.

Pump Station Construction Experience

Tenderer has provided references and completion certificates as follows

- FIDIC Contract - Take-Over Certificate /Completion Certificate.

or

- NEC Contract - Take-Over Certificate /Completion Certificate.

or

- GCC Contract – Completion Certificate / Final Approval Certificate.

The above is confirming that the Service Provider has successfully completed one (1) pump station project with a capacity of at least 400 ℓ/s.

The procedure for the evaluation of responsive tenders is Financial Offer and Preferences:

1. APPLICATION OF THE PREFERENCE POINTS SCORING SYSTEMf

The following preference point systems are applicable to all tenders:

- The 90/10 system for requirements with a Rand value above R50 000 000 (all applicable taxes included).

(a) The value of this tender is estimated to exceed R50 000 000 (all applicable taxes included) and therefore the 90/10 preference point system shall be applicable.

(b) Preference points for this tender shall be awarded for:

(a) Price; and

(b) B-BBEE Status Level of Contributor.

(c) The maximum points for this tender are allocated as follows:

	POINTS
PRICE	90
B-BBEE STATUS LEVEL OF CONTRIBUTOR	10
Total points for Price and B-BBEE must not exceed	**100**

(d) Failure on the part of the tenderer to submit proof of BBBEE status level of contributor Certificate will be interpreted to mean that preference points for BBBEE status level of contribution are not claimed.

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

2. ADJUDICATION USING A POINT SYSTEM

(a) The tender obtaining the highest number of total points will be awarded the contract.

(b) Preference points shall be calculated after prices have been brought to a comparative basis taking into account all factors of non-firm prices and all unconditional discounts.

(c) Points scored must be rounded off to the nearest 2 decimal places.

(d) In the event that two or more tenders have scored equal total points, the successful tender must be the one scoring the highest number of preference points for B-BBEE.

(e) However, when functionality is part of the evaluation process and two or more tenders have scored equal points including equal preference points for B-BBEE, the successful tender must be the one scoring the highest score for functionality.

(f) Should two or more tenders be equal in all respects, the award shall be decided by the drawing of lots.

3. POINTS AWARDED FOR PRICE

THE 90/10 PREFERENCE POINT SYSTEMS

	A maximum of 90 points is allocated for price on the following basis: **90/10** $$Ps = 90\left(1 - \frac{Pt - P\min}{P\min}\right)$$ Where Ps = Points scored for comparative tender price under consideration Pt = Comparative tender price under consideration Pmin = Comparative price of lowest acceptable tender
C.3.13.1	Add to the existing clause: Tender offers will only be accepted if: a) the tenderer submits a valid SARS tax Compliance status Pin for tenders issued by the South African Revenue Services or has made arrangements to meet outstanding tax obligations; b) Proof of CSD registration ie MA xxxxx number; c) the tenderer submits a letter of intent from an approved insurer undertaking to provide the Performance Guarantee to the format included in Part T2.2.22 of this procurement document d) the tenderer is registered with the Construction Industry Development Board in an appropriate contractor grading designation; e) the tenderer or any of its directors/shareholders is not listed on the Register of Tender Defaulters in terms of the Prevention and Combating of Corrupt Activities Act of 2004 as a person prohibited from doing business with the public sector; f) the tenderer has not: i) abused the Employer's Supply Chain Management System; or ii) failed to perform on any previous contract and has been given a written notice to this effect; g) the tenderer has completed the Compulsory Enterprise Questionnaire and there are no conflicts of interest which may impact on the tenderer's ability to perform the contract in the best interests of the Employer or potentially compromise the tender process and persons in the employ of the state are permitted to submit tenders or participate in the contract; h) the tenderer is registered and in good standing with the compensation fund or with a licensed compensation insurer; i) the Employer is reasonably satisfied that the tenderer has in terms of the Construction Regulations, 2003, issued in terms of the Occupational Health and Safety Act, 1993, the necessary competencies and resources to carry out the work safely; and j) the tenderer: i) has sufficiently substantiated his experience in this type work; ii) has the required and experienced key personnel; and iii) Owns the primary equipment to effectively and efficiently execute the work.
C.3.17	The number of paper copies of the signed contract to be provided by the Employer is one.
	There are no additional conditions of tender.

--- END OF PART ---

Johannesburg Water (SOC) Ltd

Johannesburg Water

CONTRACT JW14322

CONSTRUCTION OF A 26ML CONCRETE RESERVOIR AND 2ML CONCRETE WATER TOWER IN BRIXTON WITH ASSOCIATED PIPE AND PUMP WORKS

VOLUME 1A

TENDER

T2.1 LIST OF RETURNABLE DOCUMENTS

T2.1 LIST OF RETURNABLE DOCUMENTS

The tenderer must complete the following returnable documents:

T2.2 LIST OF RETURNABLE DOCUMENTS

T2.3 LIST OF RETURNABLE SCHEDULES

T2.4 LIST OF RETURNABLE SCHEDULES

NOTE: The Tenderer is required to complete each and every schedule listed above to the best of his ability as the evaluation of tenders and the eventual contract will be based on the information provided by the tenderer.

T2.1 LIST OF RETURNABLE DOCUMENTS

T2.1.1 RECORD OF ADDENDA TO TENDER DOCUMENTS

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

Tenderer .....

T2.1.2 CERTIFICATE OF AUTHORITY

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

(I) COMPANY	(II) CLOSE CORPORATION	(III) PARTNERSHIP	(IV) JOINT VENTURE	(V) SOLE PROPRIETOR

(I) Certificate for Company

I, ……, chairperson of the Board of Directors of ....., hereby confirm that by resolution of the Board (copy attached) taken on ....., Mr/Ms ....., acting in the capacity of ....., was authorized to sign all documents in connection with the tender for Contract No. JW14322 and any contract resulting from it on behalf of the company.

Chairman: .....

As Witnesses: 1.....

2.....

Date: .....

(II) Certificate for Close Corporation

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

..... hereby authorize Mr/Ms …….... , acting in the capacity of

....., to sign all documents in connection with the

tender and any contract resulting from it on our behalf.

NAME	ADDRESS	SIGNATURE	DATE

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

(III) Certificate for Partnership

We, the undersigned, being the key partners in the business trading as, ……

.....……., hereby authorize Mr/Ms .....…… ,

acting in the capacity of …….. , to sign all documents in connection

with the tender and any contract resulting from it on our behalf.

NAME	ADDRESS	SIGNATURE	DATE

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

(IV) Certificate for Joint Venture

This Returnable Schedule is to be completed by joint ventures.

We, the undersigned, are submitting this tender offer in Joint Venture and hereby authorise Mr/Ms …… , authorised signatory of the company ……..., acting in the capacity of lead partner, to sign all documents in connection with the tender 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

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

(V) Certificate for Sole Proprietor

I, ..., hereby confirm that I am the sole owner of the Business

trading as …….....

Signature of Sole owner: .....

As Witnesses:

1.....

2. .....

Date: .....

T2.1.3 COMPULSORY ENTERPRISE QUESTIONNAIRE

The following particulars must be furnished. In the case of a joint venture, **separate** enterprise questionnaires in respect of each partner must be completed and submitted.

Section 1: Name of enterprise: ……

Section 2: VAT registration number, if any: ……

Section 3: CIDB registration number, if any: ……..

Section 4: Particulars of sole proprietors and partners in partnerships

Name*	Identity number*	Personal income tax number*

* Complete only if sole proprietor or partnership and attach separate page if more than 3 partners

Section 5: Particulars of companies and close corporations

Company registration number……

Close corporation number……..

Proof of CSD registration ie MA xxxxxxxxx number……...

SARS Tax Compliance status Pin number……...

Section 6: Record in the service of the state

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

- ☐ a member of any municipal council
- ☐ a member of any provincial legislature
- ☐ a member of the National Assembly or the National Council of Province
- ☐ a member of the board of directors of any municipal entity
- ☐ an official of any municipality or municipal entity
- ☐ an employee of any provincial department, national or provincial public entity or constitutional institution within the meaning of the Public Finance Management Act, 1999 (Act 1 of 1999)
- ☐ a member of an accounting authority of any national or provincial public entity
- ☐ an employee of Parliament or a provincial legislature

If any of the above boxes are marked, disclose the following:

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

*insert separate page if necessary

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

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

- ☐ a member of any municipal council
- ☐ a member of any provincial legislature
- ☐ a member of the National Assembly or the National Council of Province
- ☐ a member of the board of directors of any municipal entity
- ☐ an official of any municipality or municipal entity
- ☐ an employee of any provincial department, national or provincial public entity or constitutional institution within the meaning of the Public Finance Management Act, 1999 (Act 1 of 1999)
- ☐ a member of an accounting authority of any national or provincial public entity
- ☐ an employee of Parliament or a provincial legislature

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

*insert separate page if necessary

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

i) authorizes the Employer to verify the tax compliance status from the South African Revenue Services that my / our tax matters are in order;

ii) confirms that the neither the name of the enterprise or the name of any partner, manager, director or other person, who wholly or partly exercises, or may exercise, control over the enterprise appears on the Register of Tender Defaulters established in terms of the Prevention and Combating of Corrupt Activities Act of 2004;

iii) confirms that no partner, member, director or other person, who wholly or partly exercises, or may exercise, control over the enterprise appears, has within the last five years been convicted of fraud or corruption;

iv) confirms that I / we are not associated, linked or involved with any other tendering entities submitting tender offers and have no other relationship with any of the tenderers or those responsible for compiling the scope of work that could cause or be interpreted as a conflict of interest; and

iv) confirms that the contents of this questionnaire are within my personal knowledge and are to the best of my belief both true and correct.

Signed ..... Date .....

Name ..... Position .....

Enterprise name .....

T2.1.4 PREFERENTIAL PROCUREMENT

Forms for Completion by the Tenderer included in this section are:

Form No.	Form Title	Description
JW6.1	Special Conditions	Sub-contracting and Skills Transfer
MBD 6.2	Declaration certificate for local production and content for designated sectors	Form to be completed by the Tenderer
MBD 6.1	Empowerment and Preferential Procurement	Procedures and adjudication criteria for the information of the Tenderer
MBD 4	Declaration of any potential Conflict of Interest	Form to be completed by the Tenderer
MBD 8	Declaration of bidder's past supply chain management practices	Form to be completed by the Tenderer
MBD 5	Declaration for Procurement above R10 Million (VAT Included)	Form to be completed by the Tenderer
MBD9	Certificate of Independent Bid Determination	Form to be completed by the Tenderer

Note:
All information supplied must be current and valid. Proposed or imminent changes to a Tenderer's status may be mentioned but the declarations must reflect current circumstances.

SPECIAL CONDITIONS

Although the total value of this contract exceeds R30m, Johannesburg Water deems it **not** feasible to subcontract a minimum of 30% of the contract. However, the successful tenderer must subcontract a minimum of 12% of the value of this contract to an entity that is an EME or QSE that is 51% Black Owned or 51 Black Women Owned or 51% Black Youth Owned. The subcontractor/s chosen for this purpose must be registered on National Treasury's Central Supplier Database (CSD).

- An EME or QSE which is at least 51% black owned by black people;
- An EME of QSE which is at least 51% owned by black people who are youth;
- An EME of QSE which is at least 51% owned by black people who are women;
- More than one of the categories referred to above.

1. Subcontractors must be chosen from National Treasury's Central Supplier Database which can be accessed on National Treasury's website.

2. A subcontracting agreement between main contractor and the subcontractor shall be submitted to JW upon appointment and must include minimum information below.
   - Name of sub-contractor and BBBEE status
   - Area and location of project
   - Scope of work issued to the sub-contractor
   - Value of the work issued including P&G's (auditable)
   - Assistance provided to the sub-contractor e.g. acquisition of materials, machinery and tools
   - Skills transfer plan

3. The successful contractor must submit periodic SMME reports to the Project Manager as follows:
   - Name of sub-contractor and BBBEE status
   - Area and location of project
   - Scope of work issued to the sub-contractor
   - Value of the work issued (auditable)
   - Monthly payments made to the subcontractor (auditable)
   - Assistance provided to the sub-contractor e.g. acquisition of materials, machinery and tools
   - Performance of the sub-contractor

4. Upon completion of the project, the contractor is required to provide a final report to JW on skills acquired, description and value of work performed as well as their overall performance.

   (The above information will assist the sub-contractor to improve their CIDB grading)

Skills transfer

It is an absolute requirement that the successful tenderer empowers the appointed sub-contractor through the transfer of skills. In this regard a skills transfer plan must be submitted prior to commencement of the project.

I / we representing the tenderer hereunder agree to the above conditions in the event of being successful.

Failure to complete this form or disagree with subcontracting conditions will result in disqualification.

Name of tenderer: _____

Authorised signatory_____**Date**_____

DECLARATION CERTIFICATE FOR LOCAL PRODUCTION AND CONTENT FOR DESIGNATED SECTORS MBD 6.2

This Municipal Bidding Document (MBD) must form part of all bids invited. It contains general information and serves as a declaration form for local content (local production and local content are used interchangeably).

Before completing this declaration, bidders must study the General Conditions, Definitions, Directives applicable in respect of Local Content as prescribed in the Preferential Procurement Regulations, 2017, the South African Bureau of Standards (SABS) approved technical specification number SATS 1286:2011 (Edition 1) and the Guidance on the Calculation of Local Content together with the Local Content Declaration Templates [Annex C (Local Content Declaration: Summary Schedule), D (Imported Content Declaration: Supporting Schedule to Annex C) and E (Local Content Declaration: Supporting Schedule to Annex C)].

1. General Conditions

1.1. Preferential Procurement Regulations, 2017 (Regulation 8) make provision for the promotion of local production and content.

1.2. Regulation 8.(2) prescribes that in the case of designated sectors, organs of state must advertise such tenders with the specific bidding condition that only locally produced or manufactured goods, with a stipulated minimum threshold for local production and content will be considered.

1.3. Where necessary, for tenders referred to in paragraph 1.2 above, a two stage bidding process may be followed, where the first stage involves a minimum threshold for local production and content and the second stage price and B-BBEE.

1.4. A person awarded a contract in relation to a designated sector, may not sub-contract in such a manner that the local production and content of the overall value of the contract is reduced to below the stipulated minimum threshold.

1.5. The local content (LC) expressed as a percentage of the bid price must be calculated in accordance with the SABS approved technical specification number SATS 1286: 2011 as follows:

$$LC = [1 - x / y] * 100$$

Where
x is the imported content in Rand
y is the bid price in Rand excluding value added tax (VAT)

Prices referred to in the determination of x must be converted to Rand (ZAR) by using the exchange rate published by South African Reserve Bank (SARB) on the date of advertisement of the bid as indicated in paragraph 3.1 below.

The SABS approved technical specification number SATS 1286:2011 is accessible on http://www.thedtic.gov.za/industrial development/ at no cost.

1.6. A bid may be disqualified if this Declaration Certificate and the Annex C (Local Content Declaration: Summary Schedule) are not submitted as part of the bid documentation;

2. The stipulated minimum threshold(s) for local production and content (refer to Annex A of SATS 1286:2011) for this bid is/are as follows:

Item no.(* see Note below)		Description of Goods	Stipulated minimum threshold
		Street Light Steel Poles	**100%**
4.3.7.20		Galvanised steel light pole	100%
		Electrical and Telecom Cables	**90%**
		PVC/PVC/SWA/PVC Copper cable	**90%**
4.3.5.1		185mm², 4-Core	90%
4.3.5.2		150mm², 4-Core	90%
4.3.5.3		10mm², 3-Core	90%
		PVC/PVC/PVC Copper cable	**90%**
4.3.5.4		10mm², 5-Core	90%
4.3.5.5		4mm², 3-Core	90%
4.3.5.6		2.5mm², 3-Core	90%
		Bare Copper Earth Wire (BCEW)	**90%**
4.3.5.7		70mm², 1-Core	90%
4.3.5.8		2.5mm², 1-Core	90%
		Conduits & Wire Ways	
4.3.6.15		160mm diameter PVC sleeves	90%
4.3.6.16		110mm diameter PVC sleeves	90%
4.3.6.17		25mm GALV. steel conduit	90%
4.3.6.18		32mm GALV. steel conduit	90%
4.3.6.19		25mm PVC. conduit	90%
		Individually and overall screened twisted pair instrument cable	**90%**
4.3.10.22		1 Pair	90%
4.3.10.23		2 Pair	90%
4.3.10.24		4 Pair	90%
4.3.10.25		6 Pair	90%
4.3.10.26		8 Pair	90%
4.3.10.27		24 Pair	90%
		Valves Products and actuators	**70%**
2.7.7.8		400mm dia VOSA non-rising wedge gate valve or similar approved	70%
2.7.7.10		400 mm dia Cla-Val orifice plate complete or similar approved	70%
2.7.7.12		400 mm dia Cla-Val flow control valve complete or similar approved	70%
2.7.7.13		400 mm dia Cla-Val strainer complete or similar approved	70%

Item no.(* see Note below)		Description of Goods	Stipulated minimum threshold
2.7.7.20		200 mm dia VOSA non-rising wedge gate valve or similar approved	70%
2.7.7.21		200 mm dia Cla-Val strainer complete or similar approved	70%
2.7.7.22		200 mm dia Cla-Val flow control valve complete or similar approved	70%
2.7.7.24		200 mm dia Cla-Val orifice plate complete or similar approved	70%
2.7.7.25		200 mm dia Woltman WP type meter complete or similar approved	70%
2.7.7.30		100 mm dia non-rising spindle resilient seal gate valve	70%
2.7.7.31		100 mm dia Vent-O-Mat Series RBX double office air valve with anti shock office mechanism	70%
2.7.7.35		100 mm dia non-rising spindle resilient seal gate valve	70%
2.7.7.36		100 mm dia Vent-O-Mat Series RBX double office air valve with anti shock office mechanism	70%
2.8.7.9		400 mm dia VOSA non-rising wedge gate valve or similar approved	70%
2.8.7.10		200 mm dia VOSA non-rising wedge gate valve or similar approved	70%
2.8.7.14		100 mm dia non-rising spindle resilient seal gate valve	70%
2.8.7.15		100 mm dia Vent-O-Mat Series RBX double office air valve with anti shock office mechanism	70%
2.8.7.17		200 mm dia wedge gate valve, both ends flanged	70%
2.9.7.7		600 mm dia VOSA non-rising wedge gate valve or similar approved	70%
2.9.7.9		200 mm dia VOSA non-rising wedge gate valve or similar approved	70%
2.9.7.12		100 mm dia non-rising spindle resilient seal gate valve	70%
2.9.7.13		100 mm dia Vent-O-Mat Series RBX double office air valve with anti shock office mechanism	70%
2.9.7.16		200 mm dia wedge gate valve,both ends flanged	70%
2.10.4.34		160mm dia flanged class 16 gate valve	70%
2.10.4.35		200mm dia flanged class 16 gate valve	70%
2.10.4.36		250mm dia flanged class 16 gate valve	70%
2.10.4.37		315mm dia flanged class 16 gate valve	70%
2.10.4.38		450mm dia flanged class 16 gate valve	70%
2.11.4.22		160mm dia flanged class 16 gate valve	70%
2.11.4.23		250mm dia flanged class 16 gate valve	70%
2.11.4.24		315mm dia flanged class 16 gate valve	70%
2.11.4.25		400mm dia flanged class 16 gate valve	70%

Item no.(* see Note below)		Description of Goods	Stipulated minimum threshold
4.2.3.1		DN600 PN16 wedge gate valves, non-rising spindle c/w gearbox	70%
4.2.3.2		DN500 PN16 wedge gate valves, non-rising spindle c/w gearbox	70%
4.2.3.3		DN450 PN16 wedge gate valves, non-rising spindle c/w gearbox	70%
4.2.3.4		DN400 PN16 wedge gate valves, non-rising spindle c/w gearbox	70%
4.2.3.5		DN400 PN16 Wedge gate valve	70%
4.2.3.6		DN350 PN16 Wedge gate valve	70%
4.2.3.7		DN600 PN16 Swing type non return valve	70%
4.2.3.8		DN400 PN16 Swing type non return valve	70%
4.2.3.9		DN100 PN16 Swing type non return valve	70%
4.2.3.10		DN450 PN16 Ball float valve	70%
4.2.3.11		DN400 PN16 Pressure reducing valve (PRV)	70%
4.2.3.12		DN100 PN16 RSV gate valves	70%
4.2.3.13		DN100 PN16 Air valve	70%
4.2.3.14		DN50 PN16 Ball valves	70%
4.2.3.15		DN25 PN16 Ball valves	70%
		Transformers and Shunt Reactors	
4.3.2		400kVA mini-substation transformer (Class 3B)	45%
		Steel Products and Component for Construction	
2.1.3.1		Handrail assembly complete: Horizontal	100%
2.1.3.2		Handrail assembly complete: Sloping	100%
2.1.3.3		Handrail assembly complete: Shaped Ends	100%
2.3.6.1		Galvanised steel rectagrid RS40 with 50 x 4.5mm bearers	100%
2.5.3.1		DN700 Grade X42 to API 5L steel pipes (t = 8 mm), with Single Coat Solvent Free Liquid Epoxy Lining and Polyisobutene Visco-elastic coating.	80%
2.6.2.7		High-tensile steel bars for scour and overflow collection chamber	100%
2.6.3.1		Access ladders, complete with corrosion protection	100%
2.6.3.2		Floor frame, complete with corrosion protection	100%
2.6.3.3		Floor grating (rectagrid), complete with corrosion protection	100%
2.6.4.1		Spool piece DN 200 x 4.5 mm	80%
2.6.4.2		Short radius bend (2 d); 90 degree DN 700 x 8 mm	80%
2.7.5.10		Mild-steel and high tensile steel bars	100%

Item no.(* see Note below)		Description of Goods	Stipulated minimum threshold
2.7.5.38		700mm diameter manhole cover and frame with lockable cover to sans 558 Type 4 Mild Steel	100%
2.7.5.40		Air breather	100%
2.7.6.1		Galvanized mild steel ladders Type A bolted to concrete walls for air valve chambers	100%
2.7.6.2		Galvanized mild steel ladders Type A bolted to concrete walls for isolating valve chambers	100%
		Grade X42 to API 5L welded steel pipes, internally lined with Single Coat Solvent Free Liquid Epoxy lining (600 microns DFT) to SANS 1217 and externally coating with Polyisobutene Visco-elastic (Stopaq) or similar approved:	
2.7.7.1		610mm dia x 8 mm thickness steel pipe, flange drilling to SANS 1123 T1600/3	80%
		Isolating valve chambers	
2.7.7.3		219 mm dia x 90 degree steel bend, flanged	80%
2.7.7.4		610 mm dia steel flange with 1500 mm long integral straight pipe	80%
2.7.7.5		400mm dia X 610mm dia steel reducer flanged both ends	80%
2.7.7.6		400 mm dia x 1450 mm steel puddle pipe, flanged both end	80%
2.7.7.7		400 mm dia x 219 mm dia steel tee, all ends flanged	80%
2.7.7.9		400 mm x 400 mm dia. equal steel tee , flanged both ends	80%
2.7.7.11		400 mm dia. x 2000 mm steel straight pipe, flanged both ends	80%
2.7.7.14		400 mm dia x 620 mm steel straight pipe, flanged both ends	80%
2.7.7.15		610 mm dia x 610 mm equal steel tee, flanged	80%
2.7.7.16		675 mm dia x 610 mm dia steel reducer, flanged both ends	80%
2.7.7.17		675 mm dia steel flange welded to exisitng 675 mm dia existing steel pipe	80%
2.7.7.18		610 mm dia x 1595 mm steel puddle pipe, flanged both ends	80%
2.7.7.19		209 mm x 1643 mm steel straight pipe, flanged both ends	80%
2.7.7.23		209 mm dia x 1000 mm steel straight pipe, flanged both ends	80%
2.7.7.26		209 mm dia x 209 mm equal steel tee, flanged	80%
2.7.7.27		150 mm x 60 mm x 25 mm triangular shaped support bracket welded on	80%
2.7.7.28		580 mm dia steel flange fitting with 80 mm dia x 250 mm steel spool pipe and lifting hooks	80%
2.7.7.29		340 mm dia flange fitting with 80 mm dia x 250 mm steel spool pipe and lifting hooks	80%
		Air valve chambers	
2.7.7.32		610 mm dia x 350 mm dia x 1181 mm unequal steel tee, both ends flanged	80%

Item no.(* see Note below)		Description of Goods	Stipulated minimum threshold
2.7.7.33		150 mm x 60 mm x 25 mm triangular shaped support bracket welded on	80%
2.7.7.34		100 mm dia. Steel pipe with 840 mm dia. Steel flange fitted on one end and 220 mm dia steel flange fitted on one end with lifting hooks	80%
		Bends in change of 610 mm dia pipe directions:	
2.7.7.38		Over 5° up to 10°	80%
2.7.7.39		Over 10° up to 15°	80%
2.7.7.40		Over 15° up to 20°	80%
2.7.7.41		Over 25° up to 30°	80%
2.7.7.42		Over 40° up to 45°	80%
2.7.7.43		Over 50° up to 55°	80%
2.7.7.44		Over 70° up to 75°	80%
2.7.7.45		Over 85° up to 90°	80%
2.8.5.10		Mild-steel and high tensile steel bars	100%
2.8.5.24		Steel strap pipe fixing bracket for 200mm dia pipe	100%
2.8.5.25		3 mm thick x 2.02 m long x 1,60 m girth L-shaped galvanized steel plate fixed with chemical anchors at maximum 500 mm centres in both directions to concrete walls and floors	100%
2.8.5.26		Galvanized mild steel grid formed of 100 mm x 3 mm thick x 1 600 mm long flat section base plate with 20 mm dia x 150 mm long studs welded on at 150 mm centres and six times bolted to concrete with chemical anchors	100%
2.8.5.38		700mm diameter manhole cover and frame with lockable cover to sans 558 Type 4 Mild Steel	100%
2.8.5.39		Calcamite 4 Ever type step irons	100%
2.8.5.40		Air breather	100%
2.8.6.1		Galvanized mild steel ladders Type A bolted to concrete walls for air valve chambers	100%
2.8.6.2		Galvanized mild steel ladders Type A bolted to concrete walls for isolating valve chambers	100%
2.8.6.3		Galvanized mild steel ladders Type A bolted to concrete walls for scour valve chambers	100%
			100%
		Grade X42 to API 5L welded steel pipes, internally lined with Single Coat Solvent Free Liquid Epoxy lining (600 microns DFT) to SANS 1217 and externally coating with Polyisobutene Visco-elastic (Stopaq) or similar approved:	
2.8.7.1		610mm dia x 8 mm thickness steel pipe, flange drilling to SANS 1123 T1600/3	80%
		Isolating valve chambers	
2.8.7.4		219 mm dia x 90 degree steel bend, flanged	80%
2.8.7.5		219 mm dia x 446 mm steel straight pipe, flanged both sides	80%

Item no.(* see Note below)		Description of Goods	Stipulated minimum threshold
2.8.7.6		400mm dia steel flange with flange adaptor to mPVC pipe	80%
2.8.7.7		400 mm dia x 1450 mm steel puddle pipe, flanged both end	80%
2.8.7.8		407 mm dia x 219 mm dia steel tee, all ends flanged	80%
		Air valve chambers	
2.8.7.11		407 mm dia x 407 mm dia x 1181 mm steel tee, one end flanged,with flange adaptor to mPVC pipe	80%
2.8.7.12		150 mm x 60 mm x 25 mm triangular shaped support bracket welded on	80%
2.8.7.13		100 mm dia. Steel pipe with 580 mm dia. Steel flange fitted on one end and 220 mm dia steel flange fitted on one end with lifting hooks	80%
		Scour valve chambers	
2.8.7.16		407 mm dia x 4800 mm double puddle pipe, flanged both ends combination fitting comprising 407 mm dia x 219 mm dia flanged scour outlet, with 407 mm dia. X 610 mm dia. access pipe and flange adaptor to mPVC pipe	80%
2.8.7.18		219 mm dia x 614 mm spool pipe,both ends flanged	80%
2.8.7.19		219 mm dia x 1 100 mm puddle pipe flanged one end	80%
		Bends in change of 610 mm dia pipe directions:	
2.8.7.20		Over 5° up to 10°	80%
2.8.7.21		Over 10° up to 15°	80%
2.8.7.22		Over 15° up to 20°	80%
2.8.7.23		Over 35° up to 40°	80%
2.8.7.24		Over 85° up to 90°	80%
		Tees:	
2.8.7.29		610mm dia x 407mm dia unequal tee	80%
2.8.7.30		407 mm dia x 407mm dia equal tee	80%
		Flange adaptor:	
2.8.7.31		610 mm dia.	80%
2.8.7.32		407 mm dia.	80%
		Reducers, flanged:	
2.8.7.33		610 mm dia x 250mm dia	80%
2.8.7.34		610 mm dia x 315mm dia	80%
2.9.5.10		Mild-steel and high tensile steel bars	100%
2.9.5.25		Steel strap pipe fixing bracket for 200mm dia pipe	100%

Item no.(* see Note below)		Description of Goods	Stipulated minimum threshold
2.9.5.26		3 mm thick x 2.02 m long x 1,60 m girth L-shaped galvanized steel plate fixed with chemical anchors at maximum 500 mm centres in both directions to concrete walls and floors	100%
2.9.5.27		Galvanized mild steel grid formed of 100 mm x 3 mm thick x 1 600 mm long flat section base plate with 20 mm dia x 150 mm long studs welded on at 150 mm centres and six times bolted to concrete with chemical anchors	100%
2.9.5.38		700mm diameter manhole cover and frame with lockable cover to sans 558 Type 4 Mild Steel	100%
2.9.5.39		Calcamite 4 Ever type step irons	100%
2.9.5.40		Air breather	100%
2.9.6.1		Galvanized mild steel ladders Type A bolted to concrete walls for air valve chambers	100%
2.9.6.2		Galvanized mild steel ladders Type A bolted to concrete walls for isolating valve chambers	100%
2.9.6.3		Galvanized mild steel ladders Type A bolted to concrete walls for scour valve chambers	100%
		Grade X42 to API 5L welded steel pipes, internally lined with Single Coat Solvent Free Liquid Epoxy lining (600 microns DFT) to SANS 1217 and externally coating with Polyisobutene Visco-elastic (Stopaq) or similar approved:	
2.9.7.1		610mm dia x 8 mm thickness steel pipe, flange drilling to SANS 1123 T1600/3	80%
		Isolating valve chambers	
2.9.7.3		219 mm dia x 90 degree steel bend, flanged	80%
2.9.7.4		219 mm dia x 446 mm steel straight pipe, flanged both sides	80%
2.9.7.5		610mm dia Steel flange with integral straight pipe	80%
2.9.7.6		610 mm dia x 1 450 mm steel puddle pipe, flanged both sides	80%
2.9.7.7		610 mm dia x 219 mm dia steel tee, all ends flanged	80%
		Air valve chambers	
2.9.7.10		610 mm dia x 610 mm dia x 1181 mm steel tee, flanged both ends	80%
2.9.7.11		150 mm x 60 mm x 25 mm triangular shaped support bracket welded on	80%
2.9.7.12		100 mm dia. Steel pipe with 840 mm dia. Steel flange fitted on one end and 220 mm dia steel flange fitted on one end with lifting hooks	80%
		Scour valve chambers	
2.9.7.16		610 mm dia x 4800 mm double puddle pipe, flanged both ends combination fitting comprising 610 mm dia x 219 mm dia flanged scour outlet, with 610 mm dia. X 610 mm dia. Access pipe	80%

Item no.(* see Note below)		Description of Goods	Stipulated minimum threshold
2.9.7.18		219 mm dia x 614 mm spool pipe,both ends flanged	80%
2.9.7.19		219 mm dia x 1 100 mm puddle pipe flanged one end	80%
		Bends in change of 610 mm dia pipe directions:	
2.9.7.21		Over 5° up to 10°	80%
2.9.7.22		Over 10° up to 15°	80%
2.9.7.23		Over 20° up to 25°	80%
2.9.7.24		Over 30° up to 35°	80%
2.9.7.25		Over 40° up to 45°	80%
2.9.7.26		Over 45° up to 50°	80%
2.9.7.27		Over 65° up to 70°	80%
2.9.7.28		Over 70° up to 75°	80%
2.9.7.29		Over 85° up to 90°	80%
		Tees:	
2.9.7.30		610mm dia x 610mm dia equal tee	80%
		Flanged Tees:	
2.10.4.15		160mm dia x 160mm dia	80%
2.10.4.16		200mm dia x 200mm dia	80%
2.10.4.17		250mm dia x 250mm dia	80%
2.10.4.18		315mm dia x 315mm dia	80%
2.10.4.19		450mm dia x 450mm dia	80%
		Blank flange drilled to SANS Table 16:	
2.10.4.20		160mm dia	80%
2.10.4.21		315mm dia	80%
		Reducers, flanged:	
2.10.4.22		160mm dia x 160mm dia	80%
2.10.4.23		200mm dia x 160mm dia	80%
2.10.4.24		250mm dia x 160mm dia	80%
2.10.4.25		315mm dia x 200mm dia	80%
2.10.4.26		315mm dia x 250mm dia	80%
2.10.4.27		450mm dia x 160mm dia	80%
2.10.4.28		450mm dia x 315mm dia	80%
		Flange adaptor:	
2.10.4.29		160mm dia	80%
2.10.4.30		200 mm dia	80%
2.10.4.31		250 mm dia	80%

Item no.(* see Note below)		Description of Goods	Stipulated minimum threshold
2.10.4.32		315mm dia	80%
2.10.4.33		450 mm dia	80%
		Flanged Tees:	
2.11.4.9		160mm dia x 160mm dia	80%
2.11.4.10		250mm dia x 250mm dia	80%
2.11.4.11		315mm dia x 315mm dia	80%
2.11.4.12		400mm dia x 400mm dia	80%
		Reducers, flanged:	
2.11.4.13		250mm dia x 160mm dia	80%
2.11.4.14		315mm dia x 160mm dia	80%
2.11.4.15		315mm dia x 250mm dia	80%
2.11.4.16		500mm dia x 315mm dia	80%
2.11.4.17		500mm dia x 250mm dia	80%
		Flange adaptor:	
2.11.4.18		160mm dia	80%
2.11.4.19		250 mm dia	80%
2.11.4.20		315mm dia	80%
2.11.4.21		400 mm dia	80%
		Supply and erection of new fencing material complete	
2.13.9.1		Clearvu Mesh panel 3297 wide x 2100mm high	100%
2.13.9.2		Galvanized post, 2700 mm long	100%
2.13.9.3		Concrete post foundation (400x400x600)mm	100%
2.13.9.4		Shark tooth spike rail, 100mm high	100%
2.13.9.5		Anti Burrow Ripper Flatwrap, 500mm wide	100%
		New gates	
2.13.9.6		Double Leaf Swing Gates with Clearvu Fencing complete	100%
2.13.9.7		Sliding Gates with Clearvu Fencing complete	100%
		Tower	
3.2.23		8 mm to 16 mm mild steel bars	100%
3.2.24		10 mm to 16 mm high-tensile steel bars	100%
3.2.25		20 mm to 32 mm high-tensile steel bars	100%
3.3.1		Structural Steel Staircase Complete with all, handrails, grating, fixing bolts, cleats etc.	100%
3.3.2		TDX maximum security door from interlock systems complete with all. For access into tower	100%

Item no.(* see Note below)		Description of Goods	Stipulated minimum threshold
3.3.3		Galvanised fixed handrail assembly complete and installed on concrete floors	100%
3.3.4		Galvanised fixed handrail assembly complete and installed on tank shaft	100%
3.3.5		Galvanised fixed handrail assembly complete and installed on roof	100%
3.3.6		Galvanised removable handrails, with floor sockets complete and installed on concrete floors around access way opening	100%
3.3.7		Stainless steel ladder with safety cage inside water tank	100%
3.3.8		Galvanised steel ladder with safety cage in tank shaft	100%
3.3.9		Trap door and frame (galvanised), access to tank roof	100%
3.4.1		Hot-dipped galvanised 305 x 305 x 97 kg/m steel universal column for tower cladding	100%
		Reservoir	
4.3.24		High-tensile steel bars	100%
		Hot dipped galvanised steel for access slab, cat ladder, channels, walkways, staircases, pumphouse roof etc	
4.5.1		40 x 40 x 4mm Thick angle section (type:kb)	100%
4.5.2		40 x 40 x 5mm Thick angle section (type:a8)	100%
4.5.3		50 x 50 x 5mm Thick angle section (type:a15)	100%
4.5.4		50 x 50 x 6mm Thick angle section (type:a16)	100%
4.5.5		60 x 60 x 6mm Thick angle section (type:a20)	100%
4.5.6		70 x 70 x 8mm Thick angle section (type:a25)	100%
4.5.7		80 x 60 x 8mm Thick angle section (type:ua7)	100%
4.5.8		90 x 65 x 8mm Thick angle section (type:ua9)	100%
4.5.9		90 x 90 x 6mm Thick angle section (type:a90)	100%
4.5.10		120 x 120 x 10mm Thick angle section (type:a44)	100%
4.5.11		88.9 x 5mm Thick circular hollow section (type:hs1)	100%
4.5.12		88.9 x 6mm Thick circular hollow section (type:hs2)	100%
4.5.13		76.2 x 5mm Thick circular hollow section (type:hs3)	100%
4.5.14		150 x 75 x 20 x 3.0mm Thick cold formed lipped channel (type:lc15)	100%
4.5.15		180 x 70 x 21.1kg/m Parallel flange channel (type:pc2)	100%
4.5.16		200 x 75 x 24.3kg/m Parallel flange channel (type:pc4)	100%
4.5.17		300 x 100 x 45.4kg/m Parallel flange channel (type:pc7)	100%
4.5.18		152 x 152 x 23kg/m Universal column (type:uc1)	100%
4.5.19		254 x 254 x 107.1kg/m Universal beam (type:uc13)	100%

Item no.(* see Note below)		Description of Goods	Stipulated minimum threshold
		Stainless steel balustrading formed with 43mm diameter x 3mm thick stanchions at 1200mm centres, 33mm diameter x 2.6mm thick top and bottom rails, filled with 15mm diameter vertical bars at 125mm centres, finished on all surfaces with a epoxy coated painted finish and erected complete in strict accordance with manufactures instructions	
4.5.60		Horizontal top mounted 1100mm high bolted to steel Rectagrid walkway including ends	100%
4.5.61		Raking top mounted balustrading 1100mm high bolted to Rectagrid walkway	100%
4.5.62		Stainless steel ladder 4500mm high	100%
4.5.63		370mm wide x 1240mm long x 6mm thick "Vastrap" plate continuous treads with flat section stringers and both side bolted to steel member (bolts and stringer measured elsewhere).	100%
4.5.64		370mm wide x 1100mm long x 6mm thick "Vastrap" plate continuous treads with flat section stringers and both side bolted to steel member (bolts and stringer measured elsewhere).	100%
4.5.65		Stainless steel Rectagrid RS40 with 40 x 5mm placed on 40 x 40 x 5mm angle section (angle section measured elsewhere)	100%
4.5.66		Stainless steel Rectagrid RS40 with 80 x 5.5mm placed on 90 x 90 x 10mm angle section (angle section measured elsewhere)	100%
4.5.67		40 x 40 x 5mm Thick stainless steel angle section with 200 x 20 x 5 fishtail lugs welded at 500mm c/c welded along length , cast into concrete	100%
4.5.68		90 x 90 x 10mm Thick stainless steel angle section with 200 x 20 x 5 fishtail lugs welded at 500mm c/c welded along length , cast into concrete	100%
4.6.1		0.58mm thick concealed fix " Klip-lok 406" or similar approved light industrial Z275 spelter galvanised steel sheeting with "Globalcoat" or similar approved finish and colour to one side, "Globalcoat Grey" or similar approved finish to other side with and including accessories fixed structural steel members for Curved roof coverings with pitches not exceeding 25Â°, fixed to steel purlins	100%
4.6.2		0.8mm thick concealed fix " Klip-lok 406" or similar approved light industrial Z275 spelter galvanised steel sheeting with "Globalcoat" or similar approved finish and colour to one side, "Globalcoat Grey" or similar approved finish to other side with and including accessories fixed structural steel members for Side wall flashing.	100%
4.6.3		0.8mm thick concealed fix " Klip-lok 406" or similar approved light industrial Z275 spelter galvanised steel sheeting with "Globalcoat" or similar approved finish and colour to one side, "Globalcoat Grey" or similar approved finish to other side with and including accessories fixed structural steel members for narrow or broad flute closers.	100%
4.6.4		4mm Thick Alulite 4040 insulation sheeting installed according to suppliers specification under curved roof	100%

Item no.(* see Note below)		Description of Goods	Stipulated minimum threshold
4.8.1		100mm Stainless steel holderbat fix to wall with stainless steel HSL K8 anchors @ 1500mm c/c max	100%
4.11.7		900 x 900mm "Trox" or similar approved aluminium lourvers	100%
4.11.8		Semi solid core flush panelled single door size 813 x 2032 x 44mm thick, cut 100mm short, with commercial veneered finish suitable for painting on both sides including pressed steel double rebated door frame suitable for 230mm wall, including all necessary ironmongery.	100%
4.11.10		Steel door frames	100%
4.11.13		4800 x 3400mm high Purpose made Motorised galvanised steel security gates comprising 60kg/m2 steel frame and guide frame, complete with and including wheels, rails, cover plates, motor etc. as per drawings and specifications.	100%
		Mechanical	
4.2.3.16		DN600 PN16 Dismantling Joint	80%
4.2.3.17		DN500 PN16 Dismantling Joint	80%
4.2.3.18		DN450 PN16 Dismantling Joint	80%
4.2.3.19		DN400 PN16 Dismantling Joint	80%
4.2.3.20		DN350 PN16 Dismantling Joint	80%
4.2.3.21		DN250 PN16 Dismantling Joint	80%
		Reservoir Inlet Pipework	
4.2.4.1		Item 1: DN 600 Pipe Spool	80%
4.2.4.2		Item 2: DN 450 Pipe Spool	80%
4.2.4.3		Item 5: DN 450 Pipe Spool	80%
4.2.4.4		Item 6: DN 450 Pipe Spool	80%
4.2.4.5		Item 7: DN 450 Pipe Spool	80%
4.2.4.6		Item 8: DN 450 Pipe Spool	80%
4.2.4.7		Item 9: DN 450 Pipe Spool	80%
4.2.4.8		Item 10: DN 450 Pipe Spool	80%
4.2.4.9		Item 11: DN 450 Pipe Spool	80%
4.2.4.10		Item 12: DN 450 Pipe Spool	80%
4.2.4.11		Item 14: DN 450 Pipe Spool	80%
4.2.4.12		Item 15: DN 450 Pipe Spool	80%
4.2.4.13		Item 16: DN 450 Pipe Spool	80%
4.2.4.14		Item 17: DN 450 Pipe Spool	80%
4.2.4.15		Item 18: DN 450 Pipe Spool	80%
		Reservoir Outlet Pipework	
4.2.4.16		Item 1: DN 450 Pipe Spool	80%

Item no.(* see Note below)		Description of Goods	Stipulated minimum threshold
4.2.4.17		Item 2: DN 450 Pipe Spool	80%
4.2.4.18		Item 5: DN 450 Pipe Spool	80%
4.2.4.19		Item 6: DN 600 Pipe Spool	80%
4.2.4.20		Item 10: DN 600 Pipe Spool	80%
4.2.4.21		Item 11: DN 600 Pipe Spool	80%
4.2.4.22		Item 12: DN 450 Pipe Spool	80%
4.2.4.23		Item 16: DN 450 Pipe Spool	80%
4.2.4.24		Item 18: DN 100 Pipe Spool	80%
4.2.4.25		Item 19: DN 450 Full-face flange insulating gasket kit	80%
		Pump Pipework	
4.2.4.26		Item 2: DN 500 Reducing Pipe Spool	80%
4.2.4.27		Item 3: DN 500 Pipe Spool	80%
4.2.4.28		Item 6: DN 500 Pipe Spool	80%
4.2.4.29		Item 7: DN 500 Pipe Spool	80%
4.2.4.30		Item 9: DN 400 Reducing Pipe Spool	80%
4.2.4.31		Item 10: DN 400 Pipe Spool	80%
4.2.4.32		Item 12: DN 500 Full-face flange insulating gasket kit	80%
4.2.4.33		Item 14: DN 400 Pipe Spool	80%
4.2.4.34		Item 15: DN 400 Pipe Spool	80%
4.2.4.35		Item 16: DN 400 Pipe Spool	80%
4.2.4.36		Item 17: DN 400 Pipe Spool	80%
4.2.4.37		Item 18: DN 400 Pipe Spool	80%
4.2.4.38		Item 19: DN 400 Pipe Spool	80%
4.2.4.39		Item 20: DN 400 Pipe Spool	80%
4.2.4.40		Item 21: DN 400 Pipe Spool	80%
4.2.4.41		Item 22: DN 50 Pipe Spool	80%
4.2.4.42		Item 24: DN 50 Pipe Spool	80%
		Bypass Pipework	
4.2.4.43		Item 1: DN 400 Pipe Spool	80%
4.2.4.44		Item 2: DN 400 Pipe Spool	80%
4.2.4.45		Item 6: DN 400 Pipe Spool	80%
4.2.4.46		Item 8: DN 400 Pipe Spool	80%
4.2.4.47		Item 9: DN 500 Pipe Spool	80%
4.2.4.48		Item 12: DN 500 Pipe Spool	80%
4.2.4.49		Item 14: DN 500 Pipe Spool	80%
4.2.4.50		Item 15: DN 500 Pipe Spool	80%
		Scour and Overflow Pipework	
4.2.4.51		Item 1: DN 350 Reducing Pipe Spool	80%

Item no.(* see Note below)		Description of Goods	Stipulated minimum threshold
4.2.4.52		Item 2: DN 350 Reducing Pipe Spool	80%
4.2.4.53		Item 3: DN 350 Pipe Spool	80%
4.2.4.54		Item 4: DN 350 Pipe Spool	80%
4.2.4.55		Item 7: DN 350 Pipe Spool	80%
4.2.4.56		Item 8: DN 700 Reducing Pipe Spool	80%
4.2.4.57		Item 9: DN 700 Pipe Spool	80%
4.2.4.58		Item 10: DN 700 Pipe Spool	80%
4.2.4.59		Item 11: DN 700 Pipe Spool	80%
4.2.4.60		Item 12: DN 350 Full-face flange insulating gasket kit	80%
4.2.4.61		Item 13: DN 700 Pipe Spool	80%
4.2.4.62		Item 14: DN 700 Pipe Spool	80%
4.2.4.63		Item 15: DN 700 Full-face flange insulating gasket kit	80%
		Tower Pipework	
4.2.4.64		Item 1.1: DN 400 Pipe Spool	80%
4.2.4.65		Item 1.2: DN 400 Pipe Spool	80%
4.2.4.66		Item 1.3: DN 400 Pipe Spool	80%
4.2.4.67		Item 1.4: DN 400 Pipe Spool	80%
4.2.4.68		Item 1.5: DN 400 Pipe Spool	80%
4.2.4.69		Item 1.6: DN 400 Full-face flange insulating gasket kit	80%
4.2.4.70		Item 2.1: DN 500 Pipe Spool	80%
4.2.4.71		Item 2.2: DN 500 Pipe Spool	80%
4.2.4.72		Item 2.3: DN 500 Pipe Spool	80%
4.2.4.73		Item 2.4: DN 500 Pipe Spool	80%
4.2.4.74		Item 2.5: DN 500 Pipe Spool	80%
4.2.4.75		Item 2.6: DN 500 Full-face flange insulating gasket kit	80%
4.2.4.76		Item 3.1: DN 500 Pipe Spool	80%
4.2.4.77		Item 3.2: DN 500 Pipe Spool	80%
4.2.4.78		Item 3.3: DN 500 Pipe Spool	80%
4.2.4.79		Item 3.4: DN 500 Pipe Spool	80%
4.2.4.80		Item 3.7: DN 400 Pipe Spool	80%
4.2.4.81		Item 3.8: DN 400 Pipe Spool	80%
4.2.4.82		Item 3.9: DN 500 Pipe Spool	80%
4.2.4.83		Item 3.10: DN 500 Pipe Spool	80%
4.2.4.84		Item 3.11: DN 500 Pipe Spool	80%
4.2.4.85		Item 3.12: DN 500 Pipe Spool	80%
4.2.4.86		Item 3.13: DN 500 Pipe Spool	80%
4.2.4.87		Item 3.14: DN 500 Full-face flange insulating gasket kit	80%
4.2.4.88		Item 3.15: DN 400 Full-face flange insulating gasket kit	80%

Item no.(* see Note below)		Description of Goods	Stipulated minimum threshold
		Sump Pump Assembly Pipework	
4.2.4.89		Item 2: DN 100 Pipe Spool	80%
4.2.4.90		Item 4: DN 100 Pipe Spool	80%
4.2.4.91		Item 5: DN 100 Pipe Spool	80%
		Supply, installation, testing and commissioning	
4.2.6.1		Single Girder Electric Overhead Travelling Crane (SGEOT), 5 ton lifting capacity	100%
		Electrical	
4.3.6.10		Supply and install galvanized steel cable trays complete with all wall and floor mounting P2000 supports, splicing other fixing materials required as per suppliers specifications. Cable tray earth wire at every joint, 457mm x 76mm - straight runs.	100%
4.3.6.11		Supply and install galvanized steel cable trays complete with all wall and floor mounting P2000 supports, splicing other fixing materials required as per suppliers specifications. Cable tray earth wire at every joint, 300mm x 50mm - straight runs.	100%
4.3.6.12		Supply and install galvanized steel cable trays complete with all wall and floor mounting P2000 supports, splicing other fixing materials required as per suppliers specifications. Cable tray earth wire at every joint, 300mm - T-off.	100%
4.3.6.13		Steel angle irons for the support of motor feeder cables - 50mm x 50mm, including all materials required to complete the installation. Cable to be strapped to support with "Bandit " strapping.	100%
4.3.6.14		Unistrut 50mm x 50mm for the supporting of all types of cables, including all materials required to complete the installation and strapping of cables with "Bandit" strapping.	100%
4.3.10.29		3R12 stainless steel 25mm x 25mm angle iron for support of instrument cables, including all materials required to complete the installation. Cable to be strapped to support with "Bandit" strapping.	100%
		Pumps, Medium Voltage (MV) Motor and Associated Accessories	
		Supply, installation, testing and commissioning of pumps	
4.2.2.1		Horizontal split casing centrifugal pump, complete with motor, coupling, baseframe and anciliaries	70%
4.2.2.3		Submersible pump, complete with duckfoot, guides and quick coupling	70%
		Supply, installation, testing and commissioning	
4.2.6.3		MCC room filtered fresh air pressurisation unit comprising weather cowl, filter plenum with compact pocket filters, centrifugal fan (500 L/s at 140 Pa), weather louvres, mountings, isolator, controls, wiring	70%

Item no.(* see Note below)		Description of Goods	Stipulated minimum threshold
		and ancillaries	
4.2.6.4		MCC room split type air conditioning unit 24 000 BTUh cooling only	70%
		Supply, installation, testing and commissioning	
4.2.6.7		Pressure gauges for pump suction and discharge	70%
		Back-up power diesel generator	
4.3.3.1		Supply, deliver, install and commissioning of a 350kVA (pf = 1) enclosed sound proof PRIME rated back-up diesel generator CANOPY set, including change-over panel with circuit breakers as specified in specifications.	70%
		Plastic Pipes	
2.4.3.1		25mm diameter HDPE PE 100 PN 12.5 SDR 13.6 pipe	100%
2.4.5.1		110mm diameter uPVC heavy duty class 34 to SANS 791 pipes	100%
2.8.7.3		400mm diameter mPVC class 16 pipes to SANS 966	100%
		Supplying, laying, and bedding of mPVC / PVC-O specials complete with couplings:	
2.8.7.35		11.25° bends: 400 mm dia.	100%
2.8.7.36		22.5° bends: 400 mm dia.	100%
2.8.7.37		45° bends: 400 mm dia.	100%
2.8.7.38		90° bends: 400 mm dia.	100%
2.10.4.1		160 mm diameter mPVC class 16 pipes to SANS 966	100%
2.10.4.2		200mm diameter mPVC class 16 pipes to SANS 966	100%
2.10.4.3		250mm diameter mPVC class 16 pipes to SANS 966	100%
2.10.4.4		315mm diameter mPVC class 16 pipes to SANS 966	100%
2.10.4.5		450mm diameter mPVC class 16 pipes to SANS 966	100%
2.10.4.6		160mm diameter HDPE PE 100 PN 16 SDR 11 pipe	100%
2.10.4.7		200mm diameter HDPE PE 100 PN 16 SDR 11 pipe	100%
2.10.4.8		450mm diameter HDPE PE 100 PN 16 SDR 11 pipe	100%
		Supplying, laying, and bedding of mPVC / PVC-O specials complete with couplings:	
2.10.4.9		22.5° bends: 160 mm dia.	100%
2.10.4.10		22.5° bends: 200 mm dia.	100%
2.10.4.11		45° bends: 200 mm dia.	100%
2.10.4.12		90° bends: 200 mm dia.	100%
2.10.4.13		90° bends: 315 mm dia.	100%

Item no.(* see Note below)		Description of Goods	Stipulated minimum threshold
2.10.4.14		90° bends: 450 mm dia.	100%
2.11.4.1		160mm diameter mPVC class 16 pipes to SANS 966	100%
2.11.4.3		250mm diameter mPVC class 16 pipes to SANS 966	100%
2.11.4.4		315mm diameter mPVC class 16 pipes to SANS 966	100%
2.11.4.5		400mm diameter mPVC class 16 pipes to SANS 966	100%
2.11.4.6		250mm diameter HDPE PE 100 PN 16 SDR 11 pipe	100%
		Supplying, laying, and bedding of mPVC / PVC-O specials complete with couplings:	
2.11.4.7		90° bends: 250 mm dia.	100%
2.11.4.8		90° bends: 250 mm dia.	100%
4.8.3		100mm diameter perforated normal duty uPVC pipes complete with couplings	100%
4.8.4		110mm diameter perforated normal duty uPVC pipes complete with couplings	100%

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Annex C

Local Content Declaration - Summary Schedule

(C1) **Tender No.** JW14322
(C2) **Tender description:** Construction of a 26ML Concrete Reservoir and 2ML Concrete Water Tower in Brixton with associated pipe and pump works
(C3) **Designated product(s)**
(C4) **Tender Authority:**
(C5) **Tendering Entity name:**
(C6) **Tender Exchange Rate:** USD EU GBP
(C7) **Specified local content %** Shown in Table below

Note: VAT to be excluded from all calculations

		Calculation of local content						Tender summary			
Tender item no's	List of items	Tender price each (excl VAT)	Exempted imported value	Tender value net of exempted imported content	Imported value	Local value	Local content % (per item)	Tender Qty	Total tender value	Total exempted imported content	Total Imported content
(C8)	(C9)	(C10)	(C11)	(C12)	(C13)	(C14)	(C15)	(C16)	(C17)	(C18)	(C19)
	Street Light Steel Poles										
4.3.7.20	Galvanised steel light pole						100%	10 No.			
	Electrical and Telecom Cables										
	PVC/PVC/SWA/PVC Copper cable										
4.3.5.1	185mm², 4-Core						90%	160 m			
4.3.5.2	150mm², 4-Core						90%	130 m			
4.3.5.3	10mm², 3-Core						90%	460 m			
	PVC/PVC/PVC Copper cable										
4.3.5.4	10mm², 5-Core						90%	40 m			
4.3.5.5	4mm², 3-Core						90%	330 m			
4.3.5.6	2.5mm², 3-Core						90%	450 m			
	Bare Copper Earth Wire (BCEW)										
4.3.5.7	70mm², 1-Core						90%	315 m			
4.3.5.8	2.5mm², 1-Core						90%	360 m			
	Conduits & Wire Ways										
4.3.6.15	160mm diameter PVC sleeves						90%	85 m			
4.3.6.16	110mm diameter PVC sleeves						90%	350 m			
4.3.6.17	25mm GALV. steel conduit						90%	120 m			
4.3.6.18	32mm GALV. steel conduit						90%	380 m			
4.3.6.19	25mm PVC. conduit						90%	165 m			
	Individually and overall screened twisted pair										
4.3.10.22	1 Pair						90%	100 m			
4.3.10.23	2 Pair						90%	460 m			
4.3.10.24	4 Pair						90%	120 m			
4.3.10.25	6 Pair						90%	120 m			
4.3.10.26	8 Pair						90%	120 m			
4.3.10.27	24 Pair						90%	140 m			
	Valves Products and actuators										
2.7.7.8	400mm dia VOSA non-rising wedge gate valve or similar approved						70%	2 no.			
2.7.7.10	400 mm dia Cla-Val orifice plate complete or similar approved						70%	1 no.			
2.7.7.12	400 mm dia Cla-Val flow control valve complete or similar approved						70%	1 no.			
2.7.7.13	400 mm dia Cla-Val strainer complete or similar approved						70%	1 no.			

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Annex C

Local Content Declaration - Summary Schedule

(C1) **Tender No.** JW14322
(C2) **Tender description:** Construction of a 26ML Concrete Reservoir and 2ML Concrete Water Tower in Brixton with associated pipe and pump works
(C3) **Designated product(s)**
(C4) **Tender Authority:**
(C5) **Tendering Entity name:**
(C6) **Tender Exchange Rate:** USD [ ] EU [ ] GBP [ ]
(C7) **Specified local content %** Shown in Table below

Note: VAT to be excluded from all calculations

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(C8)	(C9)	(C10)	(C11)	(C12)	(C13)	(C14)	(C15)	(C16)	(C17)	(C18)	(C19)
2.7.7.20	200 mm dia VOSA non-rising wedge gate valve or similar approved						70%	2 no.			
2.7.7.21	200 mm dia Cla-Val strainer complete or similar approved						70%	1 no.			
2.7.7.22	200 mm dia Cla-Val flow control valve complete or similar approved						70%	1 no.			
2.7.7.24	200 mm dia Cla-Val orifice plate complete or similar approved						70%	1 no.			
2.7.7.25	200 mm dia Woltman WP type meter complete or similar approved						70%	1 no.			
2.7.7.30	100 mm dia non-rising spindle resilient seal gate valve						70%	1 no.			
2.7.7.31	100 mm dia Vent-O-Mat Series RBX double office air valve with anti shock office mechanism						70%	1 no.			
2.7.7.35	100 mm dia non-rising spindle resilient seal gate valve						70%	1 no.			
2.7.7.36	100 mm dia Vent-O-Mat Series RBX double office air valve with anti shock office mechanism						70%	1 no.			
2.8.7.9	400 mm dia VOSA non-rising wedge gate valve or similar approved						70%	2 no.			
2.8.7.10	200 mm dia VOSA non-rising wedge gate valve or similar approved						70%	2 no.			
2.8.7.14	100 mm dia non-rising spindle resilient seal gate valve						70%	2 no.			
2.8.7.15	100 mm dia Vent-O-Mat Series RBX double office air valve with anti shock office mechanism						70%	2 no.			
2.8.7.17	200 mm dia wedge gate valve, both ends flanged						70%	2 no.			
2.9.7.7	600 mm dia VOSA non-rising wedge gate valve or similar approved						70%	1 no.			
2.9.7.9	200 mm dia VOSA non-rising wedge gate valve or similar approved						70%	1 no.			
2.9.7.12	100 mm dia non-rising spindle resilient seal gate valve						70%	2 no.			
2.9.7.13	100 mm dia Vent-O-Mat Series RBX double office air valve with anti shock office mechanism						70%	2 no.			
2.9.7.16	200 mm dia wedge gate valve,both ends flanged						70%	2 no.			
2.10.4.34	160mm dia flanged class 16 gate valve						70%	2 no.			
2.10.4.35	200mm dia flanged class 16 gate valve						70%	2 no.			
2.10.4.36	250mm dia flanged class 16 gate valve						70%	2 no.			
2.10.4.37	315mm dia flanged class 16 gate valve						70%	4 no.			

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Annex C

Local Content Declaration - Summary Schedule

(C1) **Tender No.** JW14322
(C2) **Tender description:** Construction of a 26ML Concrete Reservoir and 2ML Concrete Water Tower in Brixton with associated pipe and pump works
(C3) **Designated product(s)**
(C4) **Tender Authority:**
(C5) **Tendering Entity name:**
(C6) **Tender Exchange Rate:** USD [ ] EU [ ] GBP [ ]
(C7) **Specified local content %** Shown in Table below

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(C8)	(C9)	(C10)	(C11)	(C12)	(C13)	(C14)	(C15)	(C16)	(C17)	(C18)	(C19)
2.10.4.38	450mm dia flanged class 16 gate valve						70%	4 no.			
2.11.4.22	160mm dia flanged class 16 gate valve						70%	4 no.			
2.11.4.23	250mm dia flanged class 16 gate valve						70%	4 no.			
2.11.4.24	315mm dia flanged class 16 gate valve						70%	1 no.			
2.11.4.25	400mm dia flanged class 16 gate valve						70%	2 no.			
4.2.3.1	DN600 PN16 wedge gate valves, non-rising spindle c/w gearbox						70%	2 no.			
4.2.3.2	DN500 PN16 wedge gate valves, non-rising spindle c/w gearbox						70%	3 no.			
4.2.3.3	DN450 PN16 wedge gate valves, non-rising spindle c/w gearbox						70%	4 no.			
4.2.3.4	DN400 PN16 wedge gate valves, non-rising spindle c/w gearbox						70%	5 no.			
4.2.3.5	DN400 PN16 Wedge gate valve						70%	1 no.			
4.2.3.6	DN350 PN16 Wedge gate valve						70%	1 no.			
4.2.3.7	DN600 PN16 Swing type non return valve						70%	1 no.			
4.2.3.8	DN400 PN16 Swing type non return valve						70%	2 no.			
4.2.3.9	DN100 PN16 Swing type non return valve						70%	1 no.			
4.2.3.10	DN450 PN16 Ball float valve						70%	2 no.			
4.2.3.11	DN400 PN16 Pressure reducing valve (PRV)						70%	1 no.			
4.2.3.12	DN100 PN16 RSV gate valves						70%	6 no.			
4.2.3.13	DN100 PN16 Air valve						70%	2 no.			
4.2.3.14	DN50 PN16 Ball valves						70%	5 no.			
4.2.3.15	DN25 PN16 Ball valves						70%	10 no.			
	Transformers and Shunt Reactors										
4.3.2	400kVA mini-substation transformer (Class 3B)						45%	1 sum			
	Steel Products and Component for Construction										
2.1.3.1	Handrail assembly complete: Horizontal						100%	50 m			
2.1.3.2	Handrail assembly complete: Sloping						100%	10 m			
2.1.3.3	Handrail assembly complete: Shaped Ends						100%	8 no.			
2.3.6.1	Galvanised steel rectagrid RS40 with 50 x 4.5mm bearers						100%	15 m²			
2.5.3.1	DN700 Grade X42 to API 5L steel pipes (t = 8 mm), with Single Coat Solvent Free Liquid Epoxy Lining and Polyisobutene Visco-elastic coating						80%	22 m			
2.6.2.7	High-tensile steel bars for scour and overflow collection chamber						100%	2 t			

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Local Content Declaration - Summary Schedule

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(C1) **Tender No.** JW14322
(C2) **Tender description:** Construction of a 26ML Concrete Reservoir and 2ML Concrete Water Tower in Brixton with associated pipe and pump works
(C3) **Designated product(s)**
(C4) **Tender Authority:**
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(C6) **Tender Exchange Rate:** USD [ ] EU [ ] GBP [ ]
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(C8)	(C9)	(C10)	(C11)	(C12)	(C13)	(C14)	(C15)	(C16)	(C17)	(C18)	(C19)
2.6.3.1	Access ladders, complete with corrosion protection						100%	1 no.			
2.6.3.2	Floor frame, complete with corrosion protection						100%	1 no.			
2.6.3.3	Floor grating (rectagrid), complete with corrosion protection						100%	8 m²			
2.6.4.1	Spool piece DN 700 x 8 mm						80%	1 no.			
2.6.4.2	Short radius bend (2 d); 90 degree DN 700 x 8 mm						80%	1 no.			
2.7.5.10	Mild-steel and high tensile steel bars						100%	9.4 t			
2.7.5.38	700mm diameter manhole cover and frame with lockable cover to sans 558 Type 4 Mild Steel						100%	3 no.			
2.7.5.39	Air breather						100%	4 no.			
2.7.6.1	Galvanized mild steel ladders Type A bolted to concrete walls for air valve chambers						100%	1 no.			
2.7.6.2	Galvanized mild steel ladders Type A bolted to concrete walls for isolating valve chambers						100%	1 no.			
	Grade X42 to API 5L welded steel pipes, internally lined with Single Coat Solvent Free Liquid Epoxy lining (600 microns DFT) to SANS 1217 and externally coating with Polyisobutene Visco-elastic (Stopaq) or similar approved:										
2.7.7.1	610mm dia x 8 mm thickness steel pipe, flange drilling to SANS 1123 T1600/3:						80%	880 m			
	Isolating valve chambers										
2.7.7.3	219 mm dia x 90 degree steel bend, flanged						80%	2 no.			
2.7.7.4	610 mm dia steel flange with 1500 mm long integral straight pipe						80%	1 no.			
2.7.7.5	400mm dia X 610mm dia steel reducer flanged both ends						80%	1 no.			
2.7.7.6	400 mm dia x 1450 mm steel puddle pipe, flanged both end						80%	2 no.			
2.7.7.7	400 mm dia x 219 mm dia steel tee, all ends flanged						80%	2 no.			
2.7.7.9	400 mm x 400 mm dia. equal steel tee , flanged both ends						80%	1 no.			
2.7.7.11	400 mm dia. x 2000 mm steel straight pipe, flanged both ends						80%	1 no.			
2.7.7.14	400 mm dia x 620 mm steel straight pipe, flanged both ends						80%	1 no.			
2.7.7.15	610 mm dia x 610 mm equal steel tee, flanged						80%	1 no.			
2.7.7.16	675 mm dia x 610 mm dia steel reducer, flanged both ends						80%	2 no.			

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Annex C

Local Content Declaration - Summary Schedule

(C1) **Tender No.** JW14322
(C2) **Tender description:** Construction of a 26ML Concrete Reservoir and 2ML Concrete Water Tower in Brixton with associated pipe and pump works
(C3) **Designated product(s)**
(C4) **Tender Authority:**
(C5) **Tendering Entity name:**
(C6) **Tender Exchange Rate:** USD EU GBP
(C7) **Specified local content %** Shown in Table below

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		Calculation of local content						Tender summary			
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(C8)	(C9)	(C10)	(C11)	(C12)	(C13)	(C14)	(C15)	(C16)	(C17)	(C18)	(C19)
2.7.7.17	675 mm dia steel flange welded to exisitng 675 mm dia existing steel pipe						80%	2 no.			
2.7.7.18	610 mm dia x 1595 mm steel puddle pipe, flanged both ends						80%	1 no.			
2.7.7.19	209 mm x 1643 mm steel straight pipe, flanged both ends						80%	2 no.			
2.7.7.23	209 mm dia x 1000 mm steel straight pipe, flanged both ends						80%	1 no.			
2.7.7.26	209 mm dia x 209 mm equal steel tee, flanged						80%	1 no.			
2.7.7.27	150 mm x 60 mm x 25 mm triangular shaped support bracket welded on						80%	8 no.			
2.7.7.28	580 mm dia steel flange fitting with 80 mm dia x 250 mm steel spool pipe and lifting hooks						80%	1 no.			
2.7.7.29	340 mm dia flange fitting with 80 mm dia x 250 mm steel spool pipe and lifting hooks						80%	1 no.			
	Air valve chambers										
2.7.7.32	610 mm dia x 350 mm dia x 1181 mm unequal steel tee, both ends flanged						80%	1 no.			
2.7.7.33	150 mm x 60 mm x 25 mm triangular shaped support bracket welded on						80%	4 no.			
2.7.7.34	100 mm dia. Steel pipe with 840 mm dia. Steel flange fitted on one end and 220 mm dia steel flange fitted on one end with lifting hooks						80%	1 no.			
	Bends in change of 610 mm dia pipe directions:										
2.7.7.38	Over 5° up to 10°						80%	1 no.			
2.7.7.39	Over 10° up to 15°						80%	2 no.			
2.7.7.40	Over 15° up to 20°						80%	1 no.			
2.7.7.41	Over 25° up to 30°						80%	1 no.			
2.7.7.42	Over 40° up to 45°						80%	1 no.			
2.7.7.43	Over 50° up to 55°						80%	1 no.			
2.7.7.44	Over 70° up to 75°						80%	1 no.			
2.7.7.45	Over 85° up to 90°						80%	1 no.			
2.8.5.10	Mild-steel and high tensile steel bars						100%	9 t			
2.8.5.24	Steel strap pipe fixing bracket for 200mm dia pipe						100%	1 no.			
2.8.5.25	3 mm thick x 2.02 m long x 1,60 m girth L-shaped galvanized steel plate fixed with chemical anchors at maximum 500 mm centres in both directions to concrete walls and floors						100%	1 no.			

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Annex C

Local Content Declaration - Summary Schedule

Note: VAT to be excluded from all calculations

(C1) **Tender No.** JW14322
(C2) **Tender description:** Construction of a 26ML Concrete Reservoir and 2ML Concrete Water Tower in Brixton with associated pipe and pump works
(C3) **Designated product(s)**
(C4) **Tender Authority:**
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(C8)	(C9)	(C10)	(C11)	(C12)	(C13)	(C14)	(C15)	(C16)	(C17)	(C18)	(C19)
2.8.5.26	Galvanized mild steel grid formed of 100 mm x 3 mm thick x 1 600 mm long flat section base plate with 20 mm dia x 150 mm long studs welded on at 150 mm centres and six times bolted to concrete with chemical anchors						100%	13 no.			
2.8.5.38	700mm diameter manhole cover and frame with lockable cover to sans 558 Type 4 Mild Steel						100%	8 no.			
2.8.5.39	Calcamite 4 Ever type step irons						100%	60 no.			
2.8.5.40	Air breather						100%	12 no.			
2.8.6.1	Galvanized mild steel ladders Type A bolted to concrete walls for air valve chambers						100%	2 no.			
2.8.6.2	Galvanized mild steel ladders Type A bolted to concrete walls for isolating valve chambers						100%	2 no.			
2.8.6.3	Galvanized mild steel ladders Type A bolted to concrete walls for scour valve chambers						100%	1 no.			
	Grade X42 to API 5L welded steel pipes, internally lined with Single Coat Solvent Free Liquid Epoxy lining (600 microns DFT) to SANS 1217 and externally coating with Polyisobutene Visco-elastic (Stopaq) or similar approved:										
2.8.7.1	610mm dia x 8 mm thickness steel pipe, flange drilling to SANS 1123 T1600/3:						80%	433 m			
	Isolating valve chambers										
2.8.7.4	219 mm dia x 90 degree steel bend, flanged						80%	4 no.			
2.8.7.5	219 mm dia x 446 mm steel straight pipe, flanged both sides						80%	4 no.			
2.8.7.6	400mm dia steel flange with flange adaptor to mPVC pipe						80%	4 no.			
2.8.7.7	400 mm dia x 1450 mm steel puddle pipe, flanged both end						80%	4 no.			
2.8.7.8	407 mm dia x 219 mm dia steel tee, all ends flanged						80%	4 no.			
	Air valve chambers										
2.8.7.11	407 mm dia x 407 mm dia x 1181 mm steel tee, one end flanged,with flange adaptor to mPVC pipe						80%	2 no.			
2.8.7.12	150 mm x 60 mm x 25 mm triangular shaped support bracket welded on						80%	8 no.			
2.8.7.13	100 mm dia. Steel pipe with 580 mm dia. Steel flange fitted on one end and 220 mm dia steel flange fitted on one end with lifting hooks						80%	2 no.			

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Annex C

Local Content Declaration - Summary Schedule

(C1) **Tender No.** JW14322
(C2) **Tender description:** Construction of a 26ML Concrete Reservoir and 2ML Concrete Water Tower in Brixton with associated pipe and pump works
(C3) **Designated product(s)**
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(C8)	(C9)	(C10)	(C11)	(C12)	(C13)	(C14)	(C15)	(C16)	(C17)	(C18)	(C19)
	Scour valve chambers										
2.8.7.16	407 mm dia x 4800 mm double puddle pipe, flanged both ends combination fitting comprising 407 mm dia x 219 mm dia flanged scour outlet, with 407 mm dia. X 610 mm dia. access pipe and flange adaptor to mPVC pipe						80%	1 no.			
2.8.7.18	219 mm dia x 614 mm spool pipe,both ends flanged						80%	1 no.			
2.8.7.19	219 mm dia x 1 100 mm puddle pipe flanged one end						80%	1 no.			
	Bends in change of 610 mm dia pipe directions:										
2.8.7.20	Over 5° up to 10°						80%	1 no.			
2.8.7.21	Over 10° up to 15°						80%	1 no.			
2.8.7.22	Over 15° up to 20°						80%	1 no.			
2.8.7.23	Over 35° up to 40°						80%	2 no.			
2.8.7.24	Over 85° up to 90°						80%	2 no.			
	Tees:										
2.8.7.29	610mm dia x 407mm dia unequal tee						80%	1 no.			
2.8.7.30	407 mm dia x 407mm dia equal tee						80%	1 no.			
	Flange adaptor:										
2.8.7.31	610 mm dia.						80%	1 no.			
2.8.7.32	407 mm dia.						80%	1 no.			
	Reducers, flanged:										
2.8.7.33	610 mm dia x 250mm dia						80%	1 no.			
2.8.7.34	610 mm dia x 315mm dia						80%	1 no.			
2.9.5.10	Mild-steel and high tensile steel bars						100%	16 t			
2.9.5.25	Steel strap pipe fixing bracket for 200mm dia pipe						100%	1 no.			
2.9.5.26	3 mm thick x 2.02 m long x 1,60 m girth L-shaped galvanized steel plate fixed with chemical anchors at maximum 500 mm centres in both directions to concrete walls and floors						100%	1 no.			
2.9.5.27	Galvanized mild steel grid formed of 100 mm x 3 mm thick x 1 600 mm long flat section base plate with 20 mm dia x 150 mm long studs welded on at 150 mm centres and six times bolted to concrete with chemical anchors						100%	13 no.			
2.9.5.38	700mm diameter manhole cover and frame with lockable cover to sans 558 Type 4 Mild Steel						100%	6 no.			

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Annex C

Local Content Declaration - Summary Schedule

Note: VAT to be excluded from all calculations

(C1) **Tender No.** JW14322
(C2) **Tender description:** Construction of a 26ML Concrete Reservoir and 2ML Concrete Water Tower in Brixton with associated pipe and pump works
(C3) **Designated product(s)**
(C4) **Tender Authority:**
(C5) **Tendering Entity name:**
(C6) **Tender Exchange Rate:** USD [ ] EU [ ] GBP [ ]
(C7) **Specified local content %** Shown in Table below

		Calculation of local content						Tender summary			
Tender item no's	List of items	Tender price each (excl VAT)	Exempted imported value	Tender value net of exempted imported content	Imported value	Local value	Local content % (per item)	Tender Qty	Total tender value	Total exempted imported content	Total Imported content
(C8)	(C9)	(C10)	(C11)	(C12)	(C13)	(C14)	(C15)	(C16)	(C17)	(C18)	(C19)
2.9.5.39	Calcamite 4 Ever type step irons						100%	190 no.			
2.9.5.40	Air breather						100%	8 no.			
2.9.6.1	Galvanized mild steel ladders Type A bolted to concrete walls for air valve chambers						100%	2 no.			
2.9.6.2	Galvanized mild steel ladders Type A bolted to concrete walls for isolating valve chambers						100%	1 no.			
2.9.6.3	Galvanized mild steel ladders Type A bolted to concrete walls for scour valve chambers						100%	1 no.			
	Grade X42 to API 5L welded steel pipes, internally lined with Single Coat Solvent Free Liquid Epoxy lining (600 microns DFT) to SANS 1217 and externally coating with Polyisobutene Visco-elastic (Stopaq) or similar approved:										
2.9.7.1	610mm dia x 8 mm thickness steel pipe, flange drilling to SANS 1123 T1600/3:						80%	1407 m			
	Isolating valve chambers										
2.9.7.3	219 mm dia x 90 degree steel bend, flanged						80%	2 no.			
2.9.7.4	219 mm dia x 446 mm steel straight pipe, flanged both sides						80%	2 no.			
2.9.7.5	610mm dia Steel flange with integral straight pipe						80%	2 no.			
2.9.7.6	610 mm dia x 1 450 mm steel puddle pipe, flanged both sides						80%	2 no.			
2.9.7.7	610 mm dia x 219 mm dia steel tee, all ends flanged						80%	1 no.			
	Air valve chambers										
2.9.7.10	610 mm dia x 610 mm dia x 1181 mm steel tee, flanged both ends						80%	2 no.			
2.9.7.11	150 mm x 60 mm x 25 mm triangular shaped support bracket welded on						80%	8 no.			
2.9.7.12	100 mm dia. Steel pipe with 840 mm dia. Steel flange fitted on one end and 220 mm dia steel flange fitted on one end with lifting hooks						80%	2 no.			
	Scour valve chambers										
2.9.7.16	610 mm dia x 4800 mm double puddle pipe, flanged both ends combination fitting comprising 610 mm dia x 219 mm dia flanged scour outlet, with 610 mm dia. X 610 mm dia. Access pipe						80%	1 no.			
2.9.7.18	219 mm dia x 614 mm spool pipe,both ends flanged						80%	1 no.			

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Annex C

Local Content Declaration - Summary Schedule

(C1) **Tender No.** JW14322
(C2) **Tender description:** Construction of a 26ML Concrete Reservoir and 2ML Concrete Water Tower in Brixton with associated pipe and pump works
(C3) **Designated product(s)**
(C4) **Tender Authority:**
(C5) **Tendering Entity name:**
(C6) **Tender Exchange Rate:** USD [ ] EU [ ] GBP [ ]
(C7) **Specified local content %** Shown in Table below

Note: VAT to be excluded from all calculations

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(C8)	(C9)	(C10)	(C11)	(C12)	(C13)	(C14)	(C15)	(C16)	(C17)	(C18)	(C19)
2.9.7.19	219 mm dia x 1 100 mm puddle pipe flanged one end						80%	1 no.			
	Bends in change of 610 mm dia pipe directions:										
2.9.7.21	Over 5° up to 10°						80%	1 no.			
2.9.7.22	Over 10° up to 15°						80%	3 no.			
2.9.7.23	Over 20° up to 25°						80%	3 no.			
2.9.7.24	Over 30° up to 35°						80%	1 no.			
2.9.7.25	Over 40° up to 45°						80%	1 no.			
2.9.7.26	Over 45° up to 50°						80%	1 no.			
2.9.7.27	Over 65° up to 70°						80%	1 no.			
2.9.7.28	Over 70° up to 75°						80%	1 no.			
2.9.7.29	Over 85° up to 90°						80%	3 no.			
	Tees:										
2.9.7.30	610mm dia x 610mm dia equal tee						80%	1 no.			
	Flanged Tees:										
2.10.4.15	160mm dia x 160mm dia						80%	1 no.			
2.10.4.16	200mm dia x 200mm dia						80%	1 no.			
2.10.4.17	250mm dia x 250mm dia						80%	1 no.			
2.10.4.18	315mm dia x 315mm dia						80%	2 no.			
2.10.4.19	450mm dia x 450mm dia						80%	2 no.			
	Blank flange drilled to SANS Table 16:										
2.10.4.20	160mm dia						80%	1 no.			
2.10.4.21	315mm dia						80%	1 no.			
	Reducers, flanged:										
2.10.4.22	160mm dia x 160mm dia						80%	1 no.			
2.10.4.23	200mm dia x 160mm dia						80%	2 no.			
2.10.4.24	250mm dia x 160mm dia						80%	2 no.			
2.10.4.25	315mm dia x 200mm dia						80%	1 no.			
2.10.4.26	315mm dia x 250mm dia						80%	1 no.			
2.10.4.27	450mm dia x 160mm dia						80%	1 no.			
2.10.4.28	450mm dia x 315mm dia						80%	2 no.			
	Flange adaptor:										
2.10.4.29	160mm dia						80%	5 no.			
2.10.4.30	200 mm dia						80%	3 no.			
2.10.4.31	250 mm dia						80%	2 no.			
2.10.4.32	315mm dia						80%	4 no.			
2.10.4.33	450 mm dia						80%	4 no.			

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Annex C

Local Content Declaration - Summary Schedule

(C1) **Tender No.** JW14322
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(C8)	(C9)	(C10)	(C11)	(C12)	(C13)	(C14)	(C15)	(C16)	(C17)	(C18)	(C19)
	Flanged Tees:										
2.11.4.9	160mm dia x 160mm dia						80%	2 no.			
2.11.4.10	250mm dia x 250mm dia						80%	2 no.			
2.11.4.11	315mm dia x 315mm dia						80%	1 no.			
2.11.4.12	400mm dia x 400mm dia						80%	1 no.			
	Reducers, flanged:										
2.11.4.13	250mm dia x 160mm dia						80%	3 no.			
2.11.4.14	315mm dia x 160mm dia						80%	1 no.			
2.11.4.15	315mm dia x 250mm dia						80%	1 no.			
2.11.4.16	500mm dia x 315mm dia						80%	1 no.			
2.11.4.17	500mm dia x 250mm dia						80%	1 no.			
	Flange adaptor:										
2.11.4.18	160mm dia						80%	4 no.			
2.11.4.19	250 mm dia						80%	3 no.			
2.11.4.20	315mm dia						80%	2 no.			
2.11.4.21	400 mm dia						80%	1 no.			
	Supply and erection of new fencing material complete										
2.13.9.1	Clearvu Mesh panel 3297 wide x 2100mm high						100%	179 no.			
2.13.9.2	Galvanized post, 2700 mm long						100%	180 no.			
2.13.9.3	Concrete post foundation (400x400x600)mm						100%	19 m^3			
2.13.9.4	Shark tooth spike rail, 100mm high						100%	605 m			
2.13.9.5	Anti Burrow Ripper Flatwrap, 500mm wide						100%	202 m			
	New gates										
2.13.9.6	Double Leaf Swing Gates with Clearvu Fencing complete						100%	1 no.			
2.13.9.7	Sliding Gates with Clearvu Fencing complete						100%	3 no.			
	Tower										
3.2.23	8 mm to 16 mm mild steel bars						100%	2 t			
3.2.24	10 mm to 16 mm high-tensile steel bars						100%	70 t			
3.2.25	20 mm to 32 mm high-tensile steel bars						100%	162 t			
3.3.1	Structural Steel Staircase Complete with all, handrails, grating, fixing bolts, cleats etc.						100%	6 t			
3.3.2	TDX maximum security door from interlock systems complete with all. For access into tower						100%	1 no.			

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Annex C

Local Content Declaration - Summary Schedule

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(C1) **Tender No.** JW14322
(C2) **Tender description:** Construction of a 26ML Concrete Reservoir and 2ML Concrete Water Tower in Brixton with associated pipe and pump works
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(C8)	(C9)	(C10)	(C11)	(C12)	(C13)	(C14)	(C15)	(C16)	(C17)	(C18)	(C19)
3.3.3	Galvanised fixed handrail assembly complete and installed on concrete floors						100%	34 m			
3.3.4	Galvanised fixed handrail assembly complete and installed on tank shaft						100%	7 m			
3.3.5	Galvanised fixed handrail assembly complete and installed on roof						100%	64 m			
3.3.6	Galvanised removable handrails, with floor sockets complete and installed on concrete floors around access way opening						100%	26 m			
3.3.7	Stainless steel ladder with safety cage inside water tank						100%	1 no.			
3.3.8	Galvanised steel ladder with safety cage in tank shaft						100%	1 no.			
3.3.9	Trap door and frame (galvanised), access to tank roof						100%	1 no.			
3.4.1	Hot-dipped galvanised 305 x 305 x 97 kg/m steel universal column for tower cladding						100%	156 t			
	Reservoir										
4.3.24	High-tensile steel bars						100%	439 t			
	Hot dipped galvanised steel for access slab, cat ladder, channels, walkways, staircases, pumphouse roof etc										
4.5.1	40 x 40 x 4mm Thick angle section (type:kb)						100%	0.35 t			
4.5.2	40 x 40 x 5mm Thick angle section (type:a8)						100%	1.59 t			
4.5.3	50 x 50 x 5mm Thick angle section (type:a15)						100%	0.20 t			
4.5.4	50 x 50 x 6mm Thick angle section (type:a16)						100%	0.09 t			
4.5.5	60 x 60 x 6mm Thick angle section (type:a20)						100%	0.25 t			
4.5.6	70 x 70 x 8mm Thick angle section (type:a25)						100%	0.22 t			
4.5.7	80 x 60 x 8mm Thick angle section (type:ua7)						100%	0.32 t			
4.5.8	90 x 65 x 8mm Thick angle section (type:ua9)						100%	0.39 t			
4.5.9	90 x 90 x 6mm Thick angle section (type:a90)						100%	0.38 t			
4.5.10	120 x 120 x 10mm Thick angle section (type:a44)						100%	0.25 t			
4.5.11	88.9 x 5mm Thick circular hollow section (type:hs1)						100%	0.24 t			
4.5.12	88.9 x 6mm Thick circular hollow section (type:hs2)						100%	0.23 t			
4.5.13	76.2 x 5mm Thick circular hollow section (type:hs3)						100%	0.09 t			
4.5.14	150 x 75 x 20 x 3.0mm Thick cold formed lipped channel (type:lc15)						100%	1.43 t			
4.5.15	180 x 70 x 21.1kg/m Parallel flange channel (type:pc2)						100%	2.54 t			
4.5.16	200 x 75 x 24.3kg/m Parallel flange channel (type:pc4)						100%	0.49 t			

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Annex C

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4.5.17	300 x 100 x 45.4kg/m Parallel flange channel (type:pc7)						100%	0.64 t			
4.5.18	152 x 152 x 23kg/m Universal column (type:uc1)						100%	0.75 t			
4.5.19	254 x 254 x 107.1kg/m Universal beam (type:uc13)						100%	4.04 t			
	Stainless steel balustrading formed with 43mm diameter x 3mm thick stanchions at 1200mm centres, 33mm diameter x 2.6mm thick top and bottom rails, filled with 15mm diameter vertical bars at 125mm centres, finished on all surfaces with a epoxy coated painted finish and erected complete in strict accordance with manufactures instructions										
4.5.60	Horizontal top mounted 1100mm high bolted to steel Rectagrid walkway including ends						100%	40 m			
4.5.61	Raking top mounted balustrading 1100mm high bolted to Rectagrid walkway						100%	22 m			
4.5.62	Stainless steel ladder 4500mm high						100%	7 no.			
4.5.63	370mm wide x 1240mm long x 6mm thick "Vastrap" plate continuous treads with flat section stringers and both side bolted to steel member (bolts and stringer measured elsewhere).						100%	25 no.			
4.5.64	370mm wide x 1100mm long x 6mm thick "Vastrap" plate continuous treads with flat section stringers and both side bolted to steel member (bolts and stringer measured elsewhere).						100%	21 no.			
4.5.65	Stainless steel Rectagrid RS40 with 40 x 5mm placed on 40 x 40 x 5mm angle section (angle section measured elsewhere)						100%	64 m²			
4.5.66	Stainless steel Rectagrid RS40 with 80 x 5.5mm placed on 90 x 90 x 10mm angle section (angle section measured elsewhere)						100%	5 m²			
4.5.67	40 x 40 x 5mm Thick stainless steel angle section with 200 x 20 x 5 fishtail lugs welded at 500mm c/c welded along length , cast into concrete						100%	0.12 t			
4.5.68	90 x 90 x 10mm Thick stainless steel angle section with 200 x 20 x 5 fishtail lugs welded at 500mm c/c welded along length , cast into concrete						100%	0.03 t			

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Local Content Declaration - Summary Schedule

(C1) **Tender No.** JW14322
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4.6.1	0.58mm thick concealed fix " Klip-lok 406" or similar approved light industrial Z275 spelter galvanised steel sheeting with "Globalcoat" or similar approved finish and colour to one side, "Globalcoat Grey" or similar approved finish to other side with and including accessories fixed structural steel members for Curved roof coverings with pitches not exceeding 25Â°, fixed to steel purlins						100%	279 m²			
4.6.2	0.8mm thick concealed fix " Klip-lok 406" or similar approved light industrial Z275 spelter galvanised steel sheeting with "Globalcoat" or similar approved finish and colour to one side, "Globalcoat Grey" or similar approved finish to other side with and including accessories fixed structural steel members for Side wall flashing.						100%	39 m			
4.6.3	0.8mm thick concealed fix " Klip-lok 406" or similar approved light industrial Z275 spelter galvanised steel sheeting with "Globalcoat" or similar approved finish and colour to one side, "Globalcoat Grey" or similar approved finish to other side with and including accessories fixed structural steel members for narrow or broad flute closers.						100%	66 m			
4.6.4	4mm Thick Alulite 4040 insulation sheeting installed according to suppliers specification under curved roof						100%	279 m²			
4.8.1	100mm Stainless steel holderbat fix to wall with stainless steel HSL K8 anchors @ 1500mm c/c max						100%	22 no.			
4.11.7	900 x 900mm "Trox" or similar approved aluminium lourvers						100%	9 no.			
4.11.8	Semi solid core flush panelled single door size 813 x 2032 x 44mm thick, cut 100mm short, with commercial veneered finish suitable for painting on both sides including pressed steel double rebated door frame suitable for 230mm wall, including all necessary ironmongery.						100%	3 no.			
4.11.10	Steel door frames						100%	1 m²			

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4.11.13	4800 x 3400mm high Purpose made Motorised galvanised steel security gates comprising 60kg/m2 steel frame and guide frame, complete with and including wheels, rails, cover plates, motor etc. as per drawings and specifications.						100%	1 no.			
	Mechanical										
4.2.3.16	DN600 PN16 Dismantling Joint						80%	2 no.			
4.2.3.17	DN500 PN16 Dismantling Joint						80%	3 no.			
4.2.3.18	DN450 PN16 Dismantling Joint						80%	4 no.			
4.2.3.19	DN400 PN16 Dismantling Joint						80%	6 no.			
4.2.3.20	DN350 PN16 Dismantling Joint						80%	1 no.			
4.2.3.21	DN250 PN16 Dismantling Joint						80%	2 no.			
	Reservoir Inlet Pipework										
4.2.4.1	Item 1: DN 600 Pipe Spool						80%	1 no.			
4.2.4.2	Item 2: DN 450 Pipe Spool						80%	2 no.			
4.2.4.3	Item 5: DN 450 Pipe Spool						80%	1 no.			
4.2.4.4	Item 6: DN 450 Pipe Spool						80%	1 no.			
4.2.4.5	Item 7: DN 450 Pipe Spool						80%	1 no.			
4.2.4.6	Item 8: DN 450 Pipe Spool						80%	12 no.			
4.2.4.7	Item 9: DN 450 Pipe Spool						80%	1 no.			
4.2.4.8	Item 10: DN 450 Pipe Spool						80%	1 no.			
4.2.4.9	Item 11: DN 450 Pipe Spool						80%	1 no.			
4.2.4.10	Item 12: DN 450 Pipe Spool						80%	1 no.			
4.2.4.11	Item 14: DN 450 Pipe Spool						80%	1 no.			
4.2.4.12	Item 15: DN 450 Pipe Spool						80%	1 no.			
4.2.4.13	Item 16: DN 450 Pipe Spool						80%	1 no.			
4.2.4.14	Item 17: DN 450 Pipe Spool						80%	1 no.			
4.2.4.15	Item 18: DN 450 Pipe Spool						80%	1 no.			
	Reservoir Outlet Pipework										
4.2.4.16	Item 1: DN 450 Pipe Spool						80%	2 no.			
4.2.4.17	Item 2: DN 450 Pipe Spool						80%	1 no.			
4.2.4.18	Item 5: DN 450 Pipe Spool						80%	2 no.			
4.2.4.19	Item 6: DN 600 Pipe Spool						80%	1 no.			
4.2.4.20	Item 10: DN 600 Pipe Spool						80%	1 no.			
4.2.4.21	Item 11: DN 600 Pipe Spool						80%	1 no.			
4.2.4.22	Item 12: DN 450 Pipe Spool						80%	1 no.			
4.2.4.23	Item 16: DN 450 Pipe Spool						80%	1 no.			
4.2.4.24	Item 18: DN 100 Pipe Spool						80%	1 no.			
4.2.4.25	Item 19: DN 450 Full-face flange insulating gasket kit						80%	2 no.			

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	Pump Pipework										
4.2.4.26	Item 2: DN 500 Reducing Pipe Spool						80%	2 no.			
4.2.4.27	Item 3: DN 500 Pipe Spool						80%	2 no.			
4.2.4.28	Item 6: DN 500 Pipe Spool						80%	2 no.			
4.2.4.29	Item 7: DN 500 Pipe Spool						80%	2 no.			
4.2.4.30	Item 9: DN 400 Reducing Pipe Spool						80%	2 no.			
4.2.4.31	Item 10: DN 400 Pipe Spool						80%	2 no.			
4.2.4.32	Item 12: DN 500 Full-face flange insulating gasket kit						80%	2 no.			
4.2.4.33	Item 14: DN 400 Pipe Spool						80%	1 no.			
4.2.4.34	Item 15: DN 400 Pipe Spool						80%	1 no.			
4.2.4.35	Item 16: DN 400 Pipe Spool						80%	1 no.			
4.2.4.36	Item 17: DN 400 Pipe Spool						80%	1 no.			
4.2.4.37	Item 18: DN 400 Pipe Spool						80%	1 no.			
4.2.4.38	Item 19: DN 400 Pipe Spool						80%	1 no.			
4.2.4.39	Item 20: DN 400 Pipe Spool						80%	1 no.			
4.2.4.40	Item 21: DN 400 Pipe Spool						80%	1 no.			
4.2.4.41	Item 22: DN 50 Pipe Spool						80%	1 no.			
4.2.4.42	Item 24: DN 50 Pipe Spool						80%	1 no.			
	Bypass Pipework										
4.2.4.43	Item 1: DN 400 Pipe Spool						80%	1 no.			
4.2.4.44	Item 2: DN 400 Pipe Spool						80%	1 no.			
4.2.4.45	Item 6: DN 400 Pipe Spool						80%	1 no.			
4.2.4.46	Item 8: DN 400 Pipe Spool						80%	1 no.			
4.2.4.47	Item 9: DN 500 Pipe Spool						80%	1 no.			
4.2.4.48	Item 12: DN 500 Pipe Spool						80%	1 no.			
4.2.4.49	Item 14: DN 500 Pipe Spool						80%	2 no.			
4.2.4.50	Item 15: DN 500 Pipe Spool						80%	1 no.			
	Scour and Overflow Pipework										
4.2.4.51	Item 1: DN 350 Reducing Pipe Spool						80%	1 no.			
4.2.4.52	Item 2: DN 350 Reducing Pipe Spool						80%	1 no.			
4.2.4.53	Item 3: DN 350 Pipe Spool						80%	1 no.			
4.2.4.54	Item 4: DN 350 Pipe Spool						80%	1 no.			
4.2.4.55	Item 7: DN 350 Pipe Spool						80%	1 no.			
4.2.4.56	Item 8: DN 700 Reducing Pipe Spool						80%	1 no.			
4.2.4.57	Item 9: DN 700 Pipe Spool						80%	1 no.			
4.2.4.58	Item 10: DN 700 Pipe Spool						80%	1 no.			
4.2.4.59	Item 11: DN 700 Pipe Spool						80%	1 no.			
4.2.4.60	Item 12: DN 350 Full-face flange insulating gasket kit						80%	1 no.			

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Annex C

Local Content Declaration - Summary Schedule

(C1)	**Tender No.**	JW14322
(C2)	**Tender description:**	Construction of a 26ML Concrete Reservoir and 2ML Concrete Water Tower in Brixton with associated pipe and pump works
(C3)	**Designated product(s)**	
(C4)	**Tender Authority:**	
(C5)	**Tendering Entity name:**	
(C6)	**Tender Exchange Rate:**	USD ____ EU ____ GBP ____
(C7)	**Specified local content %**	Shown in Table below

Note: VAT to be excluded from all calculations

		Calculation of local content						Tender summary			
Tender item no's	List of items	Tender price - each (excl VAT)	Exempted imported value	Tender value net of exempted imported content	Imported value	Local value	Local content % (per item)	Tender Qty	Total tender value	Total exempted imported content	Total Imported content
(C8)	(C9)	(C10)	(C11)	(C12)	(C13)	(C14)	(C15)	(C16)	(C17)	(C18)	(C19)
4.2.4.61	Item 13: DN 700 Pipe Spool						80%	1 no.			
4.2.4.62	Item 14: DN 700 Pipe Spool						80%	1 no.			
4.2.4.63	Item 15: DN 700 Full-face flange insulating gasket kit						80%	1 no.			
	Tower Pipework										
4.2.4.64	Item 1.1: DN 400 Pipe Spool						80%	1 no.			
4.2.4.65	Item 1.2: DN 400 Pipe Spool						80%	3 no.			
4.2.4.66	Item 1.3: DN 400 Pipe Spool						80%	1 no.			
4.2.4.67	Item 1.4: DN 400 Pipe Spool						80%	1 no.			
4.2.4.68	Item 1.5: DN 400 Pipe Spool						80%	1 no.			
4.2.4.69	Item 1.6: DN 400 Full-face flange insulating gasket kit						80%	1 no.			
4.2.4.70	Item 2.1: DN 500 Pipe Spool						80%	1 no.			
4.2.4.71	Item 2.2: DN 500 Pipe Spool						80%	1 no.			
4.2.4.72	Item 2.3: DN 500 Pipe Spool						80%	2 no.			
4.2.4.73	Item 2.4: DN 500 Pipe Spool						80%	1 no.			
4.2.4.74	Item 2.5: DN 500 Pipe Spool						80%	1 no.			
4.2.4.75	Item 2.6: DN 500 Full-face flange insulating gasket kit						80%	1 no.			
4.2.4.76	Item 3.1: DN 500 Pipe Spool						80%	1 no.			
4.2.4.77	Item 3.2: DN 500 Pipe Spool						80%	2 no.			
4.2.4.78	Item 3.3: DN 500 Pipe Spool						80%	1 no.			
4.2.4.79	Item 3.4: DN 500 Pipe Spool						80%	1 no.			
4.2.4.80	Item 3.7: DN 400 Pipe Spool						80%	1 no.			
4.2.4.81	Item 3.8: DN 400 Pipe Spool						80%	1 no.			
4.2.4.82	Item 3.9: DN 500 Pipe Spool						80%	1 no.			
4.2.4.83	Item 3.10: DN 500 Pipe Spool						80%	1 no.			
4.2.4.84	Item 3.11: DN 500 Pipe Spool						80%	1 no.			
4.2.4.85	Item 3.12: DN 500 Pipe Spool						80%	1 no.			
4.2.4.86	Item 3.13: DN 500 Pipe Spool						80%	1 no.			
4.2.4.87	Item 3.14: DN 500 Full-face flange insulating gasket kit						80%	1 no.			
4.2.4.88	Item 3.15: DN 400 Full-face flange insulating gasket kit						80%	1 no.			
	Sump Pump Assembly Pipework										
4.2.4.89	Item 2: DN 100 Pipe Spool						80%	1 no.			
4.2.4.90	Item 4: DN 100 Pipe Spool						80%	2 no.			
4.2.4.91	Item 5: DN 100 Pipe Spool						80%	1 no.			
	Supply, installation, testing and commissioning										

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Annex C

Local Content Declaration - Summary Schedule

(C1) **Tender No.** JW14322
(C2) **Tender description:** Construction of a 26ML Concrete Reservoir and 2ML Concrete Water Tower in Brixton with associated pipe and pump works
(C3) **Designated product(s)**
(C4) **Tender Authority:**
(C5) **Tendering Entity name:**
(C6) **Tender Exchange Rate:** USD EU GBP
(C7) **Specified local content %** Shown in Table below

Note: VAT to be excluded from all calculations

		Calculation of local content						Tender summary			
Tender item no's	List of items	Tender price each (excl VAT)	Exempted imported value	Tender value net of exempted imported content	Imported value	Local value	Local content % (per item)	Tender Qty	Total tender value	Total exempted imported content	Total Imported content
(C8)	(C9)	(C10)	(C11)	(C12)	(C13)	(C14)	(C15)	(C16)	(C17)	(C18)	(C19)
4.2.6.1	Single Girder Electric Overhead Travelling Crane (SGEOT), 5 ton lifting capacity						100%	1 no.			
	Electrical										
4.3.6.10	Supply and install galvanized steel cable trays complete with all wall and floor mounting P2000 supports, splicing other fixing materials required as per suppliers specifications. Cable tray earth wire at every joint, 457mm x 76mm - straight runs.						100%	95 m			
4.3.6.11	Supply and install galvanized steel cable trays complete with all wall and floor mounting P2000 supports, splicing other fixing materials required as per suppliers speifications. Cable tray earth wire at every joint, 300mm x 50mm - straight runs.						100%	46 m			
4.3.6.12	Supply and install galvanized steel cable trays complete with all wall and floor mounting P2000 supports, splicing other fixing materials required as per suppliers speifications. Cable tray earth wire at every joint, 300mm - T-off.						100%	1 no.			
4.3.6.13	Steel angle irons for the support of motor feeder cables - 50mm x 50mm, including all materials required to complete the installation. Cable to be strapped to support with "Bandit " strapping.						100%	30 m			
4.3.6.14	Unistrut 50mm x 50mm for the supporting of all types of cables, including all materials required to complete the installation and strapping of cables with "Bandit" strapping.						100%	75 m			
4.3.10.29	3R12 stainless steel 25mm x 25mm angle iron for support of instrument cables, including all materials required to complete the installation. Cable to be strapped to support with "Bandit" strapping.						100%	28 m			
	Pumps, Medium Voltage (MV) Motor and Associated Accessories										
	Supply, installation, testing and commissioning of pumps										
4.2.2.1	Horizontal split casing centrifugal pump, complete with motor, coupling, baseframe and anciliaries						70%	2 no.			
4.2.2.3	Submersible pump, complete with duckfoot, guides and quick coupling						70%	1 no.			
	Supply, installation, testing and commissioning										

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Annex C

Local Content Declaration - Summary Schedule

Note: VAT to be excluded from all calculations

(C1) **Tender No.** JW14322
(C2) **Tender description:** Construction of a 26ML Concrete Reservoir and 2ML Concrete Water Tower in Brixton with associated pipe and pump works
(C3) **Designated product(s)**
(C4) **Tender Authority:**
(C5) **Tendering Entity name:**
(C6) **Tender Exchange Rate:** USD [ ] EU [ ] GBP [ ]
(C7) **Specified local content %** Shown in Table below

		Calculation of local content						Tender summary			
Tender item no's	List of items	Tender price each (excl VAT)	Exempted imported value	Tender value net of exempted imported content	Imported value	Local value	Local content % (per item)	Tender Qty	Total tender value	Total exempted imported content	Total Imported content
(C8)	(C9)	(C10)	(C11)	(C12)	(C13)	(C14)	(C15)	(C16)	(C17)	(C18)	(C19)
4.2.6.3	MCC room filtered fresh air pressurisation unit comprising weather cowl, filter plenum with compact pocket filters, centrifugal fan (500 L/s at 140 Pa), weather louvres, mountings, isolator, controls, wiring and ancillaries						70%	1 no.			
4.2.6.4	MCC room split type air conditioning unit 24 000 BTUh cooling only						70%	1 no.			
	Supply, installation, testing and commissioning										
4.2.6.7	Pressure gauges for pump suction and discharge						70%	4 no.			
	Back-up power diesel generator										
4.3.3.1	Supply, deliver, install and commissioning of a 350kVA (pf = 1) enclosed sound proof PRIME rated back-up diesel generator CANOPY set, including change-over panel with circuit breakers as specified in specifications.						70%	1 sum			
	Plastic Pipes										
2.4.3.1	25mm diameter HDPE PE 100 PN 12.5 SDR 13.6 pipe						100%	60 m			
2.4.5.1	110mm diameter uPVC heavy duty class 34 to SANS 791 pipes						100%	60 m			
2.8.7.3	400mm diameter mPVC class 16 pipes to SANS 966						100%	597 m			
	Supplying, laying, and bedding of mPVC / PVC-O										
2.8.7.35	11.25° bends: 400 mm dia.						100%	1 no.			
2.8.7.36	22.5° bends: 400 mm dia.						100%	1 no.			
2.8.7.37	45° bends: 400 mm dia.						100%	1 no.			
2.8.7.38	90° bends: 400 mm dia.						100%	3 no.			
2.10.4.1	160 mm diameter mPVC class 16 pipes to SANS 966						100%	440 m			
2.10.4.2	200mm diameter mPVC class 16 pipes to SANS 966						100%	126 m			
2.10.4.3	250mm diameter mPVC class 16 pipes to SANS 966						100%	276 m			
2.10.4.4	315mm diameter mPVC class 16 pipes to SANS 966						100%	555 m			
2.10.4.5	450mm diameter mPVC class 16 pipes to SANS 966						100%	740 m			
2.10.4.6	160mm diameter HDPE PE 100 PN 16 SDR 11 pipe						100%	23 m			
2.10.4.7	200mm diameter HDPE PE 100 PN 16 SDR 11 pipe						100%	48 m			
2.10.4.8	450mm diameter HDPE PE 100 PN 16 SDR 11 pipe						100%	31 m			

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Annex C

Local Content Declaration - Summary Schedule

Note: VAT to be excluded from all calculations

(C1) **Tender No.** JW14322
(C2) **Tender description:** Construction of a 26ML Concrete Reservoir and 2ML Concrete Water Tower in Brixton with associated pipe and pump works
(C3) **Designated product(s)**
(C4) **Tender Authority:**
(C5) **Tendering Entity name:**
(C6) **Tender Exchange Rate:** USD [ ] EU [ ] GBP [ ]
(C7) **Specified local content %** Shown in Table below

		Calculation of local content						Tender summary			
Tender item no's	List of items	Tender price each (excl VAT)	Exempted imported value	Tender value net of exempted imported content	Imported value	Local value	Local content % (per item)	Tender Qty	Total tender value	Total exempted imported content	Total Imported content
(C8)	(C9)	(C10)	(C11)	(C12)	(C13)	(C14)	(C15)	(C16)	(C17)	(C18)	(C19)
	Supplying, laying, and bedding of mPVC / PVC-O										
2.10.4.9	22.5° bends: 160 mm dia.						100%	1 no.			
2.10.4.10	22.5° bends: 200 mm dia.						100%	2 no.			
2.10.4.11	45° bends: 200 mm dia.						100%	2 no.			
2.10.4.12	90° bends: 200 mm dia.						100%	1 no.			
2.10.4.13	90° bends: 315 mm dia.						100%	2 no.			
2.10.4.14	90° bends: 450 mm dia.						100%	2 no.			
2.11.4.1	160mm diameter mPVC class 16 pipes to SANS 966						100%	98 m			
2.11.4.3	250mm diameter mPVC class 16 pipes to SANS 966						100%	1240 m			
2.11.4.4	315mm diameter mPVC class 16 pipes to SANS 966						100%	193 m			
2.11.4.5	400mm diameter mPVC class 16 pipes to SANS 966						100%	305m			
2.11.4.6	250mm diameter HDPE PE 100 PN 16 SDR 11 pipe						100%	25 m			
	Supplying, laying, and bedding of mPVC / PVC-O										
2.11.4.7	90° bends: 250 mm dia.						100%	3 no.			
2.11.4.8	90° bends: 250 mm dia.						100%	1 no.			
4.8.3	100mm diameter perforated normal duty uPVC pipes						100%				
4.8.4	110mm diameter perforated normal duty uPVC pipes						100%				

(C20) Total tender value [ ]
(C21) Total Exempt imported content [ ]
(C22) *Total* Tender value net of exempt imported content [ ]
(C23) Total Imported content [ ]
(C24) Total local content [ ]
(C25) Average local content % of tender [ ]

Signature of tenderer from Annex B

Date: _____

3. Does any portion of the goods or services offered have any imported content? (***Tick applicable box***)

YES		NO	

3.1 If yes, the rate(s) of exchange to be used in this bid to calculate the local content as prescribed in paragraph 1.5 of the general conditions must be the rate(s) published by SARB for the specific currency on the date of advertisement of the bid.

The relevant rates of exchange information is accessible on www.resbank.co.za

Indicate the rate(s) of exchange against the appropriate currency in the table below (refer to Annex A of SATS 1286:2011):

Currency	**Rates of exchange**
US Dollar	
Pound Sterling	
Euro	
Yen	
Other	

NB: Bidders must submit proof of the SARB rate (s) of exchange used.

3. Where, after the award of a bid, challenges are experienced in meeting the stipulated minimum threshold for local content the dti must be informed accordingly in order for the dti to verify and in consultation with the AO/AA provide directives in this regard.

LOCAL CONTENT DECLARATION
(REFER TO ANNEX B OF SATS 1286:2011)

LOCAL CONTENT DECLARATION BY CHIEF FINANCIAL OFFICER OR OTHER LEGALLY RESPONSIBLE PERSON NOMINATED IN WRITING BY THE CHIEF EXECUTIVE OR SENIOR MEMBER/PERSON WITH MANAGEMENT RESPONSIBILITY (CLOSE CORPORATION, PARTNERSHIP OR INDIVIDUAL)

IN RESPECT OF BID NO. .....

ISSUED BY: (Procurement Authority / Name of Institution): …….....

NB

1 The obligation to complete, duly sign and submit this declaration cannot be transferred to an external authorized representative, auditor or any other third party acting on behalf of the bidder.

2 Guidance on the Calculation of Local Content together with Local Content Declaration Templates (Annex C, D and E) is accessible on http://www.thedtic.gov.za/industrial_development/ip.jsp. Bidders should first complete Declaration D. After completing Declaration D, bidders should complete Declaration E and then consolidate the information on Declaration C. **Declaration C should be submitted with the bid documentation at the closing date and time of the bid in order to substantiate the declaration made in paragraph (c) below.** Declarations D and E should be kept by the bidders for verification purposes for a period of at least 5 years. The successful bidder is required to continuously update Declarations C, D and E with the actual values for the duration of the contract.

I, the undersigned, ……..... (full names),

do hereby declare, in my capacity as …… ……

of .....(name of bidder entity), the following:

(a) The facts contained herein are within my own personal knowledge.

(b) I have satisfied myself that:

(i) the goods/services/works to be delivered in terms of the above-specified bid comply with the minimum local content requirements as specified in the bid, and as measured in terms of SATS 1286:2011; and

(c) The local content percentage (%) indicated below has been calculated using the formula given in clause 3 of SATS 1286:2011, the rates of exchange indicated in paragraph 3.1 above and the information contained in Declaration D and E which has been consolidated in Declaration C:

Bid price, excluding VAT (y)	R
Imported content (x), as calculated in terms of SATS 1286:2011	R
Stipulated minimum threshold for local content (paragraph 3 above)	
Local content %, as calculated in terms of SATS 1286:2011	

If the bid is for more than one product, the local content percentages for each product contained in Declaration C shall be used instead of the table above.

The local content percentages for each product has been calculated using the formula given in clause 3 of SATS 1286:2011, the rates of exchange indicated in paragraph 3.1 above and the information contained in Declaration D and E.

(d) I accept that the Procurement Authority / Institution has the right to request that the local content be verified in terms of the requirements of SATS 1286:2011.

(e) I understand that the awarding of the bid is dependent on the accuracy of the information furnished in this application. I also understand that the submission of incorrect data, or data that are not verifiable as described in SATS 1286:2011, may result in the Procurement Authority / Institution imposing any or all of the remedies as provided for in Regulation 14 of the Preferential Procurement Regulations, 2017 promulgated under the Preferential Policy Framework Act (PPPFA), 2000 (Act No. 5 of 2000).

SIGNATURE: _____

WITNESS No. 1 _____ **DATE:** _____

WITNESS No. 2 _____ **DATE:** _____

EXAMPLE

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Annex C

Local Content Declaration - Summary Schedule

Note: VAT to be excluded from all calculations

(C1) **Tender No.**
(C2) **Tender description:**
(C3) **Designated product(s)**
(C4) **Tender Authority:**
(C5) **Tendering Entity name:**
(C6) **Tender Exchange Rate:** USD _____ EU _____ GBP _____
(C7) **Specified local content %** Shown in Table below

		Calculation of local content						Tender summary			
Tender item no's	List of items	Tender price - each (excl VAT)	Exempted imported value	Tender value net of exempted imported content	Imported value	Local value	Local content % (per item)	Tender Qty	Total tender value	Total exempted imported content	Total Imported content
(C8)	(C9)	(C10)	(C11)	(C12)	(C13)	(C14)	(C15)	(C16)	(C17)	(C18)	(C19)

(C20) Total tender value
(C21) Total Exempt imported content
(C22) *Total* Tender value net of exempt imported content
(C23) Total Imported content
(C24) Total local content
(C25) Average local content % of tender

Signature of tenderer from Annex B

Date:

EXAMPLE

SATS 1286.2011

Annex D

Imported Content Declaration - Supporting Schedule to Annex C

(D1)	Tender No.					
(D2)	Tender description:					
(D3)	Designated Products:					
(D4)	Tender Authority:					
(D5)	Tendering Entity name:					
(D6)	Tender Exchange Rate:	USD		EU		GBP

Note: VAT to be excluded from all calculations

A. Exempted imported content

				Calculation of imported content						Summary	
Tender item no's	Description of imported content	Local supplier	Overseas Supplier	Forign currency value as per Commercial Invoice	Tender Exchange Rate	Local value of imports	Freight costs to port of entry	All locally incurred landing costs & duties	Total landed cost excl VAT	Tender Qty	Exempted imported value
(D7)	(D8)	(D9)	(D10)	(D11)	(D12)	(D13)	(D14)	(D15)	(D16)	(D17)	(D18)

(D19) Total exempt imported value

This total must correspond with Annex C - C 21

B. Imported directly by the Tenderer

				Calculation of imported content						Summary	
Tender item no's	Description of imported content	Unit of measure	Overseas Supplier	Forign currency value as per Commercial Invoice	Tender Rate of Exchange	Local value of imports	Freight costs to port of entry	All locally incurred landing costs & duties	Total landed cost excl VAT	Tender Qty	Total imported value
(D20)	(D21)	(D22)	(D23)	(D24)	(D25)	(D26)	(D27)	(D28)	(D29)	(D30)	(D31)

(D32) Total imported value by tenderer

C. Imported by a 3rd party and supplied to the Tenderer

				Calculation of imported content						Summary	
Description of imported content	Unit of measure	Local supplier	Overseas Supplier	Forign currency value as per Commercial Invoice	Tender Rate of Exchange	Local value of imports	Freight costs to port of entry	All locally incurred landing costs & duties	Total landed cost excl VAT	Quantity imported	Total imported value
(D33)	(D34)	(D35)	(D36)	(D37)	(D38)	(D39)	(D40)	(D41)	(D42)	(D43)	(D44)

(D45) Total imported value by 3rd party

D. Other foreign currency payments

			Calculation of foreign currency payments		Summary of payments
Type of payment	Local supplier making the payment	Overseas beneficiary	Foreign currency value paid	Tender Rate of Exchange	Local value of payments
(D46)	(D47)	(D48)	(D49)	(D50)	(D51)

(D52) Total of foreign currency payments declared by tenderer and/or 3rd party

Signature of tenderer from Annex B

(D53) Total of imported content & foreign currency payments - (D32), (D45) & (D52) above

This total must correspond with Annex C - C 23

Date:

EXAMPLE

SATS 1286.2011

Annex E

Local Content Declaration - Supporting Schedule to Annex C

(E1)	Tender No.	Note: VAT to be excluded from all calculations
(E2)	Tender description:	
(E3)	Designated products:	
(E4)	Tender Authority:	
(E5)	Tendering Entity name:	

Local Products (Goods, Services and Works)	Description of items purchased	Local suppliers	Value
	(E6)	(E7)	(E8)
	(E9) Total local products (Goods, Services and Works)		

(E10)	Manpower costs	(Tenderer's manpower cost)	
(E11)	Factory overheads	(Rental, depreciation & amortisation, utility costs, consumables etc.)	
(E12)	Administration overheads and mark-up	(Marketing, insurance, financing, interest etc.)	

(E13) Total local content

This total must correspond with Annex C - C24

Signature of tenderer from Annex B

Date:

MBD 6.1

PREFERENCE POINTS CLAIM FORM IN TERMS OF THE PREFERENTIAL PROCUREMENT REGULATIONS 2017

This preference form must form part of all bids invited. It contains general information and serves as a claim form for preference points for Broad-Based Black Economic Empowerment (B-BBEE) Status Level of Contribution

NB: BEFORE COMPLETING THIS FORM, BIDDERS MUST STUDY THE GENERAL CONDITIONS, DEFINITIONS AND DIRECTIVES APPLICABLE IN RESPECT OF B-BBEE, AS PRESCRIBED IN THE PREFERENTIAL PROCUREMENT REGULATIONS, 2017.

1. GENERAL CONDITIONS

1.1 The following preference point systems are applicable to all bids:

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

1.2

a) The value of this bid is estimated to exceed R50 000 000 (all applicable taxes included) and therefore the 90/10 preference point system shall be applicable

b) The 90/10 preference point system will be applicable to this tender

1.3 Points for this bid shall be awarded for:

(a) Price; and

(b) B-BBEE Status Level of Contributor.

1.4 The maximum points for this bid are allocated as follows:

	POINTS
PRICE	90
B-BBEE STATUS LEVEL OF CONTRIBUTOR	10
Total points for Price and B-BBEE must not exceed	**100**

1.5 Failure on the part of a bidder to submit proof of B-BBEE Status level of contributor together with the bid, will be interpreted to mean that preference points for B-BBEE status level of contribution are not claimed.

1.6 The purchaser reserves the right to require of a bidder, either before a bid is adjudicated or at any time subsequently, to substantiate any claim in regard to preferences, in any manner required by the purchaser.

2. DEFINITIONS

(a) **"B-BBEE"** means broad-based black economic empowerment as defined in section 1 of the Broad-Based Black Economic Empowerment Act;

(b) "**B-BBEE status level of contributor"** means the B-BBEE status of an entity in terms of a code of good practice on black economic empowerment, issued in terms of section 9(1) of the Broad-Based Black Economic Empowerment Act;

(c) **"bid"** means a written offer in a prescribed or stipulated form in response to an invitation by an organ of state for the provision of goods or services, through price quotations, advertised competitive bidding processes or proposals;

(d) **"Broad-Based Black Economic Empowerment Act"** means the Broad-Based Black Economic Empowerment Act, 2003 (Act No. 53 of 2003);

(e) **"EME"** means an Exempted Micro Enterprise in terms of a code of good practice on black economic empowerment issued in terms of section 9 (1) of the Broad-Based Black Economic Empowerment Act;

(f) **"functionality"** means the ability of a tenderer to provide goods or services in accordance with specifications as set out in the tender documents.

(g) **"price"** includes all applicable taxes less all unconditional discounts;

(h) **"proof of B-BBEE status level of contributor"** means:

1) B-BBEE Status level certificate issued by an authorized body or person;

2) A sworn affidavit as prescribed by the B-BBEE Codes of Good Practice;

3) Any other requirement prescribed in terms of the B-BBEE Act;

(i) **"QSE"** means a qualifying small business enterprise in terms of a code of good practice on black economic empowerment issued in terms of section 9 (1) of the Broad-Based Black Economic Empowerment Act;

(j) **"rand value"** means the total estimated value of a contract in Rand, calculated at the time of bid invitation, and includes all applicable taxes;

3. FORMULAE FOR PROCUREMENT OF GOODS AND SERVICES

4. POINTS AWARDED FOR PRICE

4.1 THE 80/20 OR 90/10 PREFERENCE POINT SYSTEMS

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

80/20 **or** **90/10**

$$Ps = 80\left(1 - \frac{Pt - P\,min}{P\,min}\right) \quad \text{or} \quad Ps = 90\left(1 - \frac{Pt - P\,min}{P\,min}\right)$$

Where

Ps = Points scored for price of bid under consideration

Pt = Price of bid under consideration

Pmin = Price of lowest acceptable bid

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

4.3 POINTS AWARDED FOR PRICE

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

80/20 **or** **90/10**

$$Ps = 80\left(1 + \frac{Pt - Pmax}{Pmax}\right) \text{ or } \quad Ps = 90\left(1 + \frac{Pt - Pmax}{Pmax}\right)$$

Where

Ps = Points scored for price of bid under consideration

Pt = Price of bid under consideration

Pmax = Price of highest acceptable bid

5. POINTS AWARDED FOR B-BBEE STATUS LEVEL OF CONTRIBUTOR

5.1 In terms of Regulation 6 (2) and 7 (2) of the Preferential Procurement Regulations, preference points must be awarded to a bidder for attaining the B-BBEE status level of contribution in accordance with the table below:

B-BBEE Status Level of Contributor	Number of points (90/10 system)	Number of points (80/20 system)
1	10	20
2	9	18
3	6	14
4	5	12
5	4	8
6	3	6
7	2	4
8	1	2
Non-compliant contributor	0	0

6. BID DECLARATION

6.1 Bidders who claim points in respect of B-BBEE Status Level of Contribution must complete the following:

7. B-BBEE STATUS LEVEL OF CONTRIBUTOR CLAIMED IN TERMS OF PARAGRAPHS 1.4 AND 4.1

7.1 B-BBEE Status Level of Contributor: . = ……(maximum of 10 or 20 points)

(Points claimed in respect of paragraph 7.1 must be in accordance with the table reflected in paragraph 4.1 and must be substantiated by relevant proof of B-BBEE status level of contributor.

8. SUB-CONTRACTING

8.1 Will any portion of the contract be sub-contracted?

(***Tick applicable box***)

YES		NO	

8.1.1 If yes, indicate:

i) What percentage of the contract will be subcontracted.....%
ii) The name of the sub-contractor……..
iii) The B-BBEE status level of the sub-contractor.....……..
iv) Whether the sub-contractor is an EME or QSE
(Tick applicable box)

YES		NO	

v) Specify, by ticking the appropriate box, if subcontracting with an enterprise in terms of Preferential Procurement Regulations,2017:

Designated Group: An EME or QSE which is at last 51% owned by:	**EME** √	**QSE** √
Black people		
Black people who are youth		
Black people who are women		
Black people with disabilities		
Black people living in rural or underdeveloped areas or townships		
Cooperative owned by black people		
Black people who are military veterans		
OR		
Any EME		
Any QSE		

9. DECLARATION WITH REGARD TO COMPANY/FIRM

9.1 Name of company/firm:…….

9.2 VAT registration number:……

9.3 Company registration number:……

9.4 TYPE OF COMPANY/ FIRM

- ☐ Partnership/Joint Venture / Consortium
- ☐ One person business/sole propriety
- ☐ Close corporation
- ☐ Company
- ☐ (Pty) Limited

[TICK APPLICABLE BOX]

9.5 DESCRIBE PRINCIPAL BUSINESS ACTIVITIES

……
……
……
……..

9.6 COMPANY CLASSIFICATION

- ☐ Manufacturer
- ☐ Supplier
- ☐ Professional service provider
- ☐ Other service providers, e.g. transporter, etc.

[*TICK APPLICABLE BOX*]

9.7 **MUNICIPAL INFORMATION**

Municipality where business is situated: ……

Registered Account Number: ……

Stand Number:……..

9.8 Total number of years the company/firm has been in business:……

9.9 I/we, the undersigned, who is / are duly authorised to do so on behalf of the company/firm, certify that the points claimed, based on the B-BBE status level of contributor indicated in paragraphs 1.4 and 6.1 of the foregoing certificate, qualifies the company/ firm for the preference(s) shown and I / we acknowledge that:

i) The information furnished is true and correct;

ii) The preference points claimed are in accordance with the General Conditions as indicated in paragraph 1 of this form;

iii) In the event of a contract being awarded as a result of points claimed as shown in paragraphs 1.4 and 6.1, the contractor may be required to furnish documentary proof to the satisfaction of the purchaser that the claims are correct;

iv) If the B-BBEE status level of contributor has been claimed or obtained on a fraudulent basis or any of the conditions of contract have not been fulfilled, the purchaser may, in addition to any other remedy it may have –

(a) disqualify the person from the bidding process;

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

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

(d) recommend that the bidder or contractor, its shareholders and directors, or only the shareholders and directors who acted on a fraudulent basis, be restricted by the National Treasury 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.

WITNESSES 1. …….. 2. ……	…… SIGNATURE(S) OF BIDDERS(S) DATE: …….. ADDRESS …….. …….. ……..

MBD 4

DECLARATION OF INTEREST

1. No bid will be accepted from persons in the service of the state[1].

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.

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

3.1 Full Name of bidder or his or her representative:……..

3.2 Identity Number: …….

3.3 Position occupied in the Company (director, trustee, hareholder[2]):……..

3.4 Company Registration Number: …….

3.5 Tax Reference Number:……

3.6 VAT Registration Number: ……

3.7 The names of all directors / trustees / shareholders members, their individual identity numbers and state employee numbers must be indicated in paragraph 4 below.

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

3.8.1 If yes, furnish particulars. ……

……..

[1]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.

[2] Shareholder" means a person who owns shares in the company and is actively involved in the management of the company or business and exercises control over the company.

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

3.9.1 If yes, furnish particulars……..……..

……

3.10 Do you have any relationship (family, friend, other) with persons in the service of the state and who may be involved with the evaluation and or adjudication of this bid? …… **YES / NO**

3.10.1 If yes, furnish particulars.
……
……

3.11 Are you, aware of any relationship (family, friend, other) between any other 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**

3.11.1 If yes, furnish particulars
……
……

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

3.12.1 If yes, furnish particulars.
……
……

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

3.13.1 If yes, furnish particulars.
……
……

3.14 Do you or any of the directors, trustees, managers, principle shareholders, or stakeholders of this company have any interest in any other related companies or business whether or not they are bidding for this contract. **YES / NO**

3.14.1 If yes, furnish particulars:
……..
……..

4. Full details of directors / trustees / members / shareholders.

Full Name	Identity Number	State Employee Number

…….. ……..
Signature **Date**

…… ……
Capacity **Name of Bidder**

MBD 8

DECLARATION OF BIDDER'S PAST SUPPLY CHAIN MANAGEMENT PRACTICES ……..

1 The bid of any bidder may be disregarded if that bidder, or any of its directors have-

a. abused the institution's supply chain management system;
b. committed fraud or any other improper conduct in relation to such system; or
c. failed to perform on any previous contract.

2 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 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 National Treasury after the *audi alteram partem* rule was applied).	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)? **To access this Register, enter the National Treasury's website, www.treasury.gov.za, click on the icon "Register for Tender Defaulters" or submit your written request for a hard copy of the Register to facsimile number (012) 3265445.**	Yes □	No □
4.2.1	If so, furnish particulars:		
4.3	Was the bidder or any of its directors convicted by a court of law (including a court outside of 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	Was any contract between the bidder and any organ of state terminated during the past five years on account of failure to perform on or comply with the contract?	Yes □	No □
4.4.1	If so, furnish particulars:		

CERTIFICATION

I, THE UNDERSIGNED (FULL NAME)……

CERTIFY THAT THE INFORMATION FURNISHED ON THIS DECLARATION FORM IS 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**

MBD 5

DECLARATION FOR PROCUREMENT ABOVE R10 MILLION (VAT INCLUDED)

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

1 Are you by law required to prepare annual financial statements for auditing? **YES / NO**

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

……

……

2. If the bidder is not required by law to prepare annual financial statements for auditing, they shall be required to furnish their Annual Financial Statements -

i.for the past three years , or
ii. since their establishment if established during the past three years

Do you have any outstanding undisputed commitments for municipal services towards a municipality or any other service provider in respect of which payment is overdue for more than 30 days? **YES / NO**

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

2.2 If yes, provide particulars.

……

……

3 Has any contract been awarded to you by an organ of state during the past five years, including particulars of any material non-compliance or dispute concerning the execution of such contract? **YES / NO**

3.1 If yes, furnish particulars

……

……

4 Will any portion of goods or services be sourced from outside the Republic, and, if so, what portion and whether any portion of payment from the municipality / municipal entity is expected to be transferred out of the Republic? **YES / NO**

4.1 If yes, 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

CERTIFICATE OF INDEPENDENT BID DETERMINATION MBD 9

1. This Municipal Bidding Document (MBD) must form part of all bids[1] 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 (MBD9) 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 MBD 9

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.

[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.

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

T2.1.5 PROPOSED QUALIFICATIONS

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

The Tenderer's attention is drawn to clause C.3.8 of the Standard Conditions of Tender referenced in the Tender Data regarding the employer's handling of material qualifications.

Page	Clause or item	Proposal

Signed ..... Date .....

Name ..... Position .....

Tenderer .....

T2.1.6 SCHEDULE OF THE TENDERER'S EXPERIENCE

A detailed description of the nature of works must be provided for all projects listed below must be supported by a Completion Certificate and reference letters (T2.1.7).

EMPLOYER: CONTACT PERSON AND TELEPHONE NUMBER	CONSULTING ENGINEER: CONTACT PERSON AND TELEPHONE NUMBER	NATURE OF WORK	VALUE OF WORK (inclusive of VAT)	DATE COMPLETED OR EXPECTED TO BE COMPLETED

Each Tenderers project listed in T2.1.6 above must be supported by a completion certificate/final approval certificate and reference letters as per format T2.1.7. Tenderer's to note that work completed as a subcontractor will also require confirmation letter from the client as per schedule T2.1.7.

Signed ..... Date .....

Name ..... Position .....

Tenderer .....

T2.1.7 CONTACTABLE REFERENCE TEMPLATE (STEEL PIPELINE)

Note : Please see NB at bottom of page.

To Johannesburg Water (SOC) Ltd

I, the undersigned being duly authorized to do so, hereby furnish a reference to Johannesburg Water relative to tender JW14322 Brixton Reservoir and Tower Project.

Name of tenderer_____

Description of goods / service provided _____

Pipe Diameter and Material_____

Value of Contract: ……

Start Date (DD/MM/YYYY): ……..

End Date (DD/MM/YYYY): ……

Was their performance satisfactory? Yes / No*

If No, please furnish details…….
……
……

Name of authorised person:_____ **Signature:**_____

Telephone: _____ **e-mail**_____ **date**_____

Completed on behalf (name of business)

_____

NB: This document must be completed in full by the Client and included in the tender submission. Alternatively, the client's letterhead may be used for this purpose provided it complies with all the above requirements.. A separate form must be completed for each reference as required in the evaluation criteria. Failure to adhere to this requirement will result in such tender being prejudiced.
Information provided will be verified and if found to be false or misrepresented, punitive measures will be instituted against the respective party including blacklisting and restriction from participating in any future government tender.

T2.1.7 CONTACTABLE REFERENCE TEMPLATE (25ML CONCRETE RESERVOIR)

Note : Please see NB at bottom of page.

To Johannesburg Water (SOC) Ltd

I, the undersigned being duly authorized to do so, hereby furnish a reference to Johannesburg Water relative to tender JW14322 Brixton Reservoir and Tower Project.

Name of tenderer_____

Description of goods / service provided _____

Reservoir Capacity and Material_____

Was their performance satisfactory? Yes / No*

Value of Contract: ……

Start Date (DD/MM/YYYY): ……..

End Date (DD/MM/YYYY): ……

If No, please furnish details…….
……..……
……

Name of authorised person:_____ **Signature:**_____

Telephone: _____ **e-mail**_____ **date**_____

Completed on behalf (name of business)

_____

NB: This document must be completed in full by the Client and included in the tender submission. Alternatively, the client's letterhead may be used for this purpose provided it complies with all the above requirements.. A separate form must be completed for each reference as required in the evaluation criteria. Failure to adhere to this requirement will result in such tender being prejudiced.
Information provided will be verified and if found to be false or misrepresented, punitive measures will be instituted against the respective party including blacklisting and restriction from participating in any future government tender.

T2.1.7 CONTACTABLE REFERENCE TEMPLATE (PUMPSTATION)

Note : Please see NB at bottom of page.

To Johannesburg Water (SOC) Ltd

I, the undersigned being duly authorized to do so, hereby furnish a reference to Johannesburg Water relative to tender JW14322 Brixton Reservoir and Tower Project.

Name of tenderer_____

Description of goods / service provided _____

Pumpstation Capacity (Flow Rate) _____

Was their performance satisfactory? Yes / No*

Value of Contract: ……

Start Date (DD/MM/YYYY): ……..

End Date (DD/MM/YYYY): ……

If No, please furnish details…….
……
……

Name of authorised person:_____ **Signature:**_____

Telephone: _____**e-mail**_____ **date**_____

Completed on behalf (name of business)

_____

NB: This document must be completed in full by the Client and included in the tender submission. Alternatively, the client's letterhead may be used for this purpose provided it complies with all the above requirements.. A separate form must be completed for each reference as required in the evaluation criteria. Failure to adhere to this requirement will result in such tender being prejudiced.
Information provided will be verified and if found to be false or misrepresented, punitive measures will be instituted against the respective party including blacklisting and restriction from participating in any future government tender.

T2.1.7 CONTACTABLE REFERENCE TEMPLATE (2ML CONCRETE WATER TOWER)

Note : Please see NB at bottom of page.

To Johannesburg Water (SOC) Ltd

I, the undersigned being duly authorized to do so, hereby furnish a reference to Johannesburg Water relative to tender JW14322 Brixton Reservoir and Tower Project.

Name of tenderer_____

Description of goods / service provided _____

Water Tower Capacity and Material _____

Was their performance satisfactory? Yes / No*

Value of Contract: ……

Start Date (DD/MM/YYYY): ……..

End Date (DD/MM/YYYY): ……

If No, please furnish details…….
……
……

Name of authorised person:_____ **Signature:**_____

Telephone: _____**e-mail**_____ _**date**_____

Completed on behalf (name of business)

_____

NB: This document must be completed in full by the Client and included in the tender submission. Alternatively, the client's letterhead may be used for this purpose provided it complies with all the above requirements.. A separate form must be completed for each reference as required in the evaluation criteria. Failure to adhere to this requirement will result in such tender being prejudiced.
Information provided will be verified and if found to be false or misrepresented, punitive measures will be instituted against the respective party including blacklisting and restriction from participating in any future government tender.

T2.1.8 SCHEDULE OF KEY PERSONNEL

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

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

CATEGORY OF EMPLOYEE	NUMBER OF PERSONS					
	KEY PERSONNEL, PART OF THE CONTRACTOR'S ORGANISATION		KEY PERSONNEL TO BE IMPORTED IF NOT AVAILABLE LOCALLY		UNSKILLED PERSONNEL TO BE RECRUITED FROM LOCAL COMMUNITY	
	HDI	NON-HDI	HDI	NON-HDI	HDI	NON-HDI
Site Agent, Project Managers						
Foremen, Quality Control and Safety Personnel						
Technicians, Surveyors, etc						
Artisans and other Skilled workers						
Plant Operators						
Unskilled Workers						
Others: ……..... .... …….						

SIGNATURE:.....……. DATE: …….....

(of person authorized to sign on behalf of the Tenderer)

T2.1.9 CURRICULUM VITAE OF KEY PERSONNEL

Provide separate forms for each position listed in Form: Key Personnel

Contract Manager

Name:	**Date of birth:**
Profession:	**Nationality:**
Qualifications:	
Professional Registration Number:	
Name of Employer (firm):	
Current position:	**Years with firm:**
Employment Record:	
Experience Record Pertinent to Required service:	

Certification:

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

....
Signature of person named in the schedule *Date*

Site Agent

Name:	**Date of birth:**
Profession:	**Nationality:**
Qualifications:	
Professional Registration Number:	
Name of Employer (firm):	
Current position:	**Years with firm:**
Employment Record:	
Experience Record Pertinent to Required service:	

Certification:

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

.....…… …….....
Signature of person named in the schedule *Date*

Safety Officer

Name:	**Date of birth:**
Profession:	**Nationality:**
Qualifications:	
Professional Registration Number:	
Name of Employer (firm):	
Current position:	**Years with firm:**
Employment Record:	
Experience Record Pertinent to Required service:	

Certification:

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

.....…… …….....
Signature of person named in the schedule *Date*

T2.2 LIST OF RETURNABLE DOCUMENTS

T2.2.1 CONTRACTOR'S CERTIFICATE OF REGISTRATION WITH CIDB

The Tenderer shall attach hereto the Contractor's Certificate of Registration with CIDB. Failure to submit the certificate with the tender document will lead to the conclusion that the Tenderer is not registered with the CIDB and therefore not eligible to tender.

Tenderers who have made application to CIDB for registration and are capable of being so registered prior to the evaluation of submissions must attach a notification from CIDB that their application is being considered.

T2.2.2 SARS TAX COMPLIANCE STATUS PIN AND PROOF OF CSD REGISTRATION

The Tenderer must attach hereto a copy SARS Tax Compliance Status Pin and Proof of CSD registration ie MA xxxxxxxxxx number.

T2.3 LIST OF RETURNABLE SCHEDULES

Document **Page**

3. Returnable Schedules that will be incorporated into the contract

T2.3.2 MATERIALS TO BE USED IN THE CONTRACT

Preamble to the Contract Data Sheet(s)

1. All Data sheets provided shall be completed by the Tenderer in full as diligently as possible in all required “empty” fields. All data sheet shall be completed in block letters using a black pen.
2. The tenderer shall fill in details of equipment offered in the “Offered” column and indicate with yes or no, whether the offered equipment deviate from specification or comply with specification in the “Specification Deviation” column provided.
3. The technical content, its arrangement and any incorporated references shall not be altered from the format shown in the data sheets.
4. The non-applicable (N/A) items indicated in the Data sheet will not be used for technical compliance evaluation. However, the Tenderer is required to provide detail information for the purpose of technical assessment and final contract document signing. Additional information space has been provided at the end of each data sheet, where data sheet item space is inadequate. The additional information section on each Data sheet shall be used with a cross-reference item number used for the feature description in the Data sheet provided as additional information.
5. The offered equipment shall be based on proven technology with high reliability in similar environmental condition. The Tender shall indicate the Country of origin for the offered equipment and preference shall be given to locally manufactured equipment with good after sales service.
6. The Tenderer shall ensure that the offered equipment will fit into the spaces provided prior to tender submission and where the space is inadequate, the required spaces alteration shall be submitted with the tender. If no information is received with the tender, it will mean the provided space is adequate for the offered equipment.
7. The tenderer shall ensure that they fully acquainted with content of the project specification and particular specification enclosed in Volume 2a and 2b respectively.
8. The information provided in the data sheet shall be used for the purpose of tender evaluation with reference to specified and corresponding offered items. Further the information shall be used for assessment of final technical acceptance and specification compliance for inclusion in the final contract document and signed for construction purpose.

T2.3.3 IMPORTED CONTENT SHEET: FORWARD EXCHANGE COVER FOR IMPORTED GOODS

The Tenderer shall, in the attached schedule, for each item which a price is tendered, state the item number as it appears in the Schedule of Quantities, a brief description of the item, the country of origin, the value of the imported content of all goods comprising that item, the number of items for which he requires forward exchange cover, and the total amount for which forward exchange cover will be required.

Each Part of the Schedule of Quantities must be dealt with separately.

In the event of components being imported from more than one country, a separate entry shall be made for each country.

The Tenderer shall state the applicable rate(s) for the relevant country(ies) as at the date seven days prior to the closing date for the receipt of tenders.

Exchange rate(s) as at ..... (*insert date*)

Country	Exchange Rate

SIGNED ON BEHALF OF TENDERER : .....

NAME (in print) : .....

DATE : .....

Equipment Schedule

Item No. in BoQ	Brief Description	Country of Origin	Value of Imported Content	No. of Items	Amount (R)
				Quantity Scheduled	
Total Value of Imported Content for Section 1 carried to Item 1.1.5 in Bill of Quantities					

T2.3.4 PRICE VARIATION ON SPECIAL MATERIALS

The following Special Materials are subject to price variation, in accordance with Clause 6.8.3 of the Conditions of Contract, as detailed below:

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

T2.4 LIST OF RETURNABLE SCHEDULES

T2.4.1 Addenda to the Tender Documents

Copies of all Addenda to the tender documents which have been issued by the Employer will be inserted here by the Employer.

T2.4.2 Minutes of the Pre-Tender Clarification Meeting and Site Inspection

The minutes of the pre-tender clarification meeting must be attached to this form.

Returnable Annexure A: Acknowledgement of SHE Specification & Annexures
JW 6.4

DECLARATION BY CONTRACTOR

I, the undersigned, and representing the tenderer as indicated hereby acknowledge that I have obtained copies of the following listed documentation and confirm that I fully understand the contents thereof and confirm compliance thereto in the event of being successful:

- OHS Specification (Volume 2)
- Annexure 1: Baseline Risk Assessment
- Annexure 2: Medical Screening Policy
- Annexure 3: Contractor Competency Evaluation
- Annexure 4: Sign off form
- Annexure 5: Environmental Management Plan
- Annexure 6: Waste Management Plan

We furthermore commit to:

- Comply with all applicable SHE related legal and other requirements.
- Inform all staff of their role in managing environmental impacts and safety hazards on site.

Signed at …… on this …….. Day of …… 20……...

Name of Tenderer	
Name of Authorized person	
Authorized Signature*	

*Signature must be as per form JW 3.3 as applicable

Returnable Annexure B: Acknowledgement of Tender Drawings

DECLARATION BY TENDERER

I, the undersigned, and representing the tenderer as indicated hereby acknowledge that I have obtained copies of the following listed documentation and confirm that I fully understand the contents thereof and confirm compliance thereto in the event of being successful:

The drawings that are issued for **TENDER PURPOSES** are those noted below:

DRAWING REGISTER		REFERENCE JW14322
PROJECT No.:	**UR 1327**	
PROJECT NAME:	**Construction of a 26 ML concrete reservoir and associated infrastructure**	
CONTRACT No.:	**JW14322**	
PHASE:	**TENDER**	
DRAWING No.	**CURRENT REVISION**	**TITLE / DESCRIPTION**
		CIVIL GENERAL LAYOUTS
113503-0000-DRG-CC-1002	T0	GENERAL SITE LAYOUT
113503-0000-DRG-CC-1003	T0	GENERAL SURVEY LAYOUT
113503-0000-DRG-CC-1004	T0	COMBINED SERVICES LAYOUT
113503-0000-DRG-CC-1005	T0	EXISTING SERVICES LAYOUT
113503-0000-DRG-CC-1007	T0	FENCING LAYOUT
113503-0000-DRG-CC-1008	T0	GENERAL SURVEY LAYOUT - SUPPLY LINE
113503-0000-DRG-CC-1009	T0	EXISTING SERVICES LAYOUT - SUPPLY LINE
113503-0000-DRG-CC-1011	T0	SCOUR AND OVERFLOW LAYOUTS
		CIVIL GENERAL DETAILS
113503-0000-DRG-CC-1060	T0	SCOUR AND OVERFLOW COLLECTION CHAMBER
113503-0000-DRG-CC-1062	T0	FENCING DETAILS
		WATER LAYOUTS (SUPPLY LINE)
113503-0000-DRG-WW-1100	T0	SCHEMATIC LAYOUT
113503-0000-DRG-WW-1101	T0	WATER SUPPLY LINE LAYOUT
		WATER SECTIONS (SUPPLY LINE)
113503-0000-DRG-WW-1130	T0	PLAN AND LONGSECTION: BULK WATER PIPELINE FROM EXISTING BRIXTON RESERVOIR TO THE NEW BRIXTON RESERVOIR SHEET 1 OF 3
113503-0000-DRG-WW-1131	T0	PLAN AND LONGSECTION: BULK WATER PIPELINE FROM NEW BRIXTON TOWER TO THE TOWER WATER SUPPLY ZONE SHEET 2 OF 3
113503-0000-DRG-WW-1132	T0	PLAN AND LONGSECTION: BULK WATER PIPELINE FROM NEW BRIXTON RESERVOIR TO THE BRIXTON RESERVOIR WATER SUPPLY ZONE SHEET 3 OF 3
		WATER DETAILS (SUPPLY LINE)
113503-0000-DRG-WW-1161	T0	TYPICAL DETAILS OF AIR VALVE CHAMBER
113503-0000-DRG-WW-1162	T0	ISOLATING VALVE CHAMBER DETAIL AT TIE IN TO EXISTING 675mm

DRAWING REGISTER		REFERENCE JW14322
		DIAMETER PIPELINE
113503-0000-DRG-WW-1163	T0	TYPICAL DETAIL OF ISOLATING VALVE CHAMBER
113503-0000-DRG-WW-1164	T0	TYPICAL DETAILS OF SCOUR VALVES SHEET 1 OF 3
113503-0000-DRG-WW-1165	T0	TYPICAL DETAILS OF SCOUR VALVES SHEET 2 OF 3
113503-0000-DRG-WW-1166	T0	TYPICAL DETAILS OF SCOUR VALVES SHEET 3 OF 3
113503-0000-DRG-WW-1167	T0	TYPICAL DETAILS FOR TRENCH EXCAVATION AND BACKFILL
113503-0000-DRG-WW-1168	T0	THRUST BLOCK DETAILS
		BULK EARTHWORKS LAYOUTS
113503-0000-DRG-CB-1200	T0	BULK EARTHWORKS EXCAVATION LAYOUT
113503-0000-DRG-CB-1201	T0	BULK EARTHWORKS IMPORTED FILL LAYOUT
113503-0000-DRG-CB-1202	T0	BULK EARTHWORKS LAYOUT FINAL FINISHED LEVELS
		BULK EARTHWORKS SECTIONS
113503-0000-DRG-CB-1230	T0	BULK EARTHWORKS CROSS SECTIONS SHEET 1 OF 3
113503-0000-DRG-CB-1231	T0	BULK EARTHWORKS CROSS SECTIONS SHEET 2 OF 3
113503-0000-DRG-CB-1232	T0	BULK EARTHWORKS CROSS SECTIONS SHEET 3 OF 3
		ROAD LAYOUTS
113503-0000-DRG-RR-1300	T0	ACCESS ROADS AND PARKING LAYOUT AND LAYERWORKS DETAIL
		ROAD SECTIONS
113503-0000-DRG-RR-1330	T0	ACCESS ROAD PROFILES
		ROAD DETAILS
113503-0000-DRG-RR-1360	T0	ROAD MARKINGS AND SIGNAGE DETAILS
		STORMWATER LAYOUTS
113503-0000-DRG-WD-1400	T0	STORMWATER DRAINAGE LAYOUT
113503-0000-DRG-WD-1401	T0	STORMWATER ATTENUATION POND AND SPILLWAY LAYOUT AND SECTIONS
		STORMWATER SECTIONS
113503-0000-DRG-WD-1430	T0	STORMWATER PLAN AND LONGITUDINAL SECTIONS SHEET 1 OF 5
113503-0000-DRG-WD-1431	T0	STORMWATER PLAN AND LONGITUDINAL SECTIONS SHEET 2 OF 5
113503-0000-DRG-WD-1432	T0	STORMWATER PLAN AND LONGITUDINAL SECTIONS SHEET 3 OF 5
113503-0000-DRG-WD-1433	T0	STORMWATER PLAN AND LONGITUDINAL SECTIONS SHEET 4 OF 5
113503-0000-DRG-WD-1434	T0	STORMWATER PLAN AND LONGITUDINAL SECTIONS SHEET 5 OF 5
		STORMWATER DETAILS
113503-0000-DRG-WD-1460	T0	STORMWATER CHANNEL AND DOWNPIPE DISCHARGE DETAILS
113503-0000-DRG-WD-1461	T0	TYPICAL MANHOLE AND JUNCTION BOX DETAILS
113503-0000-DRG-WD-1462	T0	GRID INLET, GRIT INLET/MANHOLE AND DOWNPIPE DISCHARGE DETAILS
113503-0000-DRG-WD-1463	T0	STORMWATER HEADWALL AND PIPE BEDDING DETAILS
		SEWER LAYOUTS
113503-0000-DRG-WS-1500	T0	SEWER LAYOUT AND LONG SECTION
		SEWER TYPICAL DETAILS

DRAWING REGISTER		REFERENCE JW14322
113503-0000-DRG-WS-1560	T0	MANHOLE AND PIPE BEDDING DETAILS
113503-0000-DRG-WS-1561	T0	CLEANING EYE DETAIL
113503-0000-DRG-WS-1562	T0	ERF CONNECTION DETAIL
		POTABLE WATER LAYOUTS
113503-0000-DRG-WS-1600	T0	POTABLE WATER LAYOUT AND LONG SECTION
		POTABLE WATER TYPICAL DETAILS
113503-0000-DRG-WS-1660	T0	POTABLE WATER TYPICAL DETAILS
		SCOUR AND OVERFLOW LAYOUTS
113503-0000-DRG-CC-1700	T0	SCOUR AND OVERFLOW LAYOUT AND LONG SECTION
		SCOUR AND OVERFLOW TYPICAL DETAILS
113503-0000-DRG-CC-1760	T0	SCOUR AND OVERFLOW CHAMBER DETAILS
113503-0000-DRG-CC-1761	T0	TYPICAL WATER DETAILS
113503-0000-DRG-CC-1762	T0	PIPE FITTING SCHEDULE
		STRUCTURAL GENERAL SECTIONS/ELEVATIONS
113503-0000-DRG-SS-2030	T0	STRUCTURAL GENERAL SECTIONS AND ELEVATIONS
		STRUCTURAL GENERAL DETAILS
113503-0000-DRG-SS-2060	T0	STRUCTURAL GENERAL NOTES
		RESERVOIR LAYOUTS
113503-0000-DRG-SS-2100	T0	UNDERGROUND RESERVOIR AND PUMP HOUSE SITE LAYOUT
113503-0000-DRG-SS-2101	T0	GROUND FLOOR LAYOUT
113503-0000-DRG-SS-2102	T0	SUBSOIL DRAINAGE LAYOUT
113503-0000-DRG-SS-2103	T0	ROOF LAYOUT, SECTIONS & DETAILS
113503-0000-DRG-SS-2104	T0	ROOF DRAINAGE LAYOUT
113503-0000-DRG-SS-2105	T0	ROOF LONG SECTIONS & DETAILS
113503-0000-DRG-SS-2106	T0	PUMP HOUSE FOUNDATION & FLOOR LAYOUT
113503-0000-DRG-SS-2107	T0	PLANT ROOM FOUNDATION & SURFACE BED LAYOUT, SECTIONS & DETAILS
113503-0000-DRG-SS-2108	T0	PUMP HOUSE ACCESS SLAB & WALKWAY LAYOUT, SECTIONS & DETAILS
113503-0000-DRG-SS-2109	T0	PUMP HOUSE & PLANT ROOM ROOF LAYOUT, SECTIONS AND DETAILS
		RESERVOIR SECTIONS/ELEVATIONS
113503-0000-DRG-SS-2130	T0	TYPICAL SECTIONS THROUGH RESERVOIR WALL AND FLOOR
		RESERVOIR DETAILS
113503-0000-DRG-SS-2160	T0	JOINT AND SUBSOIL DRAIN DETAILS
		WATER TOWER LAYOUTS
113503-0000-DRG-SS-2300	T0	GENERAL ARRANGEMENT ISOMETRIC VIEW AND ELEVATION
		WATER TOWER SECTIONS/ELEVATIONS
113503-0000-DRG-SS-2330	T0	WATER TOWER SECTIONAL PLANS SHEET 1 OF 2
113503-0000-DRG-SS-2331	T0	WATER TOWER SECTIONAL PLANS SHEET 2 OF 2

DRAWING REGISTER		REFERENCE JW14322
		WATER TOWER DETAILS
113503-0000-DRG-SS-2360	T0	GENERAL DETAILS SHEET 1 OF 2
113503-0000-DRG-SS-2361	T0	GENERAL DETAILS SHEET 2 OF 2
		ELECTRICAL GENERAL LAYOUTS
113503-0000-DRG-EE-3000	T0	SITE PLAN ELECTRICAL
113503-0000-DRG-EE-3001	T0	GENERAL ELECTRICAL FLOOR LAYOUT
113503-0000-DRG-EE-3002	T0	PUMP STATION SMALL POWER LAYOUT
113503-0000-DRG-EE-3003	T0	PUMP STATION LIGHTING LAYOUT
113503-0000-DRG-EE-3004	T0	WATER TOWER LIGHTING LAYOUT
113503-0000-DRG-EE-3005	T0	EARTHING AND LIGHTING PROTECTION LAYOUT
113503-0000-DRG-EE-3006	T0	PUMP STATION FIRE DETECTION LAYOUT
		ELECTRICAL DETAILS
113503-0000-DRG-EE-3160	T0	LOW VOLTAGE SINGLE LINE DIAGRAM
113503-0000-DRG-EE-3161	T0	PROCESS AND INSTRUMENTATION DIAGRAM
		MECHANICAL LAYOUTS
113503-0000-DRG-MM-5000	T0	SITE MECHANICAL ASSEMBLY SHEET 1 OF 2
113503-0000-DRG-MM-5001	T0	SITE MECHANICAL ASSEMBLY SHEET 2 OF 2
113503-0000-DRG-MM-5010	T0	PUMP PIPEWORK MECHANICAL ASSEMBLY SHEET 1 OF 3
113503-0000-DRG-MM-5011	T0	PUMP PIPEWORK MECHANICAL DETAILS SHEET 2 OF 3
113503-0000-DRG-MM-5012	T0	PUMP PIPEWORK MECHANICAL DETAILS SHEET 3 OF 3
113503-0000-DRG-MM-5020	T0	RESERVOIR INLET PIPEWORK MECHANICAL ASSEMBLY SHEET 1 OF 3
113503-0000-DRG-MM-5021	T0	RESERVOIR INLET PIPEWORK MECHANICAL DETAILS SHEET 2 OF 3
113503-0000-DRG-MM-5022	T0	RESERVOIR INLET PIPEWORK MECHANICAL DETAILS SHEET 3 OF 3
113503-0000-DRG-MM-5030	T0	RESERVOIR OUTLET PIPEWORK MECHANICAL ASSEMBLY SHEET 1 OF 3
113503-0000-DRG-MM-5031	T0	RESERVOIR OUTLET PIPEWORK MECHANICAL ASSEMBLY SHEET 2 OF 3
113503-0000-DRG-MM-5032	T0	RESERVOIR OUTLET PIPEWORK MECHANICAL DETAILS SHEET 3 OF 3
113503-0000-DRG-MM-5040	T0	SCOUR AND OVERFLOW PIPEWORK MECHANICAL ASSEMBLY SHEET 1 OF 3
113503-0000-DRG-MM-5041	T0	SCOUR AND OVERFLOW PIPEWORK MECHANICAL DETAILS SHEET 2 OF 3
113503-0000-DRG-MM-5042	T0	SCOUR AND OVERFLOW PIPEWORK MECHANICAL DETAILS SHEET 3 OF 3
113503-0000-DRG-MM-5050	T0	TOWER BYPASS PIPEWORK MECHANICAL ASSEMBLY SHEET 1 OF 2
113503-0000-DRG-MM-5051	T0	TOWER BYPASS PIPEWORK MECHANICAL ASSEMBLY DETAILS 2 OF 2
113503-0000-DRG-MM-5060	T0	TOWER PIPEWORK MECHANICAL ASSEMBLY SHEET 1 OF 4
113503-0000-DRG-MM-5061	T0	TOWER INLET PIPEWORK MECHANICAL DETAILS SHEET 2 OF 4
113503-0000-DRG-MM-5062	T0	TOWER OUTLET PIPEWORK MECHANICAL DETAILS SHEET 3 OF 4
113503-0000-DRG-MM-5063	T0	TOWER OVERFLOW AND SCOUR PIPEWORK MECHANICAL DETAILS SHEET 4 OF 4
113503-0000-DRG-MM-5070	T0	SUMP PUMP MECHANICAL ASSEMBLY SHEET 1 OF 2
113503-0000-DRG-MM-5071	T0	SUMP PUMP MECHANICAL DETAILS SHEET 2 OF 2
		ARCHITECTURAL LAYOUTS (LANDSCAPE)
113503-0000-DRG-AL-7000	T0	MASTER PLAN
113503-0000-DRG-AL-7001	T0	LANDSCAPE SKETCH PLAN
113503-0000-DRG-AL-7002	T0	LANDSCAPE SERVICES PLAN
113503-0000-DRG-AL-7005	T0	LANDSCAPE ELEMENTS PLAN

DRAWING REGISTER		REFERENCE JW14322
113503-0000-DRG-AL-7007	T0	LANDSCAPE IRRIGATION PLAN

Signed at …… on this …….. Day of …… 20……...

Name of tenderer	
Name of Authorized person	
Authorized Signature*	

Johannesburg Water SOC Ltd

Johannesburg Water

CONTRACT JW14322

CONSTRUCTION OF A 26ML CONCRETE RESERVOIR AND 2ML CONCRETE WATER TOWER IN BRIXTON WITH ASSOCIATED PIPE AND PUMP WORKS

VOLUME 1

TENDER

PART 1: AGREEMENT AND CONTRACT DATA

TABLE OF CONTENTS **PAGE (S)**

C1.1 FORM OF OFFER (ACCEPTANCE & AGREEMENT)

C1.1.1 Form of Offer

The contractor is to complete and sign the form of offer

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

JW14322: CONSTRUCTION OF A 26ML CONCRETE RESERVOIR AND 2ML CONCRETE WATER TOWER IN BRIXTON WITH ASSOCIATED PIPE AND PUMP WORKS

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

By the representative of the Contractor, deemed to be duly authorised, signing this part of this Form of Offer and Acceptance, the Contractor 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 Contractor before the end of the period of validity stated in the Tender Data, whereupon the Contractor becomes the party named as the Contractor in the Conditions of Contract identified in the Contract Data.

Signature(s) _____ _____

Name(s) _____ _____

Capacity _____ _____

For the Contractor _____

(Name and address of organisation)

Name and signature of witness _____ **Date** _____

C1.1.2 Form of Acceptance

The Employer is to complete and sign the form of acceptance

By signing this part of the Form of Offer and Acceptance, the Employer identified below accepts the Contractor'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 Contractor's Offer shall form an agreement between the Employer and the Contractor 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 1 Agreement and Contract Data, (which includes this Agreement)
Part 2 Pricing Data
Part 3 Scope of Work
Part 4 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 Tender Data and any addenda thereto listed in the Tender Schedules as well as any changes to the terms of the Offer agreed by the Contractor and the Employer during this process of offer and acceptance, are contained in the Schedule of Deviations attached to and forming part of this Agreement. No amendments to or deviations from said documents are valid unless contained in this Schedule, which must be duly signed by the authorised representative(s) of both parties.

The Contractor shall within twenty-eight (**28) days** after receiving a completed copy of this Agreement, including the Schedule of Deviations (if any), contact the employer's agent (whose details are given in the Contact Data) to arrange the delivery of any bonds, guarantees, proof of insurance and any other documentation to be provided in terms of the Conditions of Contract identified in the Contract Data at, or just after, the date of this Agreement comes into effect. Failure to fulfil any of these obligations in accordance with those terms shall constitute a repudiation of this Agreement.

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

FOR EMPLOYER OFFICIAL USE ONLY

Name(s) _____ _____

_____ _____

Capacity _____ _____

For the Employer ***Johannesburg Water (SOC) Ltd, Turbine Hall, 65 Ntemi Piliso Street, Newtown, Johannesburg, 2001***

(Name and address of organisation)

Name and signature of witness _____ **Date** _____

Employer:		Contractor:	
Witness:		Witness:	

C1.1.3 Schedule of Deviations

Notes:

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

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

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

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

1 **Subject** _____

Details _____

2 **Subject** _____

Details _____

3 **Subject** _____

Details _____

4 **Subject** _____

Details _____

5 **Subject** _____

Details _____

6 **Subject** _____

Details _____

7 **Subject** _____

Details _____

8 **Subject** _____

Details _____

By the duly authorised representatives signing this Schedule of Deviations, the Employer and the Contractor agree to and accept the foregoing Schedule of deviations as the only deviations from and

Employer:		Contractor:	
Witness:		Witness:	

amendments to the documents listed in the Tender Data and addenda thereto as listed in the Tender Schedules, as well as any confirmation, clarification or change to the terms of the offer agreed by the Contractor and the Employer during the process of offer and acceptance.

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

For the Contractor:

Signature(s) _____ _____

Name(s) _____ _____

Capacity _____ _____

_____

(Name and address of organisation)

Name and signature of witness _____ **Date** _____

For the Employer:

Signature(s) _____ _____

Name(s) _____ _____

Capacity _____ _____

Johannesburg Water (SOC) Ltd, Turbine Hall, 65 Ntemi Piliso Street, Newtown, Johannesburg, 2001

(Name and address of organisation)

Name and signature of witness _____ **Date** _____

C1.2 CONTRACT DATA

C1.2.1 Part 1: Data provided by the Employer

CONDITIONS OF CONTRACT

The General Conditions of Contract for Construction Works (2015), Third edition, second print published by the South African Institution of Civil Engineering, is applicable to this Contract.

C1.2.1.1 Contract Specific Data

The following contract specific data are applicable to this Contract:

GCC Clause	Information
1.1.1.13	The Defects Liability Period is 365 days from the date of the Certificate of Completion.
1.1.1.14	The Work shall be completed within 540 days.
1. 1.1.15	The name of the Employer is Johannesburg Water (SOC) Limited Contact person is: William Chitsa
1.1.1.16	The name of the Employer's Agent is Zutari (Pty) Ltd represented by Chester Kan, who is Registered as a Pr.Eng with the Engineering Council of South Africa
1.1.1.26	The Pricing Strategy is Re-measurement Contract.
1.2.1.2	The address of the Employer is: Physical: Turbine Hall, 65 Ntemi Piliso Street, Newtown, Johannesburg, 2001 Postal: P.O. Box 61542, Marshalltown, 2107 Tel: 011 688 1603/71 Email:william.chitsa@jwater.co.za
1.2.1.2	The address of the Employer's Agent is: Chester Kan. Physical Address: Oxford Corner, 32A Jellicoe Avenue, Rosebank, 2196 Postal: P.O. Box 653763, Benmore, 2010 Tel: 011 214 4500 Email: chester.kan@zutari.com
3.2.3	Specific Approval – The Employer's Agent is required to obtain the Employer's approval for the following: • Approval of Variation Orders • Approval to exceed the Contract Sum
5.3.1	The documentation required before commencement with Works execution are: • Approved Health and Safety File (Clause 4.3) • Approval of the Environmental File • Initial programme (Clause 5.6) • Guarantee from Bank or Insurance Company (Clause 6.2) • Insurance of Construction Machinery Plant (Clause 8.6) • Insurance of Motor Vehicle Liability (Clause 8.6) • Commissioner of COID (Clause 8.6) • Signed Notification to the Department of Labour • Construction Work Permit where applicable. It is the Employer's responsibility to obtain this permit.
5.3.2	The Contractor shall deliver the documentation as required in clause 5.3.1 within 21 days from the Commencement Date.
5.3.3	**Time to instruct commencement of the Works** Delete Clause 5.3.3 and replace with the following:

GCC Clause	Information
	The Contractor shall commence with carrying out the Works upon written instruction from the Employer's Agent to commence with the Works.
5.8	The special non-working days are All Public Holidays in terms of the Public Holidays Act as amended. Working days shall be Monday to Friday, between 07h00 to 17h00.
5.8.1	The year-end break ''builder's break'' commences on 16 December until the first working Monday of January of the succeeding year as defined by the SAFCEC on annual basis.
5.13.1	The penalty for failing to complete the Works is the greater of: An amount equal to the daily Time Related P&G rate (calculated by dividing the monthly P&G rate stated in the BoQ by 30 days) or R6500.00 per day, whichever is greater.
5.16.3	The latent defects period is 10 years.
6.2	The time to deliver the Form of Guarantee is within 28 days from the Commencement Date.
6.2.1	The liability of the guarantee shall be 10% of the Contract sum
6.8.2	This contract is subject to Contract Price Adjustment. The value of payment certificates will be adjusted by a Contract Price Adjustment Factor, the value of each payment certificates issued shall be adjusted in accordance with the Contract Price Adjustment Schedule, with the following values: The value of "x" is 0,10 The values of the coefficients are: a = 0,32 Labour b = 0,25 Contractor's equipment c = 0,33 Material d = 0,10 Fuel (a) 'L' is the 'Labour Index' and shall be the price index for 'Consumer Price Index' for the Gauteng Province as published in the Statistical News Release, P0141, Table A "Consumer Price Index: Main indices" " of Statistics South Africa. (b) 'P' is the 'Construction Equipment' and shall be the Producer Price Index applicable to Plant and Equipment (Total) as published in the Statistical Release P0151.1, Table 4 of Statistics South Africa. (c) 'M' is the 'Materials Index' and shall be the Producer Price Index applicable to Civil Engineering Material (Total) as published in the Statistical Release P0151.1, Table 6 of Statistics South Africa. (d) 'F' is the 'Fuel Index' and shall be the Producer Price Index for Final manufactured goods - Coal and Petroleum Products - Diesel as published in the Statistical News Release P0142.1, Table 1 of Statistics South Africa." The base month is one month before the tender closing date.
6.8.3	Price adjustments for variations in the costs of special materials are **NOT** allowed.
6.10.1.5	The percentage advance on materials not yet built into the Permanent Works is 80%.
6.10.3	The maximum percentage retention on the amounts due to the Contractor is 10% of the Contract Sum.

GCC Clause	Information
6.10.4	**Delivery, dissatisfaction with and payment of payment certificates** Delete Clause 6.10.4 and replace with the following: Payment shall be made upon: • The Contractor providing a payment certificate with all required supporting documents to the Employer's Agent on dates to be communicated to the Contractor upon award. • The payment certificate being submitted with an original tax invoice. • A statement being submitted on the last day of the month. Payment will be made within 30 days of receipt of the Contractor's statement by the Employer.
6.10.5	Payment of Retention Money Add to Clause 6.10.5 the following: Payment will be subject to Johannesburg Water processes as outlined in clause 6.10.4 as amended.
6.10.6	A Retention Money Guarantee is not permitted.
6.11	Delete Clause 6.11.
8.4.1.1	Add to the end of Clause 8.4.1.1 the following text: "hereby indemnifies the Employer against any liability in respect of damage or physical loss of property of any person or injury or death of any person due to non-compliance with the Occupational Health and Safety Act (Act 85 of 1993).
8.6	Delete Clause 8.6.1 and replace it with the following: Notwithstanding anything elsewhere contained in the Contract and without limiting the obligations, liabilities or responsibilities of the Contractor in any way whatsoever (including but not limited to any requirement for the provision by the Contractor of any other insurances) the Employer shall effect and maintain as appropriate in the joint names of the Employer and the Contractor and where relevant Sub-Contractors the following insurances which are subject to the terms, limits, exceptions and conditions of the Policy :
8.6.1.1	**Contract Works Insurance** – which will provide cover against accidental and Physical loss of or damage to the Works, Temporary Works and Materials intended for incorporation in the Works from whatsoever cause arising other than causes set out in Clause 8.3.1for which the Contractor is responsible for the Works in terms of Clause 8.2.1, and for a sum insured which shall, unless otherwise specified in the Contract, be the aggregate of :
8.6.1.1.1	The Contract Price,
8.6.1.1.2	A sum to cover the value (specified at the time of delivery to the Contractor) of materials supplied by the Employer for incorporation in the Works and not included in the Contract Price, and
8.6.1.1.3	A sum to cover professional fees, not included in the Contract Price, payable in respect of the repair or reinstatement of damage to the Works.
8.6.1.2	Delete clause 8.6.1.2 and replace with the following: Following the introduction of legislation affecting the articles of the **South African Special Risks Insurance Association (SASRIA)**, insurance cover for loss or damage to the Works caused by any event defined as a risk in terms of the insurance offered by SASRIA, will be provided under a certificate issued by SASRIA.
8.6.1.3	Delete clause 8.6.1.3 and replace with the following: **Public Liability Insurance** which will provide indemnity against legal liability in the event

GCC Clause	Information
	of accidental death of or injury to third party persons and/or loss or damage to third party property arising directly from the execution of the Contract and occurring during the period of Insurance with a limit of indemnity of R5million in respect of all claims arising from any one occurrence or series of occurrences consequent on or attributable to one source or original cause.
8.6.1.6	Add the following clause to 8.6.1 Full details of the Contract Works and Public Liability insurances effected by the Employer may be obtained from the Employer and the Contractor/Sub-Contractors are deemed to be aware of the terms, exclusions and conditions of these insurances.
8.6.1.7	Add the following clause to 8.6.1 The Employer shall pay the premium in connection with the insurances effected by the Employer in 8.6.1.1, 8.6.1.2 and 8.6.1.3 above.
8.6.2	Delete clause 8.6.2 and replace with the following: The Employer/Contractor/Sub-Contractors and/or any other party who obtains indemnity under the policies effected under 8.6.1.1, 8.6.1.2 and 8.6.1.3 above shall become liable for the deductibles (first amount payable) which are applicable in respect of each and every occurrence or series of occurrences attributable to one source or cause giving rise to loss or damage or indemnifiable liability.
8.6.3	Delete clause 8.6.3 and replace with the following: In the event of an occurrence which is likely to give rise to a claim under the insurance effected by the Employer, the following procedure shall be adhered to:
8.6.3.1	Add the following clause to 8.6.3 In addition to any statutory requirements and/or other requirements contained in the Conditions of Contract, the Contractor shall immediately notify the Employer's Insurance Brokers through the Employer's agent, giving the circumstances, nature and an estimate of the loss or damage.
8.6.3.2	Add the following clause to 8.6.3 The Contractor shall, when required, complete a claims advice form, available from the Employer's Insurance Brokers, to whom the form shall be returned without delay through the Employer's agent. Each claim must be approved by the Employer before submission to the insurance broker.
8.6.3.3	Add the following clause to 8.6.3 The Contractor shall afford all access to the representatives of the Insurers for the purpose of the assessment of any loss or damage.
8.6.3.4	Add the following clause to 8.6.3 Negotiations on the settlement of claims shall be conducted by the Contractor/Sub-Contractor with the Insurers through the Employer's Insurance Brokers via Employer's agent.
8.6.4	Delete clause 8.6.4 and replace with the following: Any amount which becomes payable to the Contractor or any of his Sub-Contractors as a result of claim under the Contract Works Insurance shall if required by the Employer be paid net of the deductible to the Employer who shall pay the Contractor from the proceeds of such payment upon rectification repair or reinstatement of the loss or damage but this provision shall not in any way affect the Contractor's obligations

GCC Clause	Information
	liabilities or responsibilities in terms of the Contract.
8.6.5	Delete clause 8.6.5 and replace with the following: The Contractor shall insure all Constructional Machinery and Plant (including tools, offices and other temporary structures and content) and other items, other than those intended for incorporation into the works, owned, leased or hired brought on to the Site against all risks of physical loss or damage for the period such Plant shall be on the Site to the full value thereof. In respect of Plant brought on to the Site by or on behalf of Sub-Contractors the Contractor shall be deemed to have complied with the provisions of this Sub-Clause by ensuring that such Sub-Contractors have similarly insured such Plant and Machinery. Such insurance shall be effected with an Insurer and in terms approved by the Employer (which approval shall not be unreasonably withheld) and the Contractor shall, when required, submit to the Employer's Insurance Brokers, through the Employer's agent, the policy or policies of insurance and receipts for payment of the current premiums.
8.6.6	Delete clause 8.6.6 and replace with the following: The Contractor and the Sub-Contractors shall effect and maintain at their cost insurance under the provision of the Compensation for Occupational Injuries and Diseases Act (COID), 1993 (Act No. 130 of 1993).
8.6.7	Delete clause 8.6.7 and replace with the following: The Contractor and the Sub-Contractors shall effect and maintain at their own cost motor vehicle liability insurance with at least indemnification for "balance of third party" risks, including passenger liability with a limit of indemnity of not less than R2,5million.
8.6.8	Add the following clause to 8.6 The Contractor and the Sub-Contractors shall effect and maintain at their own cost any additional insurance, which they deem necessary to cover damage or loss or injury not insured in terms of the insurance effected by the Employer. Such insurance shall be effected with an Insurer and in terms approved by the Employer (which approval shall not be unreasonably withheld) and the Contractor shall, when required, submit to the Employer's Insurance Brokers through the Employer's agent, the policy or policies of insurance and the receipts for payment of the current premiums. If the Contract entails manufacture and or assembly of the Works or part thereof on a site other than the Contract site, the Contractor must satisfy the Employer that all materials and equipment intended for incorporation into the Works are adequately insured during manufacture and assembly. If the Employer has an insurable interest in such works during manufacture or assembly, such interest shall be recorded by way of endorsement on the policies concerned. The Contractor shall furnish the appropriate insurance policies to the Employer within 21 days from the Commencement Date.

GCC Clause	Information
8.6.9	Add the following clause to 8.6 Submission of the Tender will be construed by the Employer as acceptance by the Contractor that he is satisfied with the insurance effected by the Employer supplemented by any additional insurance which he shall specify in the manner provided for in the Schedule of Rates.
8.6.10	Add the following clause to 8.6 The Contractor shall give all notices and observe all conditions and requirements imposed by any and all relevant insurance policies which shall be read as being part of the General Conditions of Contract and which shall be binding on the Contractor.
8.6.11	Add the following clause to 8.6 In addition to any statutory obligations, or other requirements contained in the Conditions of Contract, the Contractor shall report in writing to both the Employer's Agent and the Employer's Insurance Brokers every accident within 48 hours of its occurrence, whether such accident is in respect of damage to persons or property. The report shall contain full details of the accident. The Employer's Agent and/or the Employer's Insurers shall have the right to make all and any enquiries either on the Site or elsewhere as to the cause and results of any such accident and the Contractor shall give the Engineer and/or the Employer's Insurers full facilities for carrying out such enquiries.
8.6.12	Add the following clause to 8.6 Negotiations on the settlement of claims under the insurance effected by the Employer shall be conducted by the Contractor/Sub-Contractor with the Insurers through the Employer's Insurance Brokers via the Employer's Agent.
8.6.13	Add the following clause to 8.6 Any claims against the insurance effected by the Employer shall be subject to the Contractor being responsible for the payment of the amount stated in the Policy as being the Deductible (First Amount Payable) as defined in the Policy.
8.6.14	Add the following clause to 8.6 The Employer shall not be liable for or in respect of any damages or compensation payable at law in respect or in consequence of any accident or injury to any workman or other person in the employ of the Contractor or any Sub-Contractor save and except an accident or injury resulting from any act or default of the Employer, its agents or servants and the Contractor shall be deemed to have indemnified and shall keep indemnified the Employer against all such damages and compensation (save and except as aforesaid) and against all claims, demands, proceedings, costs, charges and expenses whatsoever in respect thereof or in relation thereto.

GCC Clause	Information
8.6.15	Add the following clause to 8.6 The Contractor shall insure in the joint names of the Employer, the Contractor and all Sub-Contractors (whether nominated or otherwise) for an amount of R2million per occurrence against the liability stated in Sub-Clause 8.6.6 with an Insurer approved by the Employer (which approval shall not be unreasonably withheld) and shall continue such insurance during the whole of the time that any persons are employed by him on the Works and shall submit to the Engineer such policy of insurance and the receipt of payment of the current premium. Provided always that in respect of any persons employed by any Sub-Contractor, the Contractor's obligation to insure as aforesaid under this Sub-Clause shall be satisfied if the Sub-Contractor shall have insured against the liability in respect of such persons in such manner that the Employer is indemnified under the policy of insurance but the Contractor shall require such Sub-Contractor to produce to the Employer's Agent such policy and the receipt for payment of the current premium.
8.6.16	Add the following clause to 8.6 If the Contractor shall fail to effect and keep in force the insurances referred to in this Clause or for any other insurance which he may be required to effect in terms of the Contract, then and in any such case the Employer may effect and keep in force any such insurance and pay such premium or premiums as may be necessary for that purpose and from time to time deduct the amount so paid by the Employer as aforesaid from any monies due or which may become due to the Contractor or recover the same as a debt due from the Contractor.
8.6.17	Add the following clause to 8.6 The Contractor shall ensure that all proposed and appointed Sub-Contractors are fully aware of the contents of Clause 8.6.1
8.6.1.1.2	The value of the materials supplied by the Employer to be included in the insurance sum is nil.
10.4.2	Dispute resolution shall be by arbitration if amicable settlement and adjudication have failed.
10.5.3	The adjudication board shall consist of one member.
7.8.2	**Cost of making good of defects** Amend Clause 7.8.2.1 as follows: In the first line, correct the spelling of 'therefore'.

C1.2.1.2 Additions

The additional Conditions of Contract are:

C1.2.1.2.1 Penalties

In addition to GCC clause 5.13, during the Contract Period should the Contractor:

a) Fail to report

- The Employer shall levy a penalty on Contractor, should the latter fail to provide reporting as required in the specification highlighted in the Scope of Work, with regard to content and frequency, whilst as per the Pricing Data section no payment for work completed shall be processed.

- The penalty value shall be R15,000.00 per report per occasion; and
- If the Contractor fails to complete the latter more than three incidents and should the Employer or his duly authorised representative find that the Contractor is hindering his (the Employer's) deliverables to senior management, he shall reserve the right to:

i. perform the Works internally or through another Contractor; and
ii. deduct additional costs incurred by the Employer from monies owed to the Contractor or from the Contractor's Guarantee. Additional costs incurred by the Employer shall include all claims from Contract affected parties, claims such as but not be limited to claims from customers, any costs associated with the loss of water, and all costs associated with the procurement of an alternative Contractor.
iii. terminate the Contract;

No liability in terms of this clause shall be attached to the Contractor if he can prove to the satisfaction of the Employer that the nature of the failure is due to fire, war, riot, strikes, act of God, lockout, accident or other unforeseen occurrences or circumstances beyond the Contractor's control, provided, however, that in all cases the Contractor has notified the Employer in writing within 24 hours of it first coming to his notice, that delivery shall be delayed or become impossible for the above-mentioned reasons.

b) Fail to pay any labour or SMME

- The Employer shall levy a penalty on Contractor, should the latter fail to provide payment to the any labourer or SMME as required in the specification highlighted in the Scope of Work and specified in the appointment agreements with the Contractor and the labourer or SMME.
- The penalty value shall be R 50,000.00 per report per occasion; and
- If the Contractor fails to complete the latter more than three incidents and should the Employer or his duly authorised representative find that the Contractor is hindering his (the Employer's) deliverables to senior management, he shall reserve the right to:

i) perform the Works internally or through another Contractor; and
ii) deduct additional costs incurred by the Employer from monies owed to the Contractor or from the Contractor's Guarantee. Additional costs incurred by the Employer shall include all claims from Contract affected parties, claims such as but not be limited to claims from customers, any costs associated with the loss of water, and all costs associated with the procurement of an alternative Contractor.
iii) terminate the Contract;

No liability in terms of this clause shall be attached to the Contractor if he can prove to the satisfaction of the Employer that the nature of the failure is due to fire, war, riot, strikes, act of God, lockout, accident or other unforeseen occurrences or circumstances beyond the Contractor's control, provided, however, that in all cases the Contractor has notified the Employer in writing within 24 hours of it first coming to his notice, that delivery shall be delayed or become impossible for the above-mentioned reasons

c) Failure to submit EPWP

- The Employer shall levy a penalty on Contractor, should the latter fail to EPWP information as required in the specification highlighted in the Scope of Work and specified in the appointment agreements with the Contractor and the labourer or SMME.
- The penalty value shall be R 50,000.00 per report per occasion; and
- If the Contractor fails to complete the latter more than three incidents and should the Employer or his duly authorised representative find that the Contractor is hindering his (the Employer's) deliverables to senior management, he shall reserve the right to:

iv) perform the Works internally or through another Contractor; and

v) deduct additional costs incurred by the Employer from monies owed to the Contractor or from the Contractor's Guarantee. Additional costs incurred by the Employer shall include all claims from Contract affected parties, claims such as but not be limited to claims from customers, any costs associated with the loss of water, and all costs associated with the procurement of an alternative Contractor.

vi) terminate the Contract;

d) Penalties irreversible

If the Contractor fails to achieve the monetary value of the target set by the Employer for contract participation by local SMME Contractors in terms of for Procurement and Particular Specifications in Scope of Works, the Contractor shall be liable to the Employer for a sum calculated in accordance with the Contract Data and the aforementioned Scope of Works as a penalty for such underachievement."

The penalty for failing to achieve the monetary value of the target set by the Employer for contract participation by Targeted Enterprises and local SMME Contractors in terms of Small Contractor Development of Particular Specifications in Scope of Works, is 50% of the monetary value by which the achieved monetary value falls short of the target monetary value.

e) Penalties irreversible

The Contractor shall note that all penalties once imposed shall be non-recoverable or reversible, even if the default is remedied.

C1.2.1.2.2 Source of instructions

The Contractor shall neither seek nor accept instructions from any authority external to the Employer's Agent in connection with the performance of his services under this Contract. The Contractor shall refrain from any action which may adversely affect the Employer and shall fulfill his commitments with fullest regard for the interest of the Employer. The Contractor may only take and comply with Employers Health and Safety representative or Environmental representative on matters regarding Health & Safety, as well as Environmental.

C1.2.1.2.3 Officials not to benefit

The Contractor warrants that no official of the Employer has been or shall be admitted by the Contractor to any direct or indirect benefit arising from this Contract or the award thereof. The Contractor agrees that breach of this provision is a breach of the Contract.

C1.2.1.2.4 Prevention of corruption

The Employer shall be entitled to cancel the Contract and to recover from the Contractor the amount of any loss resulting from such cancellation, if the Contractor has offered or given any person any gift or consideration of any kind as an inducement or reward for doing or intending to do any action in relation to the obtaining or the execution of the Contract or any other contract with the Employer or for showing or intending to show favor or disfavor to any person in relation to the Contract or any other contract with the Employer, if the like acts shall have been done by any persons employed by him or acting on his behalf whether with or without the knowledge of the Contractor in relation to this or any other Contract with the Employer.

C1.2.1.2.5 Confidential nature of documents

All maps, drawings, photographs, mosaics, plans, reports, recommendations, estimates, documents and all other data compiled by or received by the Contractor under the Contract shall be the property of the Employer, shall be treated as confidential and shall be delivered only to the Employer's Agent or his duly authorized representative on completion of the Works; their contents shall not be made known by the Contractor to any person other than the personnel of the Contractor performing services under this Contract without the prior written consent of the Employer.

C1.2.1.2.6 Returns of labour, SMME, plant, equipment and material

The Contractor shall provide a return in detail in the form and at such intervals as the Employer's Agent or his duly authorized representative may prescribe showing the supervisory staff and the numbers of the several classes of labour from time to time employed by the Contractor on the Site and such information respecting constructional plant, equipment and material as the Employer's Agent or his duly authorized representative may require. Contractor to report on SMME's as per requirements of JW6.1.

C1.2.1.2.7 Materials and workmanship

All materials and workmanship shall be of the respective kinds described in the Contract and in accordance with the Employer's Agent's instructions and shall be subjected from time to time to such tests as the Employer's Agent may direct at the place of manufacture or fabrication, or on the Site or at all or any of such places. The Contractor shall provide such assistance, instruments, machines, labour and materials as are normally required for examining, measuring and testing any work and the quality, weight or quantity of any materials used and shall supply samples of materials before incorporation in the Works for testing as may be selected and required by the Employer's Agent. All testing equipment and instruments provided by the Contractor shall be used only by the Employer's Agent or by the Contractor in accordance with the instructions of the Employer's Agent.

a) No material not conforming with the Specifications in the Contract shall be used for the Works without prior written approval of the Employer and instruction of the Employer's Agent, provided always that if the use of such material results or may result in increasing the Contract Price, the procedure in GCC clause 6.3 (Variations) shall apply.

C1.2.1.2.8 Examination of the work before covering up

No work shall be covered up or put out of view without the approval of the Employer's Agent or his duly authorize representative and the Contractor shall afford full opportunity for the Employer's Agent or his duly authorize representative to examine and measure any work which is about to be covered up or put out of view and to examine foundations before permanent work is placed thereon. The Contractor shall give due notice to the Employer's Agent whenever any such work or foundations is or are ready or about to be ready for examination. The Employer's Agent or his duly authorized representative shall without unreasonable delay, unless he considers it unnecessary and advises the Contractor accordingly, attend for the purpose of examining and measuring such work or of examining such foundations.

C1.2.1.2.9 Employer's Agent's power to order removal of improper work and materials

The Employer's Agent or his duly authorized representative shall during the progress of the Works have power to order in writing from time to time, and the Contractor shall execute at his cost and expense, the following operations the:

a) removal from the Site within such time or times as may be specified in the order of any materials which in the opinion of the Employer's Agent are not in accordance with the Contract;

b) substitution of proper and suitable materials; and

c) removal and proper re-execution (notwithstanding any previous test thereof or interim payment therefore) of any work which in respect of materials or workmanship is not in the opinion of the Employer's Agent or his duly authorized representative in accordance with the Contract.

C1.2.1.2.10 Default of Contractor in carrying out Employer's Agent's or his duly authorized representative's Instructions

In case of default on the part of the Contractor in carrying out an instruction of the Employer's Agent or his duly authorized representative, the Employer shall be entitled to employ and pay other persons to carry out the same, and all expenses consequent thereon or incidental thereto shall be borne by the Contractor and shall be recoverable from him by the Employer and may be deducted by the Employer from any monies due or which may become due to the Contractor.

C1.2.1.2.11 Date falling on public holiday or weekend

Where under the terms of the Contract any act is to be done or any period is to expire upon a certain day and that day or that period fall on a day of rest or recognized holiday or weekend, the Contract shall have effect as if the act were to be done or the period to expire upon the working day following such day.

C1.2.1.2.12 Ambiguities and inconsistencies

The Employer or the Contractor shall notify the other as soon as either becomes aware of an ambiguity or inconsistency in or between the documents, which are part of this

Contract. Governed by the spirit and intention of the Contract, the Employer shall give a binding instruction resolving the ambiguity or inconsistency.

C1.2.1.2.13 False claims by the Contractor

a) Failure, by the Contractor, to demonstrate or present any feature declared during the procurement stage shall constitute grounds for Contract termination or the market related equivalent price discount, if no market related value is available, the Employer shall give a final ruling on the amount. This shall be at the discretion of the Employer based on the implication of such omission. Should the Contractor refuse to accept the Employer's price, the Contract shall be terminated.

b) Any false claims by the Contractor or his staff (with or without his knowledge), based on Works to be performed or completed per site stage shall constitute grounds for Contract termination and result in blacklisting on the Employer's database.

The Contractor shall note that any of the above shall constitute non-performance on the part of the Contractor, further resulting in him forfeiting his full Contract Guarantee.

C1.2.2 Part 2: data provided by the Contractor

GCC Clause	Information
Clause 1.1.9	The name of the Contractor is ..... The Contact person is .....
Clause 1.2.1.2	The address of the Contractor is: Physical Postal Tel: …… …….. …….. …….. …….. Fax: …… …….. …….. …….. …….. …….. …….. Email: …….. …….. …….. ……..…….. …….. …….. ……
Clause 6.8.3	The variation in cost of special materials is Type Unit Rate ***NOT APPLICABLE***

Johannesburg Water SOC Ltd

Johannesburg Water

CONTRACT JW14322

CONSTRUCTION OF A 26 ML CONCRETE RESERVOIR AND 2ML CONCRETE TOWER IN BRIXTON WITH ASSOCIATED PIPE AND PUMP WORKS

VOLUME 1

CONTRACT

C1.3 FORMS AND SECURITIES

Employer:		Contractor:	
Witness:		Witness:	

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C1.3 FORMS AND SECURITIES

Forms for completion by the Contractor

The following forms are to be completed by the Contractor after the tender has been awarded to the successful Contractor

a) Form of Guarantee
b) Blasting Indemnity
c) Agreement in terms of the Occupational Health and Safety Act
d) Occupational Health and Safety Indemnity Undertaking

The forms will be completed by the Contractor who will be instructed to do so in the Form of Acceptance. The completed forms will become part of the Contract.

The Form of Guarantee is a pro forma document. The Contractor will provide an original document, from a financial institution, with the same text within the time stated in the Contract Data. Only a Bank or approved Insurance Company or Guarantee Corporation is acceptable as Guarantor.

C.1.3.1 Form of Guarantee

TO BE PRINTED ON THE OFFICIAL LETTERHEAD OF THE GUARANTOR.

PERFORMANCE GUARANTEE

WHEREAS Johannesburg Water SOC Ltd (hereinafter referred to as "the Employer" or "beneficiary") entered into a Contract with

_____

(hereinafter called "the Contractor")

on the ___ day of _____ 20 _____ for the construction of

_____

at _____

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 fulfilment of such Contract by the Contractor;

AND WHEREAS _____
has/have at the request of the Contractor, agreed to 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 excussion 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 authorised 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, alteration 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 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.
Our total liability hereunder shall not exceed the sum of _____

_____

_____

_____ (R _____)

5. The guarantor reserves the right to withdraw from this guarantee by depositing the Guaranteed Sum with the beneficiary, whereupon the Guarantor's liability hereunder shall cease.

6. 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 the _____ day of__20

Duly authorised to sign on behalf of : _____

As Witnesses:
1:

_____

2:

_____

1

Date : _____

Address : _____

C.1.3.2 Blasting Indemnity

Given by _____

*Company Registration No._____

Address _____

C.1.3.3 Health and Safety Contract Between Employer and Contractor In Terms of Section 37(2) Of The Occupational Health and Safety Act No 85 Of 1993

Written agreement between Johannesburg Water ((SOC) Limited (hereinafter referred to as "the

Employer) and _____ (hereinafter referred to as "the mandatory") as envisaged by Section 37(2) of the Occupational Health and Safety Act, No. 85, of 1993 as amended.

I _____ representing

_____ (mandatory) do hereby acknowledge that

_____ (mandatory) is an employer in its own right and shall be regarded as the employer for purposes of the contract work specified in the body of the principal agreement with duties as prescribed in the Occupational Health and Safety Act, No. 85 of 1993 as amended so as to ensure that all work will be performed or machinery and plant used in accordance with the provisions of the said Act. I furthermore agree to comply with the requirements of the Employer as contained in the Occupational Health and Safety Specification included with the principal agreement and to liaise with the employer should I, for whatever reason, be unable to perform in terms of this agreement.

Signed this _____ day of _____ at _____

Signature on behalf of mandatory _____

Signature on behalf of Employer _____

Compensation Fund Registration No. of mandatory _____

Good Standing Certificate : ☐ yes ☐ no (tick one box)

C.1.3.4 Health and Safety Contract: General Information

1. The Occupational Health and Safety Act comprises Sections 1 to 50 and all un-repealed regulations promulgated in terms of the former Machinery and Occupational Safety Act No 6 of 1983 as amended, as well as other regulations which may be promulgated in terms of the OHS Act.

2. 'Mandatory' is defined as including an agent, a contractor or a subcontractor for work, but without derogating from his status in his own right as an employer or user of plant and machinery.

3. Section 37 of the Occupational Health and Safety Act potentially punishes employers (principals) for the unlawful acts or omissions of mandatories (contractors) save where a written agreement between the parties has been concluded containing arrangements and procedures to ensure compliance with the said Aid by the mandatory.

4. All documents attached or referred to in the above agreement from an integral part of the agreement.

5. To perform in terms of this agreement mandatories must be familiar with the relevant provisions of the Act.

6. Mandatories who utilise the services of their own mandatories (subcontractors) are advised to conclude a similar written agreement.

7. Be advised that this agreement places the onus on the mandatory to contact the Employer in the event of inability to perform as per this agreement. The Employer, however, reserves the right to unilaterally take any steps as may be necessary to enforce this agreement.

8. The contractor shall be responsible for the full and proper implementation of the terms and provisions of the Act and its regulations in the area in which the work is to be undertaken by the Contractor.

9. The Contractor shall be responsible for the well-being, in relation to health and safety, of all persons coming upon or into such area in accordance with that legislation, including the implementation of any directives issued by management of the Employer in this respect.

10. The work to be done is the construction of **JW 14322: CONSTRUCTION OF A 26ML CONCRETE RESERVOIR AND 2ML CONCRETE WATER TOWER IN BRIXTON WITH ASSOCIATED PIPE AND PUMP WORKS**

11. The area in which the work is to be conducted is **BRIXTON, JOHANNESBURG.**

12. The Contractor shall familiarise himself with such area and all risks existing thereon and undertakes to report to the representative of the Employer any hazard or risk to health and safety which arises during the contract work in the area concerned and over which the Contractor may

have no control. All necessary and appropriate safety / health equipment shall be issued by the Contractor to all persons working on or coming into the area.

Occupational Health and Safety Indemnity Undertaking

I, the undersigned _____

in my capacity as _____

of the firm _____

1.0 hereby undertake to ensure that I/my firm and/or employees and/or subcontractors and/or his employees -

1.1 comply strictly with the provisions of the Occupational Health and Safety Act of 1993 (as amended) and/or the regulations promulgated in terms thereof, with specific reference to section 37(2) of the said act, as well as any relevant legislation, in the course of the performance/execution of any service and/or work in, to or on any of the Employer's buildings, construction sites and/or premises;

1.2 ensure that consultants and/or visitors comply with any instructions and measures relating to occupational health and safety, as prescribed by the Employer; and

1.3 comply strictly with the statutorily prescribed work systems, operational equipment, machinery and occupational health and safety conditions;

2.0 and as an independent employer and contractor, hereby indemnify, in terms of the above undertakings, the Employer -

2.1 in respect of any costs that I/my firm and/or employees and/or subcontractors and their employees may incur of necessity in compliance with the above undertakings; and

2.2 against any claims that may be instituted against the Employer and/or any liability that the Employer may incur, whether instituted and/or caused by me/my firm's employees, agents, consultants, subcontractors and/or their employees and visitors or the Employer's clients or neighbours in respect of any incidents related to my/my firm's activities and as a result of which the occupational health and safety of the persons involved have been detrimentally affected; and

2.3 against similar claims that I, managers or directors of my firm may have against the Employer and any damages for which I, managers or directors of my firm hold the Employer liable.

3.0 My firm's compensation commissioner number is _____

and I confirm that my firm and its subcontractors' fees have been paid up and obligations in respect of the compensation commissioner have been complied with and further that I shall furnish proof thereof in writing on request.

4.0 I hereby confirm that I have the authority to sign this indemnity undertaking and that the Employer is not obliged to confirm such confirmation.

Signed at _____ this _____ day

of _____ _____

_____ _____

Signature Capacity

As witnesses:

1 _____

2 _____

a *Company incorporated with limited liability according to the company laws of the Republic of South Africa, *Partnership, *Close Corporation, *Public Company (hereinafter called the Contractor), represented herein by in his capacity as the Contractor's

_____ duly authorised hereto by a resolution of the Contractor dated

_____ a certified copy of which resolution is attached to this Indemnity.

WHEREAS the Contractor has entered into a Contract with the Johannesburg Water SOC Ltd (hereinafter called the Employer) for,

_____

and the Company requires this Indemnity from the Contractor

NOW THEREFORE THIS DEED WITNESSETH that the Contractor does hereby indemnify and hold harmless the Company in respect of all loss or damage that may be incurred or sustained by the Employer by reason of or in any way arising out of or caused by blasting operations that may be carried out by the Contractor in connection with the aforementioned Contract and also in respect of all claims that may be made against the Employer in consequence of such blasting operations, by reason of or in any way arising out of any accidents or damage to persons, life or properly or any other cause whatsoever, and also in respect of all legal or other expenses that may be incurred by the Employer in examining, resisting or settling any such claims; for the due performance of which the Contractor binds itself according to law.

THUS DONE AND SIGNED for and on behalf of the Contractor at _____ on the

_____ day of _____ 20 _____ in the presence of the subscribing

:

Duly authorised to sign on behalf of _____

As Witnesses:
1:

_____

2:

_____

Date : _____

Address : _____

Employer:		Contractor:	
Witness:		Witness:	

Johannesburg Water (SOC) Ltd

Johannesburg Water

CONTRACT JW14322

CONSTRUCTION OF A 26ML CONCRETE RESERVOIR AND 2ML CONCRETE WATER TOWER IN BRIXTON WITH ASSOCIATED PIPE AND PUMP WORKS

VOLUME 1

CONTRACT

C2.1 PRICING INSTRUCTIONS

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C2 PRICING DATA

C2.1 PRICING INSTRUCTIONS

C2.1.1 GENERAL PREAMBLE TO THE BILL OF QUANTITIES

a) All items in the Bill of Quantities, except where otherwise specified in Clause 8 of a Standardised Specification or in the Project Specification, shall be measured and shall cover operations as recommended in the standard system of measurement of civil engineering quantities, published under the title “Civil Engineering Quantities”, by the South African Institution of Civil Engineering.

b) The basis and principles of measurement and payment are described in this section (Pricing Instructions) and Clause 8 of each of the Standardised Specifications for Civil Engineering Construction. The applicable SANS 1200 Standardised Specifications are listed in the Scope of Work, Part C3: Project Specification. Variations and amendments to the Standardised Specifications are contained in the Scope of Work, Part C3.7: Variations and Additions to the Standardised Specifications.

c) Descriptions in the Bill of Quantities are abbreviated and comply generally with those in the Standardised Specifications. Clause 8 of each Standardised Specification, read together with the relevant clauses of the Scope of Work, set out what ancillary or associated activities are included in the rates for the operations specified. Should any requirements of the measurement and payment clause of the applicable Standardised Specification or the Scope of Work, conflict with the terms of the Bill of Quantities, the requirements of the Standardised Specification or Scope of Work, as applicable, shall prevail.

d) The clauses in a specification in which further information regarding the Schedule item may be found are listed in the “Payment Refers” column in the Schedule. The reference clauses indicated are not necessarily the only sources of information in respect of listed items. Further information and specifications may be found elsewhere in the Contract Documents. Standardised Specifications are identified by the letter or letters which follow SANS in the SANS 1200 series of specifications, e.g. D for SANS 1200D.

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

f) The quantities set out in the Bill of Quantities are the estimated quantities of the Contract Works, but the Contractor shall be required to undertake whatever quantities may be directed by the Engineer from time to time. The Contract Price for the completed Works shall be computed from the actual quantities of work done, valued at the relevant unit rates and/or prices.

g) The rates and/or prices to be inserted in the Bill of Quantities are to be the full inclusive prices for the work described under the several items. Such rates and/or prices shall cover all costs and expenses that may be required in and for the execution of the work described, and shall cover the cost of all general risks, liabilities, and obligations set forth or implied in the documents, as well as overhead charges and profit. Reasonable charges shall be inserted as these shall be used as a basis for assessment of payment for additional work that may have to be carried out.

h) A price or rate is to be entered against each item in the Bill of Quantities, whether the quantities are stated or not. An item against which no price is entered will be considered to be covered by the other prices or rates in the Schedule.

i) The units of measurement described in the Bill of Quantities are metric units. Alternatives used are as follows :

mm= millimetre	h = hour
m = metre	kg = kilogram
km = kilometre	t = ton (1 000 kg)
m² = square metre	No. = number
m²-pass = square metre pass	sum = lump sum
ha = hectare	MN = meganewton
m³ = cubic metre	MN.m = meganewton-metre
m³-km =	cubic metre-kilometre PC sum = Prime Cost sum
l = litre	Prov sum = Provisional sum
kl = kilolitre	% = percent
MPa = megapascal	kW = kilowatt

j) For the purpose of this Bill of Quantities, where applicable, the following words shall have the meanings hereby assigned to them:

Unit: The unit of measurement for each item of work as defined in the SANS 1200 Standard Specifications.

Quantity: The number of units of work for each item.

Rate: The agreed payment per unit of measurement.

Amount: The product of the quantity and the agreed rate for an item.

Lump sum: An agreed amount for an item, the extent of which is described in the Bills of Quantities but the quantity of work of which is not measured in any units.

k) Arithmetical errors in the Bill of Quantities shall be corrected in accordance with Clause C3.9 of the Conditions of Tender. Should there be any discrepancy between rates and/or prices written in the Assessment Schedule and the Bill of Quantities, the latter shall govern.

l) The Bill of Quantities shall be completed by hand in **BLACK PEN INK**.

C2.1.2 SPECIAL PAYMENT CONDITIONS

This clause shall be read in conjunction with the 'Penalties' clause(s). Where the penalty clause shall always receive precedence over this clause, should it be found that duplicative financial corrective measures exists.

C2.1.2.1 Provided previously

The Contractor shall not re-execute works under this Contract where he has successfully executed works for the Employer under a previous contract(s) that comply with the requirements of this Contract. However, where applicable the Contractor shall:

a) clearly state this in his qualifications; and

b) still provide the associated rates and prices in the schedule in the associated line item, but not calculate an associated amount.

The Employer shall at his sole discretion decide to re-execute such works.

C2.1.2.2 Security

The Contractor shall be deemed to have included all security related costs in the Provisional and General item rates, including allowing for minimum 60% (high risk areas) of the sites requiring security provision for the Employer and Engineer representative(s).

C2.1.2.3 Materials and equipment

The Employer shall not provide any works material and equipment, as this shall be provided by the Contractor and deemed to have been included in his provided activity rates or prices.

C2.1.2.4 Permits and way-leaves

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.

C2.1.2.5 Confined space

The Contractor shall note that work activities shall be executed within confined spaces and it shall be deemed that allowance has been made in all activity pricing.

C2.1.2.6 Concrete

Descriptions (prices) of concrete work shall be deemed to include the design of concrete mixes and all testing of concrete and materials other than compressive strength testing of concrete samples from concrete being placed in the works (the Contractor shall only be entitled to payment for those samples and compressive strength tests called for by the Engineer or his duly authorized representative and which pass the test requirements), handling and depositing (by hoisting or lowering) concrete in the forms, working and packing (compacting) concrete around reinforcement, all "construction joints" other than "designated joints" as defined in SANS 2001-CC1 which are given separately, shaping tops of components as required and striking off and curing.

Descriptions (prices) of concrete in surface beds cast in panels shall be deemed to include

formwork, fillets and the like in forming the panels.

C2.1.2.7 Formwork

Formwork is measured to the net surfaces of concrete to be supported, except at intersections of beams with beams, columns, walls, etc. and tops of columns with slabs, beams, etc. where no deductions have been made and descriptions (prices) shall be deemed to include use and waste, except where the formwork is of a permanent nature or is to be left in, fitting together to all required shapes, all cutting, intersections, cambering where required, holes for rods, bolts, pipes and the like, propping, maintaining, keeping damp whilst the concrete is being deposited and removing of formwork.

Formwork "left in" and permanent formwork shall be deemed to include leaving in formwork, props, etc.

Descriptions (prices) of formwork to soffits shall be deemed to include propping not exceeding 3.5 m high unless otherwise described. Descriptions (prices) of formwork to walls and columns shall be deemed to be not exceeding 3.5m high above bearing level unless otherwise described.

Descriptions (prices) of formwork to soffits of solid slabs shall be deemed to be to slabs not exceeding 300mm thick unless otherwise described.

C2.1.2.8 Smooth formwork

Descriptions (prices) shall be deemed to include for rubbing off all projections at seams etc. after removal of the formwork, making good any defects with 2:1 cement mortar and leaving a smooth surface with all arises slightly rounded, all to the satisfaction of the Engineer or his duly authorized representative.

C2.1.2.9 Reinforcement

Descriptions (prices) for all steel reinforcement to concrete shall be deemed to include cutting and waste, bending, hooked ends, binding at lappings and intersections with annealed wire, all as above described, hoisting or lowering and maintaining in position whilst the concrete is being deposited and cover blocks and spacers in accordance with the relevant SANS Codes of Practice.

Descriptions (prices) of standard fabric reinforcement as included in Table 1 of SANS 1024 shall be deemed to include 300 mm wide laps.

The mass of binding wire is not included in the mass of the reinforcement and the cost thereof shall be deemed to be included in the prices for the reinforcement.

C2.1.2.10 Movement joints

Descriptions (prices) of movement joints shall be deemed to include formwork around bearings.

C2.1.2.11 Cellular concrete

Descriptions (prices) for grading shall be deemed to include for striking the bottom layer to falls, the curing and finishing smooth of top layer ready to receive waterproofing. Samples shall be taken from the bottom layer of concrete at the rate of 3 samples for every 10 m³ of concrete cast. In no sample shall the density of the concrete vary more than (plus) 80 kg/m³. Samples shall be made in standard concrete cube moulds.

C2.1.2.12 Precast concrete

Descriptions (prices) of precast concrete shall be deemed to include reinforcement required for manufacturing, handling and erection purposes, steel rod or wire loop hooks and/or mortices for Lewis bolts required for handling and transporting, any necessary temporary propping and strutting, bedding, jointing and pointing.

C2.1.2.13 Plastering and in-situ finishes

Descriptions (prices) of plaster and other in-situ finishes shall be deemed to include the necessary preparatory work and working around pipes, balusters, etc. Plastering described as "on walls" is on brick walls or block walls unless otherwise stated and shall include plaster on concrete columns, beams and lintels flush with the face of the wall.

Descriptions (prices) of mouldings shall be deemed to include dubbing out where necessary and ends mitres and intersections when the girth of the moulding does not exceed 300 mm.

C2.1.2.14 Failure to submit reports and associated visual media

The Contractor's monthly invoice shall be accompanied by confirmation from the Engineer or his duly authorised representative that items listed for payment have been successfully executed and/or delivered as required. Failure to obtain such confirmation from the Engineer or his duly authorised representative shall result in non-payment of the Contractor's invoice until the default has been corrected or the deemed incomplete items are excluded from the invoice.

C2.1.2.15 Payment ONLY for works completed

The Contractor shall note that payment shall only be made for Works activities successfully (delivering the end result) executed, complying with the quality requirements and provided to the Engineer or his duly authorised representative. ***For example****: No payment shall be made where CCTV surveys could not be successfully completed due to manhole length isolation difficulties, including payment for the unsuccessful isolation.*

C2.1.2.16 Health and safety

The principal Contractor's health and safety plan has to follow the framework as laid out in the HEALTH AND SAFETY SPECIFICATION AND ENVIRONMENTAL MANAGEMENT PLAN, as a minimum.

No payment shall be applicable where equipment is not provided and services are not rendered in terms of the approved Health and Safety Plan. Additionally, the Contractor shall also be penalised in terms of Regulation (33) of the Occupational Health and Safety Act 183 (1993), Construction Regulations (2014).

C2.1.3 BILL OF QUANTITIES

Johannesburg Water SOC Ltd

Johannesburg Water

CONTRACT JW14322

CONSTRUCTION OF A 26ML CONCRETE RESERVOIR AND 2ML CONCRETE WATER TOWER IN BRIXTON WITH ASSOCIATED PIPE AND PUMP WORKS

VOLUME 2A

PART 3:

SCOPE OF WORK

C3.2 PARTICULAR SPECIFICATIONS

PREAMBLE TO SCOPE OF WORK

General

The Standard Specification for all associated civil work shall be the SANS 1200 and SANS 2001 – Standardized Specification for Civil Engineering Construction.

The Standardized Specifications applicable to this Contract are listed in the Project Specification.

These Specifications are not issued with this volume but are available at the Contractor's expense from: SA Bureau of Standards, Private Bag X191, Pretoria, 0001.

Scope

This Project Specification is set out in three portions:

Portion 1: SCOPE OF WORK covers a general description of the project, the facilities available and the requirements to be met.

Portion 2: GENERIC SPECIFICATIONS covers variations to the standardized specifications which are applicable to the contract.

Portion 3: PARTICULAR SPECIFICATIONS covers particular specifications which are applicable to the contract.

Status

Should any requirement of the Project Specification conflict with any requirement of the standardized or particular specifications, the requirements of the Project Specifications shall prevail.

C3 SCOPE OF WORKS

C3.3 PARTICULAR SPECIFICATIONS

C3.3.1 CIVIL

PA	**FENCING**
PA 01	SCOPE
PA 02	TYPE OF FENCE
PA 03	MATERIALS
PA 04	CLEARING FENCE LINE
PA 05	INSTALLING POSTS AND STANDARDS
PA 06	INSTALLING WIRE
PA 07	INSTALLING DIAMOND MESH
PA 08	INSTALLING BARBED-TAPE CONCERTINAS
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PD	**BUILDING WORK**
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PZ 05	MEASUREMENT AND PAYMENT

C3.3.1.1 PA FENCING

C3.3.1.1.1 PA 01 SCOPE

This is a Particular Specification and covers the erection of new fences.

C3.3.1.1.2 PA 02 TYPE OF FENCE

The fence shall be a security fence and shall be erected in accordance with the dimensions shown on the Drawings.

C3.3.1.1.3 PA 03 MATERIALS

C3.3.1.1.3.1 PA 03.1 POSTS, STAYS AND STANDARDS

Posts, stays and standards shall be of the type and size indicated on the Drawings. Posts shall include gate posts, straining posts, and corner posts.

Metal posts, stays and standards shall comply with the requirements of CKS 82 and SABS 280. "Acceptable" in CKS 82 means "acceptable to the Engineer".

Tubular posts, standards and stays shall be galvanized in accordance with SANS 10684 Table 1 for type B articles. All rail and Y-sections shall be provided with a protective coating of tar or other approved material.

Corner, gate, and straining posts shall be suitably drilled for stay bolts or gate fittings as indicated on the Drawings.

C3.3.1.1.3.2 PA 03.2 BOLTS FOR STAYS

Bolts shall be of mild steel and galvanized in accordance with SANS 10684 Table 1 for type C articles. The length and diameter of the bolts shall be as shown on the Drawings. All the necessary bolts, together with nuts and washers, shall be supplied with each post.

C3.3.1.1.3.3 PA 03.3 WIRE

All wire shall conform to the requirements of SABS 675 and shall be class B galvanized, except where otherwise specified below.

(a) Barbed wire

Barbed wire shall be one or both of the following types:

(i) High-tensile grade, oval shaped, single-strand wire, 2,60 mm x 2,00 mm
(ii) Mild-steel grade, double-strand, uni-directional twist wire, each strand 2,50 mm in diameter

Barbs shall be spaced at not more than 150 mm intervals.

(b) Smooth wire

Smooth wire shall be of the types specified below:

(i) Straining wire shall be mild-steel wire, 4,00 mm in diameter.
(ii) Fencing wire shall be high-tensile grade 2,24 mm diameter wire.

(iii) Tying wire or binding wire shall be 2,50 mm diameter, mild-steel, class C galvanized wire for tying fencing wire to standards and 1,60 mm diameter, mild-steel, class C galvanized wire for tying wire mesh to fencing wire.

(c) Barbed-tape concertinas

Barbed-tape concertinas shall comply with the requirements for type A in CKS Specification 592 and shall consist of close-coiled high-tensile wire with a continuous strip of flat steel barbs (barbed tape) crimped to the wire along the entire length of the wire. The coils shall further be attached to each other by clips to give a concertina configuration when pulled apart. The coils shall be of the diameter as shown on the Drawings. Each concertina shall have a minimum of 55 coils, and the maximum effective length of open concertina, when pulled apart, shall depend on the diameter of the roll, but shall be at least 12 m.

The high-tensile wire shall be class B galvanized and the barbed tape shall be made of cold-rolled carbon steel galvanized to class Z450. The concertina clips shall be manufactured from steel strip galvanized to class Z450.

C3.3.1.1.3.4 PA 03.4 DIAMOND MESH

Diamond mesh (chain-link fencing) shall comply with the requirements of SABS 1373. The width shall be as shown on the Drawings, and both edges shall be clinched.

The diameter of the wire shall be 2,5 mm and the mesh size shall be as shown on the Drawings and the wire shall be class B galvanized.

C3.3.1.1.3.5 PA 03.5 GATES

Gates shall comply with the requirements of CKS 146 and shall be manufactured to the dimensions shown on the Drawings.

Gates shall be complete in every respect, and shall include hinges, washers, bolts, and the locking mechanism shown on the Drawings.

C3.3.1.1.3.6 PA 03.6 CONCRETE

Concrete used for fencing shall comply with the requirements of SABS 1200 G.

C3.3.1.1.4 PA 04 CLEARING FENCE LINE

Strip clearing for the fence shall be carried out in accordance with SABS 1200 C and will be measured and paid for under Section 1200 C of the Schedule of Quantities.

C3.3.1.1.5 PA 05 INSTALLING POSTS AND STANDARDS

Straining posts shall be erected at all ends, corners, and bends in the line of fencing and at all junctions with other fences. Straining posts shall not be spaced further apart than shown on the Drawings. The height of the posts above the ground shall be such that the correct clearance between the lowest wire and the ground can be obtained.

Posts shall be accurately set in holes and, where indicated, shall be provided with concrete bases to the dimensions shown on the Drawings.
Holes shall be dug to the full specified depth. Where, due to the presence of rock, the holes cannot be excavated by hand or by pneumatic tools and the Contractor has to resort to the use of explosives, he will be paid separately for the drilling and blasting operations required.

Corner, gate, end and straining posts shall be braced by means of stays or anchors, as shown on the Drawings. Pipe stays shall be bolted to the posts. Gate posts shall not be used as straining posts, but at each gate post a straining post shall be placed as shown on the Drawings and stayed by means of an anchor consisting of six strands of wire.

Standards shall be firmly planted in the ground at the spacing shown on the Drawings or as directed by the Engineer. The spacing of standards between any two straining posts shall be uniform. In rock or hard material standards shall either be driven or set in holes drilled into the rock. The size of drilled holes shall be such that a tight fit is obtained. Care shall be taken not to buckle or damage the standards when driven. Where indicated, standards shall be provided with concrete bases to the dimensions shown on the Drawings.

All posts and standards shall be accurately aligned and set plumb and shall be planted with the overhang as shown on the Drawings and at right angles to the direction of the fence. After posts and standards have been firmly set in accordance with the aforegoing requirements, the fencing wire shall be attached thereto as described below.

C3.3.1.1.6 PA 06 INSTALLING WIRE

All fencing wire shall be carefully stretched and hung without sag and with true alignment, and care shall be taken not to stretch the wire so tightly as to cause breaking, pulling up straining posts, or being easily damaged during veld fires.

Each strand of fencing wire shall be securely fastened in the correct position to each standard with galvanized binding wire. The binding wire for each horizontal fence wire shall pass through a hole or notch in the standard, and the ends of the wire shall be wound at least four times around the fencing wire.

At the end, corner, straining, and gate posts the fencing wire shall be securely wrapped twice around the post and secured against slipping by tying the end tightly around the wire by means of at least six snug, tight twists. In the case of high-tensile wire, two long windings must first be made before the six tight twists to prevent the wire from breaking at the first twist. Where smooth wire is used, the loose end shall be bent back and hooked into the opening between the fencing wire and the first winding.

Splices in the fencing wire will be permitted if made in the following manner with the use of a splice tool: The end of each wire at the splice shall be carried at least 75 mm past the splice tool and wrapped snugly around the other wire for not less than six complete turns, after which the two separate wire ends shall be wound in opposite directions. After the splice tool has been removed, the space left by it in the splice wire shall be closed by pulling together the wire ends. The unused ends of wire shall be cut close to leave a neat splice.

The gaps between gate posts and the adjacent straining posts shall be fenced off with short fencing wires.

C3.3.1.1.7 PA 07 INSTALLING DIAMOND MESH

Where indicated on the Drawings, diamond mesh shall be stretched against the fence and properly tied to the fencing wire. The diamond mesh shall be secured by means of binding wire at 1,2 m centres along the top and bottom wires and at 3 m centres along each of the other fencing wires, unless shown otherwise on the Drawings.

C3.3.1.1.8 PA 08 INSTALLING BARBED-TAPE CONCERTINAS

Barbed-tape concertinas shall be positioned on the fence as shown on the Drawings. The concertinas shall be fastened to the appropriate fencing wires at each standard as well as at 1,0 m maximum intervals between standards.

Rolls of barbed-tape concertinas shall be joined with binding wire at four points, spaced at equidistant intervals around the circumference of the loop. Joints shall be made to coincide with the positions of standards.

C3.3.1.1.9 PA 09 CLOSING OPENINGS UNDER FENCES

At ditches, streams, drainage channels or other hollows where the fence cannot follow the general ground contour, the Contractor shall close the opening under the fence by means of horizontal barbed wires 150 mm apart and stretched between additional straining posts as shown on the Drawings. The opening shall be covered with strips of diamond mesh, 1 000 mm wide, fixed to the barbed wires.

In the case of larger streams, the opening below the lower fencing wire shall be closed by means of loose-hanging wire nets as shown on the Drawings. These nets shall be erected at streams only on the instructions of the Engineer.

C3.3.1.1.10 PA 10 INSTALLING GATES

Gates shall be installed at the positions indicated on the Drawings or pointed out on Site. The gates shall be hung on gate fittings in accordance with the details shown on the Drawings. Gates shall be so erected that they swing in a horizontal plane at right angles to the gate posts and clear of the ground in all positions. Double swing gates shall close to have a gap of not more than 25 mm between them, and other gates shall close to be not more than 25 mm from the gate post.

C3.3.1.1.11 PA 11 GENERAL REQUIREMENTS AND TOLERANCES

The completed fences shall be plumb, taut, true to line and to the ground contour, and with all posts, standards and stays firmly set.

The height of the lower fencing wire above the ground at posts and standards shall not vary by more than 25 mm from that shown on the Drawings. Other fencing wires shall not vary by more than 10 mm from their prescribed relative vertical positions.

Anchoring of a fence to structures shall be done as shown on the Drawings.

The Contractor shall, on completion of each section of fence, remove all cut-offs and other loose wire or mesh so as to leave the fence with a neat and finished appearance.

C3.3.1.1.12 PA 12 EASUREMENT AND PAYMENT

C3.3.1.1.12.1 PA 12.1 Supply and erection of new fencing material

(a) Barbed wire (grade, size and type of wire indicated)……Unit: m

(b) Smooth wire (grade and size indicated)……Unit: m

(c) Barbed tape concertinas (coil diameter indicated)……Unit: m

The unit of measurement shall be the metre of each type of fencing wire and barbed-tape concertinas measured between end posts. Binding wire and wire used for the bracing and anchoring of posts shall not be measured for payment.

(d) Diamond mesh (mesh size indicated)……..……..Unit: m²

The unit of measurement shall be the square metre of diamond mesh and the quantity shall be calculated on the prescribed width and the length between straining posts or gate posts, or the length of strips for covering openings under fences, or the length used for the covering of gates.

(e) Corner, end, and straining posts, including anchors (type, size and length indicated. ……Unit: number

The unit of measurement shall be the number of posts required to conform to the maximum spacing specified or such lesser spacing as authorised by the Engineer.

(f) Standards (length and type indicated)……..Unit: number

The unit of measurement shall be the number of standards required to conform to the maximum spacing specified or such lesser spacing as authorised by the Engineer.

(g) Droppers (length and type indicated)……Unit: number

The unit of measurement shall be the number of droppers required to conform to the maximum spacing specified or such lesser spacing as authorised by the Engineer.

The tendered rates shall include full compensation for concrete, binding wire, straining wire, bolts, washers and nuts, all excavations, drilling of holes for standards, and the complete erection of the fence as specified and as shown on the Drawings. The tendered rate for posts shall make provision for the construction of the stays of the types shown on the Drawings.

The quantity of material used shall be determined by measuring the quantities of individual items of material installed in the completed fence. No linear measure of completed fence shall be applicable.

C3.3.1.1.12.2 PA 12.2 New gates

(a) Single leaf (size and type indicated)……..Unit: number

(b) Double leaf (size and type indicated)……Unit: number

The unit of measurement shall be the number of new gates erected. A pair of gates shall be measured as one.

The tendered rate shall include full compensation for gate posts, hinges, bolts, concrete, locking mechanism and straining wire, and for the erection of the gates complete as specified and as shown on the Drawings. It shall not include compensation for any fencing wire or mesh used on the gate.

C3.3.1.1.12.3 PA 12.3 Drilling and blasting holes for posts and anchors……..Unit: number

The unit of measurement shall be the number of holes for posts and anchors made by drilling and blasting where excavation by hand-tools or pneumatic tools cannot be done economically.

The tendered rate shall include full compensation for drilling and blasting the holes and for all other expenses in connection with the provision, storage, transportation and use of explosives.

C3.3.1.2 PC DIRECTIONAL DRILLING

C3.3.1.2.1 PC 01 SCOPE

This Section deals with the design, site establishment, services location, drilling, reaming and installation of pipes and sleeve pipes for cables using Trenchless Technology (Horizontal Directional Drilling), surface reinstatement and de-establishment.

C3.3.1.2.2 PC 02 DEFINITIONS

C3.3.1.2.2.1 PC 02.1 DIRECTIONAL DRILLING

A steerable method for the underground installation of pipes or conduits in a shallow arc using a surface launched drilling rig. In particular, the term applies to large scale crossings in which a fluid filled pilot bore is drilled without rotating the drill string, and this is then enlarged by a washover pipe and back reamer to the size required for the product pipe.

Trenchless technology terminology used on this Contract has the meaning given in the definitions used by the International Society for Trenchless Technology (ISTT).

C3.3.1.2.3 PC 03 MATERIALS

C3.3.1.2.3.1 PC 03.1 SLEEVE PIPE MATERIAL

The sleeve pipe material shall be HDPE unless specified otherwise. The HDPE pipe shall comply with the requirements of SANS ISO 4427. The wall thickness shall be determined by the Contractor taking into account the pulling forces applied during installation and the external load on the sleeve pipe.

C3.3.1.2.3.2 PC 03.2 DRILLING FLUID

The selected drilling fluid shall be compatible with the environment. Waste oil and environmentally non bio-degradable polymers shall not be used.

C3.3.1.2.4 PC 04 EQUIPMENT

Drilling rigs and navigation equipment with the capacity to install up to a 200 mm diameter sleeve pipe over a distance varying between 5 m and 50 m shall be used. The pulling force that the selected equipment is capable of exerting shall be a minimum of 1.5 times the weight of the pipe to be installed.

The Contractor shall indicate what rock drilling and reaming equipment will be required. Refer to Clause 11.9.

C3.3.1.2.5 PC 05 CONSTRUCTION

C3.3.1.2.5.1 PC 05.1 GENERAL PROCEDURES

The Contractor shall:

a) Determine the drilling length and equipment pull strength for the type of soil and rock encountered.

b) Provide the method to control line and grade.
   i) Provide and maintain instrumentation that accurately locates the pilot hole.
   ii) Drill the pilot hole along the path within 100 mm tolerances.

iii) Include electronic monitoring of the horizontal and vertical drilling head location. Obtain an accuracy range within 25 mm of the actual position of the pipeline. Record the position readings at a maximum of 3 m intervals.
iv) At completion of the pilot hole drilling, furnish the Engineers representative with tabulations of the horizontal and vertical alignment.

c) When water is encountered:
i) Provide and maintain a dewatering system of sufficient capacity to remove water.
ii) Keep the excavation free of water until the backfill operation is in progress.
iii) Perform dewatering in such a manner that the removal of soils particles is kept to a minimum.

d) Maintain close observation to detect settlement or displacement of surface and adjacent facilities.
i) Notify the Engineer immediately if settlement or displacement is detected.
ii) Act to maintain safe conditions and prevent damage.

C3.3.1.2.5.2 PC 05.2 DRILLING OPERATION

The Contractor shall:

a) Apply Drilling Fluids as follows:
i) Maintain drilling fluid in the bore hole to increase stability of the surrounding soil and reduce drag on the pulled pipe.
ii) Dispose of the drilling fluid and other spoils at location following laws, ordinances, rules, and regulations.
iii) Transport excess fluids and other spoil to an approved disposal site.
iv) Minimize drilling fluid at locations other than entry and exit points. Immediately clean up any drilling fluids that inadvertently surface.
v) Provide clean water for drilling.

b) Execute the Pilot Hole Drilling as follows:
i) Angle the entry hole so that curvature of the pilot hole does not exceed the allowable bending radius of the HDPE pipe or drilling rods.
ii) Be able to make a turn of up to 90 degrees and maintain a curvature not to exceed the allowable bending radius of HDPE pipe.
iii) Procedure in the event of alignment adjustment and restarts.
(1) Follow the pipeline alignment on Drawings within the tolerances specified herein. Before adjustments, notify the Engineer for approval.
(2) Notify the Engineer when forward motion of operation is stopped by an obstruction.
(3) Abandon in place with drilling fluid unless the Engineer directs otherwise.
(4) Upon the Engineer's approval, attempt a second installation at approved location or excavate at the point of difficulty and install the HDPE pipe by open trench method.
(5) Exercise caution when discovering and locating unknown services. The exact location of such service shall be confirmed prior to any adjustment or restart of the pilot hole drilling.
(6) Keep the number of boring pits to a minimum, unless otherwise approved by the Engineer. Equipment must be capable of boring in a single bore.

C3.3.1.2.5.3 PC 05.3 INSTALLING HDPE PIPE

The Contractor shall:

a) Provide a swivel to the reaming assembly and pull section of the pipe to minimize tensional stress on the pull section after drilling the pilot hole.

b) Hold the reaming diameter to 1.5 times the outside diameter of the HDPE pipe being installed.

c) Protect the pull section as it proceeds during pull back so that it moves freely and is not damaged.

d) Pull the detection wire along with the HDPE pipe. Extend the wire into the locator station at each end of the HDPE pipe.

e) When connecting to the adjacent pulled or non-pulled section of the HDPE pipe, allow the pull section of the pipe to extend past the termination point. Make the tie-ins the next day after the pullback of the HDPE pipe.

f) Test pit pipe installation to verify horizontal and vertical alignment at the Engineer's direction.

g) Replace portions of the pipeline not in compliance with the Contract Documents at the Engineer’s direction.

C3.3.1.2.6 PC 06 SUNDRY ITEMS

C3.3.1.2.6.1 PC 06.1 ENVIRONMENTAL MANAGEMENT

Management and operation of the sites shall comply with the requirements of the Environmental Specifications.

C3.3.1.2.6.2 PC 06.2 OCCUPATIONAL HEALTH AND SAFETY

The Contractor shall prove that the pipe or cable sleeve is clean and watertight.

An air test shall be done on the installed pipe or cable sleeve, witnessed by the Engineer's representative to prove water tightness of the pipe.

C3.3.1.2.7 PC 07 TOLERANCES

C3.3.1.2.7.1 PC 07.1 ALIGNMENT AND GRADE

The deviation from the specified line and level of the sleeve on the agreed bore plan shall not exceed 100 mm in any direction. The specified dimensions of a cable sleeve shall be such that the cable may be laid in the sleeve within the tolerances specified for the cable.

C3.3.1.2.8 PC 08 TESTING

C3.3.1.2.8.1 PC 08.1 AIR TEST

a) Installed pipe or cable sleeve above the water table:

An approved air testing machine shall be used to raise the gauge pressure in the section of the installed pipe or cable sleeve under test first to 3.75 kPa. After a 2-minute stabilization period the pressure shall be reduced to 2.5 kPa. The machine shall then be

switched off and the time taken for the pressure to drop from 2.5 kPa to 1.25 kPa shall be recorded. The time taken shall be at least the applicable of the following values:

Nominal diameter of pipe, mm	Minimum time (in minutes) taken for pressure to drop from 2.5 kPa to 1.25 kPa
100	2
150	3
200	4
250	4.5
300	6

b) Installed pipe or cable sleeve below the water table:

An approved air testing machine shall be used to raise the gauge pressure in the section of the installed pipe or cable sleeve under test to 2.5 kPa above the static water pressure. After this pressure has been attained and the machine stopped, any change in pressure shall be noted. There shall be no discernible loss for a period of at least 5 minutes.

C3.3.1.2.8.2 PC 08.2 PROOF OF ROUNDNESS AND CLEANLINESS

Two cable draw wires or lines shall be provided in the cable sleeve. One will be used to pull a testing cylinder through the sleeve in the presence of the Engineers representative to proof the roundness of the sleeve and that it is free of obstructions to install the cables.

C3.3.1.2.9 PC 09 DESIGN

HDPE cable sleeves with nominal internal diameter as indicated on the drawings need to be installed under the road or rail servitude using trenchless technology. The Contractor is responsible for the selection of the sleeve wall thickness and HDPE material class that suits the installation profile and drilling rig to be used at each site. The sleeve shall be installed with minimum cover of 2 m unless otherwise specified by the Way Leave requirements.

Prior to the commencement of the installation of the cable sleeve at each site, the following working drawings and method statement describing in detail the proposed method and entire operation shall be submitted for approval by the Engineer:

a) Size, capacity, and arrangement of equipment.

b) Location and size of drilling and receiving pits (Bore plan).

c) Dewatering method and method of removing spoil material.

d) Method of installing detection wire and pipe.

e) Type, location, and method of installing locator station.

f) Method of welding HDPE pipe segments and type of equipment.

g) Removal of weld bead.

h) Type of cutting head.

i) Method of monitoring and controlling line and grade.

j) Detection of surface movement.

k) Drilling fluid if required:
- Product information, material specifications, and handling procedures.
- Material safety data sheet and special precautions required.
- Method of mixing and application.

The Contractor shall refer to the geotechnical information provided in the Contract Documents and the cross sections provided in the Drawing.

C3.3.1.3 PD BUILDING WORK

C3.3.1.3.1 PD 01 SCOPE

This is a Particular Specification and covers the various construction activities associated with the erection of buildings which form part of this Contract.

Building work shall be carried out in accordance with the National Building Regulations, SANS 10400, the applicable clauses of the SANS Standardized Specifications and the information contained in this Specification.

Work appurtenant to the erection of buildings such as earthworks, concrete work, structural steelwork, etc. shall be carried out as specified in the appropriate Standardized Specifications and will be measured and paid for under those Specifications.

C3.3.1.3.2 PD 02 BRICKWORK, PLASTER WORK AND FLOOR SCREEDS

C3.3.1.3.2.1 PD 02.1 MATERIALS

(a) Bricks

Bricks shall comply with SANS 227 and shall be of the class scheduled or shown on the drawings.

Satisfactory proof of the load-bearing capacity of the bricks offered shall be submitted before deliveries are made to the site.

Air bricks shall be well-burnt terracotta and shall be free from cracks and blemishes and lined with copper mosquito gauze.

Three samples of each type of brick shall be submitted to the Engineer for approval. All subsequent deliveries shall be of a standard equal to or better than that of the approved samples.

(b) Cement

Cement shall comply with the requirements of SANS 50197 and shall be stored under cover. The use of Portland blast-furnace cement (PBFC) which complies with the requirements of SANS 50197 will only be allowed if approved by the Engineer.

(c) Aggregate

Fine aggregate shall consist of natural sand, or crushed rock or gravel, and shall be hard, clean and free from adherent coatings or other deleterious matter. Sand for plaster and mortar shall comply with the requirements of SANS 1090, whereas the aggregates for normal and granolithic floor screeds shall comply with the requirements of BS 1199 and BS 1201 respectively.

(d) Water

Water shall be clean and free from clay, silt, oil, acid, alkali, organic or other matter which would impair the required strength and durability of the mortar, plaster, or floor screed.

(e) Wall ties

Wall ties shall be of the galvanized, crimped, single-wire type, 3,5 mm in diameter, and shall comply with the requirements of SANS 28.

(f) Damp-proof sheeting

Damp-proof sheeting shall comply with SANS 248, type FV for fibre felt, or SANS 952, type B for embossed polyethylene sheeting.

C3.3.1.3.2.2 PD 02.2 CONSTRUCTION OF BRICKWORK

(a) Cement mortar

Cement mortar shall, unless otherwise specified, consist of one-part Portland cement to four parts sand (1:4) by volume for normal brickwork and one-part Portland cement to three parts sand (1:3) by volume for reinforced brickwork. The ingredients for cement mortar shall be measured in proper gauge boxes on a boarded platform and thoroughly mixed. Alternatively, mixing may be by means of an approved mechanical batch mixer. Only when the dry ingredients have been thoroughly mixed and a mixture of uniform colour has been obtained may the water be added in sufficient quantity to obtain mortar with the required consistency.

Cement mortar shall be used within two hours of adding water to the mix and shall not be used after two hours or if it has begun to set. Mortar shall be turned over frequently to prevent it from setting until it is used.

(b) Brickwork

Dimensions of all the brickwork shall be set out and built as shown on the drawings. Bricks shall be kept wet before laying and the top of brickwork shall be wetted before any further bricks are laid. Bricks shall be well buttered with mortar before being laid and all joints shall be thoroughly flushed up as the work proceeds. All joints to face brickwork shall be neatly made and key-drawn with a 6 mm key.

Brickwork shall be carried up in a uniform manner with no portion being raised more than 1 m above an adjacent portion. All perpends, quoins, etc., shall be kept strictly true and square and the whole properly bonded together.

Brickwork shall be built in stretcher bond or english bond as shown on the Drawings, and bats shall not be used except where required for the bond. All joints shall be 10 mm wide and four courses shall measure 340 mm.

Brickwork for cavity walls and solid walls built in stretcher bond shall be tied with wall ties placed not more than one metre apart in every third course and shall be staggered vertically. At openings, the ties shall be positioned not more than 300 mm apart along the periphery of the opening and 150 mm from the opening.

Face brickwork shall be kept perfectly clean and rubbing down of the brickwork shall not be allowed. Scaffold boards shall be turned back during heavy rain to avoid splashing. Soiled brickwork shall be cleaned at the Contractor's expense, and the cleaning method shall be approved by the Engineer.

(c) Reinforced brickwork

Brickwork over door and window openings shall be reinforced with steel rods, welded, or expanded mesh, etc. Reinforcement shall be placed in each course of brickwork for a minimum of four (4) courses or as shown on the drawings. Reinforced brickwork shall continue at least 300 mm on each side of the openings.

Brick lintels shall be built upon rigid temporary supports left in position for not less than seven (7) days after bricklaying. Prestressed concrete lintels may be used where approved by the Engineer.

(d) Key for plaster

Joints of all brickwork receiving plaster shall be raked out, or the brick surfaces shall otherwise be prepared with an acrylic slurry or any other approved bonding agent.

(e) Damp-proofing

A damp-proof course shall be laid over the full width of all the walls at a minimum height of 150 mm above the final ground level or wherever else it may be required, and it shall be lapped for at least 150 mm at angles and joints. A damp-proof course shall also be laid and stepped up under all external sills.

(f) General

Rough and fair cutting shall be performed as required, and the brickwork shall be fitted around any steel work. Face brickwork shall be carefully cut and fitted to suit fittings.

Chases shall be left or formed for edges of concrete floors, staircases, etc. Chases shall also be provided wherever they may be required for pipes, conduits, switch boxes, distribution boards, and the like. Joints shall be raked out for flashings.

C3.3.1.3.2.3 PD 02.3 PLASTER WORK

(a) Plaster coats

A plastered finish shall consist of a single coat, comprising one application of a 1:6 cement sand mixture with a wood or steel-float finish.

(b) Thickness

The total thickness of the plaster finish shall be 13 mm minimum and 20 mm maximum.

(c) Workmanship

All plaster work shall be finished smooth and ready to receive paint. Plaster shall be flush with the faces of all switch and plug boxes, the interiors of which shall be kept free from plaster. Plastered surfaces shall be plumb, and jambs and reveals shall be formed square.

The plasterer shall cut out and make good all cracks, blisters and other defects and leave the plaster work, on completion, in a state which is acceptable to the Engineer.

C3.3.1.3.2.4 PD 02.4 FLOOR SCREEDS

Floor screeds shall have a mix proportion by mass consisting of one (1) part Portland cement and three (3) parts (1:3) fine aggregate. A minimum amount of water is to be used, but it shall be sufficient to allow adequate compaction.

Screeds shall be laid on clean hardened bases in panels not exceeding 14 m² and shall be steel-trowelled to a true and smooth finish. In monolithic construction, the panels shall not exceed 30 m². Joints in screeds shall coincide as nearly as possible with joints in the bases. The thickness of screeds shall be as shown on the drawings or as directed by the Engineer.

The entire screed surface shall be free from loose or raised particles of aggregate, trowel marks or any irregularities, humps or depressions exceeding 5 mm when measured from a 3 m long straight edge.

Screeds shall be cured for three (3) to seven (7) days as may be directed by the Engineer and shall be protected from damage.

No moisture-sensitive floor finish shall be laid on screeds unless a reliable moisture test shows that the screed is sufficiently dry to receive the covering.

C3.3.1.3.3 PD 03 DOORS AND WINDOWS

C3.3.1.3.3.1 PD 03.1 MATERIALS

(a) General

All steel and iron work shall be delivered clean and free from rust, pitting or other defects. Shop primings shall be applied before delivery and shall consist of a coat of red oxide paint, or any other approved anti-rust paint on all surfaces.

Unless otherwise specified, all materials shall conform at least to the appropriate SANS or BS standards where such standards apply to ironmongery, or steel, cast iron and any other related materials.

(b) Pressed-steel door frames

Pressed-steel door frames shall comply with SANS 1129 and shall be manufactured from 1,6 mm thick mild-steel sheeting, pressed to the required shapes, properly mitred, welded and reinforced, with all welding neatly cleaned off.

Frames shall be of the widths required to suit the thickness of the walls into which they are built and shall be fitted with suitable tie bars and braces at the bottom. Three lugs to be built into the brickwork shall be provided on each jamb.

Rebates in frames and transoms for doors shall be of the widths required to suit the thicknesses of the doors and shall be fitted with a pair of approved steel butt hinges set flush into recesses in the frames. 4,5 mm thick reinforcing plates shall be welded to the backs of the frames at hinge positions.

Heads of frames over double doors shall be drilled where required to form keeps for bolts and shall be fitted with one rubber buffer for each leaf of the door.

Frames for single doors shall be fitted with approved chromium striking plates and an adjustable striking-plate keeper boxed in at the back of the frame by a welded-on sheet-metal box. The frames shall be fitted with a minimum of two rubber buffers.

Frames shall be protected against twisting and damage during transit and erection.

(c) Pressed-steel doors

Pressed-steel doors shall be manufactured from 1,6 mm thick steel plate. The doors shall be of standard design, pressed to shape with 40 mm reveals all round. The doors shall be strengthened with full-length vertical V-shaped or other approved sectional strengthening ribs projecting to the outer face. Two horizontal stiffening rails shall also be welded to the inner face of the doors.

A door shall be hung on a pair of 100 mm long steel butt hinges with loose pins. The leaves of the hinges shall be welded to both the door and the door frame, and a 1,6 mm thick steel plate shall be welded to the inner face of the door to protect the lock.

One leaf of double doors shall be fitted at the top and bottom with approved 150 mm cast brass barrel bolts in an approved manner and the other leaf shall be fitted with a lock, the striking plate of which shall be fixed to the first leaf.

Where indicated on the drawings, doors shall be fitted with louvred ventilation grills of approved design, backed with insect and vermin-proof gauze screening.

(d) Steel window frames

All steel window frames shall comply with SANS 727 and shall be of the types and sizes shown on the drawings.

Standard industrial types of steel window frame shall be constructed from rolled mild-steel industrial sections, 35 mm wide by 3 mm thick, with opening sections constructed from standard residential sections, 25 mm wide by 3 mm thick, welded at angles and properly jointed at intersections.

Window frames shall be formed perfectly flat, truly square, and properly jointed at all angles, and the opening portion shall fit properly on all faces and shall open and close freely.

Glazing bars shall be continuous with jointed intersections, the ends being neatly tenoned into the frame and securely welded in position.

Frames shall be fitted with standard fixing lugs.

Opening sections shall open as indicated on the drawings and shall be fitted with steel hinges with brass pins. Pivots shall be fitted with bronze ring centres.

Side hung or top hung opening sections shall be fitted with brass handles and friction stays. Bottom hung sections shall be fitted with friction pivots and spring catches.

Weather bar drips shall be attached to the fixed frames for the complete width of the window at the head of outward opening sections.

Composite windows shall preferably be delivered to the Site fully assembled, complete with mullions and transoms.

(e) Door-locks and handles

All door-locks shall comply with the requirements of SANS 4 and shall be of approved industrial-type manufacture and pattern. All locks shall be supplied with two keys. Keys shall be distinctly numbered with consecutive numbers and each key shall be stamped with the same number as that of the lock which it controls. No two locks in any one building may have the same key.

External doors shall be fitted with four-lever heavy-duty mortice locks, which shall be master-keyed.

All locks shall be properly installed, and, after completion, striker plates shall be adjusted, and the locks serviced.

Doorhandles shall be of cast zinc of approved manufacture and pattern.

(f) Miscellaneous fittings

All retaining devices for doors and windows as well as fittings such as coat hooks, retaining hooks, etc. shall be of solid brass. All fittings shall be secured by screws or set screws of the same material and finish as the fitting.

Fittings to be fixed to plastered walls, masonry or floors shall be fixed direct by means of patent plastic or fibre plugs fitted into drilled holes.

Doorstops shall be provided at every door and shall be 40 mm diameter rubber stops.

(g) Aluminium windows and doors

Aluminium extrusions shall be of 6063-T6 alloy and temper. Aluminium sheet and strips shall be of 1200-H4 alloy and temper.

Joints in all aluminium members shall be formed in an approved manner so that the joints are practically invisible. Screw heads, pins, rivets, etc shall be concealed as far as possible. 300 Series stainless steel screws and bolts shall be used for jointing and fixing aluminium work.

The surfaces of all aluminium which are in contact with other materials when fixed shall be suitably insulated with a non-absorbent insulating material to prevent corrosion. All aluminium work shall be suitably protected against damage, deterioration or discolouration caused by mortar droppings, paint, etc by taping with removable tape, covering with temporary casings or by covering with motor oil.

Aluminium described as “anodized” shall be treated with Grade 25 coating thickness for exterior use or Grade 15 for interior use as specified, to the required finish. All alloys to be anodized shall be suited to anodizing.

These specifications shall apply to aluminium windows, doors, etc in all respects in so far as they are applicable. Aluminium windows and doors shall be manufactured from extruded aluminium members of 6063T6, 6261-T6 or 6082-T6 alloy and temper.

Ancillary members such as sills, flashings, infill panels and the like formed from flat sheet material shall be of an appropriate alloy selected from 1200, 3004 or 5251 complying with BS 1470 of a temper suitable for the method of forming and a composition suitable for anodizing or painting as required.

Windows, doors, etc shall be of an approved standard system, manufactured by an approved firm experienced in this type of work, and shall meet with the minimum recommended performance requirements as set out by the Association of Architectural Aluminium Manufacturers of South Africa (AAAMSA) in the latest edition of the Selection Guide.

The fittings for all opening sashes shall be substantial and, unless otherwise described, shall be of high quality aluminium alloy finished to match the windows, doors, etc on which they occur. Samples of all fittings shall be supplied to the Principal Agent for approval.

Top, side and bottom hung opening sashes shall be hung on two aluminium hinges with 300 Series stainless steel pins, nylon bushes and stainless-steel washers. Side hung sashes shall have fasteners and sliding stays, top hung sashes shall have peg stays and bottom hung sashes shall have spring catches and concealed arms.

Projected out sashes shall have aluminium fasteners and concealed arms of a non-corrosive material compatible with aluminium.

The frames which are to be built into openings in brickwork shall be fitted with the manufacturer’s standard type fixing lugs, not less than 20 x 3 x 150mm long, screwed to frame and placed one near each corner and intermediately not more than 450mm apart to sides, top and bottom and where fixed to concrete reveals, wood sub-frames or to preformed openings in brickwork shall have countersunk holes for screws, one near each corner and intermediately not more than 450mm apart to sides, top and bottom.

Where so described, openings and sashes of windows and doors shall be fitted with approved channel section aluminium glazing beads sufficient in size and profile to suit the method of glazing employed, finished to match the windows, doors, etc and neatly mitred. Screws where necessary shall be of aluminium or 300 Series stainless steel and have pan or raised heads finished to match the beads

Windows, doors, etc described as “anodized” shall be treated with Grade 25 coating thickness. Windows, doors, etc described as “factory painted” shall have an electrostatically applied oven baked polyester paint coating not less than 25 micrometres thick

Aluminium windows, doors, etc shall include glass as described, fixing in position, sealing and protection against damage, deterioration or discolouration by taping with removable tape or covering with temporary casings or motor oil and removing same on completion

C3.3.1.3.3.2 PD 03.2 INSTALLATION OF DOORS AND WINDOWS

All built-in door and window frames shall be set straight, plumb, and level, and shall operate to the satisfaction of the Engineer after fixing has been completed.

Fittings shall be either removed, or wrapped and protected from damage, until all rough trades have been completed.

C3.3.1.3.4 PD 04 GLAZING

C3.3.1.3.4.1 PD 04.1 MATERIALS

(a) Glass

Glass shall comply with the requirements of CKS 55. The quality of all window glass shall be such that surface deterioration will not develop after glazing.

All glass shall be free from bubbles, waviness, scratches, stains, or other imperfections.

Unless otherwise specified, sheet glass for glazing shall be flat-drawn clear glass of ordinary glazing quality and of the thicknesses indicated below:

For panes not exceeding 0,75 m² in area	3 mm
For panes exceeding 0,75 m² but not exceeding 1,5 m² in area	4 mm

(b) Putty

All putty shall comply with the requirements of SANS 680.

Putty shall not be too hard or soft or caked when used and shall dry evenly without crazing or cracking.

Defective putty shall be cut out and replaced by the Contractor at his own expense, and any broken glass shall also be so replaced and putty so repainted.

C3.3.1.3.4.2 PD 04.2 GLAZING

Glass shall be cut in panes to suit all glazed openings with sufficient clearance all round to prevent cracking by expansion, contraction, or vibration.

In all cases the glass shall be well bedded and back-puttied and installed as specified in SANS Code of Practice 10137.

All putty shall be carefully trimmed, cleaned off and neatly finished off straight with smooth surfaces and sharp mitres. A paint primer shall be applied as soon as the putty has dried out sufficiently to prevent shrinkage cracks from forming.

The entire glazing operation shall be cleaned before the premises are handed over for occupation.

C3.3.1.3.5 PD 05 CARPENTRY AND JOINERY

C3.3.1.3.5.1 PD 05.1 GENERAL

(a) Materials

All timber used for structural purposes shall be of merchantable grade and shall comply with the requirements of SANS 1783-1 and SANS 1783-2. Structural timber shall be carefully selected and of the best quality, free from large or dead knots, shakes, waney edges or other defects. Purlins and brandering shall comply with the requirements of SABS 1783-4. Finger-jointed structural timber shall comply with the requirements of SANS 10096 and laminated timber with the requirements of SABS 1460.

Hardwoods and softwoods for joinery shall comply with SANS 1099 and SANS 1783-3 respectively and suitable species shall be used for the various purposes.

Unless otherwise specified, all materials shall conform to the appropriate SANS or BS Specification where such standards exist for nails, screws, bolts, adhesives, etc.

(b) Preservative treatment

All structural timber shall be given a preservative treatment suitable for the duty for which the timber is intended in accordance with SANS 10005, and no untreated timber shall be used. The preservative treatment shall not impair the final finish. The timber shall be impregnated throughout. When surface coating is specified, the compounds applied on the surfaces of the timber shall form an unbroken film.

(c) Priming

The jointing surfaces of all joints exposed to the weather and built-in portions of frames shall be thickly primed except where adhesives are specified.

Carpentry and joinery items which are prepared for painting by the manufacturer, shall be knotted and primed before being dispatched to the Site.

Primed surfaces shall be touched up where necessary during the progress of the work or where site adjustments have been made.

C3.3.1.3.5.2 PD 05.2 CARPENTRY WORK

(a) Scope of work

Carpentry work shall be carried out in a manner consistent with good workmanship and in compliance with the drawings.

The carpenter shall perform all cutting away and making good in attendance upon all other trades and he shall provide and maintain temporary coverings required for the protection of any finished work that might be damaged if left unprotected during the progress of the work.

(b) Dimensions

Unwrought timber shall be as sawn and shall be to the dimensions and within the tolerances specified in the relevant SANS Standard Specifications mentioned in subclause PD 05.1(a).

(c) Jointing

Unless otherwise specified, all joints shall be secured by means of a suitable type and a sufficient number of approved connectors. All joints shall be carefully made in such a way that they will not impair the strength and stiffness of the beams or members.

(d) Timber roof construction

The plates, joists, rafters, purlins, brandering and other pieces used for the construction of the roof and trusses shall be of the dimensions, spacing and construction as shown on the drawings.

All the joints in the framework shall be of the most appropriate type, accurately formed and adequately secured with fasteners as specified.

C3.3.1.3.5.3 PD 05.3 JOINERY WORK

(a) Scope of work

Joinery work shall consist of the manufacture, delivery to the site, and fixing in the buildings, of all joinery shown on the drawings.

Except where a special finish is specified, the Contractor shall have all stairs, landings, doors, shelves, and other joinery work cleaned and scrubbed down and shall leave all his work in a good order to the satisfaction of the Engineer.

(b) Dimensions

All wrought timber shall be sawn, planed, drilled, or otherwise machined or worked to the correct sizes and shapes shown on the drawings.

Reasonable tolerances shall be provided at all connections between joinery works and the building structure to compensate adequately for any irregularities, settlements, or any other movements.

(c) Manufacture

The joiner shall perform all the necessary mortising, tenoning, grooving, matching, tonguing, housing, rebating and all the other works necessary for correct jointing. He shall also provide all metal plates, screws, nails, and other fixings that may be necessary for doing the specified joinery work properly.

(d) Joints

Where joints are not specifically indicated, they shall be the recognised forms of joints for each position. The joints shall be so made as to comply with Part 2 of BS 1186.

(e) Doors and frames

Door frames, linings, panel doors, framed, ledged and braced doors, flush doors, sliding doors, etc. shall be supplied or made by the joiner and shall be installed, fitted, or hung as detailed on the drawings.

All timber shall be wrought and prepared for oiling, staining, varnishing, or painting.

(f) Skirtings, cornices, etc.

Skirtings, cornices, etc. shall not be installed until after the wall coverings have been applied, the flooring laid and ceilings installed, unless otherwise specified.

(g) In-situ joinery

In-situ joinery work shall not be executed until after all floor, wall and ceiling surfaces have been formed or constructed, unless otherwise instructed.

(h) Ceilings

Ceilings shall consist of plaster board or fibre-cement panels as shown on the drawings and shall be nailed to the brandering or suspended from the roof structure. The panels shall be separated by exposed tees and insulated with a 50 mm thick fibreglass wool blanket where shown on the drawings.

C3.3.1.3.6 PD 06 ROOF SHEETING AND ACCESSORIES

Roof sheeting and accessories shall comply with and will be measured and paid for under SANS 1200 HC.

C3.3.1.3.7 PD 07 ELECTRICAL WORK

The electrical wiring of buildings shall be carried out by registered and licensed electricians in accordance with the requirements of SANS 10142-1 and the regulations of the Employer.

The electrician shall work in close co-operation with the Contractor to ensure that all conduits, switchboards, plug boxes and switch boxes are installed in their correct position.

The work shall be carried out in accordance with the drawings and to the satisfaction of the Engineer and the local authority.

C3.3.1.3.8 PD 08 PLUMBING

C3.3.1.3.8.1 PD 08.1 MATERIALS

(a) General

All materials shall be of the best quality and shall be approved by the Engineer before installation. Cracked, chipped, dented, or faulty items or materials shall be replaced at the Contractor's expense. Glazed ceramic sanitary ware shall comply with the requirements of SANS 497 and all other materials shall comply with the standards as specified, scheduled, or shown on the Drawings.

(b) Water closet (WC) suites

WC suites shall consist of a white glazed vitreous china closet with an S or P trap and seat lugs, a 14 litre low-level matching flat-bottomed flushing cistern placed and fixed on the closet, or a suspended enameled cast-iron cistern with the flush pipe connected to the flushing rim of the closet with rubber cone joints, and a solid heavy-duty plastic seat with cover, hinges and buffers.

(c) Urinals

Urinals shall be of the type detailed or scheduled, of white glazed vitreous china, wall mounted, with an automatic or a manual flushing system, and chromium-plated fittings.

(d) Wash-hand-basins

Wash-hand-basins shall be of white glazed vitreous china or enameled cast iron, wall mounted on a pair of cast-iron brackets, and fitted with chromium-plated fittings consisting of two taps, outlet and chain, and supplied with a plug and an anti-siphon trap.

(e) Sinks

Sinks shall comply with the requirements of SANS 242 and shall be complete with cabinet, chromium-plated outlet, anti-siphon trap, plug, chain and two bib taps or one mixer tap, all as detailed or as scheduled.

(f) Pipes and tubing

Cast-iron and steel pipes used in plumbing work shall comply with the requirements of SANS 746 and SANS 62 respectively. Copper tubing shall comply with the requirements of SANS 460 and malleable cast-iron fittings with SANS 14.

C3.3.1.3.8.2 PD 08.2 CONSTRUCTION

Plumbing shall be carried out strictly in accordance with the Drawings and with the National Building Regulations, with specific reference to Government Notice R1875 dated 31 August 1979.

Steel pipes and their malleable cast-iron fittings shall be joined with red lead and hemp, lead pipes shall have wiped soldered joints, and cast-iron pipes shall be joined by caulking with hemp and metallic lead.

Soil pipes from WCs shall have an internal diameter of at least 100 mm and shall be fitted with a pan connector and an access bend (or an access junction where a vent pipe is used), and carried through walls and into the ground for connection to the sewer. Vent pipes shall be fitted with approved balloon gratings.

Waste pipes from basins and sinks shall have an internal diameter of at least 32 mm and shall discharge into gulleys. Bends for waste pipes shall incorporate cleaning eyes.

Cisterns, basins and sinks shall be connected to the pipe system with 12 mm diameter copper service pipes, and chromium-plated stopcocks shall be installed for isolation and maintenance purposes.

C3.3.1.3.9 PD 09 PAINTING

C3.3.1.3.9.1 PD 09.1 GENERAL

No paint shall be applied to any surface containing traces of dust, grit, grease, oil, loose rust, mill scale or corrosion products of any kind or to any surface that is not free from moisture. Where necessary, surfaces shall be thoroughly washed to remove all traces of soluble salts and/or corrosive air-borne contaminants prior to painting, and the surfaces shall be dried and painted immediately thereafter.

Welding shall be completed in so far as it is possible before painting commences, but in cases where welding can be done only at a later stage, no paint shall be applied to within 75 mm of the proposed weld position unless otherwise specified. Welds and adjacent parent metal shall be abrasive blasted and/or ground and all contaminants such as flux shall be removed prior to painting.

Surfaces of members which are to rest on concrete or other floors or which will be otherwise inaccessible after erection shall receive the full paint system prior to erection.

Damaged paint areas on metal surfaces shall be cleaned, rust spots removed where applicable and the surrounding paint which is still intact shall be feathered for a distance of 20 mm beyond the damaged area. Spot priming and repair shall consist of all the coats previously applied and shall overlap the damaged area.

Damaged galvanised areas shall be cleaned and any rust spots and any flakes of the coating surrounding the damaged area removed. The coating shall then be restored by zinc spraying or soldering, or painting with a zinc-rich paint, as may be approved by the Engineer.

Where the shop coat is allowed to age for a few months before the final painting is done, light sanding or rubbing with steel wool or scrubbing with clean water using a bristle brush shall be carried out.

Steel to be embedded in concrete shall not be painted below 50 mm from the final level of the concrete.

Each priming coat and each undercoat of paint shall be inspected and approved by the Engineer before any subsequent undercoat or finishing coat is applied.

All finishing colours shall be as shown on the drawings, or as directed by the Engineer.

C3.3.1.3.9.2 PD 09.2 MATERIALS

Paints shall comply with the requirements of the appropriate specifications below:

- Painting of Structural Steel - EN ISO 12944
- Painting of Buildings - BS 6150
- Undercoats and Finishing Coats - BS 7664

The Contractor shall furnish the Engineer with the following information and details regarding the paints and decorative materials for the painting system he proposes to use, for written approval:

(i) The name of the manufacturer and trade name

(ii) The brand, type or grade of paint and the appropriate Specification

(iii) Manufacturer's data sheets, colour references, instructions for use, including surface preparation, sealers, primers, undercoats, finishing coats, coat thicknesses and curing periods, which shall all be considered as being part of these Specifications if approved by the Engineer

(iv) Safeguards to protect the applied paint from damage until the work is accepted by the Engineer

(v) The shelf or pot life of materials, if applicable

(vi) An undertaking that the proposed paint system is suitable for its intended use and that the various coats of paint are compatible with one another

Where proprietary brands are used, the manufacturer's priming and all subsequent coats of paint suitable for that particular brand shall be employed in accordance with the manufacturer's instructions.

No other materials of a similar nature and quality or from another manufacturer may be used instead of those approved, unless written permission to do so has been obtained from the Engineer.

All materials shall be brought onto the site in containers sealed by the manufacturer. Paints of a different quality, type, brand or colour shall not be mixed, or thinned and shall not be adulterated in any way, but shall be used as supplied by the manufacturer. Any mixing or tinting required shall be carried out by the manufacturer.

Tinting of paint on the site by the Contractor will only be allowed with the written permission of the manufacturer and the Engineer.

C3.3.1.3.9.3 PD 09.3 INSPECTION AND PRELIMINARY WORK

Before commencing paintwork, the Contractor shall carefully inspect the surfaces to be painted to satisfy himself that the surfaces are in a satisfactory or acceptable condition to receive the paint system specified.

All metal fittings and fastenings shall be removed where applicable before the preparatory processes are commenced. On completion, the metal fittings and fastenings shall be cleaned and refitted in position.

C3.3.1.3.9.4 PD 09.4 WORKMANSHIP AND FINISHES

Paint may be applied by spray, brush or roller depending on the materials used, the surface to be painted, and the manufacturer's instructions.

Every coat of paint, irrespective of the method of application, shall be adequately and permanently keyed or bonded to the base material or previously applied coat, and shall be evenly distributed, continuous, free from sags, runs, brush marks, pin holes or other imperfections, and shall dry to a smooth finish.

An approved water trap and air-regulating valve shall be furnished and installed on all equipment used in spray painting.

Before painting the interiors of buildings they shall be cleaned and the floors shall be washed and kept free from dust during the progress of the interior work.

The Contractor shall protect all nearby surfaces against disfigurement by spatters, splashes and smirches of paint or paint materials. The Contractor shall be responsible for any damage by paint or dirt caused by his operations to vehicles or property or injury to persons and he will be required to provide protective measures to prevent any such damage or injury and make good, where required, at his own expense.

If passing traffic creates dust which may harm or spoil the appearance of external painted surfaces, the Contractor shall sprinkle the adjacent areas with water, at his own cost, for a sufficient distance on each side of the location where painting is being done.

Undercoats shall be tinted by the manufacturer to distinguish between successive coats.

The final coats or finishing coats of paint shall be applied after all the other work in the vicinity has been completed.

The painter shall keep some of the final paint in reserve in the event of his having to make good any patching which may be required as a result of damage or unforeseen circumstances.

Upon completion, the Contractor shall, in the case of buildings, clean all glass, remove all paint spots from walls, floors and fittings, and leave the premises clean and fit for occupation.

All inflammable materials, comprising solvents, thinners, wiping cloths, etc., shall be placed in tightly closed containers and properly disposed of.

C3.3.1.3.9.5 PD 09.5 PAINTING OF PLASTER, CONCRETE OR BRICK SURFACES

(a) Surface preparation

Surfaces for painting shall be prepared by sandpapering, scraping or wire-brushing to remove loose material, dust, laitance, scum or other deleterious materials or high spots. Defective areas shall be cut out where necessary and made good with an approved non-shrink filler. Cracks shall be cut out, suitably keyed, and given a coat of an approved bonding agent before the filler is applied. All patches shall be rubbed down to an even surface. Surfaces shall be washed and allowed to dry.

Surfaces shall be treated with neutralising liquid for walls, and if the surface is coarse or textured, either one full coat of pigmented wall sealer or one full filler coat shall be applied in addition to the neutralising liquid.

(b) Paint application

Prior to the emulsion paint being applied, the surface shall be sealed with an approved clear sealer and primed with an undercoat diluted to 50%. Emulsion paint (PVA or acrylic) shall then be applied in two finishing coats.

Egg-shell finish (alkyd oil-based), oil gloss paint or enamel gloss paint shall be applied as follows: one coat of universal undercoat shall be applied and it shall be followed by one coat of a mixture comprising 50% of the undercoat and 50% of the paint to be used for the finishing coat. A finishing coat of semi-gloss egg-shell, or oil gloss paint or enamel gloss paint shall then be applied.

C3.3.1.3.9.6 PD 09.6 PAINTING OF WOODWORK

(a) Surface preparation

The surfaces shall be cleaned, sandpapered and rubbed down to a smooth, even face before painting. The moisture content of the timber shall not be more than 20% at the time when the first coat is applied. All cracks, shakes or scars shall be filled flush with a filler approved by the Engineer before painting. The surface shall then be washed with cleaner and allowed to dry.

(b) Primer application

One coat of an approved wood primer shall be applied.

After open-grained timber has been prepared and primed, the grain shall be stopped and filled with synthetic filler and rubbed down with water paper.

All new woodwork shall be properly primed on all surfaces and edges before being fixed in position. All woodwork not previously painted shall be given a prime coat, well brushed in.

(c) Paint application

One coat of universal undercoat shall be applied followed by one coat of a mixture of 50% of the undercoat and 50% of the paint to be used for the finishing coat. A finishing coat of oil gloss paint or enamel gloss paint or semi-gloss egg-shell (alkyd oil-based) paint shall then be applied.

(d) Varnish finish

Two coats of gloss varnish or egg-shell varnish shall be prepared, stopped and applied.

C3.3.1.3.9.7 PD 09.7 PAINTING OF METAL SURFACES

(a) General

Wherever possible, all painting shall be done at the manufacturer's works, but where this is not feasible, the Engineer may permit the application of the undercoat and finishing coats to be carried out on the Site, in which case a prime coat shall be applied at the manufacturer's works prior to the members being dispatched to the Works.

(b) Surface preparation

The preparation of metal surfaces shall comply with SANS Code of Practice 10064 and shall receive the greatest care to ensure rust-free conditions prior to the paint system being applied.

All surfaces shall be prepared by removing loose paint, rust, plaster, scale, dust, dirt, grease, etc. and by repairing or patching defective paint surfaces before painting or repainting. Damaged shop-primed surfaces shall be thoroughly cleaned of rust and patched with a prime coat.

(c) Paint application

(i) Iron and steel work

All iron and steel work shall be properly primed with a red-lead-based primer where steel work is likely to be exposed to the elements for longer than 30 days. Zinc-chromate primer may be used where overpainting will be completed within 30 days of priming. Metal-etch wash primers may be used under dry conditions where overpainting will be completed within 24 hours of priming. The dry-film thickness of the prime coat shall not be less than 0,300 mm.

After priming, one coat of universal undercoat shall be applied. If necessary, the undercoat shall be tinted to a shade just lighter than the desired finish with approved liquid stainers. The dry-film thickness shall not be less than 0,250 mm.

The two finishing coats shall either be of alkyd resin-based synthetic enamel, gloss or matt oil paint, or as specified elsewhere. The dry-film thickness shall not be less than 0,250 mm per coat.

When mating surfaces are brought together, both surfaces shall have been given the full treatment specified, but where this cannot be done, each surface shall be given a copious coating of primer and the surfaces drawn together while the paint is still wet.

The portion of structural steel members to be buried in soil, and all bases to a height of 500 mm shall be given two coats of an epoxy-tar primer instead of the zinc-chromate primer specified for other surfaces.

The surfaces of steel and cast-iron articles, such as floor gratings, grids and manhole covers, shall, after a thorough brushing to remove loose rust, be painted with two coats of epoxy-tar paint, each at least 0,230 mm thick.

(ii) Galvanized iron and steel

All traces of protective coating shall be removed with galvanized iron cleaner, and two coats of calcium plumbate primer shall be applied. One coat of tinted universal undercoat and two finishing coats of alkyd resin-based synthetic enamel gloss paint shall be applied.

(iii) Non-ferrous metals

Surfaces of aluminium, copper, etc. shall be prepared and cleaned, and one coat of self-etch zinc-chromate wash primer shall be applied. One coat of universal tinted undercoat and two finishing

coats of enamel gloss paint shall then be applied. Where non-ferrous metals are not to be painted, the surfaces shall be cleaned, polished and two coats of lacquer applied.

C3.3.1.3.9.8 PD 09.8 PAINTING OF FLOOR SCREEDS

Where chemicals could cause damage to floors, such floors shall be painted with an approved epoxy paint. The type of paint to be used will be shown on the drawings and will depend on the types of chemical that are used.

The preparation of such floor screeds for painting and the subsequent application of paints shall be carried out strictly in accordance with the manufacturer's instructions.

C3.3.1.3.9.9 PD 09.9 PAINT THICKNESS

Unless otherwise specified, all coats of paint, whether prime coat, undercoat or finishing coat, shall have a dry-film thickness of not less than 0,200 mm, irrespective of the method of application.

C3.3.1.3.9.10 PD 09.10 INSPECTION

The Contractor shall provide the necessary equipment to establish whether the primers, undercoats and finishing coats have been applied to the correct thickness according to the correct applications. The Engineer may take samples of the paints during painting operations for testing and quality control.

C3.3.1.3.10 PD 10 MEASUREMENT AND PAYMENT

C3.3.1.3.10.1 PD 10.01 Brickwork:

(a) (Thickness, type, and class indicated) ……Unit: m²

(b) Etc. for other thicknesses, types and classes

The unit of measurement shall be the square metre of each type of brickwork built, calculated from the leading dimensions of the brickwork. Areas of pipes, etc. built into brickwork shall not be included in the areas measured. At corners and intersections common to more than one brick wall, the areas shall be measured only once.

The tendered rates shall include full compensation for the construction of the brickwork complete as specified, including pointing, the building-in of conduits, beams, lintels, pipe sleeves, doors, windows, the raking-out of joints, damp-proof course, brickforce reinforced as specified, etc.

C3.3.1.3.10.2 PD 10.02 Plaster work:

(a) (Thickness of plaster and finish indicated) ……. Unit: m²

(b) Etc. for other thicknesses and finishes

The unit of measurement shall be the square metre of each type of coat completed as specified.

The tendered rates shall include full compensation for the construction of the plaster work, including supplying all materials, mixing, applying, finishing, forming reveals, joints, narrow widths, rounded angles, V-joints, etc. complete as specified.

C3.3.1.3.10.3 PD 10.03 Floor screeds:

(a) (Description and thickness indicated) ……Unit: m²

(b) Etc. for other thicknesses

The unit of measurement shall be the square metre of floor screed laid, as specified, on floors, steps or areas shown on the drawings or as designated by the Engineer.

The tendered rates shall include full compensation for constructing the floor screeds, including supplying all materials, mixing, laying, finishing, and forming nosings, reedings, skirtings, etc.

C3.3.1.3.10.4 PD 10.04 Doors and windows:

(a) (Type and size indicated) ……Unit: number

(b) Etc. for other types and sizes

The unit of measurement shall be the number of doors and windows installed complete as specified.

The tendered rates shall include full compensation for manufacturing and installing steel doors, powder-coated aluminium windows, and frames complete with hinges, handles, industrial-type locks, barrel bolts, retaining devices, door stops, stays and any other work necessary to complete the work as specified or as shown on the drawings. The tendered rate for windows shall also include full compensation for glazing, window sills as specified, and damp-proof sheeting.

C3.3.1.3.10.5 PD 10.05 Structural timber:

(a) Plates (sizes indicated) ...……..……Unit: m

(b) Beams (sizes indicated) ...……Unit: m

(c) Joists (sizes indicated)……..……. Unit: m

(d) Rafters (sizes indicated) ……..……...Unit: m

(e) Purlins (sizes indicated) ……..……Unit: m

(f) Roof trusses complete (drawing number indicated) ……..……Unit: number

(g) Roof truss system complete (drawing number indicated) ……. Unit: Sum

The unit of measurement shall be the metre of individual types of timber element or the number of complete trusses installed.

The tendered rates shall include full compensation for supplying all materials and manufacturing, cutting, wasting, jointing and installing the timber as shown on the drawings.

C3.3.1.3.10.6 PD 10.06 Ceilings:

(a) Plaster-board ceiling (type and thickness indicated):

(i) Fixed ceiling……..Unit: m²

(ii) Suspended ceiling……Unit: m²

(b) Fibre-cement ceiling (thickness indicated):

(i) Fixed ceiling……..Unit: m²

(ii) Suspended ceiling……Unit: m²

The unit of measurement shall be the square metre of fixed or suspended ceiling installed complete as scheduled.

The tendered rates shall also include full compensation for the construction of the ceilings, including the exposed tees, insulation blanket and brandering as specified, as well as the suspension system where applicable.

C3.3.1.3.10.7 PD 10.07 Joinery:

(a) Items measured by number:

(i) Doors (type and size indicated)……Unit: number

(ii) Etc. for other items measured by number

(b) Items measured by length:

(i) Skirtings (type and size indicated)……...Unit: m

(ii) Etc. for other items measured by length

The units of measurement shall be the metre of each type and/or size of joinery item specified.

The tendered rates shall include full compensation for supplying all materials, and manufacturing, cutting, wasting, fixing and installing the joinery items.

C3.3.1.3.10.8 PD 10.08 Miscellaneous work:

(a) Paintwork……Unit: sum

(b) Plumbing……Unit: sum

(c) Electrical work……Unit: sum

The tendered sums shall include full compensation for the supply of all materials, for transport, storage, all equipment and labour, all temporary work and safety precautions, replacement of defective work, protection of completed work and clean-up after completion.

C3.3.1.3.10.9 PD 10.09 Miscellaneous items:

(a) Items measured by number:

(i) (Description of item)……Unit: number

(ii) Etc.

(b) Items measured by length:

(i) (Description of item)……Unit: metre (m)

(ii) Etc.

(c) Items measured by area:

(i) (Description of item)……..Unit: square metre (m²)

(ii) Etc.

The unit of measurement shall be the number, linear metre and square metre as applicable to each item.

The tendered rates shall include full compensation for all labour, plant, equipment, transport, etc., manufacturing or providing and installing each item complete as scheduled and shown on the drawings, and shall include all corrosion protection where applicable
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C3.3.1.4 PZ PATENTED EARTH RETAINING SYSTEMS

C3.3.1.4.1 PZ 01 SCOPE

This section covers the construction of retaining structures by means of proprietary or custom-built precast concrete block retaining systems such as Löffelstein, Enviro-wall, Terrace Blok, etc.

C3.3.1.4.2 PZ 02 MATERIALS

C3.3.1.4.2.1 PZ 02.01 GENERAL

All materials used in constructing the retaining systems, as well as all precast units of proprietary or custom-built retaining systems shall be subject to the approval of the engineer.

When requested by the Engineer, the Contractor shall submit test certificates from an approved independent testing authority to show that the respective materials comply with the specified requirements, or certificates from the patent holders or licensees certifying that the manufactured items comply in all respects with the relevant product SPECIFICATIONS.

C3.3.1.4.2.2 PZ 02.02 CONCRETE BASES FOR EARTH RETAINING SYSTEMS

All materials for concrete bases for earth retaining systems shall comply with the relevant requirements of SANS 2001 CC1.

C3.3.1.4.2.3 PZ 02.03 PRECAST CONCRETE BLOCKS

The precast concrete blocks shall be of the type shown on the drawings or specified in the project specifications, or it shall be an approved alternative type. The blocks shall be uniform of colour and durable and shall not react with soil. All materials for precast concrete blocks shall comply with the relevant requirements of SABS 1200 GE.

C3.3.1.4.2.4 PZ 02.04 BACKFILL MATERIAL

The backfill material shall be approved granular material, unless otherwise specified in the project specifications or on the drawings.

C3.3.1.4.3 PZ 03 CONSTRUCTION

C3.3.1.4.3.1 PZ 03.01 EXCAVATIONS

All excavations for the bases of the earth retaining systems shall be done in accordance with the provisions of SABS 1200 D. The contractor shall not commence with the construction of the bases before the excavations have been properly cleaned by the contractor and inspected and approved by the engineer.

C3.3.1.4.3.2 PZ 03.02 BASES

The bases for the earth retaining systems shall be of the type or types shown on the drawings or specified in the project specifications.

The provisions of SABS 2001 CC1 shall apply to the construction of concrete bases.

The bases shall be constructed in accordance with the dimensions and levels shown on the drawings.

No precast concrete blocks shall be installed until the engineer has inspected and approved in writing the completed bases.

C3.3.1.4.3.3 PZ 03.03 INSTALLING THE PRECAST CONCRETE BLOCKS

The precast concrete blocks shall be installed on the completed bases in accordance with the specifications of the patent holders or the licensees and in accordance with the lines, levels and angles of inclination shown on the drawings, or with the variations ordered in writing by the engineer.

C3.3.1.4.4 PZ 04 PATENT RIGHTS

The contractor shall negotiate direct with the patent holders or licensees in connection with royalties payable for the use of the patented systems. The contractor shall arrange for technical assistance by the patent holders or licensees before and during construction.

C3.3.1.4.5 PZ 05 MEASUREMENT AND PAYMENT

C3.3.1.4.5.1 PZ 05.01 PATENTED EARTH RETAINING SYSTEMS:

(a) Löffelstein precast concrete blocks of type (state type)……..……Unit: m²

(b) Enviro-wall precast concrete blocks of type (state type)……..Unit: m²

(c) Terrace Blok precast concrete blocks of type (state type)……Unit: m²

(d) Etc. for other patented earth retaining systems and other types of blocks……..Unit: m²

The unit of measurement shall be the square metre of the front vertical face of the earth retaining system placed in position as shown on the drawings. The front vertical face shall be measured from the top of the base to the top of the earth retaining system.

The tendered rate shall include full compensation for procuring, furnishing, transporting, handling and placing all materials and precast concrete blocks, including the specified backfill material between the blocks, compacted fill and/or drainage material behind the blocks, Bidim b3 material, and any additional costs required for placing the blocks in position complete as specified.

C3.3.1.4.5.2 PZ 05.02 EXCAVATION FOR CONCRETE BASES FOR EARTH RETAINING SYSTEMS:

(a) In soft material……..Unit: m³

(b) Extra over subitem (a) above for excavation in hard material……Unit: m³

(c) Base preparation and compaction to minimum of 90% of modified AASHTO maximum density Unit: m³

Measurement and payment for excavation shall be as specified for item PSD 8.3.3 of SABS 1200 D except that no additional excavation shall be measured were formwork is required.

Payment for base preparation and compaction shall be as specified for item PSDM 8.3.3 of SABS 1200 DM.

C3.3.1.4.5.3 PZ 05.03 CONCRETE BASES FOR EARTH RETAINING SYSTEMS (CLASS OF CONCRETE INDICATED)……Unit: m³

The unit of measurement shall be the cubic metre of concrete cast in the concrete bases for earth retaining systems, calculated in accordance with the net approved dimensions of the concrete bases.

The tendered rate shall include full compensation for supplying and placing the concrete and constructing the concrete bases, including any formwork which may be necessary, and for all steel reinforcement, complete as specified.

C3.3.2 MECHANICAL

C3.3.2.1 ZUT 0000 SCOPE OF WORKS FOR MECHANICAL PORTION

C3.3.2.1.1 ZUT 0000.1 SCOPE

ZUT 0000 specifies the project specific requirements for the construction of the new proposed Brixton Reservoir and Tower.

The Plant described hereunder is for the mechanical portion of the Works only. The Scope of Works for other portions is covered elsewhere in the Specification.

This part of the specification provides the detail of the mechanical equipment and services required for the project.

The detail specification may also include the description of items, which form the basis of payment in the Schedule of Quantities.

The mechanical contractor shall design, supply, deliver to site, install, test and commission, giving a 12-month guarantee of mechanical equipment for the Works. Supply of detailed construction drawings for all equipment layout forms part of the mechanical scope of work, and shall be deemed to be included in the tendered amounts.

C3.3.2.1.2 ZUT 0000.2 THE SITE

The site is situated at the Brixton Primary School, on the corner of Symons Road and Caroline Street in Brixton, Johannesburg, Gauteng.

The site can be accessed via the existing access gate, and is situated at approximate latitude 26°11'38.51"S and longitude 28°0'22.18"E.

The site weather conditions are found in Volume 2A, Part 4: Site Information, C4: Site Information, C4.1.3.

The average elevation of this site is 1770 metres above sea level.

C3.3.2.1.3 ZUT 0000.3 NORMATIVE REFERENCES

The following documents shall form part of the Contract Document:

- Data Sheets.
- ZUT 0001: General Mechanical Requirements.
- ZUT 0002: Operating and Maintenance Manuals.
- ZUT 0003: General Corrosion Protection for Pipelines, Water and Waste Water Works.
- ZUT 1003: Lifting Equipment.
- ZUT 1008: Ventilation for Plant Rooms.
- ZUT 5019: Horizontally Split Case Centrifugal Pump.
- ZUT 5020: Submersible and Immersible Centrifugal Pumps.
- ZUT 7001: Design and Manufacturing of Medium-pressure Steel Specials.
- ZUT 7002: Manufacture of Medium-pressure Steel Pipelines.
- ZUT 7003: Laying and Jointing of Medium-pressure Steel Pipelines and Specials.
- ZUT 7004: Valves for Water and Wastewater Installations.
- ZUT 7005: Corrosion Protection for Valves.
- ZUT 7015: Metal Seated Wedge Gate Valves.
- ZUT 7016: Resilient Seal Gate Valves.
- ZUT 7017: Slanted Seat Check Valves.
- ZUT 7022: Air Valves for Air Release and Vacuum Break on Pipelines.
- ZUT 7023: Couplings and Flange Adapters.
- ZUT 7024: Pipework Supports.

- ZUT 7028: Level Control Valves.
- The Occupational Health and Safety Act and Regulations.

Equipment, materials and operational methods shall comply with the latest edition of relevant national and/or international standards.

This Specification shall have preference should there be any contradictions between this Specification and the Particular Specifications. Contradictions between designs and standards, or requirements which defy engineering standards, laws and practices must be brought to the attention of the engineer.

C3.3.2.1.4 ZUT 0000.4 MINIMUM STANDARDS

All the equipment and systems supplied under this contract shall comply with the minimum standards as contained in this Specification, the Particular Specifications Clause 3 above, the OSH Act, as well as local and Municipal by-laws, environmental, general and safety regulations, as well as to good engineering principles.

In addition, special attention shall be applied to the following items:

A minimum of 3 complete provisional operation and maintenance manuals shall be handed over to the Engineer for review and approval.

C3.3.2.1.5 ZUT 0000.5 SCOPE OF MECHANICAL WORKS

The mechanical contractor shall design or verify designs, supply, deliver to site, install, test and commission, giving a 12 month guarantee of all the mechanical installations to ensure complete functionality and operation of the Works. The scope of works is detailed below but is not limited to the following. The contractor shall provide a proposed QCP as part of the tender submission.

Refer to P&ID 113503-0000-DRG-EE-30XX for the new installation.

C3.3.2.1.5.1 ZUT 0000.5.1 NEW BRIXTON RESERVOIR

C3.3.2.1.5.1.1 ZUT 0000.5.1.1 Valves

The reservoir valves shall be supplied, delivered, installed, tested and commissioned with valve sizes and pressure ratings as per Mechanical Drawing 113503-0000-DRG-MM-5020 and associated Data sheets. The reservoir inlet valves shall be altitude type level control valves. Refer to Clause 5.7 for valve Particular Specifications.

C3.3.2.1.5.1.2 ZUT 0000.5.1.2 Pipework

All incoming and outgoing reservoir pipework and pipe specials shall be supplied, delivered and installed by the Contractor. The Contractor shall submit workshop drawings of pipe specials to the engineer for approval prior to fabrication. The Contractor shall be responsible to ensure that all pipe specials fit precisely with the associated pipework, valves, civil structures and equipment. Refer to Clause 5.5 for manufacturing and corrosion protection of pipework.

C3.3.2.1.5.2 ZUT 0000.5.2 NEW BRIXTON TOWER

C3.3.2.1.5.2.1 ZUT 0000.5.2.1 Valves

The tower inlet and outlet valves shall be supplied, delivered, installed, tested and commissioned with valve sizes and pressure ratings as per Mechanical Drawing 113503-0000-DRG-MM-5050, 5060, and associated Data sheets. Isolation valves and scour valves shall be metal seated wedge

gate valves with non-rising spindles. Pressure reducing valves shall have hydraulic characteristics as specified in the Data sheets. Refer to Clause 5.7 for valve Particular Specifications.

C3.3.2.1.5.2.2 ZUT 0000.5.2.2 Pipework

All incoming and outgoing tower pipework and pipe specials shall be supplied, delivered and installed by the Contractor. The Contractor shall submit workshop drawings of pipe specials to the engineer for approval prior to fabrication. The Contractor shall be responsible to ensure that all pipe specials fit precisely with the associated pipework, valves, civil structures and equipment. Refer to Clause 5.5 for manufacturing and corrosion protection of pipework.

C3.3.2.1.5.3 ZUT 0000.5.3 NEW BRIXTON PUMP HOUSE

C3.3.2.1.5.3.1 ZUT 0000.5.3.1 General

The mechanical contractor shall design or verify designs, supply, deliver to site, install, test and commission, giving a 12 month guarantee of all newly installed mechanical equipment for the Brixton Pump House as shown on Mechanical Drawings 113503-0000-DRG-MM-5010, 5020, 5030, 5040, associated Data sheets and as detailed below.

C3.3.2.1.5.3.2 ZUT 0000.5.3.2 Horizontally Split Case Centrifugal Pump sets

This part of the specification shall fully comply with the requirements of Particular Specification ZUT 5019 for Horizontally Split Case Centrifugal Pump.

Two (2) horizontally split case centrifugal pumps shall be supplied, delivered and installed as indicated on the associated drawings. The pumps shall operate on a duty - standby basis, with automatic start-up of the standby pump.

Pumps shall be equipped with stainless steel impellers, and come complete with electric motors, VSD's, coupling ancillaries and base frame. Each pump shall have the following characteristics:

- Model: Should be a catalogued, locally supported brand product
- Duty flow: 200 l/s (single pump)
- Duty head: 47.1 m
- Efficiency: 88 % (estimate)
- Installed motor size: 132 kW (estimate)
- Speed: 1485 rpm
- Coupling: Rigid

The pumps shall be designed to have the highest possible efficiencies within an operating range of 80 % – 110 % of BEP (Best Efficiency Point).

Each pump line shall be supplied, delivered, and installed with valves, dismantling joints, pressure gauges and transmitters complete with ball valves, pipe specials, gaskets and fasteners to sizes as indicated on Mechanical Drawing 113503-0000-DRG-MM-5010.

C3.3.2.1.5.3.3 ZUT 0000.5.3.3 Submersible Pump

This part of the specification shall fully comply with the requirements of Particular Specification ZUT 5020 for Submersible and Immersible Centrifugal Pumps, Mechanical Drawing 113503-0000-DRG-MM-5070 and associated data sheets.

The Contractor shall supply, deliver and install one (1) submersible pump for drainage purposes in accordance to the characteristics specified below. The pump shall be fixed in the sump of the pump house and shall be supplied complete with 20 m of layflat hose.

- Model: Should be a catalogued, locally supported brand product
- Duty flow: 15 l/s
- Duty head: 12 m
- Power absorbed: 2.94 kW (estimate)
- Efficiency: 60% (estimate)
- Expected motor size: 3 kW
- Phase: 3 phase/ 50Hz

The pump shall be designed to have the highest possible efficiencies for the duties specified above.

C3.3.2.1.5.3.4 ZUT 0000.5.3.4 Valves

All valves within the boundary of the pump house shall be supplied, delivered and installed with sizes and pressure ratings as indicated on associated the Drawings and Data sheets. Isolation and scour valves shall be metal wedge seated gate valves with non-rising spindles. Non-return valves shall be the swing type with counterweight assisted closure. Refer to Clause 5.7 for valve Particular Specifications.

C3.3.2.1.5.3.5 ZUT 0000.5.3.5 Pipework

All pipework and pipe specials inside the pump house shall be supplied, delivered and installed by the Contractor. The Contractor shall submit workshop drawings of pipe specials to the engineer for approval prior to fabrication. The Contractor shall be responsible to ensure that all pipe specials fit precisely with the associated pipework, pumps, valves and ancillaries. Refer to Clause 5.5 for manufacturing and corrosion protection of pipework.

C3.3.2.1.5.3.6 ZUT 0000.5.3.6 3.2 Ton Hoist

This part of the specification shall fully comply with the requirements of Particular Specification ZUT 1003 for Lifting Equipment.

One (1), 3.2 ton Single Girder Electrically Operated Overhead Traveling Crane (SGEOT) shall be supplied, delivered, installed, tested and commissioned, to serve the entire area of the pumpstation building. The crane shall be complete with geared operating trolley, lifting steel rope and hook. The hoist shall be underslung on a single I-beam. The hoist shall have the following characteristics:

- Model: Should be a catalogued, locally supported brand product
- Hoist capacity (SWL): 3.2 ton
- Duty service: H2 (HMI Classification)
- Type: Single Girder Electrically Operated Overhead Traveling Crane
- Crane configuration: top running
- Lifting mechanism: steel rope hoist and hook with safety latch
- Travel mechanism: trolley with festoon
- Lifting height: 10 m
- Crane span: 11.6 m
- Crane travel: 19 m
- Ancillaries: lifting slings (rated for 3.2 ton load)

Each hoist must be supplied with:

a) Test Certificate for the hoist
b) Steel Rope Number for the hoist
c) Material Certificate for the Steel Rope
d) Material Certificates for the other components
e) Hook certified to lift loading tonnage

C3.3.2.1.5.3.7 ZUT 0000.5.3.7 Ventilation System

C3.3.2.1.5.3.7.1 ZUT 0000.5.3.7.1 General

This part of the specification shall fully comply with the requirements of Particular Specification ZUT 1008 for Ventilation for Plant Rooms. This Specification shall have preference should there be any contradictions between this Specification and the Particular Specifications.

The MCC room will be mechanically ventilated using filtered fresh air, pressurising the room and single-split unit air conditioners to maintain the temperature suitable for the VSD.

The Contractor shall supply, install and commission one (1) extraction wall mounted plate axial flow with flow rate of 500 l/s at 140 Pa.

One (1) supply air louvre with adjustable damper shall be supplied and installed to allow for a minimum air change rate per hour (ACPH) of 15 through the room.

C3.3.2.1.5.3.7.2 ZUT 0000.5.3.7.2 Fan Performance

It can be expected that the fan air intake system shall comply with the following requirements:

Air Volume Flow:	500 l/s
Total Pressure:	140 Pa
Altitude:	1770 m
Temperature:	20 °C
Phase:	3-phase 50 Hz

The fan shall be switched on and off by means of a manufacturer-approved switch, installed locally in an accessible location, preferably on the outside of the room. The switch shall only have two positions, “on” and “off”. The fan start method shall be direct on line. Local lock-out isolators shall be installed no more than 1 m from the fans when remote control panels / switches are used.

The selected fan shall be 3-phase (400V/50 Hz).

C3.3.2.1.5.3.7.3 ZUT 0000.5.3.7.3 Supply Air Louvres

Supply air louvres shall be manufactured of hot-dip galvanised steel and shall be of the storm resistant type, mounted on a duct collar or wooden frame. Supply air grilles shall be provided with double deflection aerofoil vanes adjustable from the front of the grille, with the front vanes vertical. Supply air grilles shall be provided with opposed blade volume control dampers adjustable from the front of the grille.

C3.3.2.1.5.3.8 ZUT 0000.5.3.8 Air Conditioning Unit

C3.3.2.1.5.3.8.1 ZUT 0000.5.3.8.1 Single-split Type Air Conditioning Unit

The single-split type air conditioning unit shall be a self-contained, direct expansion air conditioning unit each complete with an indoor evaporator and outdoor air cooled condenser and be of the fixed speed (cooling only).

The indoor and outdoor unit shall be mounted according to the manufacturer’s recommendations in the positions as shown on the associated Drawings. Hanging units shall have threaded rod of appropriate size fitted, which shall either hang from the structure above or from cantilever-type brackets, fixed to the wall.

Each unit shall be equipped with a condensate drain pan.

Temperature controls shall include a fan switch and a temperature adjustment facility and temperature scale as a minimum. The remote control shall be wireless and shall be supplied with a mounting bracket.

The Contractor shall supply, install and commission one (1) of the following:

- Location: MCC Room
- Type: Split-type air conditioning (cooling only)
- Mounting: Ceiling suspended / Under ceiling
- Nominal Cooling: 7 kW
- Nominal Heating: N/A
- Size: 24000 Btu/h
- Phase: Single/ 220V/ 50 Hz

The unit shall be controlled by means of infra-red remote controller.

The air conditioning unit shall conform to all the requirements of SANS 1125.

Local lock-out isolators shall be installed no more than 1 m from the unit when remote control panels / switches are used.

C3.3.2.1.5.4 ZUT 0000.5.4 NEW BULK WATER PIPELINES

Refer to the Civil Specifications and Drawings for details regarding mechanical installations on the bulk water pipelines. This includes the pipeline from existing Brixton reservoir to the new Brixton reservoir, pipeline from the new Brixton tower to the Brixton tower water supply zone and pipeline from the new Brixton reservoir to the new Brixton reservoir water supply zone.

C3.3.2.1.5.5 ZUT 0000.5.5 MANUFACTURING AND CORROSION PROTECTION SYSTEMS FOR PIPES, PIPE SPECIALS, FLANGES & FASTENERS

This part of the specification shall fully comply with the requirements of Particular Specification ZUT 0001 for General Mechanical Requirements, ZUT 0003 for Corrosion Protection for Pipelines, Water and Wastewater Works, ZUT 7001 for Design and Manufacturing of Medium-pressure Steel Pipe Specials, ZUT 7002 for Manufacturing of Medium-pressure Steel Pipelines, ZUT 7003 for Laying and Jointing of Medium-pressure Steel Pipelines and Specials., and ZUT 7024 for Pipework Supports.

C3.3.2.1.5.5.1 ZUT 0000.5.5.1 Pipes

The Contractor shall supply, deliver and install all pipework, pipe specials complete with flanges, fasteners and jointing materials under this Contract as indicated on the various Drawings to ensure complete operation of the entire Works.

All steel pipes and pipe specials to be used under this Contract shall be in accordance with the drawings, data sheets and specifications.

Note that the dimensions of all pipe specials are for tender purposes only and should be rechecked and confirmed by the Contractor by submitting workshop drawings for approval by the Engineer before commencing with fabrication. This is important to ensure that the pipe specials will fit the final dimensions of pumps and valves selected by the Contractor.

Corrosion protection and repair methods of steel pipes shall strictly be done in accordance with ZUT 0003 and the Data sheets.

All steel pipes shall be lined and coated with DFT (Dry Film Thickness) as per the requirements specified in the Data sheets for steel pipes. This includes steel pipes underwater, above ground and below ground.

Paint type, colour and application details are to be submitted to the engineer for approval.

Proper workshop drawings of all pipe specials showing sizes, dimensions and type of corrosion protection system to be used shall be submitted to the Engineer for approval before commencing of fabrication is allowed.

Laying and jointing of steel pipes and specials shall strictly be done in accordance with ZUT 7003.

Take note of surface preparation methods for the various applications as specified in ZUT 0003.

All steel flanges for this Contract shall be in accordance with SANS 1123 Tables 1600/3 or as indicated on the Drawings.

All pipes flanges shall be raised face.

All gaskets shall be non-asbestos ring type gaskets, 3 mm thick and shall comply with ZUT 0001.

The Contractor shall ensure that material compatibility is in accordance with Particular Specification ZUT 0003 for General Corrosion Protection for Pipelines, Water and Waste Water Works, Clause 4.5.

C3.3.2.1.5.5.2 ZUT 0000.5.5.2 Fasteners

All fasteners shall fully comply with ZUT 0001.

C3.3.2.1.5.6 ZUT 0000.5.6 PRESSURE GAUGES AND INSTRUMENTATION

C3.3.2.1.5.6.1 ZUT 0000.5.6.1 General

This part of the Specification deals with the supply, delivery and installation of pressure gauges and bosses to be welded to pipe specials to accommodate both pressure gauges and instrumentation. Payment for this scope of work will be covered under ZUT 5019 for Horizontally Split Case Centrifugal Pump.

Note that workshop drawings shall be submitted to the Engineer for approval prior to fabrication. Drawings shall show positions of all bosses to be welded onto pipe specials.
Pressure gauges shall be 100 mm diameter dials with stainless steel case filled with glycerine. Pressure gauges shall be of the direct mounting located radially in the gauge case. Pressure scales shall be in kPa.

All fittings, isolating valves and piping shall be fabricated from stainless steel material.

C3.3.2.1.5.6.2 ZUT 0000.5.6.2 Pressure Gauges

All gauges shall fully comply with ZUT 0001. All pump lines shall be equipped with pressure gauges on both suction and discharge sides of pumps.

Provision shall be made for stainless steel bosses to be welded onto both suction and discharge pipe specials of each pump line:

- 1” BSP Stainless steel boss welded onto both suction and discharge pipe specials of each pump line, nipple and stainless-steel ball valve with reducing bush to fit 1/2” BSP stainless steel pressure gauge.

The following pressure gauge ranges shall be supplied and installed:

Location	Suction (kPa)	Discharge (kPa)
Brixton Pump Station	0 to 500	0 to 1000

C3.3.2.1.5.6.2.1 ZUT 0000.5.6.2.1 Instrumentation

Supply, delivery and installation of all instrumentation for this contract are covered elsewhere under the C&I Specification.

The Contractor shall make provision for stainless steel bosses to be welded onto pipe specials where instrumentation such as flow switches, pressure transmitters and pressure switches are required. In general, stainless steel bosses shall be welded to pipe specials with nipple, ball valve and reducing bush to fit the required instrumentation. Refer to C&I drawings for details.

C3.3.2.1.5.7 ZUT 0000.5.7 VALVES

This part of the specification shall fully comply with the requirements of Particular Specifications ZUT 7004, 7005, 7014, 7015, 7016, 7017, 7022 and 7028.

Type, size and pressure rating of valves to be used under this Contract shall be as per the Drawings, Data sheets and Bills. Any discrepancies shall be brought to the attention of the engineer timeously.

The direction of valve closure shall be anti-clockwise.

C3.3.2.1.5.8 ZUT 0000.5.8 SPARES

The Contractor shall submit a list of recommended spares for approval as part of the tender offer.

C3.3.2.1.6 ZUT 0000.6 COMMISSIONING

The Contractor shall have made provision in his Bill of Quantity for the pre-commissioning and commissioning of the integrated system.

C3.3.2.1.6.1 ZUT 0000.6.1 PRE-COMMISSIONING

Pre-commissioning shall include all necessary dry field running commissioning of the various components of the plant to ensure that the various components perform in accordance with specialist supplier's recommendations and design criteria.

C3.3.2.1.6.2 ZUT 0000.6.2 COMMISSIONING

The next stage shall be wet commissioning which shall be the integrated commissioning between various components of the plant to ensure the complete integrated system operates at optimal efficiency and in accordance with the operational philosophy.

C3.3.2.1.7 ZUT 0000.7 MEASUREMENT AND PAYMENT

Measurement and payment items will be dealt with in each of the Particular Specifications.

For Particular Specifications where no measurement and payment clause is available, the following clause shall be used.

The tendered rates or sums shall cover the cost of anything not specially mentioned, but which an experienced contractor can reasonably foresee as being required to enable the apparatus and

Plant to be installed and/or function safely and correctly as specified. No claims whatsoever for extras will be allowed on the grounds that a necessary piece of Plant or part thereof is not specifically mentioned in the Bill of Quantities.

C3.3.2.1.7.1 ZUT 0000.7.1 Supply and Delivery…….Unit: number (No.) or sum (Sum)

The rates tendered shall include full compensation for the supply and delivery of plant to Site including supply of raw materials and bought-out items and associated operating Plant items; fabrication, manufacture and assembly; quality assurance and quality control; inspection and Factory Acceptance Testing (including attendance on inspections and tests witnessed by the Engineer); type and routine tests; application of finishes (painting and corrosion protection); trial erection and dismantling; preparation and packing for transport; transport from place of manufacture to the Site; insurance, harbour dues etc., during transport; loading and unloading; storage under appropriate conditions from date of delivery until commencement of erection; and any other work as specified. Payment will be made per unit. Payment will only be effected after full compliance of the items with this Section and associated documentation has been approved by the Engineer.

C3.3.2.1.7.2 ZUT 0000.7.2 Installation, Testing and Commissioning..……Unit: number (No.) or sum (Sum)

The rates tendered shall include for full compensation for the installation, testing and commissioning of the plant on Site including the provision of all labour, transport, materials and Temporary Works necessary to install the complete Works; on-site quality assurance and quality control, inspection, testing (including attendance at tests witnessed by the Engineer); the installation of all auxiliary items; necessary for the operation of the installation until taken over by the Client; the putting into service of the complete installation of the Plant; and any other work as specified.

The rate shall also include for submission of O&M Manuals, all commissioning testing and the provision of equipment therefore including all disruptions to installation caused by such testing. Payment will be made per unit. Payment will only be effected after full compliance of the items with this Section and associated documentation has been approved by the Engineer.

C3.3.2.2 ZUT 0001 GENERAL MECHANICAL

C3.3.2.2.1 ZUT 0001.1 SCOPE

ZUT 0001 specifies general technical requirements for mechanical engineering projects in which the contractor is responsible for the detailed design.

C3.3.2.2.2 ZUT 0001.2 NORMATIC REFERENCES

The following South African National Standards are referred to in this specification:

- SANS 62
- SANS 200
- SANS 4427
- SANS 719
- SANS 936/7
- SANS 989/992
- SANS 1034
- SANS 1062
- SANS 1123
- SANS 1186
- SANS 1200H
- SANS 1217
- SANS 1465
- SANS 1700
- SANS 1804
- SANS 10044
- SANS 10104
- SANS 10160
- SANS 10108
- SANS 50025
- SANS 60034-5
- SANS 61241

The following British Standards are referred to in this specification:

- BS 970
- BS 1400
- BS 1452
- BS 1490
- BS 2789
- BS 3100
- BS 3790
- BS 4515
- BS 4872
- BS 7854
- BS EN 681
- BS EN 1092
- BS EN ISO 23936

The following ISO standards are referred to in this specification:

- ISO Sa3
- ISO 4184
- ISO 8501
- ISO 10816

C3.3.2.2.3 ZUT 0001.3 MATERIALS

C3.3.2.2.3.1 ZUT 0001.3.1 GENERALLY

All materials used in the manufacture and construction of plant and equipment shall be new, unused and shall be the best of their respective kinds. The Contractor shall ensure that the materials are selected in accordance with the best engineering practice to suit the working conditions and the extremely corrosive environment.

C3.3.2.2.3.2 ZUT 0001.3.2 STEEL

Structural steel shall comply with the requirements of SANS 50025 for grade S 355 JR or for grade S 355 JO and shall be legibly marked with the maker's name or trade mark and identification marks.

C3.3.2.2.3.3 ZUT 0001.3.3 STAINLESS STEEL

The grade of stainless steel to be used shall be as specified. Unless otherwise specified, rolled material shall be supplied with a matt, annealed and pickled or otherwise de-scaled surface finish. For wrought steels, the equivalent BS 970 grade may in each case be used.

A manufacturer's test certificate shall be provided for each batch of stainless-steel giving details of the material analysis and any mechanical tests carried out on the material. Each stainless steel item supplied shall be clearly and permanently marked with the grade of stainless steel and cross referenced to the applicable test certificate.

Where grades EN Grade 1.4401 (316) and EN Grade 1.4301 (304) are specified, these shall be taken synonymously with the low carbon grades for welding.

C3.3.2.2.3.4 ZUT 0001.3.4 3CR12

This is the titanium stabilised, 12 % chrome steel as produced by Columbus Stainless, South Africa. 3CR12 shall always be supplied with an annealed and pickled finish. 3CR12, in cases where it is to be coated, shall be suitably abrasive blasted to ensure adherence of the prime coat.

C3.3.2.2.3.5 ZUT 0001.3.5 PLASTICS

Thermoplastics and fibre reinforced polymers shall be UV resistant, have adequate tensile strength and high impact strength and generally suit the application.
PVC is regarded as too brittle and shall not be used unless called for in this Specification or approved in writing by the Engineer before supply.

C3.3.2.2.4 ZUT 0001.4 CASTINGS

Castings shall comply with the relevant South African or international standard for the material used, including the following:

Grey Cast Iron	SANS 1034; BS 1452
S. G. Iron	SANS 936/7; BS 2789
Steel (General Purpose)	SANS 1465; BS 3100
Aluminium	SANS 989/992; BS 1490
Stainless Steel	DIN 17 445
Copper and Copper Alloy	SANS 200; BS 1400

Castings shall be clean and sound and shall be neatly fettled and dressed. Surfaces shall be smooth and irregularities caused by mould washaways, and the presence of porosity, inclusions and sharp edges will not be tolerated. Areas under bolt heads, nuts and washers, shall be

machined or spot faced to ensure a flat and smooth pressure bearing area, and sufficient space shall be provided for the use of ring or socket spanners.

All pressure retaining castings shall be hydrostatically tested to not less than 1,5 times the maximum working pressure after machining and shall be pressure tight.

No repairs shall be undertaken to castings without the written permission of the Engineer. Cast iron castings shall not be welded.

Castings shall be heat treated to provide optimum corrosion resistance and toughness combined with reasonable machinability. In particular stainless steel castings shall be heat treated so as to ensure that all carbides are in solution, to ensure optimum grain size, and to provide maximum corrosion resistance.

The Contractor shall provide a test certificate for each casting or batch of castings, except for those made of grey cast iron, giving details of the material analysis, the heat treatment and any mechanical tests carried out.

C3.3.2.2.5 ZUT 0001.5 FABRICATION OF STEELS

C3.3.2.2.5.1 ZUT 0001.5.1 GENERAL

Steelwork shall generally be constructed, fabricated and erected in accordance with the applicable requirements of SANS 1200 H.

Welding shall comply with the clause “Welding”.

Sharp edges, pits, inclusions, weld spatter, undercuts, indentations or other surface defects are not acceptable.

Edges shall be rounded to a radius of at least 2 mm.

Designs shall avoid inaccessible pockets and hollows.

Sharp edges on items fabricated from thin sheets will not be acceptable and sharp edges shall preferably be avoided by good design.

Inspection of fabrications shall generally be done after fabrication is complete.

C3.3.2.2.5.2 ZUT 0001.5.2 CARBON STEELS

Structural steelwork shall be of grade S 355 JR or of grade S 355 JO in accordance with SANS 50025.

The requirements of the Hot Dip Galvaniser’s Association of South Africa shall be complied with if the item is to be hot-dip galvanised. Designs shall provide proper access for safe and proper entry of the molten zinc into open spaces so that subsequent drilling at the galvaniser’s yard is avoided.

Surfaces to be coated shall be accessible by blast and spray equipment. Inaccessible pockets, such as bad weld profile as well as hollow structures, are unacceptable and the angle of impact of blast material and sprayed coatings shall not be less than 45 degrees. Edges shall be rounded for safety reasons and also to be suitable for the coating system to be applied.

C3.3.2.2.5.3 ZUT 0001.5.3 AUSTENITIC STAINLESS STEELS

Fabrication of austenitic stainless steels shall comply with the recommendations in "The Stainless Steel User Manual" issued by Columbus Stainless. Compliance with publications from equivalent authorities will be acceptable.

Stainless steel fabricators shall use permanently dedicated storage and fabrication areas and shall use machines, tools and handling equipment which are suited and permanently dedicated to this type of material.

Fabrications shall be pickled and passivated over their full surface to achieve an even colour. If grinding is required before pickling, the final grinding shall be done with a fine disc in order to remove coarse grinding marks.

C3.3.2.2.5.4 ZUT 0001.5.4 3CR12

Fabrication of 3CR12 shall comply with the requirements for austenitic stainless steels except that the recommendations in "The 3CR12 Fabrication Guide" issued by Columbus Stainless shall be used. Compliance with publications from equivalent authorities will be acceptable.

C3.3.2.2.5.5 ZUT 0001.5.5 DUPLEX AND HIGHLY ALLOYED STAINLESS STEELS

Fabrication of duplex, super austenitic and other highly alloyed stainless steels shall follow the metal producer's own guidelines.

Welding of duplex stainless steel pipework shall be in accordance with BS 4515 Part 2 or equivalent.

C3.3.2.2.6 ZUT 0001.6 WELDING

C3.3.2.2.6.1 ZUT 0001.6.1 STANDARDS

Standards complying with good modern practice, and acceptable to the Engineer, shall be adopted and the recommendations of the SAIW are acceptable in this respect.
Welders shall be experienced artisans approved in accordance with BS 4872 or equivalent.

C3.3.2.2.6.2 ZUT 0001.6.2 CONTINUOUS WELDING AND ELIMINATION OF CREVICES

Welding shall be continuous on all sides of any joint. Designs which do not allow this shall be re-designed.

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

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

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

C3.3.2.2.6.3 ZUT 0001.6.3 WELD APPEARANCE

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

C3.3.2.2.6.4 ZUT 0001.6.4 SITE WELDING

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

C3.3.2.2.6.5 ZUT 0001.6.5 WELDING OF STAINLESS STEEL AND 3CR12 – ADDITIONAL REQUIREMENTS

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

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

The welding rods used shall be the most suitable for the metal and purpose.

Only welders experienced with welding stainless materials shall be used.

Welds which are accessible from only one side shall be executed in a manner to prevent heat tint or shall be post-weld treated in order to remove all traces of heat tint.

Type 309 stainless steel welding rods shall be used for welding 3CR12 unless otherwise approved in writing. 3CR12 shall be welded as recommended in "The 3CR12 Fabrication Guide" issued by Columbus Stainless.

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

C3.3.2.2.6.6 ZUT 0001.6.6 INSPECTIONS

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

C3.3.2.2.7 ZUT 0001.7 INSTALLATION

C3.3.2.2.7.1 ZUT 0001.7.1 GENERAL

The Works shall comply with the following:

a) When erected and installed, the plant and equipment shall be of neat and workmanlike appearance, solidly and evenly supported, true to line, level, plumb and in proper working order.

b) The Contractor shall provide all foundation bolts, supports, hangers, brackets, etc. required for the support and fixing of equipment.

c) The Contractor is responsible for grouting work associated with the equipment and pipework to be provided in terms of the Contract.

d) The use of more than three shims in the alignment of equipment will not be permitted. Machined spacers shall be prepared where necessary. Shims and spacers shall be of a corrosion resistant material such as stainless steel.

e) Corrosion protection requirements shall be carefully attended to and the requirements of ZUT 0003 must be noted. All mating faces must be coated before and sealed after assembly.

f) A small amount of a nickel based, anti-seize compound shall be applied along the full length of fastener threads before the nut is applied.

g) Crevices which are formed between two metal surfaces shall, prior to final fastening, be filled with a suitable formable packing, Denso tape or equivalent, or with a suitable mastic or sealant.

C3.3.2.2.7.2 ZUT 0001.7.2 ALIGNMENT OF SHAFTS

Shafts for drives with an output above 150 kW shall be aligned to the driven shaft as follows:

a) Final alignment shall be done after installation and before commissioning and shall be checked in the presence of and to the approval of the Engineer. Alignment shall be sufficiently accurate to ensure that no initial pre-load is placed on the shaft coupling.

b) Each motor shall be aligned to its pump by alignment specialists using laser aligning equipment with real time computer display.

c) The use of pourable epoxy resin chocks (Epocast 36, Chockfast or equivalent) shall be acceptable. If pourable chocks are used, the baseframe feet do not have to be machined but each machine foot shall be provided with a screw for vertical alignment. The chock thickness shall not be less than 20 mm.

C3.3.2.2.8 ZUT 0001.8 CIVIL AND BUILDING WORKS

C3.3.2.2.8.1 ZUT 0001.8.1 GENERAL DUTIES

The Contractor shall be responsible for grouting pipework required to pass through walls, for all equipment grouting work, anchoring of equipment and closing of apertures associated with equipment to be provided in terms of this Contract.

The Contractor’s Documents shall indicate the civil and building details required to accommodate the equipment installation; subject to and in accordance with any details shown on the drawings provided by the Employer. These details shall include plinths, foundation blocks, rebates, pockets, sleeve ducts, holes, thrust blocks, anchor fasteners and openings/box-outs for pipework passing through walls.

The Contractor shall inspect and check the related structures constructed by others for accuracy and suitability of construction and for conformance with the Contractor's documents before commencing installation and construction. No payments shall be allowed for additional costs to the Contractor resulting from a failure to check such works timeously or a failure to provide the related information in Contractor’s Documents timeously.

C3.3.2.2.8.2 ZUT 0001.8.2 CIVIL CONTRACTOR’S WORK

The main civil and building works will be completed by others and will be mostly completed when the Contractor is granted access to the Site.

C3.3.2.2.8.3 ZUT 0001.8.3 PUDDLE PIPES

The Contractor shall install puddle pipes required by the design into concrete structures unless otherwise specified. For this purpose, the Contractor shall provide the details of box-outs required in the structure to the Engineer. Puddle flanges shall be of the same dimensions as standard flanges and the box-out shall be designed accordingly and with allowance for civil tolerances of + 40 mm.

The structure will be constructed by others and, if required, it will be tested for water tightness by the Engineer before handover to the Contractor by temporary closure of the box-outs.

Upon receiving access to the Site, the Contractor shall install the pipework and shall grout the puddle pipes into the structure using a suitable non-shrink grout to the approval of the Engineer. The Contractor shall provide a water tight installation and shall be responsible for rectifying any leakage at the puddle pipe.

C3.3.2.2.8.4 ZUT 0001.8.4 BASEFRAMES, PIPE SUPPORTS, ETC.

The design requirements for base frames and pipework supports are specified elsewhere in ZUT 0001.

The Contractor shall be responsible for grouting of base frames, pipe supports, plinths, etc. required for installation of the equipment and this includes any metallic structure which is mounted onto a concrete surface.

The method proposed for anchoring base frames, pipe supports, etc. to concrete shall be submitted to the Engineer for approval and shall incorporate the details of the grout proposed. The material used for grouting shall be a non-shrink, cementitious grout such as ABE Duragrout 1000, or equivalent. ABE Epidermix 324, or equivalent, is acceptable if an epoxy grout is required.

The design and grouting shall eliminate collection points for water or dirt.

If called for by the Engineer, the initial grouting shall be overseen by the grout supplier's technical representative.

Grout shall be applied only after each anchor fastener has been tested for integrity.

C3.3.2.2.9 ZUT 0001.9 PIPEWORK SUPPORTS

Supports for steel pipework and for plastic pipework shall comply with ZUT 7024.

C3.3.2.2.10 ZUT 0001.10 STEEL PIPEWORK; DN 100 AND LARGER

C3.3.2.2.10.1 ZUT 0001.10.1 GENERAL

This clause applies to carbon steel pipework and to stainless steel pipework.

Steel pipework > DN 100 shall comply generally with ZUT 7001: Design and Manufacture of Medium Pressure Steel Specials.

The remainder of this clause specifies additional requirements for pipework associated with equipment installations.

C3.3.2.2.10.2 ZUT 0001.10.2 PIPEWORK CONSTRUCTION AND CONFIGURATION

Pipework shall be joined using bolted flanges.

Stainless steel and 3CR12 pipes shall be to ASTM A312, ANSI B36.19 or ANSI B36.10 or equivalent.

Pipes and fittings shall be neatly installed, straight to line and level and adequately supported. Pipework shall be supported above floor level on supports, racks or wall mounted and shall not be installed directly on the floor.

Pipework shall be configured and shall be provided with couplings and/or bends to allow easy dismantling and disassembly of all pipework without damage to the pipework or pipe supports.

Provision shall be made for draining all sections of pipework.

Provision shall be made for venting high points of pipework.
Valves shall be mounted in horizontal pipework unless this is not feasible.

Pipework shall be correctly anchored to withstand thrust.

If the physical configuration does not provide axial restraint of pipework couplings, then these couplings shall be provided with thrust restraints.

Bends shall preferably be of the long radius type. 90 degree “lobster back bends” shall have a minimum of five segments.

Each flange shall be perpendicular to the segment to which it is welded.

Convergences shall preferably be of swept tee formation rather than tee pieces.

C3.3.2.2.10.3 ZUT 0001.10.3 PUMP SUCTION PIPEWORK

Two mechanical couplings or one rubber tyre type coupling shall be provided on each pump’s suction pipework.

Pump suction pipework shall comply with good hydraulic design.

The suction manifold/pump leg bifurcation shall be of swept tee formation if the speed of flow within the leg at that point is one metres per second or higher. If this flow speed within the leg at that point is lower than one metre per second, the bifurcation may be of a normal tee formation.

The pipework on the suction side of pumps shall be sized to ensure that the flow speed is no higher than 1,5 m/s.

High points shall be avoided in positions where the flow speed is below one metres per second. Suction pipework shall be level or shall slope upwards toward the pump.

Air leaks shall be prevented.

Flow straighteners shall not be used if there is a probability that the straightener will capture solids.

C3.3.2.2.10.4 ZUT 0001.10.4 PUMP DISCHARGE PIPEWORK

Two mechanical couplings or one rubber tyre type coupling shall be provided on each pump’s discharge pipework.

C3.3.2.2.10.5 ZUT 0001.10.5 REDUCERS

Reducers shall have a maximum angle of divergence of 10º unless otherwise shown on the drawings.

Reducers shall not have more than two longitudinal weld seams.

The taper shall not be welded directly to the flange; i.e. a short cylindrical length of pipe shall be provided between the taper and each flange.

C3.3.2.2.10.6 ZUT 0001.10.6 NOZZLES/SOCKETS

Nozzles shall be provided for the installation of gauges, transmitters, drain pipes, cooling water take offs, air release valves, etc. These shall be designed so that the pipework corrosion prevention system can be applied to all wetted surfaces without compromise. Nozzles shall consist of a flanged, welded tee off of at least 100 mm diameter, coated internally and provided with a non-corrosive blank flange, e.g. EN Grade 1.4401 (316) stainless steel. The blank flange shall be provided with tapped holes, or similar, suitable for the installation.

Carbon steel pipework may be provided with small diameter, EN Grade 1.4401 (316) stainless steel sockets nozzles/nipples which are welded into the pipework. These shall be designed so that the pipework corrosion prevention system can be applied correctly to the carbon steel surfaces and shall overlap onto the stainless steel surfaces.

Nozzles/sockets on the suction side of pumps shall be designed and positioned to provide minimum interference with the flow path.

C3.3.2.2.10.7 ZUT 0001.10.7 SLUDGE PIPEWORK

Sludge pipework shall be provided with a rodding eye or similar arrangement at each bend in order to provide access to the inside of the pipe without dismantling the pipework.

C3.3.2.2.10.8 ZUT 0001.10.8 PIPEWORK FLANGES

Flanges shall comply with SANS 1123 or BS EN 1092 unless required to match existing flanges.

Raised face flanges shall be provided for pipework of PN 25 and higher.

Flange drilling shall be "off centre" unless required to match an existing flange which is drilled otherwise.

The jointing material used on flange joints shall be of a suitable rubber or compressed mineral fibre at least 3 mm thick complying respectively with BS EN 681 or BS EN ISO 23936, as applicable. Gaskets shall be full face. Properly designed O-ring seals are also acceptable.

C3.3.2.2.10.9 ZUT 0001.10.9 PUDDLE PIPEWORK

Puddle pipes to be permanently cast into concrete shall be of EN Grade 1.4401 (316), or of EN Grade 1.4462 (2205 duplex), or of cast iron.

Puddle pipes shall be a straight length, flanged both ends and with a puddle flange. Adequate clearance shall be provided between the wall surface and the flanges for inserting flange bolts and for the handwheel/actuator of the isolation valve but the length shall be kept as short as feasible.

The puddle flange shall be of the same diameter of a normal flange and shall be positioned in the central plane of the wall. It shall be of the same material as the pipe unless otherwise specified. Puddle flanges shall have a plate thickness of at least half the thickness of the standard flange.

The surfaces not directly protected by encasement in concrete shall receive the full corrosion protection system. The coating shall extend about 50 mm into the concrete but the area in contact with the concrete shall otherwise be uncoated. The uncoated area shall be abrasive blasted to promote bonding.

Puddle pipes shall be cast into structures only after the Engineer has approved the Contractor's proposed method statement for the grouting process.

Refer, also, to the clause "Civil and Building Works".

C3.3.2.2.10.10 ZUT 0001.10.10 PIPE COUPLINGS, ALIGNMENT AND FLEXIBILITY

Pipe couplings shall be provided where misalignment or dismantling must be allowed for and also for possible pipe movement from settlement or other cause. The coupling shall have the same or a higher pressure rating than the pipework in which it is installed.
Where the type of coupling is not indicated on the drawing, pipe couplings may be of the mechanical type (VJ coupling or flange adaptor), of the stainless-steel bellows type or of the rubber bellows type.

Mechanical couplings shall be of the rubber ring compression type (i.e. VJ type flange adaptors or VJ type couplings) and shall be provided **in pairs** in order to accommodate axial misalignment and/or settlement. Where a restraint is required, this shall incorporate three tie bars or more. Stainless steel and 3CR12 pipework shall be provided with stainless steel couplings or, where approved by the Engineer, cast iron couplings protected with fusion bonded epoxy. Carbon steel pipework shall be provided with carbon steel or cast iron couplings protected by fusion bonded epoxy. All fasteners, including the studs welded to flanges of flange adaptors, shall be of stainless steel.

Suitably rated **rubber bellows type couplings** with metal backing flanges are acceptable for pipe diameters of DN 300 and below. The bellows shall be provided with two backing flanges drilled to match their mating flanges. Bellows for low carbon steel pipework shall be provided with hot-dip galvanised flanges (i.e. not zinc plated). Bellows for 3CR12 or stainless steel pipework shall be provided with matching flange material.

Stainless steel bellows type pipe couplings shall be of EN Grade 1.4401 (316), or better, and shall incorporate stainless steel fasteners. Flanges shall be of stainless steel.

C3.3.2.2.10.11 ZUT 0001.10.11 PIPEWORK FOR FLOW METER CHAMBER

A flange adaptor shall be provided on the upstream flange of a flow meter and a flange adaptor shall be provided on the downstream flange.

The pipework shall also make allowance for one isolation valve downstream of the flow meter.

C3.3.2.2.10.12 ZUT 0001.10.12 PUMP SUCTION BELL-MOUTHS

Pump suction pipework which draws from open sumps shall be provided with bell mouth inlets. The bell mouth shall have an integral flange and shall be bolted to a flange on the suction pipework.

The bell mouth shall be provided with an elliptical (i.e. not segmented) profile.

The bell mouth may be of glass reinforced plastic, EN Grade 1.4401 (316) stainless steel or of cast iron.

C3.3.2.2.10.13 ZUT 0001.10.13 FABRICATION OF PIPEWORK

Fabrication shall comply with the clauses "Fabrication of Steels" and "Welding". Welding shall achieve full penetration without crevices and both internal and external weld surfaces shall have a neat profile. An internal root run shall be provided where required to achieve a neat profile.

The internal surface of pipework shall be accessible for inspection and this might require that bends, tees and bifurcations shall be short and shall not be welded to a straight pipe rather than being flanged.

C3.3.2.2.10.14 ZUT 0001.10.14 FABRICATION OF DUPLEX STAINLESS STEEL PIPES

Duplex stainless steel pipes shall be fabricated in an automated production pipe facility using mechanised welding procedures; i.e. they shall not be fabricated by the Contractor (or the Contractor's sub-contractor) from plate.

C3.3.2.2.10.15 ZUT 0001.10.15 CORROSION PROTECTION OF PIPEWORK

Corrosion protection shall comply with ZUT 0003.

C3.3.2.2.10.16 ZUT 0001.10.16 SITE WORKS

The Contractor shall make allowance for the misalignment of other pipework to which the Contractor's pipework is to be connected in accordance with the Conditions of Contract.

C3.3.2.2.10.17 ZUT 0001.10.17 INSPECTION AND TESTING REQUIREMENTS

Where dispute arises regarding acceptance of welds, the requirements of SANS 10044 Part 3 shall be complied with.

The Contractor shall make all arrangements and carry transport and accommodation costs for the Engineer to inspect the pipework after fabrication but before any corrosion protection.

The Contractor shall perform the following (in the presence of the Engineer unless otherwise agreed):

a) Pre-manufacturing approval of quality control documentation.
b) 100 % dye penetrant testing of all welds.
c) 10 % of welds to be X-rayed (this percentage will reduce if welds are found to be in order during initial testing). On discovery of defective welds the Engineer may call for radiographic examination until it is shown that the necessary standard is being maintained. Repairs of welded joints will be permitted and the repair procedure and performance of repairs shall be in accordance with Section 10 of API Specification 5L.
d) Visual inspection of pipework.
e) Paint thickness measurements.
f) Pipelines which are not fully visible and/or below ground shall be pressure tested to 1,5 times maximum working pressure for at least 15 minutes without pressure loss. This shall be done before covering up the pipeline and shall be witnessed by the Engineer.
g) Provide inspection reports.

C3.3.2.2.10.18 ZUT 0001.10.18 FLOW VELOCITY IN PIPEWORK

Where the pipe diameter is not specified, the design flow velocities for grit free water (water, effluent, centrate and supernatant) and for high solids water (wastewater and sludge) shall be as follows:

DESIGN FLOW VELOCITY [m/s]				
	flow = 0 - 2,5 ℓ/s	*flow = 2,5 - 15 ℓ/s*	*flow = 15 - 100 ℓ/s*	*flow = 100 - 500 ℓ/s*
grit free	< 0,75	< 1,25	< 1,5	< 2
high solids	0,8 – 1,5	0,8 – 1,5	1 – 1,75	1 - 2

C3.3.2.2.11 ZUT 0001.11 STEEL PIPEWORK (< DN 100)

Steel pipework smaller than DN 100 shall comply generally with the clause above but may be of screwed rather than of flanged construction.

C3.3.2.2.12 ZUT 0001.12 PLASTIC PIPEWORK

Polyethylene or Polypropylene pipes shall comply with SANS 4427 and shall carry the SABS mark.

PVC pipework is not acceptable for applications involving vibration or shock, including hydraulic shock.

An operating life of 50 years shall be designed for and appropriate de-rating factors shall be applied to suit the application. The class of pipe selected shall be not less than 1,5 times the actual maximum operating pressure.

Plastic pipework installed externally shall be provided with protection against ultraviolet light.

Tappings, for example for gauges, shall be provided with welded, external doubler plates. The plates shall have a thickness at least equal to the wall thickness of the pipe.

C3.3.2.2.13 ZUT 0001.13 CAST IRON PIPEWORK

Cast iron pipes and fittings shall comply with BS 2035 (Class D) and shall be pressure tested in accordance with Clause 12 of that Standard. The requirements of the Standard's Clause 6 regarding freedom from defects and casting appearance and Clauses 8, 9 and 10 regarding casting accuracy will be strictly applied.

Cast iron pipework shall comply with the requirements of the clause “Castings".

C3.3.2.2.14 ZUT 0001.14 ELECTRIC MOTORS

C3.3.2.2.14.1 ZUT 0001.14.1 ELECTRIC MOTORS BELOW 30 KW

C3.3.2.2.14.1.1 ZUT 0001.14.1.1 General

Cage induction motors below 30 kW shall be rated for operation on a 3-phase, 4-wire, 400/230 volt, 50 Hz, AC supply.

Motors shall be standard squirrel cage motors with IC 0141 cooling, shall be suitable for a damp environment and shall comply with SANS 1804.

Bearings shall be of the oil or grease lubricated roller and/or ball type. Re-greaseable bearings shall be provided with grease nipples (with extension tubes where access is restricted) and sealed to suit external use but with relief from over-greasing. L-10 design life shall not be less than 100 000 hours.

Terminal boxes shall be top mounted wherever possible and arranged for cable entry from either side. The two ends of each stator winding shall be "brought out" to the terminal box.
A stainless-steel rating plate shall be secured to the frame. This shall include the lubrication details.

Motors may have nominal speeds above 1 500 rpm.

Ingress protection shall be to at least IP 55.

C3.3.2.2.14.1.2 ZUT 0001.14.1.2 Performance Requirements

Motors shall provide rated power output at an ambient temperature of up to 40 ºC and at an altitude of at least 1 500 masl.

The rated power of the motor shall be selected to be not less than 20 % in excess of the designed power requirement of the driven equipment. The Engineer might waive this requirement if the motor forms part of a factory packaged unit or another technical reason.

C3.3.2.2.14.1.3 ZUT 0001.14.1.3 Operation and Control

Protection against both starting overload and running overload shall be designed and provided so that it is specific to the application.

C3.3.2.2.14.1.4 ZUT 0001.14.1.4 Hazardous Locations

When required to suit a hazardous location in terms of SANS 10108 or in terms of this Specification, suitable motors complying with SANS 60034-5 or SANS 61241, as appropriate, shall be supplied. The relevant SANS certificates, clearly indicating the location classification in which the machine may be operated, shall be submitted to the Engineer before delivery of the motors. Each motor shall be clearly and permanently marked with the applicable certificate number.

C3.3.2.2.14.1.5 ZUT 0001.14.1.5 VFD Driven Motors

Unless of the submersible or immersible type, VFD driven motors shall be cooled by a separate, 50 Hz motor driven "piggy-back" fan (this requirement will be waived if the Contractor can provide documentation to confirm that the drive and motor design can operate in the application, with conventional shaft-mounted fan, without overheating).

Motors shall incorporate protection against damage to the bearings from induced currents.

C3.3.2.2.14.1.6 ZUT 0001.14.1.6 Corrosion Protection

Motors shall be provided with the motor manufacturer's highest grade of corrosion protection coating available.

Fan cowls shall be of cast iron, stainless steel or plastic; i.e. shall not be of carbon steel.

C3.3.2.2.14.1.7 ZUT 0001.14.1.7 Safety

Rotating parts shall be guarded as required by legislation.

C3.3.2.2.14.2 ZUT 0001.14.2 ELECTRIC MOTORS OF 30 kW AND ABOVE

C3.3.2.2.14.2.1 ZUT 0001.14.2.1 General Requirements

Cage and slipring induction motors of 30 kW and above shall comply with this clause.

400 Volt motors shall be TEFC with an ingress protection of at least IP 55 and with rolling element bearings.
Motors with a rating above 1 000 kW shall be of CACA configuration with oil lubricated sleeve bearings.

Motors shall be suitable for both "continuous running duty", Duty Class S1, and "intermittent periodic duty", Duty Class S3. Windings shall be insulated with Class F material (100 ºC rise capability) with Class B temperature rise (80 ºC). The motors shall be suitable for 6 starts per hour, two of which shall be consecutive.

The type of motor (and starter if applicable) to be supplied is determined by the requirements of the application specified and by any starting limitations specified. In the absence of such specifications, a standard squirrel cage motor shall be provided.

Wound rotor motors shall have a separate enclosure for the slip-ring assembly to ensure that dust does not enter the motor. The rings shall preferably be of stainless steel. The enclosure shall have the same ingress protection as the main motor enclosure but shall have covers for direct access to the assembly.

If a special motor is required to obtain special starting characteristics and/or variable speed, a full technical specification of the motor must be supplied and such specification shall be for equipment to a standard at least equal to this specification and shall incorporate all aspects of electrical protection.

Motors shall be structurally suitable for DOL starting. This includes motors which are VFD driven.

Motors above 30 kg shall be provided with lifting eyes or lugs.

An earth terminal shall be provided on the frame. Access shall be provided to the winding neutral point.

Protection against both starting and running overload shall be designed and provided so that it is specific to the application.

All monitored motor parameters; e.g. bearing temperature, winding temperature, current, etc.; shall be indicated and shall be provided on the SCADA or HMI mimics, if applicable.

Motors shall be of the reduced noise level type unless otherwise specified.

Motors shall be adequately protected against corrosive environments and shall be provided with the motor manufacturer's highest grade of coating available.

Motors of size 75 kW and above shall be fitted with "pocket" heaters. The heater shall be mounted at the bottom of the motor frame and shall be replaceable without dismantling the motor. These shall be arranged to switch on when the motor stops operating and switch off when it starts operating.
A stainless steel rating plate shall be secured to the frame. This shall include the lubrication details.

Vibration levels shall meet the requirements of grade B in IEC 60034-14.

When motors are transported, care shall be taken to prevent damage to bearing elements. The shaft shall either be secured against relative movement and/or the motor base shall be mounted on suitable anti-vibration mounts during transport.

C3.3.2.2.14.2.2 ZUT 0001.14.2.2 Performance Requirements

Motors shall be provided and shall perform in accordance with the requirements of the specified mechanical equipment.
Motors shall provide rated power output at an ambient temperature of up to 40 ºC and at an altitude of at least 1 500 masl.

The rated power of the motor shall be selected to be not less than 15 % in excess of the designed power requirement of the driven equipment (the Engineer might override this requirement if the motor forms part of a factory packaged unit or another technical reason).

Motors shall reach full operating speed within 5 seconds unless driven by electronic soft start or variable speed drive.

C3.3.2.2.14.2.3 ZUT 0001.14.2.3 400 Volt Motors

Motors shall be rated for operation on a 3-phase, 4-wire, 400/230 volt, 50 Hz, AC supply and shall comply with SANS 1804.

Except as otherwise specified or as required by the design of the installation, motors shall be standard squirrel cage or slip-ring motors with IP55 enclosure and IC 0141 cooling and shall be suitable for a damp environment.

Motor frames shall be of the totally enclosed fan cooled type with cast iron stator frames and cast iron end covers. The frame and end covers shall be properly machined and each cover shall locate on a spigotted register to ensure concentricity and parallelism.

Terminal boxes shall be top mounted wherever possible and arranged for cable entry from either side.

C3.3.2.2.14.2.4 ZUT 0001.14.2.4 3,3 kV, 6,6 kV, 11 kV and 15 kV Motors

Motors shall be rated for operation on a 3-phase, 4-wire, 50 Hz, AC supply.

C3.3.2.2.14.2.5 ZUT 0001.14.2.5 TEFC Motors

The fan cowl shall be of cast iron, plastic or stainless steel; i.e. carbon steel cowls are not acceptable.

An internal cooling circuit fan shall be provided for frame sizes 355 and larger.

If it is required that the motor shall produce low sound output, the fan cowl shall be provided with internal damping.

C3.3.2.2.14.2.6 ZUT 0001.14.2.6 CACA Motors

CACA motors shall have IP 55 ingress protection rating unless otherwise specified.

The heat exchanger shall be provided with lifting eyes or lugs.
Fans shall have cooling air inlet silencers and shall have outlet silencers.
Rotors shall be dynamically balanced.

The drive end bearing shall be earthed to prevent shaft currents.

Ports shall be provided for air gap measurement at the drive end and at the non-drive end.

Vertical jacking shall be provided at each holding down point.

At least one internal cooling circuit fan shall be provided for frame sizes 355 and larger.

C3.3.2.2.14.2.7 ZUT 0001.14.2.7 Hazardous Locations

When required to suit a hazardous location in terms of SANS 10108 or in terms of this Specification, suitable motors complying with SANS 60034-5 or SANS 61241, as appropriate, shall be supplied.

The relevant SANS certificates, clearly indicating the location classification in which the machine may be operated, shall be submitted to the Engineer before delivery of the motors.

Each motor shall be clearly and permanently marked with the applicable certificate number.

C3.3.2.2.14.2.8 ZUT 0001.14.2.8 Electronic Variable Speed Drive

Motors which will be driven by electronic variable speed drives shall be designed for the application and their design shall be submitted to the Engineer for approval. The design shall consider and deal with harmonic currents and with protection against bearing damage.

Unless of the submersible or immersible type, VFD driven motors shall be cooled by a separate, 50 Hz motor driven "piggy-back" fan.

Motors shall incorporate an insulated bearing and shall incorporate an earthing brush at the drive end.

C3.3.2.2.14.2.9 ZUT 0001.14.2.9 Bearings

Bearings shall comply with the clause “Bearings”.

Each bearing shall be mounted in a cartridge housing which is securely attached to the end covers.

Grease lubricated rolling element bearings shall be re-greaseable during motor operation. They shall be provided with stainless steel grease nipples (with stainless steel extension tubes where access is restricted) and shall be suited for external applications. A port for relief against over-greasing shall be provided.

Bearings on the non-drive end shall be insulated. Drive end bearings shall preferably be earthed.

Bearings for motors of 300 kW and above shall be provided with temperature measurement, indication and alarm.

C3.3.2.2.14.2.10 ZUT 0001.14.2.10 Motor Speed

(This sub clause does not apply to high speed motors with special bearings)

For motors with ratings between 30 kW and 132 kW (both inclusive), preference shall be given to nominal speeds of 1 500 rpm or lower.

Motors with ratings above 132 kW shall have a nominal speed of 1 500 rpm or below.

C3.3.2.2.14.2.11 ZUT 0001.14.2.11 Instrumentation

Motors of 30 kW and up to (but not including) 150 kW shall be provided with thermistors embedded in the windings of each phase. The thermistor tails shall be "brought out" to separate terminals mounted near the motor winding terminal block.

Motors rated at 150 kW and above, both fixed and variable speed, shall be provided with PT 100 type RTDs. Two RTDs shall be provided per phase winding. All six shall be incorporated into the control system; three to provide monitoring and three to provide high temperature trip functions.

C3.3.2.2.14.2.12 ZUT 0001.14.2.12 Safety

Rotating parts shall be guarded as required by legislation.

C3.3.2.2.15 ZUT 0001.15 BASEFRAMES

C3.3.2.2.15.1 ZUT 0001.15.1 GENERAL

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

Equipment and drivers shall be mounted on either a baseframe or on soleplates and shall not be mounted directly onto a concrete base.

Driven equipment and their drivers shall be mounted on common cast iron or fabricated steel base frames of rigid construction. This requirement applies to both direct coupled and belt driven machines.

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

C3.3.2.2.15.2 ZUT 0001.15.2 DESIGN REQUIREMENTS

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

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

At least two diagonally opposed jacking screws shall be provided for belt tensioning in the case of belt driven units. Direct coupled motors above 10 kW shall be provided with jacking screws for horizontal alignment and direct coupled motors above 150 kW shall be provided with jacking screws for vertical alignment as well. Jacking screws shall be of EN Grade 1.4401 (316), or better. A jacking point shall consist of a suitable hot rolled steel section welded to the baseframe and with a captured machine nut to accept the jacking screw. Drilled and tapped flat plate is not acceptable for jacking points.

C3.3.2.2.15.3 ZUT 0001.15.3 FABRICATION

Fabrication of baseplates shall comply with the clause “Fabrication of Steels” and welding shall comply with the clause “Welding”.

Base frames shall be manufactured of either:
- hot rolled steel sections.
- bent plate (with the overall length not more than 200 X plate thickness).

If the Engineer agrees to an organic coating system in lieu of hot-dip galvanising, practical requirements for providing accessibility for surface preparation and coating shall be taken into consideration and hidden surfaces shall not be permitted. Inaccessible pockets and hollow spaces which cannot be accessed by blast and spray equipment shall be avoided or shall be welded closed.

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

C3.3.2.2.15.4 ZUT 0001.15.4 MATERIALS

Base frames shall be fabricated from steels complying with SANS 50025 for grade S 355 JR or for grade S 355 JO.

C3.3.2.2.15.5 ZUT 0001.15.5 CORROSION PROTECTION

Steel base frames shall be hot-dip galvanized in accordance with ZUT 0003.

Designs shall provide proper access for safe and proper entry of the zinc into open spaces so that subsequent drilling at the galvaniser's yard is avoided.

C3.3.2.2.15.6 ZUT 0001.15.6 ANCHOR FASTENERS

Anchor fasteners shall be of EN Grade 1.4401 (316), or better. Fasteners shall comply with the clause "Fasteners".

A minimum of six anchors shall be provided for pumps with an inlet of DN 150 and smaller. Eight or more anchors shall be provided for pumps with an inlet larger than DN 150.

Anchor fasteners shall be sized in accordance with the table below.

Pump Inlet	Fastener Size (Minimum)
DN 50	M10
DN 100	M12
DN 200	M12
DN300	M16
DN 400	M20
DN 500	M24
DN 600	M30

Anchor fasteners shall be provided with both a lock washer and a flat washer.

C3.3.2.2.15.7 ZUT 0001.15.7 INSTALLATION

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

Concrete surfaces under base frames shall be scabbled before the baseframe is placed and shall be blown clean using compressed air immediately before grouting.

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

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

C3.3.2.2.15.8 ZUT 0001.15.8 INSPECTIONS

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

C3.3.2.3 ZUT 0002 OPERATING AND MAINTENCNACE MANUALS

C3.3.2.3.1 ZUT 0002.1 SCOPE

ZUT 0002 specifies the standard requirements for the Operating and Maintenance Manual for the Contract.

C3.3.2.3.2 ZUT 0002.2 SUBMISSION OF MANUAL

The Contractor shall submit the Manual to the Engineer for approval. If the Manual does not comply with this specification, the Contractor shall correct it and re-submit it for approval. At each submission, the Contractor shall provide a duplicate copy for the Employer.

Three (3) copies of the final version of the Manual, as approved by the Engineer, shall be provided prior to the start of the Commissioning phase.

C3.3.2.3.3 ZUT 0002.3 GENERAL REQUIREMENTS

The Manual shall comply with the following:

a) The Manual shall be for the complete Works.

b) The Manual shall be in English and shall be practically and neatly presented.

c) One Manual shall contain original documents and this set shall be marked "Original". The other 2 Manuals shall contain all the information in the original and shall be marked "Copy 2" to “Copy 3".

d) Binders shall have hard, plastic protected covers utilising four-ring, spring-clip holders. Each binder shall not be more than two-thirds full. A title label shall be affixed to the spine of each binder. This shall indicate Contract number, title, Contractor's name, Site/Plant name, volume number and contents.

e) Sections and sub-sections shall be titled, uniquely numbered, and provided with separator sheets.

f) Manufacturer’s printed matter shall be marked to identify the model provided.

g) Drawings shall be to a scale which makes details clear. Large drawings shall be held in plastic envelopes in the Manual. A4 and A3 drawings may be bound as normal pages. Drawings shall also be provided on electronic data storage in AutoCAD, or equivalent, format.

h) Cross-referencing within the Manual is acceptable if this will avoid duplication.

i) The complete Manual shall be electronically submitted in PDF format complete with index for easy search.

C3.3.2.3.4 ZUT 0002.4 FORMAT AND CONTENTS

The Manual shall comply in general with the format below but shall be modified to suit the Works:

NO	HEADING	CONTENT
1	**General**	
1.1	Contents List	Contents list for complete Manual.
1.2	Description of the Works	Description of the equipment installation with layout drawings and process flow diagrams.

		Process description and performance parameters for the Works.
1.3	Equipment List	List of the make, model, operating range and hazardous zoning of every item of mechanical, electrical, instrumentation and control equipment.
1.4	Drawing List	List of the Contractor's drawings.
2	**Operation**	
2.1	Operating System	Description of the operating system containing: **S**tart-up, adjustment, operating and shut-down procedures for manual and automatic operation - **E**mergency operating procedures - **P**rocess verification - **S**ettings, setpoints, protection, alarms and trips. This document shall be suitable for using as a Training Manual.
2.2	Commissioning	Commissioning results.
3	**Maintenance Schedule**	
	Maintenance and Lubrication	Schedule of routine maintenance for all **mechanical**, **electrical**, **instrumentation** and **control** equipment, broken down in daily, weekly, monthly, annual periods, etc. The schedule shall be all-inclusive but may refer to manufacturer's standard manuals in other parts of the Manual. The schedule shall include **all** lubrication periods, lubricants and capacities.
4	**Mechanical Equipment**	
4.1	Mechanical Equipment Item 1 (e.g. Pumps)	- The make, model, serial number, description, size, design range, performance data, motor and drive details and supplier's details of the item. - Dimensioned drawing. - A photograph of the nameplate. - Manufacturer's operating and maintenance manual. - Operating curves, test results, etc.
4.2	Equipment Item 2 (e.g. Mixers)	Ditto
4.3	etc.	Ditto
5	**Electrical Equipment**	
5.1	Elec. Equip. Item 1 (e.g. MCC Panels)	As for 4.1 above; *PLUS:* **C**ontrol and electrical details, including logic sequence, circuit diagrams and software, as applicable - **E**lectrical reticulation drawings - **E**quipment overall dimensions - **W**iring diagrams - **S**witchboard layout drawings - **S**LDs.
5.2	Elec. Equip. (e.g. VFCs)	ditto
5.3	etc.	ditto
6	**Instrumentation Equipment**	
6.1	Instrumentation Equip. Item 1 (e.g. Magflo)	As for 4.1 above; *PLUS:* **C**ircuit diagrams of instrumentation systems and of individual instruments - **I**nstallation arrangement - **N**ormal operating range - **C**alibration procedures.
6.2	Equip. Item 2 (e.g. level)	ditto
7	**Control**	
7.1	Identifying Information	Make and model of PLCs, transmitters, HMIs, computers, etc.; copied from the Equipment List.
7.2	I/O List	Cross-referenced listing of all I/Os used.

7.3	SCADA	Colour prints of SCADA mimic screens, control faceplates, sequences and trend screens. Schedule of alarm messages and TAG lists. File structures, lists and naming conventions.
7.4	Program	An annotated program listing. CDs containing all software. Loop and logic diagrams for each PLC. System control diagram and logic sequence chart.
7.5	Documents	Schedule of cable terminals. Copy of SCADA hardware diagnostic mimic.
8	**Documents**	
8.1	Drawings	All as-built Contractor's drawings, including MFDs, P&IDs, electrical panel construction drawings, etc.
8.2	Cable Schedule	Cable schedule for power, data, control and instrumentation cables. This shall include the cable construction, conductor material, insulation, protection, voltage rating, start and finish points, route length, duty, load, voltage drop, core area, no. of cores, no. of cores used and gland size. For cable voltages above 400 Volts, the schedule shall also include the purchase details, specification and date of manufacture.
8.3	Other	**L**ist of spares provided in terms of this Contract - **C**ertificate of electrical compliance - **C**orrosion protection systems used - **C**oating supplier's data sheets and coating repair procedures.

C3.3.2.3.5 ZUT 0002.5 MEASUREMENT AND PAYMENT

C3.3.2.3.5.1 ZUT 0002.5.1 Supply and Deliver

Payment for all Operation and Maintenance Manuals will be made under this Section. The lump sum shall be inclusive of all cost associated with the input required during preparation, checking, printing copying, binding etc. The extent of the services to be provided by the Contractor is covered in the Sections of the Specification.

C3.3.2.4 ZUT 0003 GENERAL CORROSION PROTECTION FOR PIPELINES, WATER AND WASTEWATER WORKS

C3.3.2.4.1 ZUT 0003.1 SCOPE

This Specification covers the painting and corrosion protection of plant, equipment in pump stations and water and wastewater treatment works and pipelines exposed to environments with variable corrosive tendencies.

Interpretations and variations of this Specification are set out in the Amendments of this Specification.

C3.3.2.4.2 ZUT 0003.2 NORMATIVE REFERENCES

C3.3.2.4.2.1 ZUT 0003.2.1 SUPPORTING SPECIFICATIONS

Where this Specification is required for a project, the following specifications shall, inter alia, form part of the Contract Document:

a) Amendments to this Specification;
b) SANS 1200 Series of Standardized Specifications:
   i) SANS 1200 L: Medium-pressure pipelines
c) Specification ZUT 7001 : Design and manufacture of medium-pressure steel specials

Equipment, materials and operational methods shall comply with the latest edition of the relevant SANS, ISO, AS, BS, DIN or equivalent American Standard as shown in Annexure A.

C3.3.2.4.3 ZUT 0003.3 DEFINITIONS AND ABBREVIATIONS

C3.3.2.4.3.1 ZUT 0003.3.1 DEFINITIONS

In this Specification the following shall have the meaning given:

a) **Coat**: A single uniform film of corrosion protection material applied to a substrate for corrosion protection purposes.
b) **Layer**: A uniform protective film of corrosion protection material applied to plant, equipment and piping in a specified manner consisting out of multiple coats.
c) **System**: A corrosion protection coating or lining consisting of multiple coats and/or layers, the type of coat, the number of coats and their thickness, the method of application and the requirements of the complete system.
d) **Coating**: A system on the outside of plant, equipment and pipework. However, certain international specifications referred to in this specification (e.g. AWWA specifications) use the term ‘coating’ to refer also to internal pipe protection and where these specifications are being referred to their terminology is used.
e) **Lining**: A system on the inside of plant, equipment and piping.
f) **Dis-bonded area**: An area of coating or lining that initially did adhere to the steel substrate after application, but which subsequently became loose from the substrate as a result of mechanical, chemical or other action.
g) **Un-bonded area**: An area of coating or lining which at no stage adhered to the steel substrate.
h) **Water path**: The distance along the surface of a material embedded in concrete but exposed to water measured from the concrete surface.
i) **Holiday**: A discontinuity in a coating or lining which exhibits electrical conductivity when exposed to a specific voltage.
j) **Abrasive blast cleaning**: The process of projecting a stream of abrasive particles at high velocity towards a surface for the purpose of removing contaminants from that surface and to

produce a textured surface which will increase the surface area and thus increase adhesion of the coating.

k) **Dry film thickness (DFT)**: The thickness of a coating or lining after it is hard dry.

l) **Electrical insulation defect (EID)**: Defects in a coating or lining that impair the protective properties of the coating or lining and that are detected instrumentally by either:
   i) a low-voltage, wet-sponge detector, or
   ii) a high-voltage, sparking detector,
   iii) operated in each case within the parameters specified.

   Note: EID's include such defects as steel projections from the substrate, conductive particles embedded in the coatings or linings, voids and those defects commonly known as pinholes and holidays.

m) **Fusion bonded epoxy (FBE)**: A thermoset epoxy powder coat. (The powder is normally applied by electrostatic spray to a preheated surface. The powder normally melts, fuses and cures at a temperature of 220ºC to 250ºC.)

n) **Inspector**: A person authorised by the Engineer to act as his representative in examining the work and materials and drawing such samples and carrying out such tests as may be necessary to ensure compliance with the specification.

o) **Lot**: A number of similar or related items submitted for inspection at one time by the Contractor and of such size that the inspector can reasonably be expected to examine adequately in not more than one working day.

p) **Paint**: A liquid material that, when applied as a thin film to a suitably prepared surface by an appropriate method, undergoes a physical or chemical change (or both) that converts it to a solid coating or lining bonded to the surface to which it is applied.

q) **Pinhole**: An electric insulation defect detected by the use of a wet sponge detector (see EID).

r) **Pot life**: The period, after the contents of the packs of a two-pack paint have been mixed together, during which the paint remains suitable for use without the addition of further solvent.

s) **Powder coat**: A material in the form of a dry, free flowing powder that, when applied to a suitably prepared steel surface by an appropriate method, can be fused by application of heat and subsequent cooling to form a continuous coating or lining that is bonded to the surface. A powder coat is classified as thermoplastic, when the applied coat may be re melted by heating, or thermoset, when it cannot be re melted by heat. Low or medium density polyethylene powder is thermoplastic whilst FBE is a thermoset material.

t) **Significant surface**: The part of the article covered or to be covered by the coating or lining and for which the coating or lining is essential for serviceability and/or appearance.

u) **Steel**: This term embraces carbon steels, 3CR12 and all grades of stainless steels.

v) **Water break free**: A surface which, when wetted all over with plain potable water, maintains a continuously wet surface and the water does not break up into islands surrounded by unwetted surfaces.

w) **Wet film thickness (WFT)**: The thickness of a coating or lining immediately after application and before any volatile matter has evaporated.

x) **Quality control**: The operational techniques and activities that are employed by the Contractor to sustain the required quality of a product, process or service.

y) **SAHDGA**: South African Hot Dip Galvanisers Association.

z) **Sa**: Followed by a number refers to a photographic illustration of the standard of blast cleaning required, as shown in ISO 8501-1

aa) **St**: Followed by a number refers to a photographic illustration of the standard of mechanical cleaning required, as shown in ISO 8501 1.

C3.3.2.4.3.2 ZUT 0003.3.2 ABBREVIATIONS

The following abbreviations shall have the meaning assigned to them:

µm : Micrometre
3Cr12 : Corrosion resistant steel
3LPE : Three layer high density polyethylene
ABS : Acrylnitrile-butadiene-styrene
Al : Aluminium

CI	:	Cast iron
CS	:	Cast steel
DCA	:	Die cast aluminium
DFT	:	Dry film thickness
FBE	:	Fusion-bonded Epoxy
FBP	:	Fusion-bonded Polyester
FBPE	:	Fusion-bonded Polyethylene
GRP	:	Glass fibre reinforced Polyester
HDG	:	Hot-dip galvanized
HDPE	:	High Density Polyethylene
MIO	:	Micaceous Iron Oxide
MS	:	Mild steel
PC	:	Polycarbonate
PVC	:	Polyvinylchloride
QCP	:	Quality Control Plan
SG	:	Spheroidal graphite cast iron
SS	:	Stainless steel – grades 304, 304L, 316 and 316L
UV	:	Ultra Violet

C3.3.2.4.4 ZUT 0003.4 REQUIREMENTS

C3.3.2.4.4.1 ZUT 0003.4.1 CONTRACTOR'S OBLIGATION

The requirements, material, surface preparation and corrosion protection systems prescribed in this Specification is regarded as a minimum requirement for the specific application. No deviation from this Specification shall be allowed without the written approval of the Engineer.

The Contractor is responsible for the design of the corrosion protection system and shall provide the Engineer with details of the material selection, surface preparation method and corrosion protection system he intends using as part of his design, including the Manufacturer's Instructions for each product and shall only proceed with the purchase of the corrosion protection materials/paints upon receipt of written approval from the Engineer.

The corrosion protection material selection, surface preparation method and corrosion protection system shall be approved by the material manufacturer/supplier. The Contractor shall obtain a written assurance from the chosen material manufacturer/supplier that the proposed materials, surface preparation method and corrosion protection system comply with the specified requirements and are suitable for the intended purposes under the specified Environmental Conditions (refer to Clause 4.3). The Contractor shall also obtain the Manufacturer's Instructions (refer to Clause 4.2). The written assurance and Manufacturer's Instructions shall be submitted to the Engineer for approval before commencement of the work.

Plant, equipment and pipes shall be manufactured and corrosion protected in accordance with the requirements specified in the Specification and Drawings. In the event that no corrosion protection is specified for any Plant, equipment or pipes within the Specifications or Drawings, this Specifications shall be used to agree the specific application.

C3.3.2.4.4.2 ZUT 0003.4.2 MANUFACTURER'S INSTRUCTIONS

The manufacturer's instructions shall be regarded as the recommendations supplied by the manufacturer in the form of the latest edition of printed data sheets, or given in writing on the manufacturer's letterhead.

The following details shall be made available to the Engineer and the applicator:

- Brand and type of corrosion protection material;
- Mixing and thinning instructions;
- Recommended type and quantity of solvent required for thinning during application;

- Pot life of mixed product;
- Minimum and maximum recommended dry film thickness per coat;
- Minimum and maximum recommended dry film thickness per layer;
- Recommended time intervals between coats;
- Recommended minimum and maximum steel surface temperatures during application;
- Time for complete drying and curing on applicable surfaces;
- Substrate surface preparation requirements;
- Recommended primers for substrate;
- Recommended method of coating and lining application;
- Repair procedures for damaged coatings and/or linings and field joints on pipelines;
- Toxicity if in contact with water, and
- All relevant information the Supplier wishes to submit on his product.

Verbal instructions by the manufacturer's representative will not be accepted unless confirmed in writing by the Contractor.

C3.3.2.4.4.3 ZUT 0003.4.3 ENVIRONMENTAL CONDITIONS

Environmental conditions shall be classified according to SANS 1200 HC: Part 3. The corrosion protection system design and applied by the Contractor shall be suitable for the Environmental Conditions specified.

Unless otherwise specified in the Amendment of this Specification the Environmental Conditions shall be classified as follows:

- Mildly-corrosive: Dry, indoor/internal, above ground and ventilated conditions, not within 5km from the coastline or polluted industrial area. Relative humidity below 70%.
- Severely corrosive: Submerged, splash-zone, underground, very moist conditions, or within 5km from coastline or polluted industrial area, or in wastewater works, or close to electrical power lines. Relative humidity above 85%.
- Medium Corrosive: All other conditions not included in the abovementioned definitions.

Notwithstanding the abovementioned information the Contractor shall satisfy himself of the environmental conditions on site and design the final corrosion protection systems accordingly.

C3.3.2.4.4.4 ZUT 0003.4.4 WORKMANSHIP

A high standard of workmanship is required. Only experienced personnel shall be used to carry out corrosion protection work. All work shall be carried out under the constant supervision of a qualified supervisor.

Similarly all repair work at Site shall be done by competent personnel under the supervision of a qualified supervisor.

C3.3.2.4.4.5 ZUT 0003.4.5 COMPATIBILITY OF MATERIALS

C3.3.2.4.4.5.1 ZUT 0003.4.5.1 Design Precautions

All equipment shall be designed to suppress corrosion in an exposed environment with special reference to galvanic corrosion.
The Contractor shall ensure that metals or alloys are compatible or are adequately protected if, in the galvanic series, there is more than a 0,3 volt difference in the galvanic potential.

C3.3.2.4.4.5.2 ZUT 0003.4.5.2 Galvanic Corrosion Prevention

The Contractor shall ensure that the following steps are taken to minimise corrosion:

1) If dissimilar metals are used: Coat all surfaces of the whole assembly including the more noble member of the galvanic series.

2) If the noble member of the assembly cannot be entirely covered:
   a) Keep the anode/cathode ratio as large as possible in the particular component.
   b) Use electrical insulators between two metals. Insulation must be complete; a bolt requires a sleeve as well as washers of an insulating material.

3) Joints and crevices between metals shall be sealed.

4) Where fastening is unavoidable, the fasteners shall be more noble (cathodic) than the base material. Fasteners shall be coated where possible and/or adequately electrically insulated between fasteners and the base material.

C3.3.2.4.4.6 ZUT 0003.4.6 HANDLING OF CLEAN ITEMS

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

C3.3.2.4.4.7 ZUT 0003.4.7 MACHINED AND MATCHING SERVICES

Mating surfaces of joints shall be coated with primer (where specified) or first coat only. The coating or lining shall be uniform in thickness and shall not interfere with the mechanical tolerances. After assembly the outside surface of the joints shall be fully coated.

C3.3.2.4.4.8 ZUT 0003.4.8 SPECIAL AREAS

Areas that are inaccessible after assembly shall be prepared and fully coated with the specified system to the specified requirements before assembly. The coats shall be fully cured before assembly.

Steel edges to be welded after coating shall not be coated for a distance of 50 mm from the welding edge. The unlined strip of grit blasted surface shall be temporarily protected with a coat of (red or a different colour to the lining/coating) weldable primer between coating and/or lining application and installation.

Friction grip areas shall be left un-coated unless otherwise specified.

C3.3.2.4.4.9 ZUT 0003.4.9 SUPPORTS

During coating and/or lining application, the items shall be so supported to prevent damage to the wet coatings or linings until the coatings or linings have hardened adequately. Items shall remain supported during curing, storing and handling.

C3.3.2.4.4.10 ZUT 0003.4.10 WATER RETENTION AREAS

Pockets, recesses and crevices in which water and dirt may collect shall be avoided. Water retention areas shall be properly drained by holes as large as possible.

Surfaces of corrodible metals, such as the insides of tanks or hollow sections that cannot be protected by any method (e.g. painting or dipping), shall be avoided, or where not possible, be fully sealed against ingress of air and moisture.

C3.3.2.4.4.11 ZUT 0003.4.11 STRIPE COATS AND CREVICES

All complex surfaces including metal edges, up stands, welds, bolts and nuts shall be adequately coated to ensure complete corrosion protection. Additional stripe coats shall be applied after initial priming, if required or ordered by the Engineer.

Special attention shall be given to crevices and edges to ensure complete coverage and uniform paint thickness.

C3.3.2.4.4.12 ZUT 0003.4.12 REPAIR OF DAMAGED COATS

Repair procedures shall be approved by the Engineer and repairs will be subject to inspections as set out in Clause 11.2. Where the damage is extensive the particular remedial procedures for each such instance shall be agreed with the Engineer in writing.

All repairs shall comply with the requirements of the repair-product Manufacturer's Instructions. The Engineer may at his discretion request that repaired areas undergo adhesion tests.

Any damage occurring during transit from the Contractor's premises to the Site shall be the responsibility of the Contractor. The Contractor shall repair any damage occurring on Site during handling, assembly, storage, transport and erection.

A 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.

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 this Specification.

Paint surfaces which become streaky because paint has run, will be rejected.

Touching up of damage to the final paint coat will NOT be permitted. If final paint coat is damaged the item shall completely repainted with the finishing coat in accordance with the specifications.

C3.3.2.4.4.12.1 ZUT 0003.4.12.1 Repair Methods for Minor Defects

The repair of areas showing electrical insulation defects or low film thickness shall, if approved by the Engineer, be carried out as follows:

- Degrease in accordance with Clause 7.4.1.
- Thoroughly abrade the area, including an adjacent surrounding area of at least 25 mm wide, with a medium grade 220 abrasive paper.
- Vacuum-clean the surface to remove dust and debris in accordance with SANS 5769 and Clause 7.2.
- Wipe the abraded paint surface with methyl ethyl ketone and allow to dry.
- Apply as many coats of repair material as necessary to achieve the specified electrical insulation thickness and finish as to conform to the adjoining corrosion protection system's requirements.
- Apply a final top coat over the repaired area to achieve a pleasing, uniform finish of the item.

C3.3.2.4.4.12.2 ZUT 0003.4.12.2 Repair Methods for Major Defects

The repair of areas showing damage down to the steel surface shall, if approved by the Engineer, be carried out as follows:

- Degrease in accordance with Clause 7.4.1.
- Blast-clean area to Sa 3 (ISO 8501-1).
- Feather the surrounding paint for a distance of 25 mm beyond the damaged areas with a medium grade 220 abrasive paper.
- Vacuum-clean the surface to remove dust and debris in accordance with SANS 5769 and Clause 7.2.
- Wipe only the abraded paint surface with methyl ethyl ketone and allow to dry.
- Apply as many coats of repair material as necessary to conform to the specified adjoining corrosion protection system's requirements.
- Apply a final top coat over the repaired area to achieve a pleasing, uniform finish of the item.

C3.3.2.4.4.13 ZUT 0003.4.13 QUALITY CONTROL

C3.3.2.4.4.13.1 ZUT 0003.4.13.1 Responsibility for Quality

The Contractor shall accept full responsibility for the quality of his workmanship and material used, irrespective of any quality surveillance that may be carried out by the Engineer or his assistants.

The Contractor and all approved Subcontractor(s) shall:

a) Be responsible for compliance with all the Clauses of this Specification and shall carry out all inspections and tests called for in this Specification in the presence of the Engineer or his assistant. The cost of these inspections and tests shall be included in the Rates; and
b) Abide by the approved Project Quality Plan (PQP) throughout all the intended stages of testing during manufacture, cleaning, preparation and application as well as hold points for independent quality surveillance.

C3.3.2.4.4.13.2 ZUT 0003.4.13.2 Contractor Qualification

The Contractor and Subcontractor(s) shall satisfy the Engineer that they have the management, facilities and equipment, skilled staff, a quality control procedure and required test methods and standards to carry out the quality control committed to in the approved PQP during manufacture and corrosion protection application.

In this regard, the Contractor and his Subcontractors shall be subject to quality audits.

C3.3.2.4.4.13.3 ZUT 0003.4.13.3 Submission for approval

The Contractor shall submit the following to the Engineer, including data sheets where applicable, for approval:

C3.3.2.4.4.13.3.1 ZUT 0003.4.13.3.1 Corrosion Protection

- A programme;
- The Quality Control Plan (QCP) for corrosion protection indicating hold points;
- Process Method Statement;
- Blast material;
- Proposed corrosion protection systems; and
- Proposed pickling and passivating products.

C3.3.2.4.4.13.3.2 ZUT 0003.4.13.3.2 Manufacture and Corrosion Protection Programmes

The manufacture and corrosion protection programmes shall state the time and place when the following will be conducted:

- Inspection of material;

- Hydrostatic testing of uncoated castings, pipes and fittings;
- Manufacture of components;
- Fettling or dressing;
- Degreasing;
- Water soluble salts test;
- Blast cleaning and application of the first coat;
- Application of intermediate and final coats; and
- The commencement of Site repairs.

C3.3.2.4.4.13.3.4 ZUT 0003.4.13.3.4 Inspection by the Engineer and Notice of Inspection

Inspection of Plant shall be carried out by the Engineer, his appointed representative or a nominated and Approved Inspection Authority at the manufacturer's and corrosion applicator's works.

The Engineer shall be notified at least seven days in advance, or as otherwise agreed, of impending inspections or when cleaning and first coat application are to be carried out as well as for witnessing the points in terms of the agreed Quality Control Plans (QCP's).

The Engineer's inspection shall in no way relieve the Contractor or his Subcontractors of any of their obligations with respect to design, manufacture and supply Plant of superior quality and workmanship in accordance with the Specification.

C3.3.2.4.4.13.3.5 ZUT 0003.4.13.3.5 Substandard Quality Control

All material, certification and records of the Contractor will be subject to examination by the Engineer.

This shall include the checking and testing of the Plant. If any deviation to the approved QCP or product quality is found, additional testing and quality surveillance shall be carried out at no additional cost to the Employer.

If the additional testing confirms inaccurate quality control by the Contractor, all work on that particular Plant item shall be stopped and shall only proceed after remedial action has been implemented to the satisfaction of the Engineer.

C3.3.2.4.4.14 ZUT 0003.4.14 HEALTH & SAFETY REQUIREMENTS

C3.3.2.4.4.14.1 ZUT 0003.4.14.1 Control of Major Classes of Risk

1) Health risks, these include:
   a) Gases/vapours;
   b) Volatile liquids in the paint; and
   c) Powders/dust.

2) Fire or explosion risks, these include:
   a) Fire risk during storage/transport; and
   b) Explosion hazard during application.

C3.3.2.4.4.14.2 ZUT 0003.4.14.2 General Aspects of Explosion Hazards

The essential precaution to be taken is, inter alia that sufficient ventilation air shall be provided to maintain the ratio of vapour/air to no more than 10% of the lower explosive limit.

C3.3.2.4.4.14.3 ZUT 0003.4.14.3 General Aspects of Toxic Hazard

Measures shall be taken by the Contractor to ensure that the following are prevented:

- Inhalation of dust/fumes;
- Skin contact with paint;
- Ingestion of paint; and
- Eye contact/penetration of paint.

Operators shall be provided with the necessary Personal Protective Equipment (PPE), such as masks/hoods, barrier creams and protective clothing to minimize the chances of the above occurring.

Emergency procedure shall be in place and First Aid kit provided to deal adequately with any of the above occurrences.

The Contractor shall ensure that in terms of Clause 6(2) of the Construction Regulations of the OH&S Act 85 of 1993, an assistant construction supervisor is specifically appointed for the application or repairs of linings inside enclosed or semi-enclosed areas e.g. pipe linings, prior to the execution of any such work.

C3.3.2.4.4.15 ZUT 0003.4.15 SPECIFIC REQUIREMENTS FOR PIPES AND SPECIALS

C3.3.2.4.4.15.1 ZUT 0003.4.15.1 Cut Back of Coated Pipes

The blast cleaned surface shall be stopped off or cut back by suitable masking which shall not contaminate the cleaned surface. Cut-backs shall comply with the requirements as set out in Table 4.1 below:

Table 4.1: Cut-back of Coatings

PIPE END	CUT- BACK (mm)	COMMENT
Pipe ends prepared for field butt welding	100	All coatings to be mitred or feathered to prevent air entrapment in the joint coating system
Pipe ends prepared for flexible joint couplings	Various	The coating shall be cut back a sufficient distance to accommodate a standard coupling for the particular diameter of pipe
“Bell and spigot” pipe ends prepared for first welding	100	The cut back shall be measured from either side of the (field) external fillet weld position when the spigot is fully inserted into the “bell”

C3.3.2.4.4.15.1.1 ZUT 0003.4.15.1.1 Protection of Pipe Ends on Pipes with Cut-Back

Before delivery cut backs of each pipe for field welds shall be coated with an approved rust inhibitor. This inhibitor shall provide corrosion protection for up to 6 months and shall enable good cutting and welding properties (Sigmaweld 120, Plascon etching primer or equivalent approved). Plain ended pipes (to be joined by flexible couplings) are to be coated with an approved rust inhibitor for a distance of 100mm from the pipe ends on the inside and the outside of each pipe. Careful attention must be paid to ensuring the pipe ends are also completely covered. The inhibitor used must be compatible with both the lining and the coating.

C3.3.2.4.4.15.2 ZUT 0003.4.15.2 Pipe Ends

C3.3.2.4.4.15.2.1 ZUT 0003.4.15.2.1 Extension of Lining

For flanged pipes or specials and pipes or specials intended for joining with flexible couplings or for Site welding by means of double sleeve weld-on couplings, the lining shall extend to the ends of pipes and specials including edges and shall overlap by at least 300 mm on the outside of the pipe. Coatings shall overlap surfaces on the outside by at least 25 mm.

C3.3.2.4.4.15.2.1 ZUT 0003.4.15.2.1 Butt Weld Edges

For pipes and specials intended for Site butt-welding, lining and coating shall extend up to a distance of 50 mm from pipe ends. The unlined circumferential strip of grit blasted surface shall be temporarily protected between the Works and Site with a coat of weldable primer (of a different colour to the lining/coating).

C3.3.2.4.4.15.3 ZUT 0003.4.15.3 Field Joints

No welding whatsoever shall be performed on any pipe or special on which the lining or coating has been completed, unless otherwise approved by the Engineer in writing.

The materials used for the repairs to field joints, linings and coatings shall be the same as that used for the pipes, unless otherwise approved by the Engineer in writing.

The linings and coatings of butt welded steel pipes or continuously welded steel cylinder type prestressed concrete pipes, shall be made continuous over joints as soon as possible after approval and acceptance by the Engineer of the welded joint. At no time shall field joints, lining and coating repairs/remedial work lag more than 250 metres behind the last pipe laid.

Flexible couplings shall be provided with external protection as soon as the pipeline has been hydrostatically tested and electrically bonded, where applicable.

C3.3.2.4.4.15.4 ZUT 0003.4.15.4 Supports

When pipes are installed or mounted on concrete supports, rubber insertion shall be used to insulate the pipe from the support. The thickness of the rubber insertion shall not be less than 10 mm and protrude not less than 20 mm all round.

C3.3.2.4.4.15.5 ZUT 0003.4.15.5 Sealing

Pipes that enter or exit concrete shall be sealed on their circumference with a continuous polyurethane or polysulphide flexible sealer, in a 25 mm square recess, approved by the Engineer.

C3.3.2.4.4.15.6 ZUT 0003.4.15.6 Spare Pipes

Corrosion protection of spare pipes shall where applicable be supplied with a top coat of Re-coatable Polyurethane to a DFT of 30 – 50 µm, colour white or silver, for storage and above ground installation.

C3.3.2.4.5 ZUT 0003.5 MATERIALS

The material requirements for each corrosion protections system is specified in the relevant clauses of Clause 10 and shall be read in conjunction with this clause.

C3.3.2.4.5.1 ZUT 0003.5.1 GENERAL

All materials in a corrosion protection system shall be purchased from the same manufacturer unless approved by the Engineer.

Materials offered and subsequently approved shall not be changed without written approval of the Engineer.

All corrosion protection materials shall be delivered in the manufacturer's original containers clearly marked with the following:

- Manufacturer's name;
- Product Brand and Reference Number;
- Batch Number which may incorporate the date of manufacture;
- Abbreviated instructions for storage and use of material, which shall include mixing ratios of the components of multi-component materials, minimum and maximum temperature of application and the method of application; and
- The SANS mark where applicable.

Any conflict between the manufacturer's data sheet and the specification shall be referred to the Engineer for adjudication.

C3.3.2.4.5.2 ZUT 0003.5.2 TOXICITY OF LINING MATERIAL

Materials used for the lining of equipment that will be in contact with water shall be non-toxic and shall not impart any odour, taste, or colour to the water.

C3.3.2.4.5.3 ZUT 0003.5.3 STORAGE

All corrosion protection materials shall be kept in an approved dry and enclosed store. The temperature shall not drop below 0°C nor exceed 40°C.

Usage of materials shall be on a first in, first out basis and no materials shall be used that have exceeded the shelf life recommended by the manufacturer.

C3.3.2.4.6 ZUT 0003.6 PLANT/EQUIPMENT

C3.3.2.4.6.1 ZUT 0003.6.1 HANDLING AND TRANSPORTATION

The plant and equipment used by the Contractor for handling of pipes, valves, pumps and other equipment, for the purpose of corrosion protection shall be such that no pipe shell, valve or pump casing or any other piece of equipment is over stressed during any operations covered by this Specification.

C3.3.2.4.6.2 ZUT 0003.6.2 SURFACE PREPARATION EQUIPMENT

The Contractor shall provide all the equipment required for abrasive blast cleaning, preparation and cleaning of all surfaces to be coated.

C3.3.2.4.6.3 ZUT 0003.6.3 COMPRESSOR

Compressors used for abrasive blast cleaning shall be fitted with an after cooler and oil and water traps such that the air delivered at the nozzle is completely free from oil and water. The volume displacement of the compressors shall be adequate for the number and bore of blast nozzles, the spray equipment and flame spray equipment that may be necessary to carry out the specified coating operations.

C3.3.2.4.6.4 ZUT 0003.6.4 APPLICATION EQUIPMENT

The Contractor shall provide all the equipment required for airless spray painting, two component hot airless spray painting, electrostatic powder coating, fluidised bed powder coating, or any other approved method of applying the corrosion protection system in the shop or required for site application and repairs to coats. All equipment shall be thoroughly cleaned on completion of each day's work and maintained in clean working order.

C3.3.2.4.6.5 ZUT 0003.6.5 INSPECTION OF EQUIPMENT

All facilities and equipment shall be subject to inspection by the Engineer or the independent inspectorate and defects in the equipment shall be rectified when so required.

C3.3.2.4.6.6 ZUT 0003.6.6 INSPECTION EQUIPMENT

The Contractor shall supply all facilities and equipment for inspecting and testing the specified preparation and corrosion protection of all items supplied under the Contract. Recent calibration certificates shall be available for all equipment requiring calibration. This equipment shall be made available to the Engineer or his independent inspectorate for the purpose of testing the specified corrosion protection systems and verifying the accuracy of the test equipment.

C3.3.2.4.7 ZUT 0003.7 PREPARATION OF SURFACES TO BE COATED

The surfaces of all items to be coated and/or lined, irrespective of the corrosion protection system used, shall be prepared in accordance with the relevant following requirements.

C3.3.2.4.7.1 ZUT 0003.7.1 STANDARDS

Reference is made to the latest issues of the following Standards:

SANS 1344 Medium duty solvent detergent.

SANS 10064 The preparation of steel surfaces for coating.

ISO 8501-1 Preparation of steel substrates before application of paints and related products – Visual assessment of surface cleanliness – Part 1: Rust grades and preparation grades of un- coated steel substrates and of steel substrates after overall removal of previous coatings.

ISO 8504-2 Preparation of steel substrates before application of paints and related products – Surface preparation methods – Part 2: Abrasive blast cleaning.

SANS 5770 Cleanliness of blast-cleaned steel surfaces for painting (freedom of soluble salts).

SANS 5772 Profile of blast-cleaned steel surfaces for painting (profile gauge).

SANS 5769 Cleanliness of blast-cleaned steel surfaces for painting (freedom from dust and debris).

ISO 11125 Preparation of steel substrates before application of paints – Metallic blast-cleaning abrasives.

ISO 11127 Preparation of steel substrates before application of paints – Non-metallic blast–cleaning abrasives.

C3.3.2.4.7.2 ZUT 0003.7.2 SURFACE CONDITION

Before surface preparation all items to receive a coating or lining shall be in rust condition A to C of Swedish Standard SIS 05 5900. Items in rust condition D will be rejected.

Prepared surfaces shall conform to Table 7.1 below. If only surface cleanliness to ISO 8501-1 is specified in the Specifications then the corresponding values of Table 7.1 for degreasing, surface profile and soluble salts shall apply.

Table 7.1: Surface Condition

Cleanliness to ISO 8501-1 (min)

(SIS 055900)	Sa 3	Sa 2½	St 2
Residual dust and debris (SANS 5769)	0.3%	0.5%	0.5%
Oil, grease and perspiration	Nil	Nil	Nil
Surface Profile(min)	30 µm	30 µm	n/a
Layers up to 200 µm (max)	50 µm	50 µm	
Surface Profile (min)	50 µm	50 µm	n/a
Layers > 200 and up to 300 µm	80 µm	80 µm	
Surface Profile (min)	60 µm	60 µm	n/a
Layers > 300 and up to 500 µm (max)	100 µm	100 µm	
Water soluble salts:			
Maximum at any point.	100 mg/m²	400 mg/m²	500 mg/m²
Average of any 250 cm of Pipe length.	100 mg/m²	100 mg/m²	100 mg/m²

Note: The maximum surface profile shall be less than ⅓ of the coat thickness.

Unless otherwise specified in the Amendments to this Specifications the surface condition shall conform to the following requirements:

- Sa 3 for the environmental condition classified as severely corrosive,
- St 2 for Tape Wrapping, and
- for all other environmental conditions, the surface condition shall be Sa 2½.

C3.3.2.4.7.3 ZUT 0003.7.3 PREPARATION OF ITEMS

Prior to the application of any coat, each item shall comply with the following:

- Weld splatter shall have been removed by chipping or grinding to a smooth surface flush with the surrounding steel.
- Weld seams shall have a smooth contour, free from sharp edges, protrusions and undercuts.
- Sharp edges and protrusions shall have been removed by grinding to a smooth radius. The radius shall be a minimum of 3 mm for steel of thickness 6 mm or greater, or a minimum of 50% of the steel thickness for steel of thickness less than 6 mm.

- Laminations, scabs or occluded scale shall be ground out. If such grinding penetrates deeper than 3.5% of the metal thickness, the area shall be repaired by welding or the metal shall be rejected at the discretion of the Engineer.
- Articles for hot-dip galvanizing shall not have any overlapping joints. Closed sections shall be suitably vented.

C3.3.2.4.7.4 ZUT 0003.7.4 CLEANING OF ITEMS

C3.3.2.4.7.4.1 ZUT 0003.7.4.1 Degreasing

All surfaces to be coated shall be tested for oil and grease contamination by the water break free test.

In the event that degreasing is required, items shall be degreased by the use of a water based solvent degreaser such as that complying with SANS 1244 or, for use in enclosed systems, with SANS 1365.

Items shall be thoroughly washed with clean potable water to remove all residues. The items shall then be allowed to dry. The washed surfaces shall be tested after degreasing to show that no oil, grease and chemical contamination are present.

Care shall be taken to avoid entrapment of cleaning agents in recesses or other retention areas.

C3.3.2.4.7.4.2 ZUT 0003.7.4.2 Blast Cleaning

Blast-cleaning shall be done in accordance with the code of practice SANS 10064. Any abrasive used for blast cleaning shall composed of clean, non-recycled, sound hard particles free from foreign substances such as dirt, oil, grease, toxic substances, organic matter, water soluble salts and foreign metals.

The surface of the items to be coated or lined shall be blast cleaned by centrifugal or air blast cleaning methods, then vacuum cleaned or blown off to achieve the following requirements:

- The surface condition shall be in accordance with Swedish Standard SIS 05 5900 (or ISO 8501-1) as stipulated in Clause 4.2 and specified in the Amendments and Additions of the Specification, when tested in accordance with SANS Method 767.or SANS Method 772.
- Any laminations revealed by blast cleaning shall be ground out and re-blast cleaned to meet the above requirements. If grinding penetrates the steel to a depth greater than 3.5% of the nominal wall thickness, the item will be rejected.
- The time interval between abrasive blast cleaning and paint application shall not exceed those given in Clause 9.2.6.2.

C3.3.2.4.7.4.3 ZUT 0003.7.4.3 Mechanical Surface Preparation

Cleaning by hand or by means of power tools (e.g. wire brushing) shall be carried out in accordance with the methods described in SANS 10064 to the standards specified in the Amendments of this Specifications and as shown in SIS 055900 and Clause 7.2.

C3.3.2.4.7.5 ZUT 0003.7.4.3 PICKLING AND PASSIVATION

Where specified the following areas shall be pickled and passivated:

- All un-coated areas;
- Ground and sheared edges; and
- Heat affected zones caused by welding or cutting.

Where possible, pickling and passivation shall be done by the dipping process.

Proprietary pickling and passivation chemicals (as supplied by approved suppliers) shall only be used in accordance with the manufacturer's recommendations. Pickling formulations made up of 15 to 20% nitric acid (HNO3) and 1 to 2% hydrofluoric acid (HF) by volume with potable water are considered suitable. Care shall be taken not to exceed the maximum contact time recommended. After pickling and passivation, surfaces shall be very thoroughly washed with clean potable water to remove all traces of acid. Repeat the process, if necessary to remove all discolouration. Surfaces shall be allowed to dry, then polished where necessary, using polishing compounds recommended by the stainless steel manufacturer.

C3.3.2.4.8 ZUT 0003.8 SURFACE PREPARATION METHODS

The requirements as specified below shall be read in conjunction with the requirements of Clause 7: Preparation of Surfaces to be Coated. Each preparation method specified below shall also conform to the relevant requirements of Clause 7 and its sub-clauses. Where in in conflict with Clause 7 and its sub- clauses the requirements hereunder shall take precedence.

Unless otherwise specified in the Amendments of this Specifications and subject to the approval of the Engineer, the surfaces of all items to be coated and/or lined shall be prepared in accordance with one or more of the following Methods.

C3.3.2.4.8.1 ZUT 0003.8.1 METHOD 1: MILD STEEL

Components manufactured from mild steel shall be degreased and blast clean before the corrosion protection system is applied. Oil and grease contamination, when present, shall be removed to a water break free surface by degreasing (Refer to Clause 7.4.1) before blast cleaning (refer to Clause 7.4.2).

Steel items less than 2 mm thick may distort when blast cleaned. Sheet steel items less than 2 mm in thickness shall be degreased, acid pickled and phosphated with an approved proprietary 7 or 9 stage process to produce a fine grain zinc phosphate surface complying with SANS 10064 Table 2 Lightweight or by a proprietary process approved by the Engineer for the standard of cleaning specified.

All surfaces of steel 2 mm or more in thickness shall be abrasive blast cleaned in accordance with SANS 10064 Section 4.3 and cleaned to achieve the requirements given in Table 4.1 for the standard of abrasive blast cleaning specified.

C3.3.2.4.8.2 ZUT 0003.8.2 METHOD 2: CAST IRON AND CAST ALLOYS

Cast iron shall be abrasive blast cleaned until all sand particles, residual burnt-on sand and casting skin have been completely removed. Cast iron surfaces shall be abrasive blast cleaned in accordance with SANS 10064 Section 4.3 to achieve the requirements given in Clause 7.2 for the standard of abrasive blast cleaning specified.

Blowholes and omegas in cast surfaces shall be opened up where necessary and filled with a two component solvent free epoxy filler. When the filler has set hard, the surface shall be abraded to be flush with the surrounding metal.

C3.3.2.4.8.3 ZUT 0003.8.3 METHOD 3: STAINLESS AND CORROSION-RESISTANT STEEL

Components manufactured from stainless or corrosion-resistant steel shall be supplied in the fully passivated condition. Sheared edges, welds or surfaces subjected to any form of heat treatment or contamination with iron or mild steel, shall be pickled and passivated in terms of Clause 7.5.

Surfaces shall thereafter be thoroughly degreased in terms of Clause 7.4.1, then rinsed with potable water to obtain a water-break-free surface.

When it is required to paint stainless steel exceeding 2 mm thickness, the surface shall be blast cleaned in accordance with the parameters given in Clause 7.2, using non-metallic abrasives such as iron slag, copper slag or platinum slag. The use of steel shot, steel grit or cast-iron grit is strictly prohibited. Any contamination with iron or mild steel is prohibited.

Where blasting is impractical, the surface shall be cleaned with detergent solution and roughened manually using non-metallic abrasive pads, followed by washing with clean potable water to a water-break- free surface. If a water-break-free surface is not obtained, detergent cleaning shall be repeated until the surface is water-break-free. Allow the surface to dry before coating.

C3.3.2.4.8.4 ZUT 0003.8.4 METHOD 4: ALUMINIUM

Generally, aluminium surfaces will be anodized or powder coated and will require no further treatment. Where painting is required, the aluminium surface shall be thoroughly degreased then rinsed with clean potable water. If the surface is not water break free, repeat the degreasing process until a water-break-free surface is obtained. Allow to dry completely, then apply a thin coat (8 to 13 micrometres dry film thickness) of wash primer which complies with SABS 723, mixed and applied in accordance with the manufacturer's instructions. Note that the “wash primer” is an adhesion promoter and does not replace the primer specified in the paint system.

C3.3.2.4.8.5 ZUT 0003.8.5 METHOD 5: HOT-DIP GALVANIZED SURFACES

Hot-dip galvanized surfaces shall be thoroughly degreased by scrubbing with water rinsable solvent degreaser, followed by thorough washing with clean, potable water. If the water breaks up into islands of non-wetted surface, the degreasing shall be repeated until a water break free surface is obtained. Small areas may be abraded with a nonmetallic abrasive paper prior to painting. Large surfaces may be sweep blast cleaned, using ultra fine abrasive (particle size 0,2 to 0,8 mm) and a nozzle pressure not exceeding 300 kPa. A uniform matt surface shall be obtained. Loss of zinc thickness shall not exceed 10 µm. Cracking and flaking of the galvanized layer is indicative of excessive blast cleaning by using too coarse abrasive or too high blast pressure. Such surfaces will be rejected. The article shall then be stripped and re-galvanized.

C3.3.2.4.8.6 ZUT 0003.8.6 METHOD 6: PAINTED SURFACES

C3.3.2.4.8.6.1 ZUT 0003.8.6.1 Primer Only

Where the surface has been contaminated it shall be washed and dried to remove dust and deposits before overcoating.
The succeeding coats shall be compatible with the primer. Where the type of primer is unknown, a test patch shall be applied. There shall be not loss of adhesion or other defects of the primer or between primer and undercoat. If defects or adhesion loss occur, the primer shall be completely removed, feather blasted and replaced by a primer which is compatible with the specified system.

C3.3.2.4.8.6.2 ZUT 0003.8.6.2 Recoatable Materials

Surfaces painted with recoatable paints shall be abraded with abrasive paper grade 220 to a uniform matt finish, washed and dried to remove dust and deposits before overcoating.

C3.3.2.4.8.6.3 ZUT 0003.8.6.3 Fully Cured Non-Recoatable Materials

Surfaces painted with fully cured non-recoatable paints that have exceeded their overcoating time shall be thoroughly abraded with abrasive paper grade 220 to a uniform matt finish, washed and dried before overcoating. The edges of any damage shall be smoothly feathered into the sound paint. Repairs to damaged areas shall extend 25 mm beyond the damage.

C3.3.2.4.8.6.4 ZUT 0003.8.6.4 Two Component Paints within their Overcoating Time

Surfaces painted with two component paints where the paint is still within the overcoating time specified by the manufacturer shall be recoated without special surface preparation. Where the surface has become contaminated, it shall be cleaned.

C3.3.2.4.8.7 ZUT 0003.8.7 METHOD 7: PLASTIC SURFACES SUCH AS PVC AND GRP

Where the surface has been contaminated it shall be washed and dried to remove dust and deposits before overcoating.

C3.3.2.4.8.8 ZUT 0003.8.8 METHOD 8: CONCRETE AND PLASTER SURFACES

Concrete and plaster surfaces to be painted shall be clean, dry and free from laitance, dust or similar friable surface layers and from mould oil or similar contaminants that will interfere with the adhesion of the coating or lining.

Mould oil shall be removed by the use of a water-based detergent followed by high pressure water washing. When all contaminants have been removed, the surface shall be allowed to dry either to a damp condition or to a completely dry condition, depending on the coating or lining to be applied.

For immersion or other heavy duty applications, laitance shall be totally removed by water blast cleaning, with abrasive injection, or by mechanical scabbling of the surface, or by acid pickling, followed by very thorough washing with potable water.

Off shutter concrete usually shows surface blowholes or omegas. Omegas shall be drilled or chipped open to the full hole diameter. Blowholes and opened omegas shall be filled with a suitable filler such as acrylic or solvent-free epoxy. The use of gypsum or cellulose-based fillers is not permitted for underwater or humid conditions. Shutter kicks and similar projections shall be removed by grinding to a smooth surface.

For coatings or linings of low water permeability, such as solvent-borne epoxies, vinyls and chlorinated rubber, the moisture content of the concrete or plaster shall be not more than an indicated 5% when tested with an approved electrical conductivity meter, designed for use on concrete or plaster (such as the Delmhorst meter). The pins of the meter shall penetrate the concrete or plaster to a depth of not less than 5 mm.

The first coat of the coating or lining system may require thinning with the manufacturer's recommended solvent to assist in penetration.

C3.3.2.4.9 ZUT 0003.9 APPLICATION OF CORROSION PROTECTION SYSTEM

All coatings and/or linings, irrespective of the surface preparation method or corrosion protection system used, shall be applied in accordance with the relevant following requirements.

C3.3.2.4.9.1 ZUT 0003.9.1 CONDITIONS DURING APPLICATION

If in the opinion of the Engineer adverse weather conditions are such as to interfere with the successful application of an efficient corrosion protective system, he shall order a stoppage of work. The Contractor will be deemed to have accepted this risk and made provision for it in his rates.

C3.3.2.4.9.1.1 ZUT 0003.9.1.1 Dusty Conditions

Coats shall not be applied in dusty or contaminated conditions.

C3.3.2.4.9.1.2 ZUT 0003.9.1.2 Surface Temperature

Coats shall not be applied if the surface temperature of the base metal is less than 3°C above dew point or outside the range 5 - 40°C, unless otherwise recommended in the manufacturer's instructions.

C3.3.2.4.9.1.3 ZUT 0003.9.1.3 Ambient Temperature

Coats shall not be applied when the ambient temperature is less than the minimum or greater than the maximum recommended by the manufacturer's instructions of the corrosion protection material.

C3.3.2.4.9.1.4 ZUT 0003.9.1.4 Relative Humidity and Time Interval

The time interval between abrasive blast cleaning and paint application shall not exceed those given in Table 9.1

Table 9.1 - Maximum time interval - Between blast cleaning and coating

Ambient Relative Humidity	Maximum Time (hours)
Below 50%	6
50% - 70%	4
70% - 85%	2
Over 85%	Coating not permitted - Reblast and coat when rel. humidity below 85%

Should immediate lining/coating not be possible, or should any atmospheric oxidisation take place between the completion of blast cleaning and commencement of lining/coating, such oxidisation shall be removed by flash blasting to restore the specified surface finish.

C3.3.2.4.9.2 ZUT 0003.9.2 PAINTS

C3.3.2.4.9.2.1 ZUT 0003.9.2.1 Application method

The recommendations of the paint manufacturer as per the manufacturer's instruction (refer to Clause 4.2) as shown on his data sheets or given in writing on his letterhead and approved by the Engineer shall be followed.

Apart from touch up, all liquid paints applied in the shop shall be applied by means of airless spray machines. Before use all paints shall be thoroughly stirred so as to be completely homogeneous. Two component paints shall be thoroughly mixed in the correct proportions as specified in the manufacturer's data sheet.

Painting on site shall be carried out to the Engineer's written approval. Significant surfaces to be painted on site shall be those specified in the Specification or shown on the drawings. Site application methods shall comply with the paint manufacturer's recommendations.

C3.3.2.4.9.2.2 ZUT 0003.9.2.2 Colour

Successive coats shall have distinctively different shades to facilitate coverage of each coat. Unless otherwise specified in the Amendments to this Specification, or directed by the Engineer, the final paint colour shall be that given in Appendix B of this specification and shall be a commercial match to the appropriate colour in SANS 1091 - National Colour Standards for Paint.

C3.3.2.4.9.2.3 ZUT 0003.9.2.3 Wet film thickness

The Contractor shall regularly and frequently monitor wet film thickness and shall calculate the dry film thickness from the volume solids of the paint.

C3.3.2.4.9.2.4 ZUT 0003.9.2.4 Mixing

The Contractor shall ensure that all paints are mixed in accordance with the requirements of BS 5493.

All paint components, particularly two- or multi-component materials, shall be thoroughly mixed until a homogeneous mixture is achieved.

C3.3.2.4.9.2.5 ZUT 0003.9.2.5 Degree of Cure

The degree of cure of paint will vary with time, temperature and ventilation and shall be assessed by solvent wiping in accordance with the method given in SANS 1217 (Methyl Ethyl Ketone Resistance Test).

C3.3.2.4.9.2.6 ZUT 0003.9.2.6 Overcoating

C3.3.2.4.9.2.6.1 ZUT 0003.9.2.6.1 Compatibility of Coats

All primer, intermediate, finishing coats and layers shall be mutually compatible and recoatable paints shall be used where applicable. There shall be not loss of adhesion between the consecutive coats or other defects.

C3.3.2.4.9.2.6.2 ZUT 0003.9.2.6.2 Overcoating intervals

The minimum and maximum overcoating intervals provided in the manufacturer's data instructions shall be strictly observed. Times and dates of application shall be recorded for each separate item and coat in the quality control records.

Since overcoating times are frequently quoted at 20 °C or 25 °C, longer overcoating times shall be allowed at lower temperatures. As a rough guide, increase time by 50% for a 5° decrease (or by 100% for a 10° decrease) in the ambient temperature below the temperature quoted in the data sheet.

C3.3.2.4.9.2.6.3 ZUT 0003.9.2.6.3 Thickness of Consecutive Coats

Generally a corrosion protection system will be build-up with multiple coats. The thickness of all coats, primer, intermediate or finish coats shall be strictly according to the manufacturer's instructions. For solvent-based paints it is imperative that the applicator does not exceed the maximum film thickness per coat applied to prevent entrapment of the solvent and the formation of pinholes.

C3.3.2.4.9.3 ZUT 0003.9.3 POWDER COATS

Powder shall be applied in the shop by electrostatic spray or by fluidised bed as applicable. Items for powder coating shall after surface preparation, be pre heated to the required temperature, usually in the range 200 to 250ºC, coated by electrostatic spray or by fluidised bed, then post cured if necessary to obtain complete fusion and cure. For surfaces to be immersed the applied coating shall be tested for defects by high voltage spark testing. No defects will be permitted. Thermoset materials such as FBE shall be fully cured.

C3.3.2.4.9.4 ZUT 0003.9.4 HOT-DIP GALVANIZING

Hot-dip galvanizing shall be carried out in accordance with SANS 121. The coating of lining thickness shall comply with the values specified for General Applications or Heavy Duty Applications as specified in the Clause 10.8.

Galvanized surfaces which are to be painted shall NOT be passivated by the galvanizer.

Repairs to damaged galvanizing shall be carried out in accordance with the procedures specified in SANS 121 by hot metallic zinc spraying unless the use of an appropriate solder is approved. Conventional solder shall NOT be used. Solder composition shall have been approved in writing by the SANS (Metallurgy Division) or by the SAHDGA.

C3.3.2.4.9.5 ZUT 0003.9.5 CEMENT MORTAR LINING

C3.3.2.4.9.5.1 ZUT 0003.9.5.1 Mixing of mortar

Components of the mix shall be accurately weighed. Each batch shall be identical. Mixing shall be carried out in a suitable mechanical mixer. Aggregate and cement shall be measured in correct proportions, then dry mixed in the mixer. When homogeneous, water shall be added from a measuring vessel to achieve the correct consistency but shall not exceed the amount stated previously. When correctly mixed, the material shall be used as soon as possible and not later than 1 hour after the first addition of water. Re tempering of the mix by further addition of water or other material shall not be permitted.

From a random batch of each days production prepare three 150 mm test cubes, in accordance with SANS 5863. After 28 days curing, the compressive strength shall not be less than 30 MPa.

C3.3.2.4.9.5.2 ZUT 0003.9.5.2 Placing of cement mortar

Cement mortar shall be placed to the specified thickness by spin casting (preferred method) or by mechanical drag trowel. In either case, sufficient centrifugal force shall be used to ensure optimum bonding to the pipe wall and optimum compaction of the cement mortar, with minimum segregation of different sizes of aggregate. The finished lining shall be smooth and uniform. Hand application is not permitted except on specials or by prior agreement of the Engineer.

C3.3.2.4.9.5.3 ZUT 0003.9.5.3 Curing of lining

After completion of placing, spinning, troweling an end finish, the lining shall not be disturbed until set. The pipe ends shall be closed with waterproof end covers or caps and the pipe shall be left undisturbed for at least 40 hours. After 48 hours the lining shall be sprayed with a fine mist of water and the covers and caps replaced or shall be steam cured by an approved method. The lining shall be kept wet for not less than 7 days. Pipes shall not be transported within 21 days from the date of applying the lining.

During placing of the cement mortar and the whole of the curing period, the pipes shall be kept constantly in the shade or under cover. Pipes shall not be exposed to direct sunlight.

C3.3.2.4.9.6 ZUT 0003.9.6 PLASTIC TAPE WRAPPING

Pipes shall be helically wrapped on site with minimum 25 mm overlap, using a tape wrapping machine to ensure uniform tension. Wrinkling, bubbling or other visible defects are not permitted. The tape manufacturer shall approve the tape wrapping procedure and equipment and the application shall comply with SANS 10129.

C3.3.2.4.9.7 ZUT 0003.9.7 DUPLEX OR MULTI-LAYER SYSTEMS

Duplex or Multi-layer systems consist of more than one corrosion protection system applied consecutively

e.g. a Hot-Dip Galvanizing and Polyurethane system.

The specifications for each of the corrosion protection systems shall be strictly followed. Special attention shall be given to adhesion between the systems.

C3.3.2.4.9.8 ZUT 0003.9.8 FINISHING ON SITE

Repairs, finish painting and cleaning on the site are regarded as inherent parts of the installation. On completion of erection, all pipework, control gear and indicating gear shall be thoroughly cleaned.

After erection, paint work shall be washed down, using nylon brushes and detergent to remove all adhering contamination. It shall then be washed with clean water to remove all traces of detergent and allowed to dry. The finishing coat shall then be applied as specified in the Amendments to this Specification.

All surfaces which cannot be painted after erection shall be painted as specified before erection. The painting system so applied shall be allowed to become fully hard dry (for at least two weeks for epoxy type paints) before erection.

For coatings such as epoxies, having a limited overcoating interval as specified in the manufacturer's data sheets, the surface shall be washed and thoroughly abraded to a matt finish before application of the finishing coats in accordance with the manufacturer's instructions.

C3.3.2.4.9.9 ZUT 0003.9.9 TOLERANCES

C3.3.2.4.9.9.1 ZUT 0003.9.9.1 Individual Coats Film Thickness

At least 90% of all thicknesses measured shall comply with the minimum thickness of the system specification. Up to 10% of all readings may be below the specific minimum thickness, but no reading shall be less than 70% of the specified minimum thickness.

C3.3.2.4.9.9.2 ZUT 0003.9.9.2 Total Dry Film Thickness

Not more than 10% of readings shall be less than the minimum specified and no reading shall be less than 90% of the specified minimum. For severely corrosive conditions no reading shall exceed the mean specified thickness by greater than 60% of the minimum.

C3.3.2.4.10 ZUT 0003.10 CORROSION PROTECTION SYSTEMS

The requirements as specified below shall be read in conjunction with the requirements of Clause 9: Application of Corrosion Protection Systems. Each system specified below shall also conform to the relevant requirements of Clause 9 and its sub-clauses. Where in in conflict with Clause 9 and its sub- clauses the requirements hereunder shall take precedence.

C3.3.2.4.10.1 ZUT 0003.10.1 RECOMMENDED CORROSION PROTECTION SYSTEM

Unless otherwise specified in the Amendments to this Specification and subject to the approval by the Engineer, Plant, equipment and pipework in pump stations and water and wastewater treatment works and pipelines shall be corrosion protected with one or more of the corrosion protection systems described in the following paragraphs of this Specification.

C3.3.2.4.10.2 ZUT 0003.10.2 SYSTEM 1: ALKYD RESIN BASED

Alkyd systems are intended for use in environments of low corrosivity, where a good decorative finish is required. Materials shall therefore be applied with due cognizance of appearance and protection. Defects such as runs, sags, curtaining, shriveling, or wrinkling will not be permitted.

C3.3.2.4.10.2.1 ZUT 0003.10.2.1 Standards

Reference is made to the latest issues of the following Standard Specifications:
SANS 630: Decorative high gloss enamel paints.
SANS 681: Undercoats for paints
SANS 1319: Zinc phosphate primer for steel

C3.3.2.4.10.2.2 ZUT 0003.10.2.2 Material

Alkyd zinc phosphate primer for steel shall comply with the requirements of SANS 1319. General purpose alkyd undercoat shall comply with the requirements of SANS 681 Type 2. Alkyd enamel shall comply with the requirements of SANS 630.

C3.3.2.4.10.2.3 ZUT 0003.10.2.3 Surface Preparation

The substrate surface preparation shall conform to the Manufacturer's Instructions or as specified in the Amendments of this Specification as approved by the Engineer. In the event of it being omitted the surface preparation shall confirm to the requirements Sa 2½ (ISO 8501-1) and the corresponding requirements as specified in Table 7.1 and the applicable Method as specified in Clause 8.

C3.3.2.4.10.2.4 ZUT 0003.10.2.4 Repair of Damaged Coats

Repair procedures shall be approved by the Engineer and in Clause 4.12.

C3.3.2.4.10.2.5 ZUT 0003.10.2.5 Testing

Testing shall conform to the requirements of Clause 11.1 and SANS 1217.

C3.3.2.4.10.3 ZUT 0003.10.3 SYSTEM 2: VINYL RESIN BASED

Vinyl copolymer (PVC) paints are a single component vinyl resin-based paints have excellent resistance to water, chemicals, dilute acids and hypochlorites. Their resistance to heat is poor and they must never be used on surfaces continually subjected to a temperature of 70 °C or higher. They are not resistant to solvents and should not be used where there may be contact with oils, grease, kerosene, petrol etc.

The main advantage of vinyls is their easy maintainability. Whereas epoxies are difficult to recoat after about one month's exposure, vinyls may be recoated after any period of time.

Vinyls are recommended for use above water and for interior and exterior use where and could be subject to chemical fumes, as in chlorination rooms.

C3.3.2.4.10.3.1 ZUT 0003.10.3.1 Material

Vinyl copolymer (PVC) paints shall have a solids content of 50% by mass and 32% by volume with a viscosity of 4,5 poise +_ 0,5 poise. The paint shall be stabilised against UV radiation.

C3.3.2.4.10.3.2 ZUT 0003.10.3.2 Surface Preparation

The substrate surface preparation shall conform to the Manufacturer's Instructions or as specified in the Amendments of this Specification as approved by the Engineer. In the event of it being omitted the surface preparation shall confirm to the requirements Sa 2½ (ISO 8501-1) and the corresponding requirements as specified in Table 7.1.

C3.3.2.4.10.3.3 ZUT 0003.10.3.3 Repair of Damaged Coats

Repair procedures shall be approved by the Engineer and in Clause 4.12.

C3.3.2.4.10.3.4 ZUT 0003.10.3.4 Testing

Testing shall conform to the requirements of Clause 11.1 and SANS 1217.

C3.3.2.4.10.4 ZUT 0003.10.4 SYSTEM 3: TERMAL SPRAY METAL

Not Used.

C3.3.2.4.10.5 ZUT 0003.10.5 SYSTEM 4: POWDER COATS

Not Used.

C3.3.2.4.10.6 ZUT 0003.10.6 SYSTEM 5: TWO PACK EPOXY

This corrosion protection system is suitable for large steel items subject to medium corrosive and severely corrosive environmental conditions such as valves, pipes, etc.

C3.3.2.4.10.6.1 ZUT 0003.10.6.1 Standards

Reference is made to the latest issues of the following Standard Specifications:
SANS 1217: Internal and external organic coating protection for buried steel pipelines.
ISO 2808: Determination of film thickness.
BSS 5493: Protective coating of iron and steel structures against corrosion.

C3.3.2.4.10.6.2 ZUT 0003.10.6.2 Material

The material used for two component (two pack) high build polyamide epoxies shall be based on epoxy- polyamide resins and shall comply with the requirements of SABS 1217. Epoxies shall be of the high build, modified aluminium epoxy mastic type, containing at least 90% solids.

Solvent free epoxies in accordance with SANS 1217 Type 1C is preferred. Type 1A - solvent-borne chemically cured paint material (Solvent base epoxies) will only be approved by the Engineer for specific application conditions. Solvent base epoxies shall complying with the requirements of SANS 1217 Type 1A and 1B.

The epoxies shall be nontoxic and non-tainting when it will be in contact with potable water.

C3.3.2.4.10.6.3 ZUT 0003.10.6.3 Surface Preparation

Unless otherwise specified in the Amendments of this Specification the surface preparation shall confirm to the requirements Clause 7.2.

C3.3.2.4.10.6.4 ZUT 0003.10.6.4 Application

C3.3.2.4.10.6.4.1 ZUT 0003.10.6.4.1 Dry Film Thicknesses

Dry film thicknesses shall be at least 250 µm unless otherwise specified in the Amendments of this Specification.

C3.3.2.4.10.6.4.2 ZUT 0003.10.6.4.2 Mixing

In the case of two-pack materials, each component containing pigments shall be thoroughly mixed. The two components shall then be mixed in the proportions supplied by the manufacturer until the mixture is completely homogeneous. For two pack materials, the use of part of the contents (split packs) is strictly forbidden.

In the case of solvent based Epoxy materials, it is recommended that the mixed material be allowed to stand for an induction period, as recommended by the manufacturer, before use.

During application, paint materials shall be agitated regularly to keep the solids in suspension.

The preparation time, induction time and pot life of these materials shall be closely adhered to.

C3.3.2.4.10.6.4.3 ZUT 0003.10.6.4.3 Curing

Adequate ventilation (and heating if required), shall be provided for the proper curing of the epoxy coating or lining in all circumstances with special reference remedial work, repairs and to field joints of pipelines.

C3.3.2.4.10.6.5 ZUT 0003.10.6.5 Repair of Damaged Coats

Repair procedures shall be approved by the Engineer and in terms of Clause 4.12.

C3.3.2.4.10.6.6 ZUT 0003.10.6.6 Testing

Testing shall conform to the requirements of Clause 11.1 and SANS 1217.

C3.3.2.4.10.6.7 ZUT 0003.10.6.7 Pipe Field Joints for Epoxy Linings

The internal corrosion protection System of welded field joints, for pipes with epoxy linings, shall be the same as that used for the adjacent pipes.
The surface preparation of the field joint area shall be the same as for the repair of major defects as specified in Clause 4.12.2.

C3.3.2.4.10.7 ZUT 0003.10.7 SYSTEM 6: FUSION BONDED EPOXY (HEAVY DUTY)

This corrosion protection system is suitable for large steel items subject to medium corrosive and severely corrosive environmental conditions such as valves, pipes, etc.

C3.3.2.4.10.7.1 ZUT 0003.10.7.1 Standards

Reference is made to the latest issues of the following Standards:
SANS 1217: Internal and external organic coating protection for buried steel pipelines.
ISO 12944: Paints and varnishes – Corrosion protection of steel structures by protective paint systems.

C3.3.2.4.10.7.2 ZUT 0003.10.7.2 Material

Material used shall conform to SANS 1217, Type 2, powder coating.

C3.3.2.4.10.7.3 ZUT 0003.10.7.3 Surface Preparation

Unless otherwise specified in the Amendments of this Specification the surface preparation shall confirm to the requirements Clause 7.2.

C3.3.2.4.10.7.4 ZUT 0003.10.7.4 Application

C3.3.2.4.10.7.4.1 ZUT 0003.10.7.4.1 Dry Film Thicknesses

Dry film thicknesses shall be at least 250 µm unless otherwise specified in the Amendments of this Specification

C3.3.2.4.10.7.4.2 ZUT 0003.10.7.4.2 Coat Application

Items shall be heated to a temperature of 200°C (only applicable to heavy items) and coated with Fusion- bonded Epoxy by means of an electrostatic powder gun.

The normal procedures pertaining to powder application shall apply.

On completion of the coating or lining, items shall be cured for 60 minutes at 200°C (mean temperature).

C3.3.2.4.10.7.5 ZUT 0003.10.7.5 Repair of Damaged Coats

Repair procedures shall be approved by the Engineer and conform to the requirements of Clause 4.12. with an approved repair kit.

C3.3.2.4.10.7.6 ZUT 0003.10.7.6 Testing

Testing shall conform to the requirements of Clause 11.1 and SANS 1217.

C3.3.2.4.10.8 ZUT 0003.10.8 SYSTEM 7: HOT-DIP GALVANIZING (HEAVY DUTY)

This corrosion protection system is suitable for steel items subject to mildly corrosive and medium corrosive environmental conditions such as handrails, covers, small diameter pipework, etc.

C3.3.2.4.10.8.1 ZUT 0003.10.8.1 Standards

Reference is made to the latest issues of the following Standards:

SANS 14713:	Protection against corrosion of iron and steel in structures - guidelines.
SANS 32:	Internal/external protective coatings for steel tubes.
SANS 121:	Hot-dip galvanized coatings on fabricated iron and steel articles.
SANS 5772:	Profile of blast-cleaned steel surfaces for painting.
SANS 2063:	Metallic and other inorganic coatings – Thermal spraying.
ISO 2808:	Determination of film thickness.
SANS10374-1:	The suitability of hot-dip galvanized steel piping for the transportation of water.
SANS 1344:	Medium duty solvent detergent.
ISO 752:	Zinc ingots.
EN 1179:	Zinc and zinc alloys – primary zinc.
SANS 9000:	Model for quality assurance in production and installation.

C3.3.2.4.10.8.2 ZUT 0003.10.8.2 Material

Impurities in the molten zinc, as defined in ISO 752 and EN 1179, shall not exceed a total of 1.5%.

Steel to be hot-dip galvanized shall be as listed below. In both cases material certification shall be supplied:

- For aesthetic appearance:
  - Aluminium killed steel, or
  - Silicon-killed steel with a Silicon content not exceeding 0.04% and a Phosphorus content not exceeding 0.02%.

- For general corrosion protection:
  - Aluminium killed steel, or
  - Silicon killed steel with a Silicon content not exceeding 0.25% and a Phosphorus content not exceeding 0.02%.

The condition of articles to be hot-dip galvanized shall comply with “Annexure C” of SANS 121.

The condition of tubes to be hot-dip galvanized on a continuous line shall comply with “Annexure A” of SANS 32.

C3.3.2.4.10.8.3 ZUT 0003.10.8.3 Surface Preparation

Unless otherwise specified in the Amendments of this Specification the surface preparation shall confirm to the requirements Clause 7.2.

C3.3.2.4.10.8.4 ZUT 0003.10.8.4 Application

Galvanizing shall only be done by members of the Hot Dip Galvanizers Association of Southern Africa (HDGASA) in accordance with SANS 9000 and for tubes shall be in accordance with SANS 121 and SANS 32.

C3.3.2.4.10.8.5 ZUT 0003.10.8.5 Special Requirements

C3.3.2.4.10.8.5.1 ZUT 0003.10.8.5.1 Steel Specials

Steel Specials shall be in accordance with Clause 6 of SANS 121.

1) Surface
Surfaces shall be free from nodules, blisters, roughness and sharp points. Un-coated areas, flux residues, lumps and zinc ash will not be permitted.

Notwithstanding Clause 6.1 of SANS 121, in the case of handrails etc. a high quality surface finish is required and a bright smooth surface shall be achieved. Double dipping shall not be allowed.

2) Thickness
The thickness of hot-dip galvanizing shall comply with the requirements of the Table 10.1 below.

Table 10.1: Minimum Coat Thickness on Items that are not Centrifuged

ARTICLES AND ITS THICKNESS	HEAVY DUTY	LIGHT DUTY	
	Thickness µm (min)	Local Thickness µm (min)	Mean Thickness µm (min)
Steel ≥ 6 mm	105	70	85
3.0 mm ≤ Steel < 6.0 mm	80	55	70
1.5 mm ≤ Steel < 3.0 mm	65	45	55
Steel < 1.5 mm	55	35	45
Castings ≥ 6.0 mm	105	70	80
Castings ≤ 6.0 mm	-	60	70

Heavy duty coats are required except in the following cases:

- Where a high surface finish is required; and
- Where otherwise specified in the Amendments of this Specification.

C3.3.2.4.10.8.5.2 ZUT 0003.10.8.5.2 Steel Tubes

Steel tubes shall be in accordance with Clause 7 of SANS 32.

1) Surface
The surface of the coat shall be continuous, smooth and free from flux residues.

2) Thickness
The thickness shall comply with the requirements of the coat quality A1, in accordance with Clause 8, Table 1 of SANS 32, as specified below.

Table 10.2: Minimum Local Coat Thickness Requirements for Coat Quality A1

REQUIREMENTS	QUALITY A1
Minimum local coat thickness on the inside surface except at the weld bead	55 µm
Minimum local coat thickness on the inside surface at the weld bead	28 µm
Minimum local coat thickness on the outside	55 µm

3) Adhesion
The coat shall show no evidence of flaking or cracking when tested in accordance with Clause 11.4 of SANS 32.

4) Qualities
Coat qualities shall be A1 for water installations – see Sub-Clause 8.2 of SANS 32.

The surface of the coat on the inside shall be as smooth as can be achieved by steam blowing.

C3.3.2.4.10.8.6 ZUT 0003.10.8.6 Testing

This clause and its sub-clauses shall be read in conjunction with Clause 4.13 and Clause 11.1 of this Specification.

C3.3.2.4.10.8.6.1 ZUT 0003.10.8.6.1 Steel Items

1) Visual Examination
Where a superior aesthetic appearance of hot-dip galvanizing is requested, a bright mirror surface finish shall be achieved by the galvanizer.

2) Thickness
Thicknesses shall be in accordance with Clause 10.8.5 and shall be tested in accordance with Sub-Clause 6.2 of SANS 121.

C3.3.2.4.10.8.6.2 ZUT 0003.10.8.6.2 Steel Tubes

1) Visual Examination
Where a superior aesthetic appearance of hot-dip galvanizing is requested, a bright mirror surface finish shall be achieved by the galvanizer.

2) Thickness
Shall be tested in accordance with Sub-Clause 11.3 of SANS EN 10240.

3) Adhesion
Shall be tested in accordance with Sub-Clause 11.4 of SANS EN 10240.

C3.3.2.4.10.8.6.3 ZUT 0003.10.8.6.3 Chemical Analysis

Items shall be tested in accordance with Sub-Clause 11.5 of SANS EN 10240.

C3.3.2.4.10.8.7 ZUT 0003.10.8.7 Repair of Damaged Coats

C3.3.2.4.10.8.7.1 ZUT 0003.10.8.7.1 Steel Items

The total un-coated areas for renovation by the galvanizer shall not exceed 0.5% of the total surface area of a component. Each un-coated area for renovation shall not exceed 400 mm². If un-coated areas are larger, the item containing such areas shall be re-galvanized.

The repair method shall be approved by the Engineer before repairs are initiated.

Repairs shall be by zinc thermal spray in accordance with SANS 2063 or three component zinc solvent free Epoxy repair system. The repair shall include removal of any scale, cleaning and any necessary pre- treatment to ensure adhesion – refer to Clause 7

The coat thickness on the renovated areas shall be a minimum of 30 µm more than the local coat thickness specified in Clause 10.8.5 for the relevant hot-dip galvanized coat unless otherwise specified by the Engineer. The coat on the renovated areas shall be capable of giving sacrificial protection to the steel to which it is applied.

C3.3.2.4.10.8.7.2 ZUT 0003.10.8.7.2 Steel Tubes

Repairs shall not be allowed on internal surfaces of tubes. Where repairs are required, tubes shall be re- galvanized. Repairs on external surfaces shall be in accordance with Clause 10.8.7.1.

C3.3.2.4.10.9 ZUT 0003.10.9 SYSTEM 8: ELASTOPLASTIC POLYURETHANE

This part of the Specification applies to two component solvent free elastoplastic polyurethane. This system shall only be used in limited approved applications.

C3.3.2.4.10.9.1 ZUT 0003.10.9.1 Standards

Reference is made to the latest issues of the following Standards:

SANS1217: Internal and external organic coating protection for buried steel pipelines.

C3.3.2.4.10.9.2 ZUT 0003.10.9.2 Material

The paint material shall be a solvent free two-component polyurethane hybrid based on a polyester type polyol and aromatic isocyanate. The cured paint shall comply with the following requirements:

- Tensile strength at 3 mm thickness - ASTM D 638 - not less than 15 MPa.
- Adhesion to primed steel - SANS Method 776 - not less than 10 MPa.
- Impact resistance (direct) - ASTM G 14 - not less than 9 Joules.
- Dielectric Strength - not less than 10 kV/mm.
- Elongation at break - not less than 25%.
- Compressibility - not less than 25 MPa.
- Surface hardness of 5 mm thick sample - not less than 60 nor greater than 80 Shore 'D'.
- Water Vapour Permeability - not greater than 0.5 g/24 h/m²/mm².
- Cathodic disbonding - when tested in accordance with ASTM GB Method A, for 60 days, the dis- bonded area shall not exceed 500 mm².

C3.3.2.4.10.9.2.1 ZUT 0003.10.9.2.1 Adhesive

Adhesive shall be a two component polyurethane adhesive designed to maximise adhesion between used polyurethane and freshly mixed polyurethane.

C3.3.2.4.10.9.3 ZUT 0003.10.9.3 Application

C3.3.2.4.10.9.3.1 ZUT 0003.10.9.3.1 Dry Film Thicknesses

Dry film thicknesses shall be at least as follows unless otherwise specified in the Amendments of this Specification

- Overcoating as duplex system
  - The dry film thickness shall be 40 µm minimum.
- For corrosive/abrasive environmental conditions:
  - The dry film thickness shall be 1.0 mm minimum.
- For highly corrosive/abrasive environmental conditions:
  - The dry film thickness shall be 3.0 mm minimum.

C3.3.2.4.10.9.4 ZUT 0003.10.9.4 Repair of Damaged Coats

Repair procedures shall be approved by the Engineer and conform to the requirements of Clause 4.12.

C3.3.2.4.10.9.5 ZUT 0003.10.9.5 Testing

Testing shall conform to the requirements of Clause 11.1 and SANS 1217.

C3.3.2.4.10.10 ZUT 0003.10.10 SYSTEM 9: TAPE WRAPPING

The tape wrapping system is intended to be used in areas where special protection is required due to handling of items e.g. pipelines at road crossings etc. or where it is highly likely that the paint system can be damaged e.g. at specials and addition precaution is required to protect the pipeline.

It is also often used to repair field joints of pipelines. It is suitable for severely corrosive environments.

C3.3.2.4.10.10.1 ZUT 0003.10.10.1 Standards

Reference is made to the latest issues of the following Standards:
SANS 1117: Plastic wrappings for the protection of steel pipelines. SANS 10129:Plastics tape wrapping of steel pipelines.

C3.3.2.4.10.10.2 ZUT 0003.10.10.2 Material

Polyethylene pressure-sensitive tape or polyethylene laminated to an elastomeric layer of butyl rubber tapes shall conform to SANS 1117, types A, B or C.

C3.3.2.4.10.10.3 ZUT 0003.10.10.3 Application

1) General

Steel pipes, fittings and specials, protected by means of tapes, shall be wrapped in accordance with SANS 10129 as amended and supplemented by this Specification. All pipes shall be wrapped outside the trench in accordance with acceptable factory applications. Tape wrapping may be carried out in an "over the trench" operation for pipe diameters up to 450 mm.

2) Surface Preparation

Steel pipe surface preparation shall conform to Clause 3.2 of SANS 10129.

3) Priming

Immediately after surface preparation but not later than 4 hours after cleaning, provided the pipe surfaces are kept dry and free from dust, a primer shall be applied according to Clause 4.2.1 of SANS 10129.

4) Normal Wrapping

Tape wrapping shall be applied with sufficient pre-tensioning immediately after priming, in accordance with Clause 4.2.2 of SANS 10129, and shall ensure a smooth wrap free from wrinkles, blisters, frayed or torn edges, cracks or other defects at temperatures up to 65°C.

For normal wrapping, tape shall be applied in two layers with a minimum overlap of 50 mm on both the inner and outer wraps.

Tape joints and repairs shall be done in accordance with Clause 4.2.3 of SANS 10129.

Hand wrapping shall only be allowed for short lengths that are inaccessible to a wrapping machine, specials, joints, small diameter pipes and small repairs – refer Clause 10.10.6

5) Armouring

Where armour wrapping is specified, two layers of tape wrapping shall first be applied with sufficient pre- tensioning immediately after priming, in accordance with Clause 4.2.2 of SANS 10129, and shall ensure a smooth wrap free from wrinkles, blisters, frayed or torn edges, cracks or other defects even at temperatures up to 65°C.

The first layer of wrap shall overlap by half the tape width plus 25 mm and the second wrap shall overlap by not less than 50 mm.

The above-mentioned layers of tape shall be armoured by the application of a third layer of pressure- sensitive polyethylene tape with a carrier thickness of 750 micrometres and a minimum overlap of 50%.

Armoured wrappings shall generally be applied at the following positions:

- All road crossings through sleeves and culverts;
- All railway crossings through sleeves or culverts; and
- Wherever the Engineer may consider that special conditions warrant such measures.

6) Wrapping of Specials

In the case of specials or pipe lengths where length and/or shape preclude the application of a protective wrapping system by any means, the protection shall be carried out either by bitumen-fibre glass or epoxy corrosion protection system in accordance with the requirements of the applicable corrosion protection system. In the case of access, scour, air valve and farmers off-take tees the special shall be deemed to incorporate at least two (2) diameter lengths either side of the main tee barrel.

7) Armour Wrapping of Coated Pipes

Where armour wrapping of coated pipes is specified, a single layer of pressure-sensitive polyethylene tape with a carrier thickness of 750 micrometres and a minimum overlap of 50% shall be applied.

C3.3.2.4.10.10.4 ZUT 0003.10.10.4 Tolerances

1) Pressure Sensitive Tape Wrapping

The minimum thickness of the inner low-density polyethylene tape carrier component shall be 300 µm and the maximum thickness of the outer high-density tape carrier shall be 1000 µm. Total minimum polyethylene thickness of 1450 µm.

The adhesive part of the inner layer shall be a minimum thickness of 1.5 times the polyethylene tape carrier thickness. For the outer layer the adhesive layer shall be at least equal to the thickness of the polyethylene tape carrier thickness.

2) Butyl Rubber Laminates

The minimum thickness of the completed wrapping shall be 750 µm. The inner layer shall be a butyl rubber laminate of 450 µm minimum thickness of which the butyl rubber film shall not be less than 200 µm thick and the polyethylene film shall not be less than 200 µm thick.

The outer layer shall be high density pressure tape of 300 µm minimum thickness.

C3.3.2.4.10.10.5 ZUT 0003.10.10.5 Testing

This clause and its sub-clauses shall be read in conjunction with Clause 4.13 and Clause 11.1 of this Specification.

1) Visual Inspection

The wrapping shall have a smooth appearance, free from wrinkles, blisters, bridging across weld beads, frayed edges, cracks, dis-bonding and any signs of physical damage.

2) Non-Destructive Testing

i) Electrical Insulation Defect (Holiday) Testing

The entire wrapping of the pipeline shall be tested to ASTM G62 with an approved Holiday Detector equipped with a rolling ring detector around the pipe by the Contractor to the Engineer's satisfaction. The ring shall be in close contact with the surface of the wrapping along the pipe circumference. The test shall be carried out immediately prior to lowering the pipe into the trench. The wrapping on specials or short pipe lengths shall be tested with an approved Holiday Detector fitted with a copper bristle brush detector of suitable form. The wrapping shall exhibit no Holidays when tested with an effective voltage of 12 kV at a nominal pulse frequency of not less than 30 Hz.

The Engineer may instruct any length of pipe or any number of specials to be re-tested using a Holiday Detector with a copper bristle brush detector.

ii) Insulation Test

The Engineer shall carry out a conductance test on the wrapping over any section of pipeline between valves when the pipeline has been wrapped and installed in the trench with padding and back filling completed. The test shall be conducted as per NACE TM0102with the valves temporarily removed from the line, at the Contractor's expense, to ensure complete isolation of the pipeline section under test or between gaps left for tie-ins.

The length of the section of pipeline under test shall be carefully measured and the conductance over the section tested shall not exceed 180 micro-Siemens per square metre of pipe surface under all conditions of test. If the results of the test for the section of pipeline tested are not satisfactory, two sections immediately adjacent to the testing section will be tested. If the results on one or both of these sections tested are not satisfactory, all sections of wrapped pipeline shall be tested.

3) Destructive Testing

The Engineer may from time to time collect samples of 10 m of each type of tape and one litre of primer for testing, for compliance with the Specification, by any independent laboratory appointed by the Engineer. The supply of samples shall be for the Contractor's account. The Engineer reserves the right to reject the whole batch of materials from which unsatisfactory samples were obtained.

4) Repair of Damaged Coats

The Contractor shall be required to locate areas of faulty protection on all sections on which unsatisfactory results are obtained and to affect the necessary repairs. The cost of this work and all additional materials provided or supplied, including the reinstatement of the trench and the retest shall be for the Contractor's account.

C3.3.2.4.10.10.6 ZUT 0003.10.10.6 Repair Methods

Where damage to the wrapping on a pipeline has occurred and where there are creases, wrinkles and folds in the wrapping, proceed as follows:

1) Small Damaged Areas

If the width of the tape being used exceeds by at least 100 mm the length of the section affected, cut the area of damaged wrapping away to bare metal leaving no raised edges or protrusions.

Clean and prime the exposed area in accordance with Clauses 10.10.3.2 and 10.10.3.3 and apply a patch of tape, ensuring an overlap of not less than 50 mm on all sides onto the surrounding wrap. Apply by hand-wrapping with a 55% overlap, a further layer of tape commencing two turns before and continuing for two turns beyond the patch.

2) Large Damaged Areas

Where the extent of damaged or faulty wrapping is such that the tape cannot span the affected area and provide a 50 mm overlap on all sides it must be completely removed from the pipe over the affected section. The area shall be cleaned and primed in accordance with Clauses 10.10.3.2 and 10.10.3.3. The pipe must be re-wrapped with a 55% overlap, commencing two turns before and finishing two turns beyond the bared section.

3) Damage on Double Wrap

Where damage or a defect has occurred in a section that has been double wrapped and in the case of small Holidays, the outer wrap shall be removed for a distance equal to three (3) times the width of the inner wrap tape on each side of the damaged area.

The appropriate procedure given in Clauses 10.10.6 shall be used to affect the repair of the inner wrap.
The outer wrap shall be re-instated in accordance with Clause 10.10.3.5.

4) Outer Wrap Damage

Where damage extends through an outer wrap / rockshield (see Section 6 of SANS 10129), this shall be carefully removed for a distance equal to three (3) times the width of the inner wrap tape on each side of the damaged area without damaging the inner wrapping.

The repair shall be carried out by the appropriate method given in Clauses 10.10.6 and the outer wrap / rockshield re-instated in accordance with Clause 10.10.3.5.

C3.3.2.4.10.11 ZUT 0003.10.11 SYSTEM 10: PETROLATUM WRAPPING

Profiling mastic and mastic blankets are used for corrosion protection of couplings and flanges in chambers with high humidity and buried in soil.

C3.3.2.4.10.11.1 ZUT 0003.10.11.1 Standards

Reference is made to the latest issues of the following Standards:

SANS ISO 8501-1: Preparation of steel substrates before application of paints and related products – Visual assessment of surface cleanliness – Part 1: Rust grades and preparation grades of un-coated steel substrates and of steel substrates after removal of previous coatings.
SANS 0129: Plastics tape wrapping of steel pipelines.
SANS ISO 9000: Model for quality assurance in production and installation.

C3.3.2.4.10.11.2 ZUT 0003.10.11.2 Surface Preparation

Mechanically clean and wire brush the joint to remove all loose rust, scale, old coating or lining and foreign matter to St 2 (ISO 8501-1).

Areas subjected to chemical attack, salt spray, fungus or bacteria shall be neutralized, rinsed with clean potable water and mechanically cleaned as specified above.

C3.3.2.4.10.11.3 ZUT 0003.10.11.3 Priming

Brush priming solution well over the entire joint area, leaving a thin film (at a nominal coverage rate of 0.8 m²/litre). Apply a liberal amount around the bolt threads, narrow cavities and crevices.

Paste shall be used where excessive surface corrosion has occurred and under high humidity or submerged conditions.

C3.3.2.4.10.11.4 ZUT 0003.10.11.4 Application

Use profiling mastic and/or strips to fill all voids, crevices and sharp or irregular contours.

Apply mastic tape circumferentially over the area to be coated with a 25 mm overlap on either side of the mastic with a 75 mm end overlap.

Pre-formed petrolatum mastic blanket system (10 mm thick), supported by a coated tape backing, is available to provide a quick and easy method to apply this system.

Eliminate all air pockets, wrinkles and creases.

C3.3.2.4.10.11.5 ZUT 0003.10.11.5 Top Coat

1) Buried Conditions

Two complete turns of the polyethylene sheeting shall be applied circumferentially. The ends are secured to the pipe barrels with 48 mm wide bands of PVC adhesive tape, which is also applied to the outside diameter of the bolted joint.

2) High Humidity Conditions

Overcoat with a synthetic coat mixed with a cementitious filler to give a tough, flexible coat. The base coat may be over-coated with water based Acrylics or Epoxies.

NOTE:

- Detail of application shall be in accordance with the manufacturer's data sheets and approved by the Engineer.

C3.3.2.4.10.12 ZUT 0003.10.12 SYSTEM 11: POLYOLEFIN-BITUMEN WRAPPING

Not Used.

C3.3.2.4.10.13 ZUT 0003.10.13 SYSTEM PC1: SOLVENT FREE POLYURETHANE COATING ®

This corrosion protection system covers the application of Solvent Free Polyurethane as a coating to steel pipes. Generally the coating is to be applied in accordance with ANSI/AWWA C222-99 'Polyurethane Coatings for the Interior and Exterior of Steel Water Pipe and Fittings'. Where in conflict with ANSI/AWWA C222-99, the amendments hereunder shall take precedence.

C3.3.2.4.10.13.1 ZUT 0003.10.13.1 Section Numbers of ANSI/AWWA C222-99

The section (clause) and sub-section numbers in this clause refer to the same numbered sections and subsections in ANSI/AWWA C222-99.

1) ANSI Section 4.2 Test Requirements

Replace 'Table 1 Requirements' with the new Table 1 below.

New Table 1: Physical and Performance Requirements

Property	Polyurethane Coating Material	Test Method Sub-Section
Adhesion, MPa min (laboratory)	15 MPa	ASTM D 4541
Impact resistance Kg m, min	1.6 kg m	ASTM D 2794 Intrusion
Water absorption %, max	max 3%	ASTM D 570 long term
Dielectric strength kV/mm thick min	7.5 kV/mm thick min	SANS 1217 clause 8.10
Resistance to abrasion, mg max	max 100/1000 rev	ASTM D 4090 CS17 1 kg 1000 cycles
Cathodic disbondment	max 12 mm radius	ASTM G 95 at 23 deg C
Durometer Hardness	min 65 Shore D	ASTM D2240
Chemical Resistance 10% sulphuric acid 30% NaCl 30% NaOH Diesel fuel	max 5% in mass, length or width max 5% in mass, length or width max 5% in mass, length or width max 5% in mass, length or width	ASTM D543

2) ANSI Section 4.3 Coating Thickness

ANSI Sub-Section 4.3.1
The minimum dry film thickness of coating is to be 2000 microns within a tolerance of -100 microns and +1000 microns.

3) ANSI Section 4.4 Surface Preparation

The requirements of section 4.4 of ANSI/AWWA C222-99 will apply and will take precedence over Clause 3.2 above.

4) ANSI Section 4.7 Welded Field Joints

ANSI Sub-Section 4.7
The hold backs (cut-backs) are to comply with Clause 4.15.1 of this Specification.

5) ANSI Section 5.3 Coating Tests

ANSI Sub-Section 5.3.1
The basis of acceptance of proposed coating material shall be as per method (1).

6) ANSI Section 5.5 Coated Pipe Inspection

ANSI Sub-Section 5.5.4
Electrical continuity inspection shall be conducted on all pipes as per Clause 8.10 'Dielectric strength' of SABS 1217 Ed. 1.3.

7) ANSI Sub-Section 5.5.3

The adhesion is to be tested in accordance with ANSI/ASTM D4541.

8) ANSI Section 6.5 Affidavit of Compliance

The manufacturer is to submit with his/her first request for payment an affidavit that all material and work has been conducted in accordance with the requirements of this standard.

C3.3.2.4.10.14 ZUT 0003.10.14 SYSTEM PC2: FUSION-BONDED MEDIUM DENSITY POLYETHYLENE

This coating system shall comply with the Australian Standard Specification AS 4321-1955 entitled "Fusionbonded medium density polyethylene coating and lining for pipes and fittings" except as modified hereunder.

C3.3.2.4.10.14.1 ZUT 0003.10.14.1 Modifications to Specification AS 4321-1955

1) Preparation of Surface

Delete Clause 5.1 of AS 4321-1955 and replace with Section 3 "SURFACE PREPARATION FOR PIPES TO BE COATED AND LINED" of this specification.

2) Repairs

Delete the last sentence of Clause 8.1 of AS4321-1995 and replace with "Damaged areas that pass the continuity test need not be repaired provided that the coating or lining thickness is equal to or greater than the thickness specified in Table 1 of AS 4321-1995. Generally no more than 3 repairs will be allowed per 9m length of pipe and the area of a single repair is not to exceed 0.01 square m. If the area of a single repair does exceed 0.01 square m the pipe will be rejected. Repairs may be undertaken in accordance with Clause 8 of AS 4321 for the following methods of repair:- Fusion bond; Heat shrink sleeve or Hot gas welding. A wrapping system may also be used if applied as detailed hereunder.

i) Repairs with Tape

When repairs are permissible the repairs shall be made using a repair system comprising (1) a polymer bitumen primer (Denso Primer D or equivalent approved), (2) an inner seal of modified rubber bitumen sealing tape (Denso Mastic Sealing Tape or equivalent approved) and (3) an outer protective layer of acrylic coated/modified bitumen adhesive pipeline tape (Denso Acrylic Pipeline Tape or equivalent approved) is to be applied with a 50% overlap, ensuring that it is placed 50mm wider all round than the inner repair tape. The outer protective tape is to be wrapped around the entire pipe.

a) Pinholes

At each pinhole detected by the electrical test, the surrounding area shall be abraded to at least a minimum area of 175mm by 175mm around the hole. The abrasion shall be carried out (with clean emery paper of 80 to 100 mesh) around the repair so as to provide a suitable rough surface profile without causing the removal or excessive amounts of coating material. The repair area is to be feathered into the surrounding sound coating. Debris and other deleterious matter are to be removed by means of a clean rag moistened with Cleaning Solvent. The primer is applied and once it has dried the prepared surface is covered with a patch of modified rubber bitumen sealing tape (Denso Mastic Sealing Tape or equivalent approved) of size 150mm by 150mm. The bond is to be free of air bubbles and smoothed out by hand or using an aluminium fluted roller. Finally, acrylic bitumen adhesive pipeline tape (Denso Acrylic Pipeline Tape or equivalent approved) is to be applied with a 50% overlap, ensuring that it is placed 50mm wider all round than the inner repair tape.

b) Larger Damaged Areas

The edges of the damaged coating must be chamfered back to remove all potential void areas. The primer and modified bitumen rubber are applied as for pinholes but the modified bitumen rubber tape is pre-cut and applied with 55% overlap Finally acrylic bitumen adhesive pipeline tape (Denso Acrylic Pipeline Tape or equivalent approved) is to be applied with a 50% overlap, ensuring that it is placed 50mm wider all round than the inner repair tape. Weld beads are repaired with suitable lengths of the above size tapes. When covering weld beads, the centre portion of the square must make contact first. Smooth the tape out with an outward direction to remove all entrapped air."

3) Storage, Handling, Transport and Marking

Add to Clause 11 of AS4321-1955: Clause 1.5 of this specification entitled "Plant and Rigging for the handling and delivery of Pipe and Specials".

C3.3.2.4.10.15 ZUT 0003.10.15 SYSTEM PC3: THREE LAYER SYSTEM

The three layer corrosion protection system consists of a powdered epoxy primer, a polymeric adhesive and a polyethylene outer sheath which shall be applied in accordance with Canadian Standards Association Specification (CSA) Z245.20-06/Z245.21-06.

The application is to be in accordance with, inter alia, the following sections of the Canadian specifications listed below.

C3.3.2.4.10.15.1 ZUT 0003.10.15.1 Z245.20 External Fusion Bond Epoxy Coating for Steel Pipe

a) General Requirements
b) Materials
The following Fusion Bonded Epoxy primers are approved for use.
Akzo Nobel PCL 331
Jotun CORRO-COAT EP-F 1003HW
Should the Supplier wish to use any other make of primer, samples must be left with the Employer or his/her agent for testing. Delays in approval will not be accepted as a reason for late delivery.
c) Coating Application
d) Inspection and Testing
e) Repair of Coated Pipes
f) Markings
g) Handling and Storage
h) Test Reports and Certificates of Compliance
i) Test Procedures

C3.3.2.4.10.15.2 ZUT 0003.10.15.2 Z245.21 External Polyethylene Coating for Pipes

a) General Requirements
The Polyethylene outer sheath is to comply with System B1
b) Materials
The following adhesives are approved for use:-
Borealis Borcoat ME0420
Industrie Polieco M.P.B. SRL COESIVE L8.92.8
The following HDPE Outer Sheath materials are approved for use:-
Borealis Borcoat HE3450
Industrie Polieco M.P.B. SRL HDPE 2050
Should the Supplier wish to use any other make of adhesive or outer sheath materials, samples must be left with the Employer or his/her agent for testing. Delays in approval will not be accepted as a reason for late delivery.

c) Coating Application
d) Inspection and Testing
e) Repair of Coated Pipes
f) Markings
g) Handling and Storage
h) Test Reports and Certificates of Compliance
i) Test Procedure

C3.3.2.4.10.16 ZUT 0003.10.16 SYSTEM PC4: BITUMEN FIBRE COATING

Not Used.

C3.3.2.4.10.17 ZUT 0003.10.17 SYSTEM PL1: CEMENT MORTAR LINING

This corrosion protection system covers the application of Cement Mortar as a steel pipe lining. The pipes will be used to convey potable water.

C3.3.2.4.10.17.1 ZUT 0003.10.17.1 Standards

Reference is made to the latest issues of the following Standards: AS1281-2001: Cement mortar lining of steel pipes and fittings

C3.3.2.4.10.17.2 ZUT 0003.10.17.2 Material

All materials for the cement mortar lining of pipes shall be in accordance with AS1281-2001.

C3.3.2.4.10.17.3 ZUT 0003.10.17.3 Application

Some of the pipes are likely to be stored on site for periods in excess of 3 months before being laid.

C3.3.2.4.10.17.4 ZUT 0003.10.17.4 Testing

The Quality Control Plan and Procedure referred to in Clause 4.13 above will detail the means of demonstrating compliance with AS 1281-2001 and will be based on Appendix B of AS 1281-2001.

C3.3.2.4.10.18 ZUT 0003.10.18 SYSTEM PL2: SOLVENT-FREE EPOXY LINING

This system is specific design to be used as a lining system for pipelines conveying potable water and raw water.

C3.3.2.4.10.18.1 ZUT 0003.10.18.1 General

This corrosion protection system covers the application of Solvent Free Liquid-epoxy as a steel pipe lining. Generally the lining is to be applied in accordance with ANSI/AWWA C210-97 'Liquid-epoxy Coating Systems for the Interior and Exterior of Steel Water Pipelines'. Where in conflict with ANSI/AWWA C210- 97, the amendments hereunder shall take precedence. The full cost of all the testing is to be included in the rates for coating unless it is itemised separately in the Schedule of Quantities.

C3.3.2.4.10.18.2 ZUT 0003.10.18.2 Amendments to ANSI/AWWA C210-97

The section and sub-section numbers in this clause refer to the same section and sub-section numbers in ANSI/AWWA C210-97.

1) ANSI SECTION 1.1 SCOPE

ANSI Sub-Section 1.1.2 Coating and Lining Systems

The lining system is to be type (3), a single coat of a two part, chemically cured epoxy coating. In the event of the thickness being less than the minimum specified the coating shall be removed and the pipe length shall be re-blasted and re-lined to comply with the specification.

2) ANSI SECTION 4.2 QUALITY AND SAFETY

Details of all quality related controls and tests are to be included in the QCP&P referred to in Clause 4.13 of the Employer's specification above.

ANSI Sub-Section 4.2.2 Certification

Copies of the certification of the products used, as required by this section, are to be submitted with the tender documents.

3) ANSI SECTION 4.3 COATING SYSTEMS

ANSI Sub-Section 4.3.1 Liquid-Epoxy Coatings.

Add the following: -

The following products have been approved: - Sigma Line 523, Carboline 891 and Denso ST100. Should the Manufacturer/ Supplier wish to offer an alternative product it will be necessary to get the approval of the client. Only solvent free epoxies which have been certified non- toxic and non-tainting and suitable for use with potable water will be permitted. Any delays in approval will not be accepted as a reason for late delivery.

ANSI Sub-Section 4.3.2 Coating Thickness

The pipes shall be lined to a dry film thickness of a minimum of 406 and a maximum of 1000 microns and shall be free from sags and runs.

ANSI Sub-Section 4.3.4 Physical Requirements

Replace Table 1 with the following new Table 1

Tests 1 through 3 in the new TABLE 1 new shall be conducted on every pipe.

Tests 4 and 5(a) and 5(b) in the new TABLE 1 below shall be applied to at least one pipe selected at random from the first day's production or from each new batch of liquid epoxy, whichever is more frequent.

Tests 6, 7 and 8 in the new TABLE 1 below shall be applied to at least one pipe selected at random from the first day's production of each item.

Should the Manufacturer experience difficulties in achieving this specification, additional tests may be required by the Purchaser until the problem(s) has been identified and rectified. Such additional tests shall be to the Purchaser's account.

NEW TABLE 1

No	PROPERTY	REQUIREMENT	TEST METHOD
1	Visual	Smooth glossy or semi-glossy finish, free from excessive runs, sags, orange peel, occlusions or other visible defects	Use an experienced observer
2	Coating Thickness	Min 406 Max 600 microns	SABS Method 141. Take a minimum of 2 readings per m² of surface up to 300 mm nominal bore, or 12 per m² over 300 mm
3	Electrical Insulation Defects	Nil defects at 90 Volts, 10 Mega-ohm	SABS 1217, Section 8.12.1
4	Impact Resistance	No defect at 1 Joules	SABS 1217, Section 8.7 but modified as given in Note 1
5a	Degree of cure: Static Test	No softening or discolouration when fully cured	SABS 1217, Section 8.9. Cure time shall be in accordance with the manufacturer's data
5b	Dynamic Test	No softening or discolouration when fully cured	50 Double rubs with cotton wool swab soaked in MEK. Cure time shall be in accordance with the
6	Adhesion (Hot water soak)	Not more than 15 mm disbonding from point of V	Immerse in water at 75ºC for 48 hrs. Make V cut at 30º angle. Test adhesion when panel has cooled to 25ºC
7	Cathodic Disbonding	Total disbonded area not to exceed 40 mm diameter after 30 days. Current flow not to exceed 5mA	ASTM G8 Method B – Magnesium Anode - 20ºC – 7 mm holiday
8	Cathodic Disbonding	Total disbonded area (including holiday) not to exceed 20 mm diameter	Impressed current -3, 5 volts potential at 75ºC for 48 hours 3 mm artificial holiday

NOTE: Impact resistance shall be carried out on a sample of production pipe firmly clamped and choked (to be rebound free) to a rigid base. No electrical insulation defects shall be detected at the point of impact when tested at 1 Joule.

4) ANSI SECTION 4.4 COATING APPLICATION

ANSI Sub-Section 4.4.1 General

Application by airless spray is required.

ANSI Sub-Section 4.4.2 Pipe Preparation

The requirements of section 4.4.2 of ANSI/AWWA C210-97 will apply and will take precedence over the Purchaser's Clause 3.2 above.

ANSI Sub-Section 4.4.3.2 Hold-Back for Field Welds

The hold backs (cut backs) are to comply with the Clause 4.15.1 of this Specification.

ANSI Sub-Section 4.4.3.4 Application Temperature

Add the following:-

The cure rate of liquid epoxy coating is very dependent upon temperature, with the rate of cure being very slow below 10ºC and the reaction generally ceasing below 5ºC. Manufacturer's

tendering for this type of lining are therefore expected to have a heated shop or warm air blowers with suitable heat insulating tunnels to enable the temperature of the coating to be maintained at not less than 15ºC from the time of application until full cure has taken place. Adverse weather conditions will not be accepted as a reason for delay in supply.

5) ANSI SECTION 4.5 COATING REPAIR ANSI Sub-Section 4.5.1 Defective Coating

Add the following at the beginning of the Clause:

Repairs of electrical insulation defects may be carried out provided that the number of repairs necessary does not exceed 3 per pipe. A cluster of pinholes within a radius of 25mm shall be regarded as one defect. Any pipe needing repairs in excess of this number or where the lining shows any sign of flaking or loss of adhesion shall not be repaired. The lining shall be removed and the pipe length shall be re-blasted, cleaned and re-coated to comply with the requirements of the specification.

ANSI Sub-Section 4.5.1.1

Delete this sub-section and replace with the following:-

<u>Repairs with Epoxy</u>

When repairs with epoxy are permissible, the following method shall be used :-

- Abrade an area at least 25mm diameter around and beyond the defective area. The abrasive paper shall not be coarser than 220 mesh and shall be preferably 400 mesh. It shall be used preferably wet to avoid excessive removal of coating.
- The repair area shall be smoothly feathered into the surrounding sound area. The repair area shall be abraded to a matt finish, free from deep scratches and excessive removal of coating. After abrasion, the area shall be wiped clean with M.E.K. or other suitable approved clean solvent and allowed to dry.
- All repairs shall be undertaken using a repair product recommended by the material manufacturer.
- Repair material shall be mixed in the proportions supplied by the manufacturer. No splitting of packs shall be permitted unless the material is supplied in self metering packs.
- The mixed repair material shall be applied to the clean, dry, abraded repair area so as to cover the defect and extend to within 1 or 2mm of the edge of the abraded area. A “halo” of abraded area shall be visible around the repair material.
- After curing, the repair and at least 250mm surrounding area shall be tested for electrical insulation defects as specified in the contract. There shall be no electrical insulation defects.

C3.3.2.4.11 ZUT 0003.11 COMPLIANCE WTH REQUIREMENTS

C3.3.2.4.11.1 ZUT 0003.11.1 TESTING

Tests, instruments, methods and criteria shall be as specified below or in the Amendments of this Specification.
The requirements of Clauses 4.13 shall apply.

C3.3.2.4.11.1.1 ZUT 0003.11.1.1 Visual Inspection

All surfaces shall be inspected visually and shall be free from tears, runs, sags, wrinkles, blisters, change in colour or gloss, orange peel, dirt, visible pinholes, dust or fluff occlusions or any other visible defects.

C3.3.2.4.11.1.2 ZUT 0003.11.1.2 Holiday Inspection

100% of all coated surfaces shall be tested and there shall be no electrical insulation defects on any area inspected.

For films exceeding 500 µm thickness, a high voltage, electrical insulation defects detector shall be used in accordance with SABS 1217.

Except on system containing conductive pigment (Zn, Al), low-voltage wet sponge electrical insulation defects inspection shall be carried out in accordance with SANS 1217 for coatings and linings of thickness not exceeding 500 µm.

For systems exceeding 500 µm thickness, the high voltage, sparking electrical insulation defects detector shall be used in accordance with SANS 1217.

During the inspection procedure the Contractor shall ensure that sufficient moisture is always present on the surfaces to be tested.

C3.3.2.4.11.1.3 ZUT 0003.11.1.3 Dry Film Thickness

The dry film thickness (DFT) shall also conform to the requirements of Clause 9.9

a) Measurements shall be taken in accordance with ISO 2808.

b) 100% of all system thicknesses measured shall comply with the minimum requirements of this Specification.

c) Film thickness more than the prescribed maxima shall not necessarily constitute reason for rejection if the system is demonstrated to be sound in all respects.

d) The method used to measure film thickness, and the significance of the readings for each project, shall be agreed upon by all parties prior to commencement of the work.

C3.3.2.4.11.1.4 ZUT 0003.11.1.4 Degree of Cure of Fusion-Bonded Materials

The degree of cure of corrosion protection material shall be assessed by solvent wiping in accordance with the method given in SABS 1217 (methyl ethyl ketone resistance test)

C3.3.2.4.11.1.5 ZUT 0003.11.1.5 Free of Oil and Grease

C3.3.2.4.11.1.5.1 ZUT 0003.11.1.5.1 Wetting with Water

All surfaces cleaned of oil and grease shall be tested using the “water-break-free” method. The surface shall be wetted with water and the entire surface shall be covered by an unbroken film.

C3.3.2.4.11.1.5.2 ZUT 0003.11.1.5.2 Solvent-Wiping

Where water soluble lubricants may be present the surface shall be further tested by wiping with a clean cotton wool swab soaked in solvent. No stain shall be evident on the swab after solvent-wiping.

C3.3.2.4.11.1.6 ZUT 0003.11.1.6 Water Soluble Salt Contaminants

Substrate surfaces shall be tested for the presence of water soluble salt contaminants in accordance with SABS Method 770 or by means of the Weber Reilly Test.

C3.3.2.4.11.1.7 ZUT 0003.11.1.7 Standard of Mechanical Surface Preparation

Mechanical surface preparation shall be visually compared to the standard shown in SABS ISO 8501-1.

C3.3.2.4.11.1.8 ZUT 0003.11.1.8 Blast Profile

The blast profile of the substrate surfaces shall be determined in accordance with SABS Method 772.

C3.3.2.4.11.1.9 ZUT 0003.11.1.9 Residual Dust and Debris

Substrate surfaces shall be tested for the presence of residual dust and debris in accordance with SABS Method 769.

C3.3.2.4.11.1.10 ZUT 0003.11.1.10 Blasting Material

All blasting-materials shall be approved by the Engineer.

C3.3.2.4.11.1.10.1 ZUT 0003.11.1.10.1 Metallic Abrasive

Abrasive shall be tested in accordance with ISO 11125 for particle size, hardness, density, foreign matter and moisture.

C3.3.2.4.11.1.10.2 ZUT 0003.11.1.10.2 Non-Metallic Abrasive

Abrasive shall be tested in accordance with ISO 11127 for particle size, hardness, density, moisture and water soluble contaminants.

C3.3.2.4.11.2 ZUT 0003.11.2 PIPE AND SPECIALS SPECIFIC TESTING

C3.3.2.4.11.2.1 ZUT 0003.11.2.1 Dry Film Thickness (DFT)

Measurements shall be taken in accordance with ISO 2808.

100% of all system thicknesses measured shall comply with the minimum requirements of this Specification.

In the case of coats applied after the erection of steel work on Site, the frequency at which measurements of the DFT are taken shall be at the discretion of the Engineer, and may be dictated by accessibility.
DFT in excess of the prescribed maxima shall not necessarily constitute reason for rejection if the paint film is demonstrated to be sound in all respects.

DFT shall be tested within 7 days of application.

The method used to measure DFT, and the significance of the readings for each particular item, shall be agreed upon by all parties prior to commencement of the coating work.

C3.3.2.4.11.2.1.1 ZUT 0003.11.2.1.1 Automated Shop Applied Lining and Coating

The film thickness on the first pipe of a production run and thereafter on at least one pipe selected at random from every day's production, but not less than one pipe out of every ten pipes, shall be measured non-destructively by an approved eddy current instrument. At least four readings at equally spaced intervals around the circumference, approximately 300 mm from each end of the pipe, shall be taken. The first reading shall be over the weld bead. When practicable an additional four readings at equally spaced intervals around the circumference in the centre of the pipe shall be taken. The thickness shall not be less than the minimum specified over 100% of the area

including weld beads. The Engineer may at his discretion supplement the above test by checking wet film thickness on any or all pipes during application of the coats.

C3.3.2.4.11.2.1.2 ZUT 0003.11.2.1.2 Hand and In-situ Applied Lining and Coating

All the hand applied lining and coating thicknesses shall be tested by means of an approved eddy current or magnetic instrument. At least four readings shall be taken at equally spaced intervals around the pipe circumference at any test point. The first reading shall be over the weld bead. The thickness shall not be less than the minimum specified over 100% of the area including weld beads.

C3.3.2.4.12 ZUT 0003.12 MEASUREMENT AND PAYMENT

C3.3.2.4.12.1 ZUT 0003.12.1 GENERAL

Payment for the requirements of this Specification (excluding those stipulated in Clause 12.2.1) will be included in the payment item for the particular item supplied including painting or corrosion protection. No separate payment shall be made for painting and corrosion protection unless specifically allowed for in the Bill of Quantities.

C3.3.2.4.12.2 ZUT 0003.12.2 SCHEDULED ITEMS

C3.3.2.4.12.2.1 ZUT 0003.12.2.1 PQP and documentation……..Unit: lump sum (Sum)

Separate Items are provided in the Bill of Quantities for the submission of the PQP and all other pre- manufacture documentation.

The rate shall include full compensation for the preparation and submission of the PQP and the submission of all pre-manufacture documentation in compliance with the Specification.

Payment will only be made after the PQP and all documentation has been approved by the Engineer.

Annexures A: Applicable Standards

ANNEXURE A: APPLICABLE STANDARDS

The following Standards and Codes of Practice are referred to in this Specification:

American Water Works Association	
AWWA M11	Steel pipe – A guide for design and installation (3rd. edition)
AWWA: C207 – 1994	Steel pipe flanges 4" through 144".
AWWA: C208 – 1996	Dimensions for fabricated steel water pipe fittings.
South African National of Standards	
SANS 062-1	Steel pipes Part 1
SANS 064	The preparation of surfaces for coating.
SANS 044	Filler materials for manual welding
SANS 770	Cleanliness of blast-cleaned steel surfaces for painting (freedom of soluble salts).
SANS 772	Profile of blast-cleaned steel surfaces for painting (profile gauge).
SANS 769	Cleanliness of blast-cleaned steel surfaces for painting (freedom from dust and debris).
SANS 10044	Welding
SANS 10064	The preparation of steel surfaces for coating
SANS 10121	Cathodic protection of buried and submerged structures
SANS 10129	Plastics tape wrapping of steel pipelines
SANS 1091	National colour standard
SANS 1117	Plastics wrappings for the protection of steel pipelines
SANS 1123	Steel Pipe Flanges (1977 edition shall apply)
SANS 1130	Fibre reinforcing material for pipe wrapping
SANS 1344	Medium duty solvent detergent.
SANS 1178	The production of lined and coated steel pipes using bitumen or coal tar enamel

SANS 1200 L	Standardized specification for civil engineering construction Section L: Medium-pressure pipe lines
SANS 121	Hot-dip galvanised coatings on fabricated iron and steel articles
SANS 1217	The production of painted and powder-coated steel pipes
SANS 1274	Coatings applied by the powder-coating process
SANS 1344	Medium duty solvent detergent
SANS 1431	Weldable structural steels
SANS 14713	Protection against corrosion of iron and steel in structures - Zinc and aluminium coatings - Guidelines
SANS 1476	Fabricated steel pipework
SANS 1700	ISO metric black bolts, screws and nuts (hexagon and square)
SANS 1700	ISO metric precision hexagon-head bolts, screws and nuts (coarse thread medium fit series)
SANS 2063	Thermal spraying - Metallic and other inorganic coatings - Zinc, aluminium and their alloys
SANS 2808	Paints and varnishes - Determination of film thickness
SANS 32	Internal and/or external protective coatings for steel tubes - Specification for hot dip galvanized coatings applied in automatic Plants
SANS 5770	Preparation of steel substrates before the application of paints and related products - Test for the assessment of cleanliness of blast-cleaned steel surfaces - Freedom from certain soluble salts
SANS 5772	Preparation of steel substrates before the application of paints and related products - Surface roughness characteristics of blast-cleaned steel surfaces - Profile of blast-cleaned surfaces determined by a micrometre profile gauge
SANS 719	Electric welded low carbon steel pipes for aqueous fluids (ordinary duties)
SANS 9000	Quality management systems - Fundamentals and vocabulary
British Standards Institution	
BS 970	Specification for wrought steels
BS 2494	Materials for elastomeric joint rings for pipe work and pipelines
BS 2633	Class I arc welding of ferritic steel pipe work for carrying fluids

BS 2815	Compressed asbestos fibre jointing
BS 4504	Flanges and bolting for pipes, valves and fittings (metric series)
BS 534	Steel pipes and specials for water and sewage
BS 5493	Protective coating of iron and steel structures against corrosion
BS 5500	Unfired fusion welded pressure vessels
American Petroleum Institute	
API 1104	Standard for welding pipelines and related facilities
API 5L	Specification for line pipe
American Society for Testing of Materials	
ASTM A240	Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
ASTM A312	Standard Specification for Seamless and Welded Austenitic Stainless Steel Pipes
Swedish Standards Institute	
SIS 05590	Pictorial surface preparation standards for painting steel surfaces
American Society of Mechanical Engineers	
ASME IX	Boiler and Pressure Vessel Code
South African Electrolytic Corrosion Committee	
SAECC/1	Code of Practice
American National Standards Institute	
ANSI B31.3	Standards of pressure piping
International Organization for Standards	
ISO 11125	Preparation of steel substrates before application of paints – Metallic blast-cleaning abrasives
ISO 11127	Preparation of steel substrates before application of paints – Non-metallic blast–cleaning abrasives.
ISO 2808	Paints and varnishes
ISO 752	Specifies the classifications, chemical compositions, markings and other

ISO 8501-1	Preparation of steel substrates before application of paints and related products – Visual assessment of surface cleanliness – Part 1: Rust grades and preparation grades of un-coated steel substrates and of steel substrates after overall removal of previous coatings.
ISO 8504-2	Preparation of steel substrates before application of paints and related products – Surface preparation methods – Part 2: Abrasive blast cleaning.
ISO 9000	A family of standards for quality management systems
European Standards	
EN 1179	Zinc and zinc alloys

Annexures B: Paint Colour Coding

MECHANICAL AND GENERAL

ITEMS	COLOUR	SANS 1091 CODE
Structural steel, Gates	Light grey	G29
Hydraulic power Pack	Strong blue	F11
Hydraulic oil	Salmon pink	A40
Hazardous objects/areas (restricted headroom, crane hook etc.)	Golden yellow with black chevron	B49*
Handwheels and levers	Golden yellow	B49
Handrails: vertical - horizontal	Black Golden yellow	 G49
Handrails on dam walls - Aluminium - Stainless steel - Galvanized	 Un-coated Un-coated Light grey	 G29
Floors: - safe and walking areas - restricted areas - open flooring (gratings) – MS galvanized 3Cr12 Stainless steel	 Emerald green Golden yellow Un-coated Un-coated Un-coated	 E14 B49*
Fire protection Plant	Signal red	A11*
Control panels	Eau de nil	H43

PUMP STATION

ITEMS	COLOUR	SANS 1091 CODE
Electric motors	Light beige	C57
Pumps/control valves: for raw water for chem-treated water	Apple green Middle blue	H29 F07
Fan and coupling guards	Signal red	A11*
Base plates	Black	
Overhead traveling cranes	Golden yellow	B49
Isolating valves: for raw water for chem-treated water	Brilliant green Arctic blue	H10 F28

ELECTRICAL

ITEMS	COLOUR	SANS 1091 CODE
Low voltage panels: Indoor Outdoor	Light orange Light orange	B26* B26
Medium voltage panels: Indoor Outdoor	Admiral grey Admiral grey	G12 G12
Panel accessories (gland plates, back plates, interior)	White	
UPS Plant items	Light orange	B26
Transformers	Light stone	C37
LV distribution kiosks, mini subs	Light stone	C37
Standby electrical Plant items(Permanently powered)	Signal red	A11*
General outdoor	Light grey green	H40
All Plant– interior	White	

WATER TREATMENT PLANT

ITEMS	COLOUR	SANS 1091 CODE
Plant	Same colour of respective pipe work	
Handwheels (remote valves)	Same colour of respective pipe work	
PIPE WORK		
Raw water	Brilliant green	H10
Chemical treated raw water	Verdigris green	E22
Clarified raw water	Eau de nil	H43
Filtered water	Pale blue	E39
Chlorinated filtered water	Arctic blue	F28
Backwash water	Cornflower blue	F29
Air saturated water	Turquoise blue	E18
Wash water recovery	Middle buff	B33
Raw sewage	Dark earth	B11
Settled sewage effluent	Brilliant green	H10
Biologically treated sewage effluent	Verdigris green	E22
Final/chlorinated effluent	Eau de nil	H43
Digested sewage sludge	Middle brown	B07
Raw sewage sludge	Dark brown	B03
Humus sludge	Golden brown	B13

ITEMS	COLOUR	SANS 1091 CODE
Return activated sludge	Golden brown	B13
Waste activated sludge	Middle brown	B15
Supernatants/underflows returning to head of works	Middle buff	B33

DOSING/CONTROL PIPE WORK

ITEMS	COLOUR	SANS 1091 CODE
Poly-electrolyte	Pinotage	A08
Alum/Ferric chloride	Jacaranda	F18
Chlorine solution	Primrose	C67
Chlorine gas	Lemon	C54
Chlorine liquid	Light orange	B26
Lime slurry	Biscuit	B64
Lime hydrated	Biscuit	B64
Lime saturated water	Biscuit	B64
Air/compressed air	White	
Steam	Pastel grey	G54

NOTE: Colours marked thus * are restricted for specified Plant only.

C3.3.2.5 ZUT 1003 LIFTING EQUIPMENT

C3.3.2.5.1 ZUT 1003.1 SCOPE

ZUT 1003 specifies the general requirements for lifting equipment and the specific requirements for steel gantries, overhead travelling cranes, hoists, hoist trolleys, crawl beams, davits and hand cranked winches.

C3.3.2.5.2 ZUT 1003.2 NORMATIVE REFERENCES

Where this specification is required for a project, the following specifications shall, inter alia, form part of the Contract Document:

a) Amendments to this Specification.

b) ZUT 0001: General Mechanical Requirements.

c) ZUT 0003: General Corrosion Protection for Pipelines, Water and Wastewater Works.

d) SANS 50025: Hot Rolled Products of Structural Steels.

e) BS 466: Specification for Power Driven Overhead Travelling Cranes, Semi-Goliath and Goliath Cranes for General Use.

f) BS 2573: Rules for the Design of Cranes. Specification for Classification, Stress Calculations and Design Criteria for Structures.

g) BS EN 13001: Cranes. General Design.

h) SANS 4310: Cranes – Test code and procedures.

i) BS EN 1011: Welding. Recommendations for welding of metallic materials.

j) BS 4872: Specification for approval testing of welders when welding procedure approval is not required.

Equipment, materials and operational methods shall comply with the latest edition of the relevant national and/or international standard.

C3.3.2.5.3 ZUT 1003.3 GENERAL

The scope of work for which the Contractor is responsible is specified elsewhere.

The installation shall be as shown on any applicable drawings provided with the tender documents.

Lifting equipment shall be designed, constructed and installed in accordance with an internationally accepted technical design standard for the type of lifting equipment to be provided in terms of this Contract. The standard shall be noted on Contractor's drawings submitted for approval. The guidelines given in the Southern African Steel Construction Handbook may be used where applicable and where these do not conflict with the technical design standard.

The design, fabrication and installation of lifting equipment shall be in accordance with the relevant aspects of the Occupational Health and Safety Act and Regulations and, in particular, with Regulation 18 of the Driven Machinery Regulations.

The safe working load (SWL) shall be permanently marked on all components.

Equipment which has not previously been in common use in South Africa shall not be acceptable unless specifically called for in the specifications or unless the Engineer agrees in writing.

The Contractor may only use the lifting equipment for the installation of other parts of the Works if testing and certification for the complete lifting installation, including the supporting structure, has been successfully completed and submitted to the Engineer.

C3.3.2.5.4 ZUT 1003.4 INSPECTIONS

The Contractor shall arrange for the Engineer to inspect all fabrications at the following stages:

a) after fabrication. During this inspection and in the presence of the Engineer, the Contractor shall conduct dye penetrant testing of all welds on structural members. This includes any welding onto structural members.

b) after blasting.

c) after the final coat (but before the items are removed from the coatings yard).

C3.3.2.5.5 ZUT 1003.5 TESTING

Lifting equipment and installations shall be tested after installation over the complete vertical and horizontal lifting range. The Contractor shall make arrangements for the Engineer to witness this test.

The testing shall be done in accordance with the requirements of SANS 4310 and, in accordance with this Standard, the test load used shall be 125 % of the SWL.

The Contractor shall make all arrangements for the testing procedures and shall provide the test load.

A test report shall be provided in accordance with SANS 4310.

C3.3.2.5.6 ZUT 1003.6 PERFORMANCE REQUIREMENTS

The equipment shall lift and shall travel the full operating footprint with the range of loads between zero load and the specified safe working load.

The lifting equipment shall also safely lift the test load, and shall be capable of traversing the full operating footprint of the lifting equipment whilst holding the test load. All three travel movements shall be free of shake, shudder and crabbing.

Lift and travelling actions shall be snag and snatch free.

C3.3.2.5.7 ZUT 1003.7 TECHNICAL REQUIREMENTS

The technical requirements in this clause apply to all lifting equipment.

The lifting equipment shall be suitable for continuous use unless otherwise stated.

The lifting equipment, when erected and installed, shall be of neat and workmanlike appearance, solidly and evenly supported, true to line, level, plumb and in proper working order.

Fabrication shall comply with the requirements of the clauses “Fabrication of Steels” and “Welding” in ZUT 0001.

Hollow steel sections are not acceptable as structural members unless the section is fully closed by welding.

Steel foot-plates for securing steel structures to concrete shall have a minimum of four anchor bolts.

Anchor fasteners shall have a diameter of not less than M16 and shall be of EN Grade 1.4401 (316), or better. Other fasteners, including high tensile fasteners, shall be of stainless steel or of hot-dip galvanised steel. Fasteners which form standard parts of proprietary equipment shall remain as provided but might require an additional, suitable anti-corrosion coating to suit the environment.

Chemical anchor shall not be used where the load on the anchor fastener is vertically downwards. Such anchors shall preferably be through-bolted. Mechanical anchors will also be acceptable but application of the test load shall not cause the loading on the anchor to exceed 70 % of the anchor manufacturer's recommended loading.
Corrosion protection shall comply with the requirements of ZUT 0003.

Motors shall comply with the clause "Electric Motors" in ZUT 0001. Motors shall have ingress protection to at least IP 55 and shall comply with the electrical specifications. Motors shall be provided with a tropical rated corrosion protection system.

High-tensile and alloy steel chains shall have a factor of safety of at least four. Other chains shall have a factor of safety of at least five. Steel-wire ropes shall have a factor of safety of at least six. Man-made fibre ropes or woven webbing shall have a factor of safety of at least six.

C3.3.2.5.8 ZUT 1003.8 ADDITIONAL REQUIREMENTS FOR STEEL GANTRIES

C3.3.2.5.8.1 ZUT 1003.8.1 General

The same technical design standard used for the design of a crane or crawl beam shall be used for designing the gantry which supports that crane or crawl beam.

Columns shall be cross-braced and/or "triangulated" in more than one plane. In other words, columns shall not be cantilevered in any vertical plane.

C3.3.2.5.8.2 ZUT 1003.8.2 Corrosion Protection

Gantry steelwork shall be hot-dip galvanised.

If it is not feasible to protect the gantry steelwork using hot-dip galvanising, it shall be hot-metal zinc-sprayed, sealed and coated as follows:

a) The coating shall consist of the zinc metal spray plus the application of a suitable organic sealant and a suitable organic coating.
b) Thermal spray metal coatings shall be in accordance with SANS 2063.
c) The minimum zinc coating thickness shall be 150 µm.

Sealing and coating shall consist of a low viscosity sealant and a suitable coating system. The sealant shall be applied immediately after the thermal spray and until absorption is complete.

The following sealant and coating is acceptable:

d) Application of one coat of a two-part epoxy primer to a dry film thickness of 40 µm; (Carboline Rustbond Penetrating Sealer, Intergard 269, or equivalent).
e) Application of two coats of a two-part polyurethane enamel (two part) to a minimum combined dry film thickness of 70 µm.

C3.3.2.5.9 ZUT 1003.9 ADDITIONAL REQUIREMENTS FOR TRAVELLING CRANES

C3.3.2.5.9.1 ZUT 1003.9.1 TRAVELLING CRANES

C3.3.2.5.9.1.1 ZUT 1003.9.1.1 Certificate

The Contractor shall supply to the Engineer a certificate from the crane manufacturer which certifies that the crane has been manufactured in accordance with the requirements of the Driven Machinery Regulations of the Occupational Health and Safety Act. It shall also specify the technical design standard used and shall state the SWL and the test load.

This certificate shall be provided to the Engineer prior to delivery of the crane to Site.

C3.3.2.5.9.1.2 ZUT 1003.9.1.2 Construction

Construction of overhead travelling cranes, goliath cranes and semi-goliath cranes shall be in accordance with BS 466 and BS 2573 (or BS EN 13 001), as applicable. Suitable equivalent standards are acceptable.

All welding of steelwork shall be carried out in accordance with BS EN 1011 by competent artisans meeting the requirements of BS 4872. Suitable equivalent standards are acceptable.

All materials shall be new and unused and suited to the application. Structural steelwork shall comply with the requirements of SANS 50025 for grade S 355 JR or for grade S 355 JO.

The structures shall be designed with suitable dimensions, wheel spacings and gusset plates or diagonal bracing to prevent slewing.

End stops with rubber buffers shall be fitted to prevent the hoist from moving off the travelling beam. Stops and buffers are also required to limit the long travel on the rails.

C3.3.2.5.9.1.3 ZUT 1003.9.1.3 Operation

All three directions of travel shall have a fast speed, a slow speed and an inching facility.

C3.3.2.5.9.1.4 ZUT 1003.9.1.4 Rails

The crane rails shall be standard rail sections (i.e. shall not be square section steel bar).

Rail lengths shall be joined using fish-plates, with at least four fasteners, to provide the crane wheels with a smooth passage across the join.

C3.3.2.5.9.1.5 ZUT 1003.9.1.5 Machine Components

Gear wheels and other machine components shall be fully enclosed against dust. If mounted externally, they shall have ingress protection to at least IP 55.

Bearings shall be mounted in sealed, cast iron bearing housings and provided with grease nipples.

C3.3.2.5.9.1.6 ZUT 1003.9.1.6 Configuration

The long travel, cross travel and hook travel shall be electrically-powered unless otherwise specified.

The lowest hook level shall be floor level. The operating chains of manually operated cranes shall fall to one metre above floor level. These details are to be confirmed with the Engineer prior to finalisation.

C3.3.2.5.9.1.7 ZUT 1003.9.1.7 Installation

The crane and rails, when erected and installed, shall be of neat and workmanlike appearance, solidly and evenly supported, true to line, level, plumb and in proper working order. The crane rails shall be straight, over their entire length, to within the permissible deviations given in BS 466.

Every rail length shall be supported at both its ends; i.e. the ends shall not be cantilevered.

The distance between rail supports shall not exceed 1 000 mm.

Crane rail anchor fasteners shall be M16 or larger and shall be of EN Grade 1.4401 (316) or better. Crane rails which are mounted directly on concrete beams shall be grouted along the full length of the rails. A suitable gap between the rails and the beam shall be provided for application of the grout. The grout shall be applied strictly in accordance with the manufacturer's instructions. The grout shall be neatly finished with a 45º chamfer. The Engineer shall be notified prior to application of the grout.

The use of multiple shims for alignment is not acceptable. Shims shall be fully grouted in to provide corrosion protection.

Grouting shall be done using a non-shrink, cementitious grout, ABE Duragrout 1000 or equivalent, to the approval of the Engineer and in accordance with the manufacturer’s instructions.

C3.3.2.5.9.1.8 ZUT 1003.9.1.8 Cabling

Cables shall be of the insulated, festooned arrangement and shall be suitable for the applicable hazardous zone classification.

Winding drum cables will be acceptable if approved by the Engineer.

Travelling brush contacts are not generally acceptable and are prohibited on wastewater treatment works and in other corrosive environments.

C3.3.2.5.9.1.9 ZUT 1003.9.1.9 Corrosion Protection

C3.3.2.5.9.1.9.1 ZUT 1003.9.1.9.1 General

The Contractor shall arrange for the fabrication of the crane to be inspected by the Engineer at the fabricator's premises prior to preparation for corrosion protection.

Corrosion protection shall comply with ZUT 0003.

Smaller items, such as cable brackets and protective covers, shall be hot-dip galvanized.

C3.3.2.5.9.1.9.2 ZUT 1003.9.1.9.2 Crane Rails

Crane rails shall be hot-dip galvanized.

C3.3.2.5.9.1.9.3 ZUT 1003.9.1.9.3 Crane Beam and End Carriages

The crane beam and end carriages shall be hot-metal zinc-sprayed, sealed and coated in accordance with ZUT 0003. The coating shall consist of the zinc metal spray plus the application

of a suitable sealant and a suitable coating. The metal coating shall be in accordance with SANS 2063. The minimum zinc coating thickness shall be 150 µm.

Sealing and coating shall consist of a low viscosity sealant and a suitable coating system. The sealant shall be applied immediately after the thermal spray and until absorption is complete.

The following sealant and coating are acceptable:

a) Application of one coat of a two-part epoxy primer to a dry film thickness of 40 µm; (Carboline Rustbond Penetrating Sealer, Intergard 269, or equivalent).

b) Application of two coats of a two-part polyurethane enamel (two part) to a minimum combined dry film thickness of 70 µm.

C3.3.2.5.9.2 ZUT 1003.9.2 GOLIATH (AND SEMI-GOLIATH) CRANES

Goliath and Semi-Goliath cranes shall be provided with an operator's cab which is mounted on the crane. The cab shall be provided with a platform which will allow inspection of the hoist and cross travel. A ladder shall be provided on one of the legs of the goliath crane in order to provide safe access to the cab and platform.

The design and position of the cab, platform and ladder shall be decided in conjunction with the Engineer.

C3.3.2.5.9.3 ZUT 1003.9.3 OVERHEAD CRANES

C3.3.2.5.9.3.1 ZUT 1003.9.3.1 General

Electrical control pendants shall be arranged to move independently along the length of the crane beam and shall hang to one metre above floor level.

C3.3.2.5.9.3.2 ZUT 1003.9.3.2 Rail Beam, Rails and Crane Beam

The hoist and hoist trolley shall travel on a steel crane beam(or beams).

The steel crane beam shall be supported on end carriages which travel along crane rails.

The crane rails shall be supported along their full length by crane rail beams. These rail beams shall be of hot-dip galvanised steel unless the drawings indicate that they are of reinforced concrete. If the beams are of reinforced concrete, they will be provided by others but the Contractor shall submit the requirements for fixing and installation of the crane rails to the Engineer.

C3.3.2.5.9.3.3 ZUT 1003.9.3.3 Access for Installation

The Contractor shall determine a suitable method of installation and shall submit a method statement to the Engineer for approval.

C3.3.2.5.9.3.4 ZUT 1003.9.3.4 Maintenance Platform and Ladder

A maintenance platform for two people shall be provided along the length of the crane beam overhead cranes with a SWL above 3 000 kg.

The crane beam structure shall incorporate welded lugs onto which the platform shall be bolted; i.e. the platform shall be removable and shall not be welded to the crane beam. The platform floor shall have a minimum width of 500 mm. Guard rails shall be provided on the maintenance platform and

shall comply with the clause "Guard Rails" in ZUT 0001. The complete platform and all guard-railing shall be hot-dip galvanised after fabrication.

A hot-dip galvanised, fixed steel ladder shall be provided at a suitable position within the building for accessing the platform on the crane. This shall comply with Aur 1001. The design shall ensure that neither persons nor the ladder can be crushed by crane movement.

C3.3.2.5.10 ZUT 1003.10 ADDITIONAL REQUIREMENTS FOR MANUAL AND ELECTRIC HOISTS

C3.3.2.5.10.1 ZUT 1003.10.1 GENERAL

Hoists, including crane mounted hoists, shall be provided with an overload prevention device; e.g. a clutch which slips upon overloading.

The bottom hook shall swivel on a ball or roller bearing through 360º and the bearing shall have a protective skirt. The hook shall be fitted with a safety latch.

Chain boxes shall be provided for holding unloaded lengths of lifting chain.

C3.3.2.5.10.2 ZUT 1003.10.2 ELECTRIC HOISTS

Powered hoists shall comply in all applicable respects with Driven Machinery Regulation 18 of the Occupational Health and Safety Act.

Powered hoists shall hold the load stationary upon power failure.

Lifting chain is preferred for hoists of up to 5 tonnes but corrosion-protected steel wire rope is acceptable where appropriate.

Wire rope hoists shall comply with the following:

a) Drum diameter shall be at least 25 times the wire rope diameter.

b) Drums shall have no more than three layers of wire rope when fully wound up.

c) Drums shall have no fewer than three full turns of wire rope remaining when the hook is at the lowest level.

C3.3.2.5.10.3 ZUT 1003.10.3 MANUAL HOISTS

The operating chain shall be as short as feasible in order to prevent entanglement with the lifting chain.

C3.3.2.5.11 ZUT 1003.11 ADDITIONAL REQUIREMENTS FOR HOIST TROLLEYS

Hoist trolleys shall be designed so that the trolley remains on the support beam if a wheel falls off or if a wheel axle breaks.

Hoist trolleys shall have chain/gear operated movement. The operating chain shall be as short as feasible in order to prevent entanglement with the hoist chains.

C3.3.2.5.12 ZUT 1003.12 ADDITIONAL REQUIREMENTS FOR CRAWL BEAMS

Crawl beams shall be fabricated from standard I-Sections or standard H-Sections.

Crawl beams shall be hot-dip galvanised after all fabrication is complete. If this is not done and the steel is exposed by drilling or welding or any other activity, the complete beam shall have the zinc removed by abrasive blasting and it shall be returned to the galvanisers for hot-dip galvanising.

Crawl beams anchored to concrete shall be secured using EN Grade 1.4401 (316), or better, anchor bolts. The anchor bolts shall, preferably, be through-bolted. Chemical anchor secured bolts are not acceptable where the load is vertically downwards.

Crawl beams fastened to steel support structures shall be secured using hot-dip galvanised fasteners.

Fasteners which secure crawl beams shall be provided with spring washers in addition to the flat or fender washer.

C3.3.2.5.13 ZUT 1003.13 ADDITIONAL REQUIREMENTS FOR DAVITS

Davits shall be column mounted with swivelling booms and shall be designed to suit the application. Where specified, each davit shall be provided with a winch rigidly fixed to the davit at a convenient height and position.

The davit shall be designed for a SWL at least 50 % above the maximum load requirements of the equipment installation.

Guide pulleys shall be provided to suit the arrangement. These pulleys shall be machined with a groove having a radius 5 % to 7,5 % greater than the rope radius and with a flare angle of 52º. The pulley effective diameter shall be not less than 25 times the wire rope diameter. The groove depth shall be twice the rope diameter or greater.

The davit shall either be manufactured of LDX 2101 or of EN Grade 1.4401 (316), or better, or of carbon steel, hot-dip galvanized and painted. All fasteners, pins, shafts, shackles, hooks, etc., shall be of EN Grade 1.4401 (316), or better. Guide pulleys and shafts shall be made of EN Grade 1.4401 (316), or better, or other approved corrosion resistant material, and shall use suitable non-metallic bearings which do not require lubrication.

The slewing arrangement shall be properly designed for easy operation, shall be accurately fitted and shall not be subject to corrosion problems. Bushes made of nylon, "Vesconite" or other suitable non-metallic material shall be used and any metallic mating face shall be of EN Grade 1.4401 (316) stainless steel.
Operating levers, locking arrangements, fixing arrangements, etc., shall not present a hazard. If necessary, operating levers shall be hinged so that they can be swung out of the way when not in use.

C3.3.2.5.14 ZUT 1003.14 ADDITIONAL REQUIREMENTS FOR HAND CRANKED WINCHES

Hand cranked winches shall be rated for a SWL of at least 50 % in excess of the maximum expected working load. All gears, clutches, etc., shall be enclosed in a robust cast iron, cast steel or fabricated stainless steel casing which shall be grease filled and sealed against ingress of dirt and moisture. The winch shall hold the load stationary when the hand crank is released during raising and lowering. In addition, a locking arrangement to lock the position of the load at any point shall be provided.

The force required to operate the winch at its maximum rated load shall not exceed 130 Newtons.

The wire rope shall be of stainless steel. The wire rope shall be long enough to reach the lowest required position and still have at least 3 turns remaining on the drum. The drum size shall easily

store the full rope length. The drum shall have a diameter of at least 25 times the diameter of the wire rope.

The support brackets, all exposed fasteners, shafts, handles, pins, etc., shall be of EN Grade 1.4401 (316), or better, and the casing shall be hot-dip galvanized or hot-metal zinc-sprayed (to a thickness of 150 µm) and then painted.

C3.3.2.5.15 ZUT 1003.15 MEASUREMENT AND PAYMENT

The tendered rates or sums shall cover the cost of anything not specially mentioned, but which an experienced contractor can reasonably foresee as being required to enable the apparatus and Plant to be installed and/or function safely and correctly as specified. No claims whatsoever for extras will be allowed on the grounds that a necessary piece of Plant or part thereof is not specifically mentioned in the Bill of Quantities.

C3.3.2.5.15.1 ZUT 1003.15.1 Supply and Delivery…….Unit: number (No.)

The rates tendered shall include full compensation for the supply and delivery of plant to Site including supply of raw materials and bought-out items and associated operating Plant items; fabrication, manufacture and assembly; quality assurance and quality control; inspection and Factory Acceptance Testing (including attendance on inspections and tests witnessed by the Engineer); type and routine tests; application of finishes (painting and corrosion protection); trial erection and dismantling; preparation and packing for transport; transport from place of manufacture to the Site; insurance, harbour dues etc., during transport; loading and unloading; storage under appropriate conditions from date of delivery until commencement of erection; and any other work as specified. Payment will be made per unit. Payment will only be effected after full compliance of the items with this Section and associated documentation has been approved by the Engineer.

C3.3.2.5.15.2 ZUT 1003.15.2 Installation, Testing and Commissioning……...Unit: number (No.)

The rates tendered shall include for full compensation for the installation, testing and commissioning of the plant on Site including the provision of all labour, transport, materials and Temporary Works necessary to install the complete Works; on-site quality assurance and quality control, inspection, testing (including attendance at tests witnessed by the Engineer); the installation of all auxiliary items; necessary for the operation of the installation until taken over by the Client; the putting into service of the complete installation of the Plant; and any other work as specified.

The rate shall also include for submission of O&M Manuals, all commissioning testing and the provision of equipment therefore including all disruptions to installation caused by such testing. Payment will be made per unit. Payment will only be effected after full compliance of the items with this Section and associated documentation has been approved by the Engineer.

C3.3.2.6 ZUT 1008 VENTILATION FOR PLANT ROOMS

C3.3.2.6.1 ZUT 1008.1 SCOPE

ZUT 1008 specifies the standard requirements for ventilation equipment and installations in plant rooms.

The installation shall be as shown on any applicable drawings provided with the tender documents.

The scope of work for which the Contractor is responsible is specified elsewhere.

C3.3.2.6.2 ZUT 1008.2 NORMATIVE REFERENCES

Where this specification is required for a project, the following documents shall, inter alia, form part of the Contract Document:

a) Amendments.

b) ZUT 0001: General Mechanical Requirements.

c) ZUT 0003: General Corrosion Protection for Pipelines, Water and Wastewater Works.

Equipment, materials and operational methods shall comply with the latest edition of relevant national and/or international standards.

C3.3.2.6.3 ZUT 1008.3 GENERAL

As required in terms of the General Conditions, the Contractor shall:

- provide the details of all civil requirements to the Engineer for incorporation into the civil structure,
- measure on Site,
- ensure that the design can accommodate a civil tolerance of +/- 40 mm (unless a tighter tolerance is called for by the Contractor and agreed to by the Engineer).

C3.3.2.6.4 ZUT 1008.4 PERFORMANCE REQUIREMENTS

The completed installation shall provide the minimum air flow required for each room volume or shall provide for the maximum allowable temperature rise in each room; whichever is specified.

The maximum noise levels specified shall not be exceeded.

C3.3.2.6.5 ZUT 1008.5 OPERATION AND CONTROL

Unless specified otherwise, the fan(s) shall operate continuously.

A flow switch for each fan shall lead to an alarm being recorded if the flow fails.

Manual start and stop of each item of equipment shall be provided **but all protections shall be active during manual operation**.

C3.3.2.6.6 ZUT 1008.6 DESIGN AND CONSTRUCTION

C3.3.2.6.6.1 ZUT 1008.6.1 FLOW

Resistance to flow for all ductwork and associated equipment shall be calculated by the Contractor prior to equipment selection.

At least 250 Pa shall be allowed for resistance losses in filters unless the Contractor can confirm a lower figure.
Reasonable modification to ductwork during installation shall be provided for in the design, i.e. a suitable safety factor shall be incorporated in the design.

C3.3.2.6.6.2 ZUT 1008.6.2 FANS

Direct drive, axial flow fans shall incorporate manually adjustable pitch, cast aluminium, aerofoil section blades, clamped in split, metallic hubs. Fan casings shall cover the full length of the fan and motor assembly. Terminal boxes shall be mounted on the fan unit. Suspended fans shall be restrained to prevent excessive torsional and axial movement during start-up. Fan casings shall be of hot-dip galvanized steel unless otherwise specified. Axial flow fans installed in corrosive flows shall be either belt driven or shall have their motors protected by bifurcated airstreams.

Centrifugal fans shall be constructed of galvanized sheet steel with spun steel inlet cones and machined shafting supported on rolling bearings mounted in sealed bearing housings provided with grease nipples. Fans shall be mounted on steel channel base frames sized to accommodate the drive motors.

Fans and motors shall preferably have a nominal speed of 1 500 rpm or lower and motors shall have a nominal voltage of 400 Volts. Special consideration and acoustic treatment shall be provided for fans operating above 1 500 rpm.

Fans shall be dynamically balanced to ISO 1940, grade G6,3.

Fans shall be flexibly connected to ducting.

Fans shall be flexibly supported using spring or rubber-in-shear mountings having a minimum static deflection of 20 mm.

Belt drives shall be accurately aligned axially and angularly and shall be to the Engineer's approval.

Guarding shall totally enclose drives, shall be rigidly mounted off base plates and shall be to the Engineer's approval.

Pressure gauges shall be provided upstream and downstream of each fan. A differential pressure gauge or graduated manometer will be acceptable.

C3.3.2.6.6.3 ZUT 1008.6.3 DAMPERS

Dampers for the regulation of air flow shall be fabricated from the same material as the ductwork.

Adjustment, position indication and a locking arrangement shall be provided for each damper.

C3.3.2.6.6.4 ZUT 1008.6.4 DUCTING AND SHEET METALWORK

Ducting shall be manufactured in accordance with SANS 1238.

Unless otherwise specified, materials used in the fabrication of ventilation ductwork shall be of hot-dip galvanized, low carbon steel and sheet steel material thicknesses shall be in accordance with SANS 1238.

A flexible connection shall be provided on each side of each fan/attenuator assembly in order to isolate the ducting from the fan vibration and movement upon start-up. The connections shall be by means of coated fabric collars with sewn and cemented seams. Flexible collars shall have sufficient free movement to take up the deflection of the connected moving equipment. They shall not be used as a means of accommodating misalignment. When installed, collars shall not restrict the free area of the ducting.

Take off sockets shall be provided where grilles or louvres are mounted in distribution ducting. Sockets shall be long enough to ensure that no part of the grille or its associated control mechanism projects into the duct cross-section. Duct-mounted grilles shall be provided with opposed blade, volume control dampers or flap type volume controls with straightening blades.

Rectangular ducting shall be supported on trapeze type hangers constructed from hot-dip galvanized, low carbon steel angle with stainless steel hanger rods. Rod diameter shall be not less than 10 mm and support spacing shall be less than 2 000 mm.

Circular ducting shall be supported in hoops constructed from 40 mm X 5 mm hot-dip galvanized low carbon steel flat bar suspended from Ø 10 mm stainless steel rod at 3 000 mm maximum centres.

C3.3.2.6.6.5 ZUT 1008.6.5 FILTERS

Filter cells shall be mounted in proprietary frames and clip-fixed to achieve zero discernible by pass. Slide frame mounted filters shall have wing nut fixed airtight cover plates.

Filter banks shall have a differential manometer connected across them. Manometers shall be correctly set up and levelled and shall be provided with red gauge oil of the correct specific gravity.

The filter frame shall be fabricated from hot-dip galvanised steel (minimum thickness of 0,5 mm) unless otherwise specified.

Flow speed through the filter opening shall be not greater than 2 m/s.

C3.3.2.6.6.6 ZUT 1008.6.6 SCREENS

Inlets and discharges shall be effectively guarded with removable stainless steel wire screens of approximately 20 mm mesh and 1,6 mm minimum gauge.

C3.3.2.6.6.7 ZUT 1008.6.7 SOUND

C3.3.2.6.6.7.1 ZUT 1008.6.7.1 General

Sound pressure levels of a fan shall not exceed 80 dBA at 3 metres from the outer surface.

C3.3.2.6.6.7.2 ZUT 1008.6.7.2 Sound Attenuators

Attenuators shall be fabricated of the same material as the ductwork.

Circular attenuators shall be directly connected to axial flow fan flanges. Where diameters differ by more than 20 mm, hot-dip galvanized low carbon steel connecting cones shall be bolted between the fan and the attenuator to adapt the respective diameters. Attenuators containing an acoustic

pod shall have leading and trailing fairings in moulded grp or spun hot-dip galvanized steel. Pods shall be securely and concentrically fitted in the casings to the Engineer's approval.

Splitter attenuators shall be fabricated with mating flanges. Splitters shall comprise acoustic lining material mounted on galvanized sheet steel and shall be securely supported within the attenuator casing. Leading and trailing ends of splitters shall have fairings in moulded grp or hot-dip galvanized steel sheet.

Attenuators shall be constructed to achieve the acoustic performance specified. Acoustic infill material shall be "Eurolon" by Donkin or equivalent. Where air passageway velocities exceed 20 m/s, the infill material shall be supported by pre-galvanised perforated sheet steel having a thickness of at least 0,8 mm.

Where attenuators are to be used in grease or oil-laden atmospheres, a polyester membrane shall be interposed between the infill material and the perforated sheet.

Each attenuator shall not impose a resistance of more than 50 Pa at rated air-flow.

External surfaces of the attenuators shall be painted as for the general ductwork.

C3.3.2.6.6.7.3 ZUT 1008.6.7.3 Acoustic Louvres

Acoustic louvres shall be designed by a manufacturer which specialises in acoustic applications and who can provide attenuation graphs for the equipment.

C3.3.2.6.6.8 ZUT 1008.6.8 EQUIPMENT BASES IN ACOUSTICALLY SENSITIVE AREAS

Inertia bases shall be provided for centrifugal fans and motors where specified. The bases shall consist of reinforced concrete cast into sheet metal formers and shall be at least 150 mm deep. Bases shall be reinforced with Ø 13 mm reinforcing bars located at 150 mm centres each way.

The mass of bases shall be chosen to avoid operation at critical speeds and the mass ratio between bases and equipment shall be at least 1:1 for fans. Concrete bases for pump sets shall be large enough to accommodate the motors, driven equipment and any required supports and fittings. Equipment shall be bolted onto baseplates which are themselves bolted onto the concrete inertia bases.

Spring isolators shall be installed between concrete inertia bases and floor plinths. Either free standing stable spring units or caged spring units with snubbers may be used. Spring isolators shall be installed with levelling bolts and shall incorporate 6 mm thick ribbed neoprene acoustic pads bonded to the base. Spring diameters shall be large enough to prevent excessive rocking of equipment during start-up as well as normal operation.

Isolators shall be chosen to give a static deflection corresponding to a ratio of 3:1 of the lowest disturbing frequency to the natural frequency of the mounting.

Bases and spring isolators shall be arranged to give a clearance of approximately 25 mm between the underside of the bases and floor plinths.

Floor plinths shall be provided for all equipment bases. Plinths shall be large enough to accommodate the concrete inertia bases and the spring isolators.

C3.3.2.6.6.9 ZUT 1008.6.9 WEATHER LOUVRES

Weather louvres shall be of hot-dip galvanised steel and shall be of the storm resistant type.

C3.3.2.6.7 ZUT 1008.7 MOTOR/ELECTRICAL EQUIPMENT

Motors shall have a nominal rating of at least 10 % above the maximum power requirement of the fans as installed.

Motors which drive fans for wet well applications shall be of the bifurcated design; i.e. the motor shall be isolated from the air flow.

The motor shall comply with the requirements of the clause “Electric Motors” in ZUT 0001.

Motors shall have ingress protection to at least IP 55.

Motors shall be provided with a tropical rated corrosion protection system.
Motors shall comply with the requirements of the hazardous location zone for the area in which they are installed.

C3.3.2.6.8 ZUT 1008.8 INSTRUMENTATION

An hour meter which cannot be reset shall be provided for each fan motor.

Where specified, flow switches and pressure measurement shall be provided.

Instrumentation shall comply with the clause “Instrumentation” in ZUT 0001.

C3.3.2.6.9 ZUT 1008.9 FABRICATION

Fabrication shall comply with the clause “Fabrication of Steels” and welding shall comply with the clause “Welding” in ZUT 0001.

Fabrications will generally be inspected by the Engineer after fabrication is complete.

C3.3.2.6.10 ZUT 1008.10 FASTENERS

Fasteners shall comply with the clause “Fasteners” in ZUT 0001.

C3.3.2.6.11 ZUT 1008.11 SPARES

The spares which are to be provided are specified elsewhere.

C3.3.2.6.12 ZUT 1008.12 CORROSION PROTECTION

Corrosion Protection shall comply with ZUT 0003.

Corrosion protection of motors, gearboxes and bearing housings shall be the manufacturer’s standard for a tropical marine environment.

Stainless steel shall be correctly pickled and passivated. All stainless steel surfaces shall be completely clear of ferrous stain upon commissioning.

C3.3.2.6.13 ZUT 1008.13 INSTALLATION

Installation work shall comply with the clause “Installation” in ZUT 0001.

Equipment shall be mounted firm and level.

The installation shall be of neat and workmanlike appearance, solidly and evenly supported, true to line, level and plumb.

Apertures through structures for ductwork shall be neatly closed using an appropriate method. A neat hard wood frame is preferred but plaster shall be used if noise breakout is to be prevented.

Where ductwork penetrates brickwork, a wrot timber frame shall be built in to locate and mount the ductwork.

Where ductwork penetrates concrete slabs or walls, a flange shall be provided on one side to stabilize the duct and weak grout or fire stopping shall be applied to the spaces between the ducting and the structure to effectively seal the clearance.

Where ducting penetrates between areas having differing fire risk or mandatory fire separation, fire dampers to the latest amendment of SANS 193 shall be installed.

Drain points shall be provided in ductwork where condensed water could pool.

C3.3.2.6.14 ZUT 1008.14 SAFETY

The Contractor shall design and install all equipment installations in accordance with the requirements of SANS 10108.

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

C3.3.2.6.15 ZUT 1008.15 INSPECTIONS

The Contractor shall make arrangements for the Engineer to inspect the equipment for compliance prior to payment being made.

C3.3.2.6.16 ZUT 1008.16 TESTING

The correct operation of the equipment and the achievement of the specified air flow and sound level shall be demonstrated to the Engineer prior to the commissioning of the Works.

C3.3.2.6.17 ZUT 1008.17 MEASUREMENT AND PAYMENT

The tendered rates or sums shall cover the cost of anything not specially mentioned, but which an experienced contractor can reasonably foresee as being required to enable the apparatus and Plant to be installed and/or function safely and correctly as specified. No claims whatsoever for extras will be allowed on the grounds that a necessary piece of Plant or part thereof is not specifically mentioned in the Bill of Quantities.

C3.3.2.6.17.1 ZUT 1008.17.1 Supply and Delivery…….Unit: number (No.)

The rates tendered shall include full compensation for the supply and delivery of plant to Site including supply of raw materials and bought-out items and associated operating Plant items; fabrication, manufacture and assembly; quality assurance and quality control; inspection and Factory Acceptance Testing (including attendance on inspections and tests witnessed by the Engineer); type and routine tests; application of finishes (painting and corrosion protection); trial erection and dismantling; preparation and packing for transport; transport from place of manufacture to the Site; insurance, harbour dues etc., during transport; loading and unloading; storage under appropriate conditions from date of delivery until commencement of erection; and any other work as specified. Payment will be made per unit. Payment will only be effected after full compliance of the items with this Section and associated documentation has been approved by the Engineer.

C3.3.2.6.17.2 ZUT 1008.17.2 Installation, Testing and Commissioning……..Unit: number (No.)

The rates tendered shall include for full compensation for the installation, testing and commissioning of the plant on Site including the provision of all labour, transport, materials and Temporary Works necessary to install the complete Works; on-site quality assurance and quality control, inspection, testing (including attendance at tests witnessed by the Engineer); the installation of all auxiliary items; necessary for the operation of the installation until taken over by the Client; the putting into service of the complete installation of the Plant; and any other work as specified.

The rate shall also include for submission of O&M Manuals, all commissioning testing and the provision of equipment therefore including all disruptions to installation caused by such testing. Payment will be made per unit. Payment will only be effected after full compliance of the items with this Section and associated documentation has been approved by the Engineer.

C3.3.2.7 ZUT 5019 HORIZONTAL SPLIT CASE CENTRIFUGAL PUMP

C3.3.2.7.1 ZUT 5019.1 SCOPE

ZUT 5019 specifies the standard requirements for single-stage, double-entry, axially-split case centrifugal pumps (commonly referred to as “horizontal split case pumps”).

The installation shall be as shown on any applicable drawings provided with the tender documents.

The scope of work for which the Contractor is responsible is specified elsewhere.

C3.3.2.7.2 ZUT 5019.2 NORMATIVE REFERENCES

Where this specification is required for a project, the following specifications shall form part of the Contract Document:

a) Amendments to this Specification.

b) Data Sheets.

c) Specification ZUT 0001: General Mechanical Requirements.

d) Specification ZUT 0003: General Corrosion Protection for Pipelines, Water and Wastewater Works.

e) SANS 1123.

f) BS EN 1092.

g) ISO 9906.

h) SANS 10108.

Equipment, materials and operational methods shall comply with the latest edition of the relevant national and/or international standard.

C3.3.2.7.3 ZUT 5019.3 GENERAL

Equipment which has not previously been in common use in South Africa shall not be acceptable unless specifically called for in the specifications or unless the Engineer agrees in writing.

As required in terms of the General Conditions, the Contractor shall:

- provide the details of all civil and building requirements to the Engineer for incorporation into the structure,
- measure on Site,
- ensure that the design can accommodate a tolerance of +/- 40 mm (unless a tighter tolerance is called for by the Contractor and agreed to by the Engineer) for civil and building items constructed by others.

Large scale curves of the pump offered shall be provided with the tender offer. These shall include pressure, power and NPSHr vs flow.

C3.3.2.7.4 ZUT 5019.4 PERFORMANCE REQUIREMENTS

During testing in accordance with the specified ISO 9906 grade of test, the pump shall perform within the standard's acceptable tolerances for differential pressure across the pump, volume flow and energy efficiency.

During testing of the pump casing, the pump shall exhibit no leakage.

C3.3.2.7.5 ZUT 5019.5 OPERATION AND CONTROL

The operating mode for the pump is specified elsewhere but the Contractor shall provide the following specific requirements:

- Protections shall be active during manual operation.
- Manual start and stop of each item of equipment shall be provided.
- The equipment shall be designed to shut down safely and without damage upon tripping of the electrical supply.

The following trip conditions are required:

- Bearing temperature shall be monitored and high bearing temperature shall lead to a motor trip condition.
- Flushing/cooling water to seals shall be monitored and alarm and trip functions shall be provided.

C3.3.2.7.6 ZUT 5019.6 EQUIPMENT CONSTRUCTION AND DESIGN

The specified operating points (whether there will be one operating point or multiple operating points or a range of operating points) shall be within the pump manufacturer's recommended operating range for the pump as tendered and adequate information shall be provided in the tender to confirm this.

The pump operating point shall be to the left of the pump's best efficiency point for the chosen impeller size and speed unless there is another overriding factor which affects the choice of pump.

Pump casings shall be designed to withstand a hydrostatic test pressure of at least 1,5 times the pump's design pressure for a period of thirty minutes.

It shall be possible to remove the upper casing for inspection of the rotating assembly without dismantling the suction and discharge pipework. The shaft bearing support shall also be unaffected by removal of the upper casing; i.e. the bearing housings shall be supported separately from the upper casing.

Pumps shall incorporate replaceable impeller wear rings and replaceable casing wear rings.

Shaft sleeves shall be provided. The pumped fluid shall not come into contact with the shaft at any point.

The rotating assembly shall be designed to have its first critical speed at least 25% above the maximum operating speed.

A vent cock shall be fitted to the highest part of the casing.

Suction and discharge connections shall be flanged. The flanges shall be dimensionally compatible with SANS 1123 or BS EN 1092; plate flanges for welding. Flanges for PN 25 rating and above shall be of raised face configuration.

Rotating elements shall be balanced and the level of vibration severity used for the design shall not exceed VRMS = 1 mm/s at the bearings.

C3.3.2.7.7 ZUT 5019.7 CASTINGS

Castings shall be sound and free of shrink or blow holes. Scale, blisters, flashing and other sharp edges and defects shall be fettled and rounded off.

The impeller shall have a smooth finish. Indentations, pits, hollows and welding shall not be acceptable.

C3.3.2.7.8 ZUT 5019.8 SHAFT SEALS

C3.3.2.7.8.1 ZUT 5019.8.1 MECHANICAL SEALS

Mechanical shaft seals shall be of the cartridge type. Face materials shall be to the approval of the Engineer. The seals shall be rated for the pump design pressures. Pumps in series shall be provided with seals which are rated for the shut-off pressure of the upstream pump but allowing for any significant difference in elevation.

C3.3.2.7.8.2 ZUT 5019.8.2 GLAND PACKING

If shaft gland packing is specified, this shall be provided with water lubrication via a lantern ring and the packing shall be Teflon based. The shaft shall be protected against wear by a stainless steel shaft sleeve between the shaft and the packing.

C3.3.2.7.8.3 ZUT 5019.8.3 WATER SUPPLY

If flushing/cooling water is required, then water from the discharge side of the pump may be used on condition that filtration (or a suitably designed cyclone arrangement) is provided and designed to successfully remove solids from the water. The filter (or cyclone) shall be provided by the manufacturer of the seal.

Flow and pressure sensors shall be provided in the pipework between the filter (or cyclone) and each shaft seal and these shall be incorporated into a protection loop to prevent dry running.

Stainless steel ball isolation valves shall be provided in suitable positions to enable the filter (or cyclone) and the flow indicator to be serviced without having to shut the pump's isolation valves. Valves shall be lockable in the open position. If a cyclone is used, its discharge shall be piped to return to the suction pipework. Pipework shall be of stainless steel, rigidly supported.

C3.3.2.7.9 ZUT 5019.9 BEARINGS

C3.3.2.7.9.1 ZUT 5019.9.1 GENERAL

Bearings shall comply with the clause "Bearings" in ZUT 0001.

Bearings for units with prime movers of 500 kW and larger shall be slide bearings. For smaller units, if the type of bearing required for the pump is not specified in the tender document, then the bearings shall be of the type recommended by the pump manufacturer.

C3.3.2.7.9.2 ZUT 5019.9.2 ROLLING ELEMENT BEARINGS

Rolling element bearings shall be designed for an L-10 life of not less than 100 000 hours.

Bearings shall be oil lubricated and the oil bath shall be provided with a level sight glass.

If the Engineer agrees, in writing, that the bearings may be grease lubricated, then the bearing grease chamber shall be provided with a stainless steel nipple and a port for the exhaust of excess grease.

C3.3.2.7.9.3 ZUT 5019.9.3 SLIDE BEARINGS

Slide bearings shall preferably be configured for air cooling and oil-ring lubrication but more complex methods of cooling and lubrication are acceptable if recommended by the pump manufacturer.

C3.3.2.7.10 ZUT 5019.10 PLINTH AND BASEPLATE

The Contractor shall be responsible for designing the reinforced concrete pump set plinth and shall submit the design calculations to the Engineer for approval prior to construction by others. The calculations shall confirm that the pump set's enforcing vibration will cause no damaging resonant condition and that it is suitable for the ground conditions.

The Contractor shall anchor the pump baseplate to the plinth and shall submit this design to the Engineer for approval.

Baseplates shall be hot-dip galvanised and shall comply with the clause "Baseplates" in ZUT 0001. An inspection of the baseplate will be done after fabrication is complete but before galvanising. Baseplates for pump sets up to 1 000 kW shall have both pump and motor mounted on a single baseplate. Separate baseplates or sole plates may be used for pump sets above 1 000 kW.

C3.3.2.7.11 ZUT 5019.11 MOTOR

Pump motors smaller than 30 kW shall be selected so that the motor power rating is at least 20 % above the shaft power required by the pump for the application. Pump motors of 30 kW and larger shall be selected so that the motor power rating is at least 15 % above the shaft power required by the pump for the application. In variable speed applications, this requirement applies to the specified pump operating point which has the highest shaft power demand.
Motors shall have ingress protection to at least IP 55 and shall comply with the electrical specifications. Motors shall be provided with a tropical rated corrosion protection system.

The motor shall comply with the requirements of the clause "Electric Motors" in ZUT 0001.

C3.3.2.7.12 ZUT 5019.12 FABRICATION

The baseplate and any other fabricated item shall comply with the clauses "Fabrication of Steels" and "Welding" in ZUT 0001.

Fabrications will generally be inspected by the Engineer after fabrication is complete.

C3.3.2.7.13 ZUT 5019.13 MATERIALS

The pump body shall be of grey cast iron, ductile cast iron or of stainless steel.

Pump impellers shall be of grey cast iron, ductile cast iron, CF-8M stainless steel (the cast equivalent of EN Grade 1.4401 (316)) or of aluminium bronze.

The pump shaft shall be of chrome steel or of stainless steel.

Casing wear rings and impeller wear rings shall be provided and they shall be of stainless steel or of a non-ferrous material.

C3.3.2.7.14 ZUT 5019.14 CORROSION PROTECTION

C3.3.2.7.14.1 ZUT 5019.14.1 GENERAL

All components shall be suitably designed for corrosion resistance.

Corrosion Protection shall comply generally with ZUT 0003.

C3.3.2.7.14.2 ZUT 5019.14.2 WETTED SURFACES

Grey cast iron and ductile cast iron wetted parts shall be provided with corrosion resistant coatings over their full wetted surfaces. The coating shall be applied directly to the correctly prepared metal surface. The system's dry film thickness shall be about 500 microns and shall not be less than 450 microns. The system used shall be specifically suitable for pump internals such as a solids bearing vinyl ester acrylic copolymer such as Corrocoat Polyglass VEF or a ceramic coating such as Belzona 1321 or equivalent.

Where abrasion resistance is required, a suitable coating shall be provided over the pump's full wetted surface. The system's dft shall not be less than 1 200 microns. The coating shall be specifically suitable for pump internals such as a solids bearing vinyl ester copolymer of about 1 500 microns such as Corrocoat Armagel, or a ceramic carbide such as Belzona 1811/1812 or equivalent.

The coatings shall be applied in accordance with the coating supplier's method statement.

C3.3.2.7.15 ZUT 5019.15 FASTENERS

Fasteners shall comply with the clause "Fasteners" in ZUT 0001.

Anchor fasteners shall have a minimum diameter of M16.

C3.3.2.7.16 ZUT 5019.16 INSTRUMENTATION

Temperature sensors shall be provided for the pump bearings. High temperature shall cause the unit to trip. The Contractor shall note the equilibrium temperature reached after 30 minutes of normal operation and shall also note the ambient temperature. The high level trip temperature shall then be calculated as follows: Ttrip = Tequilibrium + (40ºC -Tambient) + 10ºC.

One gauge shall be installed on the suction side of each pump. One gauge shall be installed on the discharge side of each pump. One gauge shall be provided on the discharge manifold. If the suction pipework is manifolded, one gauge shall be provided on this manifold. All gauges shall be selected to suit the design pressure range and shall comply with the clause "Gauges" in ZUT 0001.

The gauges shall be positioned in order to achieve stable operation.

The discharge gauge shall be provided with a ring manifold incorporating four static pressure tappings in accordance with SANS 9906.

Instrumentation shall comply with the clause "Instrumentation" in ZUT 0001.

C3.3.2.7.17 ZUT 5019.17 AUXILIARY EQUIPMENT

A small diameter stainless steel air release cock shall be provided at the high point on each pump's casing, on each pump's suction line and on each pump's discharge line.

Drains consisting of a small bore stainless steel ball valve shall be provided. One shall be provided on the suction side and one on the discharge side. The take-off points shall be of stainless steel and the surrounding area shall be adequately corrosion protected.

The pump nameplate shall be of stamped or engraved stainless steel and shall include the manufacturer, model, year, serial number, inlet diameter, outlet diameter, duty point head and flow (or range), impeller diameter, speed, maximum allowable casing pressure and mass.

C3.3.2.7.18 ZUT 5019.18 DELIVERY AND INSTALLATION

Equipment shall be mounted firm and level.

When assembled pumps are transported, care shall be taken to prevent damage to bearing elements. Either the shaft shall be secured against relative movement or the pump base shall be mounted on suitable anti-vibration mounts during transport.

Auxiliary small bore pipework, including fittings, shall be of stainless steel. Flexible lengths shall be of stainless steel braided hose.

Manual drain valves shall be provided at all low points in pipework.

Installation work shall comply with the clause "Installation" in ZUT 0001.

C3.3.2.7.19 ZUT 5019.19 SAFETY

All rotating elements shall be guarded in accordance with legislation and it shall not be possible to insert a hand or finger to come into contact with moving parts.

Each pump set shall be provided with an emergency stop station in an appropriate position.

C3.3.2.7.20 ZUT 5019.20 INSPECTIONS

The pump shall be inspected at the factory. The impeller shall be available for inspection. This shall be done prior to payment being made.

If the equipment is manufactured and assembled in South Africa, the Contractor shall make all arrangements and carry all costs for the Engineer to inspect equipment and fabrications in the workshop prior to dispatch to Site. Fabrications shall be inspected prior to corrosion protection.

If the equipment is manufactured and assembled outside South Africa, the Contractor shall make all arrangements and carry all costs for an Engineer approved inspection authority to inspect the equipment in the workshop prior to dispatch. The inspection shall include a full report on compliance of the equipment with this specification and this report shall be submitted to the Engineer prior to dispatch of the unit from the workshop.

C3.3.2.7.21 ZUT 5019.21 TESTING REQUIREMENTS

C3.3.2.7.21.1 ZUT 5019.21.1 GENERAL

The Contractor shall demonstrate the correct operation of the equipment and achievement of the specified performance requirements shall be demonstrated to the Engineer prior to the commissioning of the Works.

The Contractor shall be responsible for all costs relating to the Engineer's witnessing of any factory testing which is specified.

The Contractor shall measure the power demand for the motor measured on Site in order to confirm that the specified motor power margin has been obtained.

The Contractor shall submit reports for all specified tests to the Engineer prior to the equipment being delivered to Site.

C3.3.2.7.21.2 ZUT 5019.21.2 PUMPSETS OF 300 kW AND ABOVE

The Contractor shall make all arrangements for the Engineer to witness the following for pumps with motor ratings of 300 kW and above:

a) the casing being pressure tested to 1,5 times design pressure for a period of 30 minutes.

b) the pump performance testing for flow, head, and efficiency at the specified duty point. The pump test shall be performed in accordance with ISO 9906 Grade 1; preferably at the manufacturer's works.

The Contractor shall submit the test report to the Engineer for approval of the results.

C3.3.2.7.21.3 ZUT 5019.21.3 PUMPSETS SMALLER THAN 300 Kw

The Contractor shall arrange that a test report for the following shall be submitted to the Engineer for pumps with motor sizes smaller than 300 kW:

a) the casing being pressure tested to 1,5 times design pressure for a period of 30 minutes.

b) the pump performance testing for flow, head, and efficiency at the specified duty point. The test shall be performed in accordance with ISO 9906 Grade 1 for pumps with motor sizes of 75 kW and above and in accordance with ISO 9906 Grade 2 for pumps with motor sizes below 75 kW.

If it is required that the Engineer witnesses the testing of pump sets smaller than 300 kW, this will be specified elsewhere.

C3.3.2.7.22 ZUT 5019.22 MEASUREMENT AND PAYMENT

The tendered rates or sums shall cover the cost of anything not specially mentioned, but which an experienced contractor can reasonably foresee as being required to enable the apparatus and Plant to be installed and/or function safely and correctly as specified. No claims whatsoever for extras will be allowed on the grounds that a necessary piece of Plant or part thereof is not specifically mentioned in the Bill of Quantities.

C3.3.2.7.22.1 ZUT 5019.22.1 Supply and Delivery……Unit: Number (No.)

The rates tendered shall include full compensation for the supply and delivery of plant to Site including supply of raw materials and bought-out items and associated operating Plant items; fabrication, manufacture and assembly; quality assurance and quality control; inspection and Factory Acceptance Testing (including attendance on inspections and tests witnessed by the Engineer); type and routine tests; application of finishes (painting and corrosion protection); trial erection and dismantling; preparation and packing for transport; transport from place of manufacture to the Site; insurance, harbour dues etc., during transport; loading and unloading; storage under appropriate conditions from date of delivery until commencement of erection; and any other work as specified. Payment will be made per unit. Payment will only be effected after full compliance of the items with this Section and associated documentation has been approved by the Engineer.

C3.3.2.7.22.2 ZUT 5019.22.2 Installation, Testing and Commissioning……Unit: number (No.)

The rates tendered shall include for full compensation for the installation, testing and commissioning of the plant on Site including the provision of all labour, transport, materials and Temporary Works necessary to install the complete Works; on-site quality assurance and quality control, inspection, testing (including attendance at tests witnessed by the Engineer); the installation of all auxiliary items; necessary for the operation of the installation until taken over by the Client; the putting into service of the complete installation of the Plant; and any other work as specified.

The rate shall also include for submission of O&M Manuals, all commissioning testing and the provision of equipment therefore including all disruptions to installation caused by such testing. Payment will be made per unit. Payment will only be effected after full compliance of the items with this Section and associated documentation has been approved by the Engineer.

C3.3.2.8 ZUT 5020 SUBMERSIBLE AND IMMERSIBLE CENTRIFUGAL PUMPS

C3.3.2.8.1 ZUT 5020.1 SCOPE

ZUT 5020 specifies the standard requirements for submersible and immersible centrifugal pumps.

The equipment installation to be provided shall be configured as shown on any applicable tender drawings.

The scope of work for a particular contract is specified elsewhere.

C3.3.2.8.2 ZUT 5020.2 NORMATIVE REFERENCES

Where this specification is required for a project, the following documents shall, inter alia, form part of the Contract Document:

a) Amendments.

b) Data Sheets.

c) ZUT 0001: General Mechanical Requirements.

d) ZUT 0003: General Corrosion Protection for Pipelines, Water and Wastewater Works.

e) ZUT 7001: Design and Manufacture of Medium-Pressure Steel Specials.

f) ZUT 7024: Pipe Supports.

Equipment, materials and operational methods shall comply with the latest edition of relevant national and/or international standards.

C3.3.2.8.3 ZUT 5020.3 GENERAL

C3.3.2.8.3.1 ZUT 5020.3.1 EQUIPMENT ELIGIBILITY

Equipment shall have a successful record of use in South Africa. Equipment shall also have had at least three years of technical support in South Africa. Upgraded versions of a manufacturer's existing designs which comply with these two criteria are also eligible.

Equipment which does not satisfy these requirements is not acceptable unless specifically called for in the specifications or unless the Engineer agrees in writing.

C3.3.2.8.3.2 ZUT 5020.3.2 CIVIL AND BUILDING MATTERS

As required in terms of the General Conditions, the Contractor shall:

- provide the details of all civil and building requirements to the Engineer for incorporation into the structure,
- measure on Site,
- ensure that the design can accommodate a tolerance of +/- 40 mm for civil and building items constructed by others (unless a tighter tolerance is called for by the Contractor and approved by the Engineer).

C3.3.2.8.4 ZUT 5020.4 PERFORMANCE REQUIREMENTS

The site specific duty points are specified elsewhere.

The specified operating conditions shall be within the pump manufacturer's recommended operating range for the pump as tendered. This applies whether there will be one operating point or multiple operating points or a range of operating points.

No perceptible sign of cavitation shall be present across the full specified operating range.

Pumps handling wastewater, primary sludge, activated sludge or similar products shall be capable of handling a solid size of 100 mm diameter and shall be capable of dealing with rags, hard solids, stringy solids, plastic and other solids which can be expected from a mixture of domestic and industrial wastewater.

C3.3.2.8.5 ZUT 5020.5 OPERATION AND CONTROL

The requirements for the normal operating system for the equipment installation are specified elsewhere.

The Contractor shall provide the following specific requirements:

- Protections shall be active during manual operation.
- Manual start and stop of each item of equipment shall be provided.
- The equipment shall be designed to shut down safely and without damage upon failure of the electrical supply.
- The motor shall be shut down automatically in the event of leakage into the separation chamber.
- The motor shall shut down automatically in the event of overheating of stator windings.

C3.3.2.8.6 ZUT 5020.6 PUMP

C3.3.2.8.6.1 ZUT 5020.6.1 GENERAL

Pumps handling wastewater, primary sludge, activated sludge or similar products shall be of the non-clog type.

Constant speed pumps shall be selected to operate to the left of best efficiency at the specified duty point and the pump shall permit an increase in flow of 20 % above the duty point flow without operating outside the manufacturer's recommended range for continuous pump operation.

The motor shall be close coupled to the pump and shall be separated from the pump by a chamber which is provided with a water ingress sensor. Mechanical seals shall isolate this separation chamber. The seal between the separation chamber and the pumped liquid shall have silicon carbide faces.

Pumps required for abrasive duties such as wastewater and sludges shall be designed for abrasion resistance. Low operating speeds are preferred. The casing or casing liner shall be of an abrasion resistant material and shall either incorporate a replaceable liner or shall permit easy adjustment of the clearance.

Preference shall be given to pumps whose speed does not exceed 1 500 rpm.

C3.3.2.8.6.2 ZUT 5020.6.2 SUBMERSIBLE PUMPS

Submersible pump sets shall be suitable for permanent submersion at the depth specified and in accordance with the drawings.

Pump sets shall operate in vertical position and shall be suitable for being lowered into position onto a duckfoot bend via guides. The guides, the duckfoot and the vertical pipework shall be provided and installed by the Contractor.

C3.3.2.8.6.3 ZUT 5020.6.3 IMMERSIBLE PUMPS

Immersible pump motors shall be provided with an integral jacket cooling system designed for non-immersed operation at full power.

The cooling fluid shall be self-contained; i.e. shall not rely on external cooling flow. The cooling fluid shall inhibit corrosion and it shall not be the pumped liquid. Positive circulation of the cooling fluid within the jacket is preferred.

Pump sets shall also be suitable for permanent submersion. Ingress protection shall be to IP 68.

C3.3.2.8.6.4 ZUT 5020.6.4 DRAINAGE PUMPS

Permanently installed drainage pumps shall be provided for applications involving seepage or leakage into rooms and chambers which do not have gravity drainage.

Pumps shall be of the free standing, submersible, sewage, heavy construction, cast iron type. Drive motors shall be three phase units with oil bath and shall have protection to IP 68. The shaft shall be of stainless steel. Switching shall be done in accordance with liquid level by a float switch on cable or by vertically mounted moisture probes (pivoting arms attached directly to the pump are not acceptable).

C3.3.2.8.7 ZUT 5020.7 STEEL PIPEWORK

Steel pipework shall comply with the requirements for steel pipework in ZUT 0001.

Pipe supports shall comply with ZUT 7024.

C3.3.2.8.8 ZUT 5020.8 MOTORS

The motor shall comply generally with the requirements for electric motors in ZUT 0001 but shall be close coupled to the pump and shall be of the submersible or immersible type and suited to the application.

The continuously rated output of motors shall exceed the driven unit's shaft power required at maximum duty and at the worst operating condition by not less than 20 %.

C3.3.2.8.9 ZUT 5020.9 INSTRUMENTATION

An hour meter which cannot be reset shall be provided for each pump.

Instrumentation shall comply with the requirements for instrumentation in ZUT 0001.

Each pump shall be provided with a discharge pressure gauge and the manifold shall be provided with one pressure gauge. Gauges shall comply with the requirements of ZUT 0001 and shall incorporate diaphragm seals unless the pumped fluid is treated water.

C3.3.2.8.10 ZUT 5020.10 SPARES

The spares which are to be provided are specified elsewhere.

C3.3.2.8.11 ZUT 5020.11 MATERIALS AND COATINGS

The Contractor shall provide the following:

ITEM	MATERIAL	COATING
Impeller	Cast iron, bronze, CF8M (stainless steel) or nickel aluminium bronze	NON-ABRASIVE: Not required. ABRASIVE: As per note #1.
Shaft	Martensitic stainless steel	
Fasteners	EN Grade 1.4401 (316)	
External metal components	EN Grade 1.4401 (316)	
Pump casing	WATER: Cast iron. WASTEWATER & SLUDGE: High chrome iron; or, Close grained cast iron with abrasion resistant liner	EXTERNAL Heavy duty epoxy or polyurethane coating system with a minimum thickness of 300 micron
		INTERNAL, NON-ABRASIVE: As for external
		INTERNAL, ABRASIVE: As per note #1 below
Motor casing	Stainless steel; or, High quality, close grained cast iron	As for pump external surface (above)
Slide shoe	Cast iron	
Guides for slide shoe	Stainless steel	
Duckfoot	Cast iron	
Chain	Stainless steel	
#1 If abrasion resistance is required, the impeller and body shall be provided with a specialist abrasion resistant coating. The system's dft shall be about 1 500 microns and shall not be less than 1 200 microns. The coating shall be specifically suitable for abrasion resistance in pump internals such as a solids bearing vinyl ester copolymer of about 1 500 microns such as Corrocoat Armagel, or a ceramic carbide such as Belzona 1811/1812 or equivalent. This requirement applies to all internal surfaces of pipework. It includes the outer surface of plain ended pipes for at least 100 mm. It also includes the faces of flanges.		
#2 Materials shall comply with the requirements of ZUT 0001.		
#3 Corrosion protection shall comply with ZUT 0003.		
# Stainless steel shall be correctly pickled and passivated. All stainless steel surfaces shall be completely clear of ferrous stain at commissioning.		

C3.3.2.8.12 ZUT 5020.12 INSTALLATION

C3.3.2.8.12.1 ZUT 5020.12.1 GENERAL

Installation work shall comply with the requirements for installation in ZUT 0001.

C3.3.2.8.12.2 ZUT 5020.12.2 INSTALLATION REQUIREMENTS FOR DRAINAGE PUMPS

The discharge pipework for drainage pumps shall be rigidly supported at distances which comply with the requirements of ZUT 7024.

The discharge pipework shall incorporate a check valve on the initial upward run of pipework.

The pump's discharge shall be connected to the discharge pipework via a clear flexible hose. It shall be possible to remove the pump and the check valve without damaging the pipework. The connections shall, however, be securely coupled and to the approval of the engineer.

The diameter of the discharge pipework shall preferably be of the same diameter as the pump outlet.

Discharge pipework shall be sloped up away from the pump except for a final straight run down to the outlet.

The discharge point will be indicated by the Engineer.

C3.3.2.8.13 ZUT 5020.13 SAFETY

C3.3.2.8.13.1 ZUT 5020.13.1 GENERAL

Each pump set shall be provided with an emergency stop station in an appropriate position.

C3.3.2.8.13.2 ZUT 5020.13.2 HAZARDOUS LOCATIONS

The Contractor shall design and install all equipment installations in accordance with the requirements of SANS 10108 as applicable.

C3.3.2.8.14 ZUT 5020.14 INSPECTIONS

The Contractor shall make arrangements for the Engineer to inspect the pump sets for compliance prior to payment being made.

C3.3.2.8.15 ZUT 5020.15 TESTING REQUIREMENTS

C3.3.2.8.15.1 ZUT 5020.15.1 FACTORY

The Contractor shall be responsible for all costs relating to the Engineer's witnessing of factory testing specified.
The Contractor shall submit reports for all factory tests to the Engineer prior to the equipment being delivered to Site.

C3.3.2.8.15.2 ZUT 5020.15.2 SITE

The correct operation of the equipment and achievement of the specified performance requirements on Site shall be demonstrated to the Engineer prior to the commissioning of the Works.

The power demand for the motor shall be measured on Site in order to confirm that the specified motor power margin has been obtained.

The Contractor shall provide site test reports to the Engineer and shall submit copies in the Manual.

C3.3.2.8.16 ZUT 5020.16 MEASUREMENT AND PAYMENT

The tendered rates or sums shall cover the cost of anything not specially mentioned, but which an experienced contractor can reasonably foresee as being required to enable the apparatus and Plant to be installed and/or function safely and correctly as specified. No claims whatsoever for extras will be allowed on the grounds that a necessary piece of Plant or part thereof is not specifically mentioned in the Bill of Quantities.

C3.3.2.8.16.1 ZUT 5020.16.1 Supply and Delivery…….Unit: number (No.)

The rates tendered shall include full compensation for the supply and delivery of plant to Site including supply of raw materials and bought-out items and associated operating Plant items; fabrication, manufacture and assembly; quality assurance and quality control; inspection and Factory Acceptance Testing (including attendance on inspections and tests witnessed by the Engineer); type and routine tests; application of finishes (painting and corrosion protection); trial erection and dismantling; preparation and packing for transport; transport from place of manufacture to the Site; insurance, harbour dues etc., during transport; loading and unloading; storage under appropriate conditions from date of delivery until commencement of erection; and any other work as specified. Payment will be made per unit. Payment will only be effected after full compliance of the items with this Section and associated documentation has been approved by the Engineer.

C3.3.2.8.16.2 ZUT 5020.16.2 Installation, Testing and Commissioning……...Unit: number (No.)

The rates tendered shall include for full compensation for the installation, testing and commissioning of the plant on Site including the provision of all labour, transport, materials and Temporary Works necessary to install the complete Works; on-site quality assurance and quality control, inspection, testing (including attendance at tests witnessed by the Engineer); the installation of all auxiliary items; necessary for the operation of the installation until taken over by the Client; the putting into service of the complete installation of the Plant; and any other work as specified.

The rate shall also include for submission of O&M Manuals, all commissioning testing and the provision of equipment therefore including all disruptions to installation caused by such testing. Payment will be made per unit. Payment will only be effected after full compliance of the items with this Section and associated documentation has been approved by the Engineer.

C3.3.2.9 ZUT 7001 DESIGN AND MANUFACTURE OF MEDIUM-PRESSURE STEEL SPECIALS

C3.3.2.9.1 ZUT 7001.1 SCOPE

This Specification covers the design, manufacture and delivery to site of electrically welded low carbon steel specials of outside diameter up to 2 280 mm, for transporting water and sewage at ambient temperatures and under working pressures of up to 2,5 MPa.

This Specification shall be read in conjunction with SANS 1200 L. Where conflict between this specification and SANS 1200 L occurs, the provisions of this specification shall apply.

Interpretations and variations of this specification are set out in the Amendments preceding this Specification.

C3.3.2.9.2 ZUT 7001.2 NORMATIVE REFERENCES

C3.3.2.9.2.1 ZUT 7001.2.1 SUPPORTING SPECIFICATIONS

Where this Specification is required for a project, the following specifications shall, inter alia, form part of the Contract Document:

a) Amendments;

b) SANS 1200 Series of Standardized Specifications;
   i) SANS 1200 L: Medium-pressure pipelines (see 1. above)

c) Specification ZUT 0003: Painting and corrosion protection for water and wastewater works

d) Specification ZUT 7003: Laying, jointing, and testing of medium-pressure steel pipes and specials

The latest issues of the specifications listed in Appendix A shall be deemed to apply to the design and manufacture of welded steel specials manufactured using approved welding techniques.

C3.3.2.9.3 ZUT 7001.3 DEFINITIONS AND ABBREVIATIONS

C3.3.2.9.3.1 ZUT 7001.3.1 DEFINITIONS

For the purposes of this Specification the definitions and abbreviations given in the applicable clauses of the specifications listed in 2.1 and the following definitions shall apply:

Cut-and-shut bend	:	A bend formed by cutting out one or more V-shaped sections equally disposed about a line at right angles to the axis of the pipe, preparing the cut-out edges for welding; bending the pipe to form the bend and welding the pipe shut along the prepared edges to complete the bend (see BS 2633, Fig 25)
Fitting	:	a) A special or valve. b) Any process of jointing (except welding) straight pipes to one another and to specials and valves.
Flexible pipe	:	A pipe of which the diameter is reduced by more than 1% under an external radial force before the appearance of cracks.
"H"	:	The cross-sectional shape of a weld at a skelp.
Manual shielded electric arc process welding	:	Electric arc welding done by hand using a filler electrode coated with a material that gasifies at the point of arc and excludes oxygen from the weld, thus improving the metallurgical quality of the completed weld.

Mitre welds	:	Welds which join two lengths of pipe at an angle point in such a manner that the axis of both lengths of pipe proceed in a straight line to the point of intersection.
Nominal diameter (size)	:	A numerical designation of diameter which is common to all components in the piping system other than components designated by OD or by thread size. It is a convenient round number for reference purposes and is only loosely related to manufacturing dimensions.
Nominal pressure	:	A numerical designation which is a convenient round number for reference purposes. All equipment of the same DN designated by the same PN number shall have compatible mating dimensions.
Pinhole	:	A very small hole indicating a flaw in the weld.
Pipe end bevel	:	A bevel cut made on the end of a pipe to afford a groove between abutting joints in order to receive weld metal.
Pipework	:	Includes all pipes, joints, specials, fittings and valves.
Skelp	:	The jointing edges of steel coils used in the manufacture of spiral welded pipe.
Special	:	Any pipe other than a straight pipe. Note: Under this definition shall be included all sizes of specials of shapes such as bends, tees, crosses, angle branches, reducers, tapers and flexible couplings with or without centre registers.
Straight pipe	:	A straight pipe of uniform bore and of standard or non-standard length.
Welding icicles	:	Congested droplets of metal which extend through the weld to the interior of the pipe, caused by excessive heat or improper welding technique.

C3.3.2.9.3.2 ZUT 7001.3.2 ABBREVIATIONS

The following abbreviations (additional to those referred to in 3.1) shall have the meanings given:

AISI	:	American Iron and Steel Institute
DN	:	Nominal diameter (e.g. DN 200 = 200 mm nominal diameter)
DS-AW	:	Double submerged-arc welded
FBE	:	Flanged both ends
FOE	:	Flanged one end
ID	:	Internal diameter
MS	:	Mild Steel
OD	:	Outside diameter, which shall mean the internal diameter + 2x (lining thickness + pipe wall thickness)
p.e.	:	Plain ended
PN	:	Nominal working pressure (e.g. PN 10 = 1 000 kPa)

Scab : Unbonded piece of plate in tight contact with the plate

SS : Stainless Steel

t : Wall thickness of pipes

TP : Test pressure

WP : Weld preparation

C3.3.2.9.4 ZUT 7001.4 REQUIREMENTS

C3.3.2.9.4.1 ZUT 7001.4.1 MATERIALS

C3.3.2.9.4.1.1 ZUT 7001.4.1.1 General

Specials and fittings shall be of the types shown on drawings or billed and, unless otherwise required in terms of the Amendments, they and their couplings shall be capable of withstanding the applicable test pressure. All specials and fittings shall be supplied complete with couplings and jointing material.

C3.3.2.9.4.1.2 ZUT 7001.4.1.2 Types of steel

Unless otherwise billed or shown on drawings, specials and fittings shall be manufactured from the following materials:

C3.3.2.9.4.1.2.1 ZUT 7001.4.1.2.1 Nominal diameter equal to or less than 150 mm

Medium or heavy class steel, complying with the applicable requirements of SANS 62.

C3.3.2.9.4.1.2.2 ZUT 7001.4.1.2.2 Mild steel

Steel grade	Minimum Yield Stress (MPa)	Chemical Composition and Physical Properties
B	241	SANS 719, Table 1
300WA	300	SANS 1431
X42	289	API 5L Table 3.1 & 4.1
X46	317	API 5L Table 3.1 & 4.1
X52	358	API 5L Table 3.1 & 4.1
X56	386	API 5L Table 3.1 & 4.1
X60	413	API 5L Table 3.1 & 4.1
X65	450	API 5L Table 3.1 & 4.1

C3.3.2.9.4.1.2.3 ZUT 7001.4.1.2.3 3CR12 Corrosion resistant steel

3CR12 corrosion resistant steel plate shall have a No.1 finish and shall be supplied ex-factory ready pickled and passivated.

C3.3.2.9.4.1.2.4 ZUT 7001.4.1.2.4 Stainless steel

Stainless steel shall be either EN Grade 1.4301 (304L stainless steel) or EN Grade 1.4401 (316L stainless steel).

C3.3.2.9.4.1.2.5 ZUT 7001.4.1.2.5 Super duplex stainless steel

Duplex stainless steel shall be either EN Grade 1.4162 (2101) or EN Grade 1.4462 (2205). Super Duplex stainless steel shall be EN Grade 1.4410 (2507).

C3.3.2.9.4.1.3 ZUT 7001.4.1.3 Flanges

Flanges on pipe ends, where applicable, shall be manufactured from the same material as the pipe, unless otherwise specified in the Amendments.

Where mild steel flanges are specified, flanges shall be manufactured from steel plate conforming to BS 4360 or SANS 1431 Grade 300W for working pressures up to PN 25. Flanges rated more than PN 25 and up to PN 60 shall be made from steel manufactured in accordance with BS EN 10222 Grade 460 or as approved. Flanges for pressures exceeding PN 60 and up to PN 250 shall be special flanges and gaskets manufactured by Hydro Power Engineering or equal approved.

C3.3.2.9.4.1.4 ZUT 7001.4.1.4 Certification

The Contractor shall submit to the Engineer the steel maker's certificates covering all steel used in the manufacture of the specials as required in Clause 4.4 of SANS 719. In addition, all information relevant to pipework fabrication shall be made available to the Engineer during the course of the manufacturing process.

C3.3.2.9.4.2 ZUT 7001.4.2 DESIGN

C3.3.2.9.4.2.1 ZUT 7001.4.2.1 General

The Contractor shall be responsible for the design of all specials in accordance with the general arrangement shown on the drawings and/or described in the Bill of Quantities and in conformity to BS 534. He shall submit his design calculations and shop drawings to the Engineer for approval before manufacturing commences. The design of saddle type reinforcement shall be in accordance with AWWA M11.

Specials shall be fabricated by welding from pipes which have been tested to SANS 719 and that conform to the requirements applicable to the Manufacture of medium-pressure steel pipes.

Lifting eyes (lugs) shall be welded to all unwieldy specials and to all specials of DN 600 and larger to facilitate handling and minimise damage to the protective coating.

C3.3.2.9.4.2.2 ZUT 7001.4.2.2 Wall thickness

Specials shall be designed so that 50% of the minimum yield stress of the steel is not exceeded under maximum working pressure and so that 75% of the minimum yield stress of the steel is not exceeded under maximum surge pressure.

An OD/t ratio of more than 100 will not be permitted unless specifically indicated otherwise on the drawings or in the Bill of Quantities.

For all branch connections (tees) the plate thickness of the barrel and branch shall be such that the maximum stress shall not be greater than that for an uncut pipe of the theoretical required minimum thickness. Where it is more economical to provide external reinforcement in the form of collar type

rings or crotch plates, as shown on the drawings, these forms of reinforcement shall be used to achieve the same results

C3.3.2.9.4.2.3 ZUT 7001.4.2.3 Bends

Unless otherwise indicated on the drawings or scheduled in the Bill of Quantities, the dimensions for bends shall be determined in accordance with AWWA C208.

Bends shall either be smooth formed (hot bent) or segmented. The maximum angle between oblique butt- ends of segments for mitred bends shall not exceed 22.5º. Cut-and-shut bends are not permitted. Segmented bends shall be classified as short, medium and long with radii equal to one, two or three diameters respectively. All bends shall be of the long radii type, unless otherwise shown on the drawings or specified in the Amendments or Bill of Quantities.

Mitres for bends (kinks) of 10 degrees and less shall be made in the field as part of the pipe laying operation for buried pipelines.

C3.3.2.9.4.2.4 ZUT 7001.4.2.4 Branches and nozzles

The attachment of reinforcement to the pipe branches shall be by full penetration welding. The extent and positioning of external reinforcement is to be determined in accordance with AWWA M11.

Branch connections shall be as remote as possible from the seam weld on the barrel and shall generally be placed as follows, except where specifically indicated to the contrary on the drawings:

a) For air valve tees the centre lines of the air valve branch and the barrel shall intersect at right angles or vertically, as shown on the drawings, depending on the type of tee specified. The branch shall be flanged and have a nominal diameter greater than 50% of the main pipe diameter.

b) For scour valve tees the branch, consisting of a 90-degree bend, shall be located centrally on the pipe invert and point vertically downwards with the horizontal section at right angles to the barrel of the pipeline. The branch flange shall be set so that the scour valve spindle points vertically upwards, as shown on the drawings.

Nozzles shall be “stub in” in accordance with ANSI B31.3 and of minimum size DN25. Such nozzles shall be threaded to BSPT and provided with appropriate reinforcement. The Contractor shall ensure that the design will withstand the test pressure of the system.

C3.3.2.9.4.2.5 ZUT 7001.4.2.5 Reducer pieces

Taper pieces shall not have more than two longitudinal weld seams and shall have a maximum angle of divergence of 10 degrees, as shown on the drawings.

C3.3.2.9.4.2.6 ZUT 7001.4.2.6 Pipe supports

Supports for pipework, valves and specials inside chambers and pump stations shall be designed by the Contractor to adequately secure the pipework to the walls and floors. Details and locations of the supports shall be submitted for approval by the Engineer.

C3.3.2.9.4.2.7 ZUT 7001.4.2.7 Dimensions

The dimensions of the pipe specials and fittings are shown on the drawings.

C3.3.2.9.4.2.8 ZUT 7001.4.2.8 Provision of cadwelding pads

Where specials are to be jointed by means of flexible couplings the manufacturer shall weld steel plates not less than 50 x 75 x 6 mm thick, 250 mm from each end of all pipes, during the pipe manufacturing process (i.e. before lining and coating) to provide adequate area for cadwelding bonding cables to the piping to make it electrically continuous and enable a cathodic protection system to be applied without damage to the coating.

C3.3.2.9.4.2.9 ZUT 7001.4.2.9 Shop drawings

The Contractor shall, before issuing of shop drawings for manufacture, provide detailed pipework layout drawings for approval in principle by the Engineer. Such drawings shall contain general arrangements and assemblies for the pipes, pipe auxiliaries, pipe specials and valves and include materials schedules, standard parts, etc. Drawings shall provide all the information necessary to demonstrate full compliance with the drawings and specifications and to facilitate subsequent submission of shop drawings free of fit-up error. The Contractor shall be fully responsible for determining the actual dimensions of the specials.

Pipe layout drawings shall incorporate all relevant prime and subsidiary dimensions (primarily, but not necessarily limited to, face-to-face dimensions).

Drawings shall be prepared to acceptable industry standards, an example of which shall be submitted for approval before draughting commences. Due account is to be taken in preparing drawings of the necessity, inter alia, to facilitate straight-forward subsequent fit-up on site, without undue site trimming and site preparation for butt welding, so minimizing also the necessity for extensive site repairs to, or extensions of, internal and external corrosion protection.

Only after approval of final pipework layout drawings by the Engineer shall shop drawings for manufacture of pipes and specials commence. For subsequent approval by the Engineer these shall be in such detail as is appropriate for manufacture. No manufacturing of pipework shall be permitted without approval of the shop drawings by the Engineer.

Approval by the Engineer of any drawing shall not relieve the Contractor of responsibility for correct manufacture and subsequent fit-up on site.

C3.3.2.9.4.3 ZUT 7001.4.3 JOINTING

C3.3.2.9.4.3.1 ZUT 7001.4.3.1 Flexible couplings

Flexible couplings for plain-ended steel pipe and adaptor couplings shall be either of the slip-on type complying with Clause 15 of BS 534 or of the slip-on type without centre register conforming to the drawings, as scheduled. Slip-on flange adaptors for steel pipes shall conform to the relevant drawings.

A coupling shall be able to withstand without failure a hydrostatic test pressure of twice the working pressure specified for the pipe for which the coupling is required, and coupling flanges shall be capable of withstanding without damage all stresses caused by proper tightening of the bolts. Rubber rings shall comply with the relevant requirements of SANS 974: Part I and shall have a hardness of 66 to 75 IRHD.

All grinding off of welds shall conform accurately with the profile of the rolled section and so that no flats occur on surfaces that are supposed to be curved. The centre register (where present) shall be ground off on either side of the weld in such a manner that all sharp edges which would result in weakening of the protective coating are removed. Flexible couplings shall be supplied complete with all necessary bolts, nuts and rubber jointing rings.

C3.3.2.9.4.3.2 ZUT 7001.4.3.2 Flanges

Flanges shall be designed and manufactured to BS EN 1092 Part 1 for steel flanges and Part 2 for cast iron flanges, unless otherwise specified on the Drawings. Flanges not covered by BS EN 1092 shall be manufactured according to the detailed dimensions and requirements shown on the Drawings.

All flanges shall be suitable for Site welding (SW) to pipes and specials and shall conform to BS 2633, Section 7 with preparation of plate flanges as shown in Fig 41 ("slip-on") for pipes and specials up to DN 100 and Fig 39 or 40 ("bore and fillet") for pipes and specials DN 125 and larger.

The drilling of steel and cast iron flanges shall be off-centre and shall conform to the requirements of SANS 1123, BS EN 1092: Section 3.1, or ISO 7005: Part 1 as applicable, appropriate to the class of pipe specified, except that in the case of flanges, where M27 and M33 bolts are specified in BS EN 1092: Section 3.1, M24 and M30 bolts respectively shall be used as specified in SANS 1123.

Any pipe that has flanges which are incorrectly drilled will be rejected. Reaming of bolt holes to oversize dimension in order to make a particular piece fit will not be permitted.
All flanges shall be machined overall with gramophone finish in accordance with SANS 1123, or as specified below:

a) Flange sizes up to and including DN 400 with a pressure rating up to and including 1600 kPa shall have flat joint faces, and where the pressure rating exceeds 1600 kPa, shall have a raised face sealing arrangement;

b) Flange sizes exceeding DN 400 up to and including DN 1000 shall have a raised face sealing arrangement for all pressure ratings up to and including 2500 kPa.

For flanges not covered by BS EN 1092, and for domes and conical ends, thicknesses shall be calculated and where applicable the flanges manufactured in accordance with Section 3 of BS 5500.

C3.3.2.9.4.3.3 ZUT 7001.4.3.3 Insulated flanges

Where called for, insulating flanges and materials shall be arranged as set out in Code of Practice No. SAECC/1 or SANS 15589-1.

The design, manufacturing, supplying, installation and testing of the insulating flanges complete with spark gap arrestors shall be in accordance with drawing no. 1A-C6-066 and to the approval of the Engineer. Insulating flanges shall be provided at locations as indicated on the Drawings.

All insulating gaskets, irrespective of pressure rating, shall be full-face gaskets to prevent foreign material from collecting and creating a bridge, thus shorting out the isolation.

C3.3.2.9.4.3.4 ZUT 7001.4.3.4 Loose flanges

Loose flanges for welding onto steel pipes on Site shall be manufactured from at least the same steel as specified for the pipes and shall be in accordance with SANS 1123 where applicable (see also 4.3.2), or alternatively in accordance with BS EN 1092.

Loose flanges shall be suitable for field welding to pipes and specials and shall conform to 4.3.2 in respect of attachment.

C3.3.2.9.4.3.5 ZUT 7001.4.3.5 Gasketing

Each flanged pipe and fitting of less than DN 400 and rated for PN 16 or less shall be supplied complete with one insertion piece (gasket) of the appropriate diameter and made of a material that is suitable for the maximum test pressure, and one set of bolts, nuts and washers.

Unless otherwise specified in the Amendments, asbestos gaskets in accordance with BS 1832 Grade B, and having a minimum thickness of 1,5 mm, shall be supplied for working pressures not exceeding PN 16.

Where working pressures exceed PN 16, and for DN 400 and over, rubber "O" rings dimensioned in accordance with BS EN 1092 Section 3.1, Fig. 4 for Types G and H flanges, shall be supplied to suit appropriately machined flanges.

Where flanges have not been machined in accordance with the above, spiral wound gaskets, style CG to BS 3381 shall be used. The external ring shall be made of carbon steel and electro plated. The metal windings shall consist of Grade 316 L stainless steel with asbestos filler.

Where flanges with flat faces as specified in 4.3.2, paragraph 1, are jointed, the gaskets shall be of the type manufactured by HPE and as specified below:

The gasket shall consist of a seal ring made from ultra-high molecular weight polyethylene (UHMWPE) (section 10 mm x 5 mm minimum) which fits snugly inside a 3 mm thick x 30 mm wide (minimum) flat steel outer ring. The reuse of UHMWPE seal rings is inadmissible.

The outer ring shall consist either of:

a) A mild steel ring, hot-dip galvanized in accordance with SANS 121 to a minimum mean coating thickness of 65 µm. The finish shall be of even thickness to ensure that the ring bears evenly throughout between the two flanges.

   Or

b) A 3CR12 steel ring where specified in the Amendments.

C3.3.2.9.4.3.6 ZUT 7001.4.3.6 Bolts, nuts, and washers

Bolts and nuts shall comply with the relevant requirements of SANS 1700 or, where high strength friction grip bolts are specified in the Amendments or considered necessary by the Contractor, the bolts shall comply with the requirements of BS 3139, and their use and design shall be as specified in BS 3294: Part 1 and BS 4604.

Locking devices for nuts shall be provided wherever there is a possibility of the nuts becoming loose during service. Bolts shall be of sufficient length for at least two screw-threads to protrude from the nut when assemblies are fully tightened. Two washers complying with SANS 1700 shall be supplied with each bolt.

All bolts, nuts and washers shall be of a material with equal or better corrosion properties than the pipe materials being joined. All anchor bolts and nuts shall be Grade 316 stainless steel or as approved.

C3.3.2.9.4.3.7 ZUT 7001.4.3.7 Screwed joints

The threads for screwed joints shall comply with the relevant requirements of SANS 1109. Male ends shall have taper threads and female ends shall have parallel threads.

C3.3.2.9.4.3.8 ZUT 7001.4.3.8 Plain ended specials

Each plain ended or spigot ended special, as shown on the drawings, shall be supplied with one sleeve coupling (or such other type of coupling as is shown on the drawings) to suit the particular pipe with which the special mates. The coupling shall fit the larger end of the barrel in the case of a reducer.

C3.3.2.9.4.4 ZUT 7001.4.4 PLANT

All specials and fittings shall be manufactured in an approved works which has the necessary tools, plant and equipment to manufacture pipework consistently in accordance with the specifications.

Manufacturing at only one works will be permitted. No site fabrication of specials, other than kinks of 10 degrees or less on buried pipelines, will be permitted.

C3.3.2.9.4.5 ZUT 7001.4.5 FABRICATION

C3.3.2.9.4.5.1 ZUT 7001.4.5.1 Qualified welders

Only qualified welders, certified as having passed the qualification tests as specified in Clauses 6.1 to 6.7 inclusive of API Standard 1104 or alternatively, SANS 10044: Part IV, shall be used to do all welding required. Copies of the certificates shall be made available to the Engineer.

C3.3.2.9.4.5.2 ZUT 7001.4.5.2 Welding

Welding and inspection of welds shall be in accordance with Clauses 7 to 11.4 inclusive of API Standard 1104 or alternatively, SANS 10044: Part III. Where radiographic inspection is specified in the Amendments, the procedure followed shall be in accordance with Clause 11.1 of API Standard 1104. Only qualified radiographers as specified in API Standard 1104 shall be employed to do the radiography.

All butt welds and branch fillet welds on specials shall where practicable have an internal weld. The weld bead of this internal weld shall not protrude above the prolongation of the original inside surface of the special by more than 1 mm.

Internal reinforcement in the form of backing rings at weld seams shall not be permitted.

C3.3.2.9.4.5.3 ZUT 7001.4.5.3 Preparation of special ends for:

C3.3.2.9.4.5.3.1 ZUT 7001.4.5.3.1 Mechanical couplings

Ends for use with mechanical couplings shall be square cut or bevelled plain ends, cut square to the pipe axis, with all edge burrs, weld splatter and scratches removed. The outside of the pipe shall be free of indentations, projections or roll marks for a distance of 250 mm from each end to permit proper make-up of the coupling. Longitudinal or spiral welds on the outside of the plain end shall be ground to plate or sheet surface for a minimum distance of 250 mm.

C3.3.2.9.4.5.3.2 ZUT 7001.4.5.3.2 Fillet welds

Ends for use with fillet welded sleeve joints shall be prepared as specified in 4.5.3.1.

C3.3.2.9.4.5.3.3 ZUT 7001.4.5.3.3 Butt welds

Specials which require joints to be butt welded on site shall be supplied with ends bevelled in accordance with the requirements of SANS 719, Clause 5.1.5. Square cut ends will require approval.

For specials to be jointed by butt welding, the internal weld bead shall be ground flush with the internal surface of the pipe or special for a length of 200 mm from the ends to be jointed.

C3.3.2.9.4.5.3.4 ZUT 7001.4.5.3.4 Bevelling

All bevelling, where required, shall be delayed until after all non-destructive testing has been completed.

C3.3.2.9.4.5.3.5 ZUT 7001.4.5.3.5 Flanges

Ends to be fitted with flanges shall have the longitudinal or spiral welds ground to plate or sheet surface for a distance from the ends sufficient to accommodate the flange.

C3.3.2.9.4.5.4 ZUT 7001.4.5.4 Rectification of defects

If a special fails to pass any of the tests specified, it will be rejected but the Engineer may permit repairs or alterations to be made to enable the special to pass the test.

Repairs of welded joints will be permitted during the process of manufacture. Where repairs are required the defective weld metal shall be cut out, and the parent metal prepared by grinding, and re-welded, to the satisfaction of the Engineer.
The repair procedure and performance on repairs shall be in accordance with Section 10 of API Specification 5L where not in conflict with SANS 719. Only qualified welders shall be employed. Each repair weld shall be marked with the welder's identifying stamp.

When the repair has been made, it shall be radiographically tested (X-rayed) over the full length of the repair.

On discovery of defective welds the Engineer may, at his discretion, call for additional radiographic examination until it is shown that the necessary standard is being maintained.

Should a weld repair be required on a special subsequent to hydraulic testing, the repaired special shall be retested in accordance with Clause 5.3.2 Hydraulic testing of this specification.

C3.3.2.9.4.6 ZUT 7001.4.6 COATINGS AND LININGS

Coatings and linings of specials shall be undertaken in accordance with the requirements of Specification ZUT 0003.

C3.3.2.9.4.7 ZUT 7001.4.7 MARKING

Upon fabrication, each special shall be hard stamped with a unique reference number to ensure traceability. The stamp is to be 100mm from the pipe end and next to a weld. On completion of the contract or at reasonable intervals during the contract, the following pipe information shall be supplied to the Engineer in Microsoft Excel ® format:

a) Pipe reference number

b) Contract number

c) Date of manufacture

d) Outside diameter

e) Wall thickness/pressure rating

f) Grade of steel

g) Coating type and nominal thickness

h) Lining type and nominal thickness

i) Mass of uncoated and unlined special in kg/m

j) Applicable drilling tables stamped on the periphery of all flanges

k) Bends shall have their “centre plane” marked with two small punch marks close to both ends of the bends to facilitate correct positioning of the bends during laying.

C3.3.2.9.4.8 ZUT 7001.4.8 STORAGE, HANDLING AND TRANSPORT

C3.3.2.9.4.8.1 ZUT 7001.4.8.1 Handling and rigging

Specials shall be protected against damage at all stages from manufacture to delivery. Particular care shall be taken to protect the ends of all specials against denting.

In the transportation, loading and unloading of specials, an adequate fleet of vehicles shall be operated and maintained at all times to ensure that specials and their protective linings and coatings are not damaged.

Specials shall be so transported, stored and handled that they are not overstressed at any time and fittings are not damaged in any way. All thin-walled and soft-coated specials shall be handled with particular care and shall be so stored that they are not subjected to concentrated pressure from stones or other objects. Specials damaged or cracked in any way shall be removed from the Site at no cost to the Employer.

If cradles are used to transport the specials they must be rubber lined to avoid damage to the coating. During transportation specials shall be safely secured.
The Contractor shall be responsible for dispatching and transporting of the pipes to site and off-loading.

C3.3.2.9.4.8.2 ZUT 7001.4.8.2 Protection of pipe ends

Satisfactory temporary end covers shall be provided for the protection of flanges, prepared ends of plain- ended fittings, and threads, and to prevent damage to the internal lining during transportation and during handling on Site.

C3.3.2.9.4.8.3 ZUT 7001.4.8.3 Material that deteriorate under the action of sunlight

All rubber rings or other materials which will deteriorate under the action of sunlight, ozone or inclement weather, shall be stored in permanent shade in lockable weather-proof sheds. Welding and the running of welding machines and electric machinery shall not be permitted in or near places where rubber or plastic products are stored and care shall be taken at all times to prevent contamination of these products by oil or other petroleum derived products.

C3.3.2.9.5 ZUT 7001.5 COMPLIANCE WITH REQUIREMENTS

C3.3.2.9.5.1 ZUT 7001.5.1 FACILITIES FOR TESTING

The Contractor shall provide at his own cost, all facilities and equipment required for testing and shall carry out all tests at his own expense. Complete records of test results shall be kept.

The testing machines shall be of a design which will allow a steady application of the test pressure and shall be equipped with an accurate pressure gauge. Provision shall be made for expelling all air from any special under test during filling and before application of the pressure.

Test calibration certificates from an independent laboratory, verifying the accuracy of all measuring and testing instruments requiring calibration, shall be provided by the Contractor. Recalibration shall be carried out as necessitated by circumstances but at intervals not exceeding 3 months.

C3.3.2.9.5.2 ZUT 7001.5.2 QUALITY ASSURANCE

All steel specials shall be fabricated and tested in accordance with an approved quality control plan and procedure. The quality assurance of all specials rated over PN 16 shall be in accordance with ISO 9002 and the manufacturer shall be in possession of a current ISO 9002 certificate.

Manufacture shall not commence until such time as the quality control plan and procedure has been approved by the Engineer.

The quality control plan and procedure shall address, as a minimum, the following tests/inspections:

a) Material certification

b) Non-Destructive Evaluation (NDE) testing

c) Verification of tolerances

d) Workmanship

e) Surface preparation (e.g. cleanliness and blast profile for coatings and linings)

f) Material identification

g) Personnel certification (including welders and NDE)

h) Welding procedures and certification

i) Weld preparation

j) Compliance with drawings

k) Hydrostatic testing

C3.3.2.9.5.3 ZUT 7001.5.3 INSPECTIONS

C3.3.2.9.5.3.1 ZUT 7001.5.3.1 Visual inspections

All finished pipework shall be visually inspected and shall be free of injurious defects as defined in API 5L Section 10.7.

C3.3.2.9.5.3.2 ZUT 7001.5.3.2 Hydraulic testing

When all aspects of fabrication have been completed, but before being cleaned, lined or coated, each and every special is to be tested to a hydrostatic pressure test of P,

Where P = the lesser of: 2 x 0.85 x Y x t/D or 7 MPa
Y = Minimum Specified Yield Stress (MPa)
t = Nominal Wall Thickness of pipe (mm)
D = Nominal Diameter of Pipe (mm)

Pipe end plugs shall be restrained during the test to ensure that no longitudinal stresses are induced in the pipe wall. Upon completion of the hydraulic test, the ends of the pipe specials shall be tested by means of Go, No-go gauges to check whether flaring or cupping has occurred. If necessary the ends shall be expanded or ground until they comply with the specification.

The test pressure in the pipe special shall be maintained for at least 10 seconds and thereafter shall be inspected for weeps, leaks or deformation. The special will be deemed defective and may be rejected if any leaks, weeps or deformation are evident. Where defects are repaired, the special shall be re-tested. Should the special, after repair, fail to pass the second hydraulic test the Engineer may order its rejection.

C3.3.2.9.5.3.3 ZUT 7001.5.3.3 Non-destructive testing

Non-destructive testing shall be in accordance with Section 9 of API Specification 5L.

On completion of the hydrostatic testing (see 5.3.2) and before the ends of the specials are bevelled, non-destructive tests shall be carried out on all manual or semi-automatic welds, as follows:

a) All welds shall initially be radiographically tested (X-rayed) over 100% of the weld length. When consistently acceptable results are obtained, the number of welds to be so tested may be reduced on a sound statistically controlled basis by mutual agreement between the Engineer, Inspectorate and Contractor. At least 10% of all welds shall be radiographically tested.

b) Repairs to welds (see 4.5.4), shall be radiographically tested (X-rayed) over the full length of the repair.

Each radiograph, the test-pieces and results and interpretations of examinations and tests shall be submitted to the Engineer within 24 hours of the particular examination or test.

C3.3.2.9.5.3.4 ZUT 7001.5.3.4 Testing of specials

Where hydrostatic testing of specials is not practicable, the welds shall be subjected to 100% dye penetrant tests to determine surface cracks, and/or where ordered by the Engineer, to one of the tests specified in 5.3.3 to determine internal defects. Dye penetrant testing shall be done as specified in Subclause 7.2.1 of SANS 1200 L.

C3.3.2.9.5.3.5 ZUT 7001.5.3.5 Magnetic particle testing

Where requested by the Inspectorate, magnetic particle testing shall be done in accordance with ASME Boiler and Pressure Vessel Code, Section V, Article 7.

C3.3.2.9.5.4 ZUT 7001.5.4 INSPECTORATE

The Engineer may at his sole discretion appoint an independent inspection authority to carry out additional Quality Surveillance at the premises of the manufacturer. The manufacturer shall provide

all facilities and shall facilitate access to their premises at reasonable times as may be necessary for the independent inspectorate to perform its function.

The manufacturer's quality control records shall be available for inspection by the independent inspectorate at all reasonable times, and copies of such records shall be made available on request.

Notwithstanding any surveillance carried out by, or on behalf of the Engineer, the Contractor shall retain full responsibility for the quality of specials supplied.

C3.3.2.9.5.5 ZUT 7001.5.5 MARKING PROCEDURE

All weld lengths to be radiographed shall be clearly marked by the Inspector using his identification symbol. This symbol shall appear on the respective radiograph. The radiographed weld and symbol shall not be obliterated by finishing processes until the respective weld has been accepted by the Inspector.

C3.3.2.9.5.6 ZUT 7001.5.6 COATINGS AND LININGS

The testing of the coatings and linings of specials shall be undertaken in accordance with the requirements of Specification ZUT 0003.

C3.3.2.9.6 ZUT 7001.6 TOLERANCES

Refer to Clauses 4 and 5 above.

C3.3.2.9.7 ZUT 7001.7 TESTING

Refer to Clause 5 above.

C3.3.2.9.8 ZUT 7001.8 MEASUREMENT AND PAYMENT

C3.3.2.9.8.1 ZUT 7001.8.1 BASIC PRINCIPLES

C3.3.2.9.8.1.1 ZUT 7001.8.1.1 Corrosion protection

Unless specific provision is made in the Bill of Quantities, no separate payment will be made for corrosion protection. The rates tendered for item 8.2.1 will be held to cover the cost of any protection system specified.

C3.3.2.9.8.2 ZUT 7001.8.2 BILLED ITEMS

C3.3.2.9.8.2.1 ZUT 7001.8.2.1 Supply of specials

Unit: ……number (No)

Specials will be measured by the number of each type, class, and size.

The unit rates shall cover the cost of the provision of each special, complete with couplings and/or other jointing materials as appropriate, and for the design of all specials including all drawings and shop drawings.

Unless specific provision is made in the Bill of Quantities, no separate payment will be made for the supply and delivery to Site of any additional couplings and jointing materials which may be required for the connection of the specials.

Annexures

APPENDIX A. APPLICABLE STANDARDS

Reference is made to the latest issues of the following standards:

API Specification 5L	American Iron and Steel Institute - Specification for LINEPIPE
API Standard 1104	American Iron and Steel Institute - Standard for welding pipelines and related facilities
ASME	Boiler and Pressure vessels Code, Section V, Article 7
AWWA M 11	Steel pipe - A guide for design and installation (3rd edition)
BS 534	Steel pipes and specials for water and sewage
BS 639	Covered electrodes for the manual metal-arc welding of carbon and carbon-manganese steels
BS 1387	Steel tubes and tubulars suitable for screwing to BS 21 pipe threads
BS 1640	Steel butt-welding pipe fittings for the petroleum industry: Part 1 : Wrought carbon and ferritic alloy steel fittings
BS 1832	Compressed asbestos fibre jointing
BS 2633	Class 1 arc welding of ferritic steel pipe work for carrying fluids
BS 3139	High strength friction grip bolts for structural engineering
BS 3294	The use of high strength friction grip bolts in structural steelwork : Part 1 : General grade bolts
BS 3381	Metallic spiral wound gaskets for use with flanges to BS 1560 : Part 1 and 2
BS 4360	Weldable structural steels
BS 4604	The use of high strength friction grip bolts in structural steelwork (metric series)
BS EN 1092	Flanges and their joints. Circular flanges for pipes, valves, fittings and accessories. Steel flanges
BS EN 10222	Steel forgings for pressure purposes
PD 5500	Unfired fusion welded pressure vessels
ISO 7005	Metallic Flanges: Part 1 : Steel flanges
ISO 9000	Quality management
ISO 9002	Quality systems. Model for quality assurance in production, installation and servicing
SANS 62	Steel pipes Part 1 Pipes suitable for threading and of nominal size not exceeding 150 mm Part 2 Screwed pieces and pipe fittings of nominal size not exceeding 150 mm.
SANS 121	Hot dip galvanized coatings on fabricated iron and steel articles - Specification and test methods
SANS 719	Electric welded low carbon steel pipes for aqueous fluids (ordinary duties)
SANS 974	Rubber joint rings (non-cellular) Part I : Joint rings for use in gas, water, sewer, and drainage systems
SANS 1109	Pipe threads where pressure-tight joints are made on the threads Part 1 Dimensions, tolerances and designation Part 2 Verification by means of limit gauges
SANS 1123	Pipe flanges
SANS 1431	Weldable structural steels
SANS 1476	Fabricated flanged steel pipework
SANS 1700	Fasteners
SANS 10044	Welding
SANS 10121	Cathodic protection of buried and submersed structures
SANS 1200 L	Medium-pressure steel pipelines
SAECC/1	Code of Practice

C3.3.2.10 ZUT 7002 MANUFACTURE OF MEDIUM-PRESSURE STEEL PIPELINES

C3.3.2.10.1 ZUT 7002.1 SCOPE

This Specification covers the design, manufacture and delivery to site of electrically welded low carbon steel pipes of outside diameter up to 2 280 mm, for transporting water and sewage at ambient temperatures and under working pressures of up to 2,5 MPa.

This Specification shall be read in conjunction with SANS 1200 L. Where conflict between this specification and SANS 1200 L occurs, the provisions of this specification shall apply.

Interpretations and variations of this specification are set out in the Amendments preceding this Specification.

C3.3.2.10.2 ZUT 7002.2 NORMATIVE REFERENCES

C3.3.2.10.2.1 ZUT 7002.2.1 Supporting specifications

Where this Specification is required for a project, the following specifications shall, inter alia, form part of the Contract Document:

a) Amendments;

b) SANS 1200 Series of Standardized Specifications;

c) SANS 1200 L: Medium-pressure pipelines (see 1. above)

d) Specification ZUT 7001: Design and manufacture of medium-pressure steel fittings and specials

e) Specification ZUT 0003: Painting and corrosion protection for water and wastewater works

f) Specification ZUT 7003: Laying, jointing, and testing of medium-pressure steel pipes and specials

The latest issues of the specifications listed in Appendix A shall be deemed to apply to the manufacture of pipes using either submerged arc spiral welding or longitudinal welded “cans” rolled from low carbon or steel plate and joined by submerged arc circumferential welding to form suitable pipe lengths.

C3.3.2.10.3 ZUT 7002.3 DEFINITIONS AND ABBREVIATIONS

C3.3.2.10.3.1 ZUT 7002.3.1 Definitions

For the purposes of this Specification the definitions and abbreviations given in the applicable clauses of the specifications listed in 2.1 and the following definitions shall apply:

Cut-and-shut bend	:	A bend formed by cutting out one or more V-shaped sections equally disposed about a line at right angles to the axis of the pipe, preparing the cut-out edges for welding; bending the pipe to form the bend and welding the pipe shut along the prepared edges to complete the bend (see BS 2633, Fig 25)

Fitting	:	a) A special or valve. b) Any process of jointing (except welding) straight pipes to one another and to specials and valves.
Flexible pipe	:	A pipe of which the diameter is reduced by more than 1% under an external radial force before the appearance of cracks.
"H"	:	The cross-sectional shape of a weld at a skelp.
Manual shielded electric arc process welding	:	Electric arc welding done by hand using a filler electrode coated with a material that gasifies at the point of arc and excludes oxygen from the weld, thus improving the metallurgical quality of the completed weld.
Nominal diameter (size)	:	A numerical designation of diameter which is common to all components in the piping system other than components designated by OD or by thread size. It is a convenient round number for reference purposes and is only loosely related to manufacturing dimensions.
Nominal pressure	:	A numerical designation which is a convenient round number for reference purposes. All equipment of the same DN designated by the same PN number shall have compatible mating dimensions.
Pinhole	:	A very small hole indicating a flaw in the weld.
Pipe end bevel	:	A bevel cut made on the end of a pipe to afford a groove between abutting joints in order to receive weld metal.
Pipework	:	Includes all pipes, joints, specials, fittings and valves.
Skelp	:	The jointing edges of steel coils used in the manufacture of spiral welded pipe.
Special	:	Any pipe other than a straight pipe. Note: Under this definition shall be included all sizes of specials of shapes such as bends, tees, crosses, angle branches, reducers, tapers and flexible couplings with or without centre registers.
Straight pipe	:	A straight pipe of uniform bore and of standard or non-standard length.
Welding icicles	:	Congested droplets of metal which extend through the weld to the interior of the pipe, caused by excessive heat or improper welding technique.

C3.3.2.10.3.2 ZUT 7002.3.2 ABBREVIATIONS

The following abbreviations (additional to those referred to in 3.1) shall have the meanings given:

AISI : American Iron and Steel Institute

DN : Nominal diameter (e.g. DN 200 = 200 mm nominal diameter)

DS-AW : Double submerged-arc welded

E-RW : Electric-resistance welded

FBE : Flanged both ends

FOE : Flanged one end

ID : Internal diameter

MSEAP	:	Manual Submerged Electric Arc Process
MS	:	Mild Steel
OD	:	Outside diameter, which shall mean the internal diameter plus 2 x (lining thickness + pipe wall thickness)
p.e.	:	Plain ended.
PN	:	Nominal working pressure (e.g. PN 10 = 1 000 kPa)
SA-AW	:	Semi-automatic arc welded
SAW	:	Submerged arc weld
Scab	:	Unbonded piece of plate in tight contact with the plate
SS	:	Stainless Steel
t	:	Wall thickness of pipes
TP	:	Test pressure
WP	:	Weld preparation

C3.3.2.10.4 ZUT 7002.4 REQUIREMENTS

C3.3.2.10.4.1 ZUT 7002.4.1 MATERIALS

C3.3.2.10.4.1.1 ZUT 7002.4.1.1 General

Steel pipe shall be manufactured in accordance with SANS 719:2011 Edition 3.2, except as added or amended hereunder. Where the amendments hereunder are in conflict with SANS 719, the amendments shall take precedence.

C3.3.2.10.4.1.2 ZUT 7002.4.1.2 Chemical composition (SANS 719, Clause 4.2)

Delete Clause 4.2 and replace with:

Unless otherwise billed or shown on drawings, pipes shall be manufactured from the following materials:

<u>Nominal diameter equal to or less than 150 mm:</u>

Medium or heavy class steel, complying with the applicable requirements of SANS 62.

Nominal diameter larger than 150 mm:

Table 1a

Steel grade	Minimum Yield Stress (MPa)	Chemical Composition and Physical Properties
B	241	SANS 719, Table 1
300WA	300	SANS 1431
X42	289	API 5L Table 3.1 & 4.1
X46	317	API 5L Table 3.1 & 4.1
X52	358	API 5L Table 3.1 & 4.1
X56	386	API 5L Table 3.1 & 4.1
X60	413	API 5L Table 3.1 & 4.1
X65	450	API 5L Table 3.1 & 4.1

Flanges on pipe ends, where applicable, shall be manufactured from steel plate conforming to BS 4360 or SANS 1431 Grade 300W for working pressures up to PN 25. Flanges rated more than PN 25 and up to PN 60 shall be made from steel manufactured in accordance with BS EN 10222 Grade 460 or as approved. Flanges for pressures exceeding PN 60 and up to PN 250 shall be special flanges and gaskets manufactured by Hydro Power Engineering or equal approved.

C3.3.2.10.4.1.3 ZUT 7002.4.1.3 Physical properties (SANS 719, Clause 4.3)

Insert in the first sentence after "the requirements given in table 1" the following:

"and table 1a".

C3.3.2.10.4.1.4 ZUT 7002.4.1.4 Certification (SANS 719, Clause 4.4)

Add the following sentence:

"All information relevant to pipe fabrication shall be made available to the Engineer during the course of the manufacturing process."

C3.3.2.10.4.2 ZUT 7002.4.2 DESIGN

C3.3.2.10.4.2.1 ZUT 7002.4.2.1 Dimensional requirements

C3.3.2.10.4.2.1.1 ZUT 7002.4.2.1.1 Pipe length (SANS 719, Clause 5.1.1)

1) General (SANS 719, Clause 5.1.1.1)

Add the following under Clause 5.1.1.1:

"Unless otherwise specified, all pipes shall be manufactured in one fixed standard length between 9 m and 19.5 m. The standard lengths of pipes supplied shall be 9.14 m, 12.19 m or 18.28 m."

2) Random lengths (SANS 719, Clause 5.1.1.2)

Delete the wording of Clause 5.1.1.2 and replace with:

"Pipes of random length will be accepted subject to their total length not exceeding 10% of the supplied length for each category of pipe and subject to the length of each pipe being within 10% of a standard pipe length.

Standard pipes from which samples for destructive testing have been cut may be jointed together by butt-welding to form single pipe lengths of the required standard length.

Each change in steel grade, pipe diameter or wall thickness will be classes as a separate category."

3) Exact lengths (SANS 719, Clause 5.1.1.3)

The exact lengths of pipes shall be to a tolerance of -0 mm and +50 mm.

C3.3.2.10.4.2.2 ZUT 7002.4.2.2 Dimensions (SANS 719, Clause 5.1.2)

Insert the following after b):

"The tolerances on outside diameters of pipe ends for pipe diameters greater than 1250mm and less than 2230mm shall be as for pipes of 1250mm diameter (refer to Table 3 of SANS 719)."

C3.3.2.10.4.2.3 ZUT 7002.4.2.3 Wall thickness (SANS 719, Clause 5.1.3)

Delete "+10% or – 8%" and replace with:

"+13.5% or – 0%"

C3.3.2.10.4.2.4 ZUT 7002.4.2.4 Pipe ends (SANS 719, Clause 5.1.5)

Add at the beginning of Clause 5.1.5 the following:

"Pipes shall be supplied with each end complying with one of the following criteria:

a) Bevel ended to be joined by field welding

b) Plain ended to be joined by flexible couplings

c) Bell and spigot (plain) ended to be joined by fillet weld as specified in the Amendments and Additions or Bill of Quantities

d) Flanged ends to be joined by bolts, nuts, and washers.

Where both ends are specified as bevel ended or plain ended the requirements of SANS 719 Clause 5.1.5 shall apply.

Bell and spigot ends will generally be specified on pipe diameters of 508 mm or smaller.

The welding requirements for the preparation of these pipe ends shall comply with Clause 4.4.7 of this specification."

C3.3.2.10.4.2.5 ZUT 7002.4.2.5 Flanges

Flanges shall be designed and manufactured to BS EN 1092 Part 1 for steel flanges and Part 2 for cast iron flanges, unless otherwise specified on the Drawings. Flanges not covered by BS EN 1092 shall be manufactured according to the detailed dimensions and requirements shown on the Drawings.

All flanges shall be suitable for Site welding (SW) to pipes and specials and shall conform to BS 2633, Section 7 with preparation of plate flanges as shown in Fig 41 ("slip-on") for pipes and specials up to DN 100 and Fig 39 or 40 ("bore and fillet") for pipes and specials DN 125 and larger.

The drilling of steel and cast iron flanges shall be off-centre and shall conform to the requirements of SANS 1123, BS EN 1092: Section 3.1, or ISO 7005: Part 1 as applicable, appropriate to the class of pipe specified, except that in the case of flanges, where M27 and M33 bolts are specified in BS EN 1092: Section 3.1, M24 and M30 bolts respectively shall be used as specified in SANS 1123.

Any pipe that has flanges which are incorrectly drilled will be rejected. Reaming of bolt holes to oversize dimension in order to make a particular piece fit will not be permitted.

All flanges shall be machined overall with gramophone finish in accordance with SANS 1123, or as specified below:

a) Flanges for nominal pipe diameters greater than DN 250 shall have Type B raised faces in accordance with Fig 4 and Table 7 of BS EN 1092, unless otherwise approved.

b) Where the working pressure exceeds PN 16, and for all nominal diameters of DN 400 and over, flange faces shall be machined in accordance with matching flanges Type G (O-ring recess) and Type H (O-ring groove) as detailed in Fig 4 of BS EN 1092.

For flanges not covered by BS EN 1092, and for domes and conical ends, thicknesses shall be calculated and where applicable the flanges manufactured in accordance with Section 3 of BS 5500.

C3.3.2.10.4.2.6 ZUT 7002.4.2.6 Provision of cadwelding pads

Where pipes are to be jointed by means of flexible couplings the manufacturer shall weld steel plates not less than 50 x 75 x 6 mm thick, 250 mm from each end of all pipes, during the pipe manufacturing process (i.e. before lining and coating) to provide adequate area for cadwelding bonding cables to the piping to make it electrically continuous and enable a cathodic protection system to be applied without damage to the coating.

C3.3.2.10.4.3 ZUT 7002.4.3 PLANT

Pipes shall be manufactured in an approved works which has the necessary tools, plant and equipment to manufacture pipes consistently in accordance with the specifications.

C3.3.2.10.4.4 ZUT 7002.4.4 FABRICATION

C3.3.2.10.4.4.1 ZUT 7002.4.4.1 General

Only qualified welders, certified as having passed the qualification tests as specified in Clause 6 of API Standard 1104 or alternatively, SANS 10044: Part IV, shall be used to do all welding required. Copies of the certificates shall be made available to the Engineer.

C3.3.2.10.4.4.2 ZUT 7002.4.4.2 Forming (SANS 719, Clause 5.2.1)

Delete the sub-clause and replace with the following:

"Unless otherwise specified in the Amendments and Additions, pipes shall be formed in accordance with one of the following forming techniques:

a) Electric resistance welding (ERW). This technique may be used for pipes ranging in outside diameter from 219mm to 610mm and ranging in wall thickness from 3.5mm to 12mm.

b) Submerged arc welding (SAW). This technique may be used for manufacturing spirally welded pipes ranging in outside diameter from 219mm to 2230mm and wall thicknesses ranging from 4.5mm to 18mm.

Where automatic submerged arc welding is employed, at least one pass shall be made on the inside and at least one pass on the outside of all pipes.

The number of longitudinal weld seams on pipes shall not exceed 1 for pipes up to and including DN 1000, and 2 for pipes larger than DN 1000 up to DN 2200.

The fabrication of larger diameters and/or use of thicker plate using these techniques may be agreed between the Manufacturer and the Engineer. In both techniques, circumferential joints shall be at least 1.5m apart and longitudinal welds of mated sections shall be at least 30° apart."

C3.3.2.10.4.4.3 ZUT 7002.4.4.3 Welds (SANS 719, Clause 5.2.2.1)

Add the following as the first sentence:

"All X-grade steel is to be welded in accordance with API 1104 'Welding of Pipelines and Related Facilities'."

C3.3.2.10.4.4.4 ZUT 7002.4.4.4 Weld reinforcements (SANS 719, Clause 5.2.2.2.7)

All butt welds and branch fillet welds on pipes shall where practicable have an internal weld. The height of the inner weld shall not exceed 1mm.

Internal reinforcement in the form of backing rings at weld seams shall not be permitted.

C3.3.2.10.4.4.5 ZUT 7002.4.4.5 Seams

Longitudinal seams, spiral seams and shop girth seams shall all be butt welded.

C3.3.2.10.4.4.6 ZUT 7002.4.4.6 Rounding of pipe and sizing of ends

If it is necessary to reshape pipes after they have been welded, reshaping shall be performed by rerolling or by pressure. Reshaping of pipes by dropping or hammering is not permitted. Sizing of pipe ends to come within specified end tolerances is permitted. This may include expanding pipe ends either mechanically or hydraulically up to a maximum of 1,5% of its original diameter.

C3.3.2.10.4.4.7 ZUT 7002.4.4.7 Preparation of pipe ends for:

C3.3.2.10.4.4.7.1 ZUT 7002.4.4.7.1 Mechanical couplings

Ends for use with mechanical couplings shall be square cut or bevelled plain ends, cut square to the pipe axis, with all edge burrs, weld splatter and scratches removed. The outside of the pipe shall be free of indentations, projections or roll marks for a distance of 250 mm from each end to permit proper make-up of the coupling. Longitudinal or spiral welds on the outside of the plain end shall be ground to plate or sheet surface for a minimum distance of 250 mm.

C3.3.2.10.4.4.7.2 ZUT 7002.4.4.7.2 Fillet welds

Ends for use with fillet welded sleeve joints shall be prepared as specified in 4.4.7.1.

C3.3.2.10.4.4.7.3 ZUT 7002.4.4.7.3 Butt welds

Pipes which require joints to be butt welded on site shall be supplied with ends bevelled in accordance with the requirements of SANS 719, Clause 5.1.5. Square cut ends will require approval.

For pipes to be jointed by butt welding, the internal weld bead shall be ground flush with the internal surface of the pipe or special for a length of 200 mm from the ends to be jointed.

C3.3.2.10.4.4.7.4 ZUT 7002.4.4.7.4 Spigot and socket

Spigot and socket ends shall be rolled or fabricated from plate, sheet or special sections to the required shape without hammering. Longitudinal or spiral welds on the inside of the socket and the outside of the spigot shall be ground to plate or sheet surface for a distance not less than the depth of insertion of the spigot into the socket.

C3.3.2.10.4.4.7.5 ZUT 7002.4.4.7.5 Bevelling

All bevelling, where required, shall be delayed until after all non-destructive testing has been completed.

C3.3.2.10.4.4.7.6 ZUT 7002.4.4.7.6 Flanges

Ends to be fitted with flanges shall have the longitudinal or spiral welds ground to plate or sheet surface for a distance from the ends sufficient to accommodate the flange.

C3.3.2.10.4.4.8 ZUT 7002.4.4.8 Rectification of defects (SANS 719, Clause 5.2.3)

Add the following to Clause 5.2.3:

"If a pipe fails to pass any of the tests specified, it will be rejected but the Engineer may permit repairs or alterations to be made to enable the pipe to pass the test.

Repairs of welded joints will be permitted during the process of manufacture. Where repairs are required the defective weld metal shall be cut out, and the parent metal prepared by grinding, and re-welded, to the satisfaction of the Engineer.

The repair procedure and performance on repairs shall be in accordance with Section 10 of API Specification 5L where not in conflict with SANS 719. Only qualified welders shall be employed. Each repair weld shall be marked with the welder's identifying stamp.

When the repair has been made, it shall be radiographically tested (X-rayed) over the full length of the repair.

On discovery of defective welds, the Engineer may, at his discretion, call for additional radiographic examination until it is shown that the necessary standard is being maintained.

Should a weld repair be required on a pipe subsequent to hydraulic testing, the repaired pipe shall be retested in accordance with Clause 5.5 Hydraulic testing of this specification.
Dents shall, where practicable, be jacked out."

C3.3.2.10.4.5 ZUT 7002.4.5 COATINGS AND LININGS

Coatings and linings of pipes shall be undertaken in accordance with the requirements of Specification ZUT 0003.

C3.3.2.10.4.6 ZUT 7002.4.6 MARKING (SANS 719, Clause 7)

Delete this clause and replace with the following:

Upon fabrication, each pipe shall be hard stamped with a unique reference number to ensure traceability. The stamp is to be 100mm from the pipe end and next to a weld. On completion of the contract or at reasonable intervals during the contract, the following pipe information shall be supplied to the Engineer in Microsoft Excel ® format:

a) Pipe reference number

b) Contract number

c) Date of manufacture

d) Outside diameter

e) Wall thickness

f) Grade of steel

g) Coating type and nominal thickness

h) Lining type and nominal thickness

i) Forming technique

j) Length

k) Mass of uncoated and unlined pipe in kg/m

l) Applicable drilling tables stamped on the periphery of all flanges

In addition to the hard stamping, all pipes shall be clearly marked with the unique reference number in appropriate height characters in durable paint on a black background at one end of each pipe. The supplier's and Employer's name and logo shall be stenciled on each pipe.

Where specified in the Amendments, all pipes shall also be clearly marked with colour bands to reflect the grade steel and wall thickness."

C3.3.2.10.4.7 ZUT 7002.4.7 STORAGE, HANDLING AND TRANSPORT

C3.3.2.10.4.7.1 ZUT 7002.4.7.1 Handling and rigging

The plant and rigging equipment used for the handling of pipes shall be such that no pipe shell is over-stressed
during any operation.

In the transportation, loading and unloading of pipes, an adequate fleet of vehicles shall be operated and maintained at all times to ensure that pipes and their protective linings and coatings are not damaged. In particular, the use of excavation equipment for handling of pipes will not be permitted.

Coated pipes shall be moved with the use of padded slings of width sufficient to prevent damage to the coating. The slings shall be at least 500mm wide for pipes up to DN600, 600mm wide for pipes of DN700 and up to DN1200, and 800mm wide for pipes of DN1400 and larger, or as approved by

the Engineer. Chain slings, hooks, wire ropes, rope slings without canvas covers, composition belt slings with protruding rivets and any other equipment liable to damage the coating shall not be used.

Slings shall be suitably rated for the loads to be handled and in good condition. The use of deteriorating and frayed slings is prohibited.

All pipes are to be lifted and handled with the aid of a “spreader” lifting beam. Special care shall be taken to ensure that no damage occurs to pipes or coatings as a result of pipes sliding on or hitting adjacent pipes. The dragging or skidding of pipes in contact with the ground is not permitted.

If cradles are used to transport the pipes they must be rubber lined to avoid damage to the pipe coating.

During transportation pipes shall be safely secured to its final destination with slings of an adequate width.

The Contractor shall be responsible for dispatching and transporting of the pipes to site and off-loading.

C3.3.2.10.4.7.2 ZUT 7002.4.7.2 Dunnage and storage

Whenever pipes are stacked or otherwise stockpiled or are transported (unless special cradles are used), use shall be made of suitably resilient material as dunnage which shall not disintegrate or deteriorate when exposed to the elements for prolonged periods. Pipes of 6m length shall be stacked with a minimum of 2 dunnage supports. Pipes of 9m and 12m lengths shall be stacked with a minimum of 3 supports (one support at each pipe end and one at mid-span). Pipes of 18m length shall be stacked with a minimum of 4 supports at equal spacing. The supports shall have a minimum width of 500mm for pipes up to DN500 and 1000mm wide for larger pipes. The length of the support shall be a minimum length of 1.5 times the diameter of the pipe to be supported and shall be profiled to match the coated outside radius of the pipe.

Pipes shall be stacked with a minimum clearance of 50mm between adjacent pipe walls and a minimum of 200mm clear of the ground.

Pipes shall be stacked with sufficient supports to prevent permanent longitudinal deflections or deformation of the pipe body in excess of 2 per cent of the pipe diameter. Pipes shall also be stacked in a manner that limits loading on lower layers of pipes. Any pipe showing permanent ovality as a result of surcharge loading shall be rejected. Dents causing a protrusion in excess of 3mm into the interior of a pipe may also result in the pipe being rejected.

Each class and size of pipe shall be stacked and stored separately.

Coated steel pipes shall always be supported on a sufficient number of approved soft bolsters to prevent damage or the permanent deformation of coatings. Coated steel pipes shall not be stacked more than two pipes high, each layer separated by bolsters.

The number of layers of bare steel pipes in a stockpile shall not exceed:

$$N = \frac{1730.f.t}{(D-t)^2}$$

Where N is the permissible number of layers, D is the outside diameter of the pipe in mm, f is the guaranteed minimum yield strength in MPa for the steel plate, and t is the nominal wall thickness in mm.

Any material which is not delivered and off-loaded on Site in the same condition as it left the factory may be rejected by the Engineer.

C3.3.2.10.4.7.3 ZUT 7002.4.7.3 Protection of pipe ends

Before transportation all pipes are to be fitted with end caps made from plastic or other suitable material. Each end cap must remain in place until its pipe has been laid and the pipe end is no longer open to the elements. It must, therefore, remain in place until it is no longer needed to protect the pipe from ingress of foreign material.

In addition, bevel-ended pipes are to be fitted with bevel protectors before leaving the Manufacturer's premises. These are to remain in place until removed to permit the welding operation.

C3.3.2.10.5 ZUT 7002.5 COMPLIANCE WITH REQUIREMENTS

C3.3.2.10.5.1 ZUT 7002.5.1 FACILITIES FOR TESTING

The Contractor shall provide at his own cost, all facilities and equipment required for testing and shall carry out all tests at his own expense. Complete records of test results shall be kept.

The testing machines shall be of a design which will allow a steady application of the test pressure and shall be equipped with an accurate pressure gauge. Provision shall be made for expelling all air from any pipe under test during filling and before application of the pressure.

Test calibration certificates from an independent laboratory, verifying the accuracy of all measuring and testing instruments requiring calibration, shall be provided by the Contractor. Recalibration shall be carried out as necessitated by circumstances but at intervals not exceeding 3 months.

C3.3.2.10.5.2 ZUT 7002.5.2 QUALITY ASSURANCE

All steel pipes shall be fabricated and tested in accordance with an approved quality control plan and procedure. Manufacture shall not commence until such time as the quality control plan and procedure has been approved by the Engineer.

The quality control plan and procedure shall address, as a minimum, the following tests/inspections:

a) Material certification

b) Non-Destructive Evaluation (NDE) testing

c) Verification of tolerances

d) Workmanship

e) Surface preparation (e.g. cleanliness and blast profile for coatings and linings)

f) Material identification

g) Personnel certification (including welders and NDE)

h) Welding procedures and certification

i) Weld preparation

j) Compliance with drawings

k) Hydrostatic testing

C3.3.2.10.5.3 ZUT 7002.5.3 INSPECTIONS

C3.3.2.10.5.3.1 ZUT 7002.5.3.1 Visual inspections

All finished pipes shall be visually inspected and shall be free of injurious defects as defined in API 5L Section 10.7.

C3.3.2.10.5.3.2 ZUT 7002.5.3.2 Dimensions (SANS 719, Clause 6.1.1)

Add the following as the first sentence:

"The outside diameter, ovality and straightness of each pipe is to be checked in accordance with this clause."

C3.3.2.10.5.3.3 ZUT 7002.5.3.3 Welds (SANS 719, Clause 6.1.2)

Add the following at the end of the clause:

"The welds of each pipe are to be tested using one of the two options below. If not specifically stated elsewhere, pipes manufactured by ERW are to be tested as per Option 2 and spirally welded pipes as per Option 1.

a) Option 1 (excluding ERW pipes)
100% of the welds of all pipes shall be tested by fluoroscopic means. Where defects are detected they shall be adjudicated in accordance with API 5L and, if necessary, repaired in accordance with the requirements of API 1104.

b) Option 2 (ERW pipes)
100% of the welds of all pipes shall be tested by ultrasonic means. Where defects are detected in a pipe by means of ultrasonic testing, the defection section of pipe shall be 100% re-tested by means of X-ray and adjudicated in accordance with API 5L and, if necessary, repaired in accordance with the requirements of API 1104.

For rail, road, river and stream crossings, 100% of the total length of all welds shall be examined radiographically."

C3.3.2.10.5.4 ZUT 7002.5.4 DESTRUCTIVE TESTS (SANS 719, CLAUSE 6.2)

At least one set of the three tests described in SANS 719, Clauses 6.2.1, 6.2.2 and 6.2.3, shall be carried out for each pipe diameter and wall thickness combination. The Engineer may require that, after the first pipe, every 500th subsequent pipe of each diameter and wall thickness combination be tested.

C3.3.2.10.5.5 ZUT 7002.5.5 HYDRAULIC TEST (SANS 719, CLAUSE 6.3)

Delete this clause and substitute with the following:

"When all aspects of fabrication have been completed, but before being cleaned, lined or coated, each and every pipe is to be tested to a hydrostatic pressure test of P,

Where P = the lesser of: $2 \times 0.85 \times Y \times t/D$ or 7 MPa

Y = Minimum Specified Yield Stress (MPa)
t = Nominal Wall Thickness of pipe (mm)
D = Nominal Diameter of Pipe (mm)

Pipe end plugs shall be restrained during the test to ensure that no longitudinal stresses are induced in the pipe wall. Upon completion of the hydraulic test, the ends of the pipes shall be tested by means of Go, No-go gauges to check whether flaring or cupping has occurred. If necessary the ends shall be expanded or ground until they comply with the specification.

The test pressure in the pipe shall be maintained for at least 10 seconds and thereafter shall be inspected for weeps, leaks or deformation. The pipe will be deemed defective and may be rejected if any leaks, weeps or deformation are evident. Where defects are repaired, the pipe shall be re-tested. Should the pipe, after repair, fail to pass the second hydraulic test the Engineer may order its rejection."

C3.3.2.10.5.6 ZUT 7002.5.6 INSPECTORATE

The Engineer may at his sole discretion appoint an independent inspection authority to carry out additional Quality Surveillance at the premises of the pipe manufacturer. The manufacturer shall provide all facilities and shall facilitate access to their premises at reasonable times as may be necessary for the independent inspectorate to perform its function.

The manufacturer's quality control records shall be available for inspection by the independent inspectorate at all reasonable times, and copies of such records shall be made available on request.

Notwithstanding any surveillance carried out by, or on behalf of the Engineer, the Contractor shall retain full responsibility for the quality of pipes supplied.

C3.3.2.10.5.7 ZUT 7002.5.7 MARKING PROCEDURE

All weld lengths to be radiographed shall be clearly marked by the Inspector using his identification symbol. This symbol shall appear on the respective radiograph. The radiographed weld and symbol shall not be obliterated by finishing processes until the respective weld has been accepted by the Inspector.

C3.3.2.10.5.8 ZUT 7002.5.8 COATINGS AND LININGS

The testing of the coatings and linings of pipes shall be undertaken in accordance with the requirements of Specification ZUT 0003.

C3.3.2.10.6 ZUT 7002.6 TOLERANCES

Refer to Clauses 4 and 5.

C3.3.2.10.7 ZUT 7002.7 TESTING

Refer to Clause 5.

C3.3.2.10.8 ZUT 7002.8 MEASUREMENT AND PAYMENT

C3.3.2.10.8.1 ZUT 7002.8.1 BASIC PRINCIPLES

C3.3.2.10.8.1.1 ZUT 7002.8.1.1 Corrosion protection

Unless specific provision is made in the Bill of Quantities, no separate payment will be made for corrosion protection. The rates tendered for item 8.2.1 will be held to cover the cost of any protection system specified.

C3.3.2.10.8.1.2 ZUT 7002.8.1.2 Pipes tested to destruction

Pipes tested to destruction and the repair of the tested pipes for use in the Works, if ordered by the Engineer, will be measured and paid on a daywork basis.

C3.3.2.10.8.2 ZUT 7002.8.2 BILLED ITEMS

C3.3.2.10.8.2.1 ZUT 7002.8.2.1 Supply of pipes

Unit: …….metre (m)

The supply of pipes will be measured by length. The maximum length measured will be equal to the length as laid, no deductions being made for specials and valves and no extra length measured for waste. (See Subclause 8.2 of SANS 1200 L)

Separate items will be billed for each diameter and wall thickness.

The unit rates shall cover the cost of the fabrication and supply of the pipes, complete with couplings where applicable, the cost of handling where applicable, and the cost of factory testing, inspection and transportation to Site and shall, where it is necessary to limit ovality to within the specified limits, also cover the cost of bracing the pipes internally.

Separate items are provided in the Bill of Quantities for the laying, jointing, testing and commissioning of the pipes.

Annexures

APPENDIX A. APPLICABLE STANDARDS

Reference is made to the latest issues of the following standards:

API Specification 5L	American Iron and Steel Institute - Specification for LINEPIPE
API Standard 1104	American Iron and Steel Institute - Standard for welding pipelines and related facilities
ASME	Boiler and Pressure vessels Code, Section V, Article 7
AWWA M 11	Steel pipe - A guide for design and installation (3rd edition)
BS 534	Steel pipes and specials for water and sewage
BS 639	Covered electrodes for the manual metal-arc welding of carbon and carbon-manganese steels
BS 1387	Steel tubes and tubulars suitable for screwing to BS 21 pipe threads
BS 1640	Steel butt-welding pipe fittings for the petroleum industry: Part 1 : Wrought carbon and ferritic alloy steel fittings
BS 1832	Compressed asbestos fibre jointing
BS 2633	Class 1 arc welding of ferritic steel pipe work for carrying fluids
BS 3139	High strength friction grip bolts for structural engineering
BS 3294	The use of high strength friction grip bolts in structural steelwork: Part 1 : General grade bolts
BS 3381	Metallic spiral wound gaskets for use with flanges to BS 1560 : Part 1 and 2
BS 4360	Weldable structural steels
BS 4604	The use of high strength friction grip bolts in structural steelwork (metric series)
BS EN 1092	Flanges and their joints. Circular flanges for pipes, valves, fittings, and accessories. Steel flanges
BS EN 10222	Steel forgings for pressure purposes
PD 5500	Unfired fusion welded pressure vessels
ISO 7005	Metallic Flanges: Part 1 : Steel flanges
ISO 9000	Quality management
ISO 9002	Quality systems. Model for quality assurance in production, installation and servicing
SANS 62	Steel pipes Part 1 Pipes suitable for threading and of nominal size not exceeding 150 mm Part 2 Screwed pieces and pipe fittings of nominal size not exceeding 150 mm.

SANS 121	Hot dip galvanized coatings on fabricated iron and steel articles - Specification and test methods
SANS 719	Electric welded low carbon steel pipes for aqueous fluids (ordinary duties)
SANS 974	Rubber joint rings (non-cellular) Part I : Joint rings for use in gas, water, sewer, and drainage systems
SANS 1109	Pipe threads where pressure-tight joints are made on the threads Part 1 Dimensions, tolerances and designation Part 2 Verification by means of limit gauges
SANS 1123	Pipe flanges
SANS 1431	Weldable structural steels
SANS 1476	Fabricated flanged steel pipework
SANS1700	Fasteners
SANS 10044	Welding
SANS 10121	Cathodic protection of buried and submersed structures
SANS 1200 L	Medium-pressure steel pipelines
SAECC/1	Code of Practice
Specification ZUT 0003	Painting and corrosion protection for water and wastewater works
Specification ZUT 7001	Design and manufacture of medium-pressure steel specials
Specification ZUT 7003	Laying and jointing of medium-pressure steel pipes and specials

C3.3.2.10 ZUT 7003 LAYING AND JOINTING OF MEDIUM-PRESSURE STEL PIPES AND SPECIALS

C3.3.2.10.1 ZUT 7003.1 SCOPE

This Specification covers the laying and jointing of electrically welded low carbon steel pipes and specials of diameter up to 2 280 mm, for transporting water and sewage under working pressures of up to 2,5 MPa.

This Specification shall be read in conjunction with Specification ZUT 7001.

This Specification contains clauses that are generally applicable to the laying and jointing of medium- pressure steel pipes and specials. Interpretations and variations of this specification are set out in the Amendments preceding this Specification.

C3.3.2.10.2 ZUT 7003.2 NORMATIVE REFERENCES

C3.3.2.10.2.1 ZUT 7003.2.1 SUPPORTING SPECIFICATIONS

Where this Specification is required for a project, the following specifications shall, inter alia, form part of the Contract Document:

a) Amendments;

b) Specification ZUT 7001 : Design and manufacture of medium-pressure steel specials;

c) Valves specifications

d) Flow meter specifications

e) Specification ZUT 0003 : General corrosion protection for pipelines, water and wastewater works; and

f) Standards listed in Appendix A.

C3.3.2.10.3 ZUT 7003.3 DEFINITIONS AND ABBREVIATIONS

For the purposes of this Specification the definitions and abbreviations given in the specifications listed in
2.1 shall apply.

C3.3.2.10.4 ZUT 7003.4 REQUIREMENTS

C3.3.2.10.4.1 ZUT 7003.4.1 MATERIALS

C3.3.2.10.4.1.1 ZUT 7003.4.1.1 General

Refer to Subclause 4.1.1 of ZUT 7001

Pipes and fittings shall be of the types specified in the Bill of Quantities or in the project specification and, unless otherwise required in terms of the project specification, they and their couplings shall be capable of withstanding the applicable test pressure specified in the Amendments. All pipes and fittings shall be supplied complete with couplings and jointing material.

Satisfactory temporary end covers shall be provided for the protection of threads, flanges, and prepared ends of plain-ended pipes and fittings, and to prevent damage to internal lining during transportation and during handling on Site.

C3.3.2.10.4.1.2 ZUT 7003.4.1.2 Flanges

Refer to Subclauses 4.1.3 and 4.3.2 of ZUT 7001.

C3.3.2.10.4.1.3 ZUT 7003.4.1.3 Insulating flanges

Refer to Subclause 4.3.3 of ZUT 7001.

C3.3.2.10.4.1.4 ZUT 7003.4.1.4 Gaskets

Refer to Subclause 4.3.5 of ZUT 7001.

C3.3.2.10.4.1.5 ZUT 7003.4.1.5 Bolts, nuts, and washers

Refer to Subclause 4.3.6 of ZUT 7001.

C3.3.2.10.4.1.6 ZUT 7003.4.1.6 Bricks

Bricks shall be obtained from an approved manufacturer and shall be either general purpose (special), burnt clay, or engineering bricks that comply with the applicable requirements of SANS 227, or Class S14 calcium silicate bricks that comply with the applicable requirements of SANS 285.

The Contractor shall submit to the Engineer samples of the bricks he intends using in the construction of the Works. The samples of bricks that are approved will be retained by the Engineer.

C3.3.2.10.4.1.7 ZUT 7003.4.1.7 Precast cylinders

Precast cylinders may be of spun concrete, glass reinforced polyester, or PVC, except where particular materials are required in terms of the Bill of Quantities or the project specification. Precast concrete cylinders shall comply with the applicable requirements of SANS 1294. Sectional spun concrete cylinders shall comply with the requirements for pipes of SC type, Class A, of SANS 677. Jointing between cylinders shall be of the interlocking self-centering type suitable for sealing.

C3.3.2.10.4.1.8 ZUT 7003.4.1.8 Concrete

Concrete shall comply with the requirements of SANS 1200 G or SANS 1200 GA, as applicable.

C3.3.2.10.4.1.9 ZUT 7003.4.1.9 Welding rods

The Contractor shall supply all the necessary welding electrodes, which shall be of the shielded type. The chemical composition of weld metal and parent metal shall be similar. Electrodes that show signs of deterioration or damage shall be removed from Site and replaced at the Contractor's expense. Electrodes shall comply with the requirements of BS 639.

C3.3.2.10.4.1.10 ZUT 7003.4.1.10 Corrosion protection

Refer to Specification ZUT 0003.

C3.3.2.10.4.1.11 ZUT 7003.4.1.11 Records of materials on site

The Contractor shall keep and maintain a complete and comprehensive record of each pipe, special and fitting delivered to Site. The record shall at least denote the reference number, size, pressure class, location in the pipeline, date and condition of delivery and the location of delivery and the location of storage. Copies of the record shall be submitted to the Engineer at the end of each month or whenever requested by the Engineer.

Where pipes, specials and fittings are delivered without reference numbers, same shall be provided by stenciling, labelling or other methods approved by the Engineer.

C3.3.2.10.4.2 ZUT 7003.4.2 PLANT

C3.3.2.10.4.2.1 ZUT 7003.4.2.1 Packing

Goods shall be suitably packed in such a manner as will ensure safe and efficient transport by road or rail, and the Contractor shall include in his prices for whatever packing may be necessary in this respect. Small items particularly liable to damage or loss in transit should be crated. All crates and packing material shall, after use, become the property of the Employer, unless distinctly specified otherwise, or if returnable, shall be so at the Contractor's expense.

C3.3.2.10.4.2.2 ZUT 7003.4.2.2 Handling and rigging

The plant and rigging equipment used by the Contractor for the handling and placing of pipes shall be such that no pipe shell is over-stressed during any operation covered by the specification.

C3.3.2.10.4.2.3 ZUT 7003.4.2.3 Setting out

The Contractor may use any acceptable device, including one incorporating a laser beam, to control the alignment and laying of the pipeline.

C3.3.2.10.4.2.4 ZUT 7003.4.2.4 Site equipment

The Contractor shall furnish all equipment, tools, and supplies, including the necessary welding electrodes. Welding machines shall be operated within the amperage and voltage ranges recommended for each size and type of electrode. Any equipment that does not meet these requirements shall be repaired or replaced upon request of the Engineer. (Refer also API 1104 Clause 1.3.)

C3.3.2.10.4.2.5 ZUT 7003.4.2.5 Testing

The Contractor shall provide all equipment, materials, tools, and fittings required for the performance of the tests given in Clause 5.

C3.3.2.10.4.3 ZUT 7003.4.3 METHODS AND PROCEDURES

C3.3.2.10.4.3.1 ZUT 7003.4.3.1 Laying

C3.3.2.10.4.3.1.1 ZUT 7003.4.3.1.1 General

The pipelines shall be laid and bedded to even grades and to the levels and alignments shown on the drawings or as directed. It shall be laid centrally in the trench in such a manner that the side allowance conforms to the applicable value specified in Clause 8 of SANS 1200 DB. For ease of inspection and testing the pipes shall be laid with the manufacturer's class and quality identification

marks visible from the top of the trench, unless, in the case of large pipes, the position of lifting eyes render this impracticable.

Control of laying and bedding shall be by means of boning rods and sight rails or an acceptable laser beam device. Sight rails shall be painted black and white and shall be fixed securely and accurately.

C3.3.2.10.4.3.1.2 ZUT 7003.4.3.1.2 Damage

Each pipe, pipe special and fitting shall be thoroughly cleaned and carefully examined for damage and defects prior to laying. Should any damaged or defective pipe, pipe special or fitting be laid, it shall be removed and replaced at the Contractor's expense and to the satisfaction of the Engineer.

During laying, the anti-corrosion lining of pipes being joined by butt welding shall be protected against damage by foot traffic or weld spatter, to the satisfaction of the Engineer and in the manner described in Clause 4.3.2.4.6.

C3.3.2.10.4.3.1.3 ZUT 7003.4.3.1.3 Keeping pipelines clean

Every reasonable precaution shall be taken to prevent the entry of foreign matter and water into the pipe(s). At the close of each day's work, or at any time when work is suspended for a significant period, the last laid section of the pipeline shall be plugged, capped or otherwise tightly closed until laying is recommenced.

The interior of pipes shall be perfectly clean before being laid and the Engineer may instruct that the pipe interior be cleaned or washed before the pipes are lowered into the trench. All brushes, trowels, welding rod stumps, pieces of mortar, dust and all foreign matter shall be removed from pipes immediately before laying. Once a section of pipeline has been cleaned, it shall be sealed off and not be entered again unless permitted by the Engineer.

During laying and jointing of pipes and until the pipeline has passed the required acceptance tests and the trench has been backfilled, the trench shall be kept in a state which, in the opinion of the Engineer, is reasonably dry.

The Contractor shall at his own expense make good any damage to valves and fittings or clogging of off- takes or malfunctioning of fittings which result from his failure to keep the pipeline in a thoroughly clean condition.

C3.3.2.10.4.3.1.4 ZUT 7003.4.3.1.4 Depths and cover

Unless otherwise specified in the Amendments, shown on the Drawings, or ordered by the Engineer, the minimum cover for pipelines shall be 1.0 m.

The minimum clearance between the outside of a pipeline being laid and the outside of any other pipe that it crosses shall be 300 mm. Where this requirement conflicts with the requirements for cover over the pipeline the Contractor shall ask the Engineer for written instructions and shall carry out the work in accordance with those instructions.

C3.3.2.10.4.3.1.5 ZUT 7003.4.3.1.5 Cold stresses and deflection in pipe curvature

Pipes shall be laid free from cold stresses. No deflections shall be taken in curvature of pipes, but shall be taken with approved bends with exceptions as hereinafter specified. All deflections in pipes with flexible couplings shall not exceed those recommended by the manufacturer of the couplings after making allowance for ground movements.

C3.3.2.10.4.3.1.6 ZUT 7003.4.3.1.6 Mitres to effect pipe deflections

All deflections in the axis of butt-welded steel pipelines of 10 degrees or less shall be made by mitering equally the ends of the two pipes to be joined so that the maximum mitre in any one pipe shall be 5 degrees. Where the total deflection is 3 degrees or less, the mitering may be made in one pipe end only. Ends to be mitred shall be carefully and accurately marked and then either machine cut or machine planed.

Hand planing will not be permitted. After mitering, the pipe ends shall be re-chamfered as described in Clause 5.1.5 of SANS 719. The minimum gap between pipe end root faces before welding shall be 1,5 mm and the maximum gap shall be 3,0 mm. After mitering all pipe ends shall be thoroughly cleaned before the field weld is carried out.

C3.3.2.10.4.3.1.7 ZUT 7003.4.3.1.7 Cold bends

Where the Engineer gives written approval for cold bends on pipes with diameters of 450 mm and smaller, they shall be made by the cold stretch method in such a manner as to preserve the cross-sectional shape of the pipe. The minimum radius of any such bend shall be twenty five times the outside diameter of the pipe. Approved bending shoes shall be used for bending of the pipes.

C3.3.2.10.4.3.1.8 ZUT 7003.4.3.1.8 Snaking

Snaking into the trench of butt-welded sections of steel pipeline which has been factory lined and/or coated will not be permitted without the written approval of the Engineer.

C3.3.2.10.4.3.1.9 ZUT 7003.4.3.1.9 Stringing of pipes

The Contractor shall ensure that pipes are strung in accordance with a method statement to be approved by the Engineer. The method statement shall cover the proper placement by diameter, wall thickness and specifications. Any movement of pipes resulting from failure to comply with the approved method statement shall be rectified at the Contractor's expense.

C3.3.2.10.4.3.1.10 ZUT 7003.4.3.1.10 Handling and transporting

Pipes and specials shall be handled as specified in Clause 4.8 of ZUT 7001.
Wrapped pipes shall be protected from grit and other sharp objects while the pipe is in the trench prior to bedding. Walking on wrapped pipes will not be allowed. The Engineer may reject any length of wrapping on which physical damage due to any cause whatsoever is visible.

Cement mortar lined pipes shall not be moved or transported for a period of 14 days after the date of lining.

C3.3.2.10.4.3.1.11 ZUT 7003.4.3.1.11 Skids

Skids of sufficient number shall be supplied to support the pipe to proper height. If a pipe is supported over the trench, skids shall be of sufficient length to prevent collapsing of the trench and of sufficient strength to carry the pipe.

For coated pipe a sufficient number of skids shall be used to prevent damage to the coating.

C3.3.2.10.4.3.2 ZUT 7003.4.3.2 Jointing methods

C3.3.2.10.4.3.2.1 ZUT 7003.4.3.2.1 Flexible couplings

The joints of steel pipes by flexible couplings shall be made only in their final laid position. Before assembling the joint, care shall be taken to ensure that pipe ends and couplings are clean and free from burrs and ridges. Such burrs and ridges shall be removed if present. Pipe ends shall be mated carefully before joints are made. Pipe ends shall be concentric and perfectly lined up and the coupling shall not be relied upon to line up or to support the pipe.

Joints shall be made and couplings assembled to the manufacturer's instructions. Two-thirds of the number of coupling bolts, equally spaced, shall first be partially tightened up in a regular sequence, using a short spanner. The remaining bolts shall then be similarly tightened. After checking the coupling alignment, the bolts shall then be finally tightened evenly, using a torque wrench.

Where couplings without central registers are used, precautions shall be taken to ensure that the pipe ends are apart by the same distance as if a coupling with central register had been used and the coupling shall be carefully centred over the pipe ends.

Flexible couplings shall be provided with external protection as soon as the pipeline has been hydrostatically tested and electrically bonded, where applicable.

C3.3.2.10.4.3.2.2 ZUT 7003.4.3.2.2 Flanged joints

All flanges shall be installed with bolt holes off-centre and symmetrically off-set from the vertical centre lines of the flanges. Flanges shall be installed truly square to the axis of the pipe.

In the jointing of steel pipes with flanges, special care shall be taken to align, grade and level the pipes, specials and valves to avoid straining of the flanges. All bitumen and paint shall be removed from the mating face of each flange immediately before jointing. Epoxy paints shall not be removed from flange faces. Insertion pieces that have accurately cut holes for bolts shall be placed to form a continuous one- piece ring between the flanges. Bolts shall be tightened up to ensure uniform bearing on the insertion. Care shall be taken to avoid damage to the internal surface of the pipes during assembly of the pipeline.

Wherever loose flanges are welded onto pipelines, the Contractor shall ensure that the inner lining is restored to the thickness specified for such lining and that the new repaired lining is soundly jointed to the existing lining.

In making the joint the Contractor shall ensure that the flanges are truly parallel with all bolts evenly firm before being finally drawn up with torque wrenches to watertightness. Taper gauges shall be used to check that there is a uniform gap before and after final tightening up of bolts. Bolts shall be tightened in an approved sequence with bolts equally spaced and tightened equally at opposite ends first. The Contractor shall ensure that the correct jointing materials, i.e. gaskets and bolts and nuts are available when required. The gaskets shall be in accordance with Subclause 4.3.5 of ZUT 7001. In the case of insulated joints the insulated materials shall be arranged as set out in Code of Practice No. SAECC/1.

Flanged fittings shall be so installed that there are no stresses induced into the pipework specials or fittings by forcing ill-fitting units into position or by bolting up flanges with faces not uniformly in contact with their gaskets over their whole faces.

C3.3.2.10.4.3.2.3 ZUT 7003.4.3.2.3 Bolts and nuts

Bolts and nuts shall be in accordance with Subclause 4.3.6 of ZUT 7001.

Only correct diameters and lengths of bolts and studs shall be used. Flat washers shall be used under all nuts and bolt heads. The length of bolts and studs shall be such that approximately two threads protrude from the nut when fully tightened. The threads of bolts, studs and nuts shall be thoroughly cleaned and then coated with a graphite-grease compound immediately prior to assembly.

C3.3.2.10.4.3.2.4 ZUT 7003.4.3.2.4 Field welding

1) General

Field welding of pipes which have been lined will only be permitted in pipes of DN 450 and larger where a man is able to enter the pipe to make good the lining after welding and testing in accordance with Clause 5.1 has been completed. Pipes of lesser diameter may be field welded where concrete linings will be made after the pipeline has been laid and all welds have been tested and approved.

At the discretion of the Engineer, roll welding will be permitted, provided an alignment is maintained by use of skids or of structural framework to accommodate two or more lengths of pipe with an adequate number of roller dollies to prevent sag in the pipe. The entire root bead, however, shall be made with the pipe in a stationary position.

All pipes welded in the trench shall be properly laid and aligned before welding commences. Joint holes shall be excavated at all field welds. The Contractor shall not lift the pipe to provide adequate access for the welders to enable them to weld the joint.

The alignment of abutting ends shall be such that the offset will not exceed 1.5 mm. Line up clamps shall be used for joint “fit-ups”. The use of “bridges and wedges” or any method that may induce unnecessary stresses will not be permitted.

Both ends of coated and lined pipes shall be wrapped for a distance of at least 800 mm on either side of the weld by means of an asbestos mat or other approved material to ensure that weld spatter or other damage is not caused to the coating and lining during the welding process. The pipe trench shall be kept free of all dirt and water in the vicinity of the weld until after all corrosion protection measures have been completed and approved.

Destructive testing as specified in Clause 5.1.2.2 shall be carried out. The Contractor shall submit to the Engineer for approval a full procedure specification as detailed in API 1104 Clause 5.3 prior to any field welding being allowed.

2) Welding procedure and qualification of welders

Welding shall only be done by qualified welders who satisfy the requirements of API Std. 1104, Clause 6 and who have been tested at the Contractor’s expense by an Independent Inspectorate.

Before any welding of pipeline materials commences, the qualification of welders shall have been approved, all detailed welding procedure specifications with weld diagrams required for their completion shall have been submitted for approval in a neat form and the welding procedure qualification tests shall have been successfully concluded all in accordance with the relevant standard specifications. Each welder shall mark the pipe adjacent to the weld with the figure assigned to him.

Sufficient records shall be kept by the Contractor to ensure that all field welds can be subsequently identified with the welder concerned.

As far as practicable all out of trench welding shall preferably be done by an automatic submerged process and the Contractor shall provide all necessary plant to carry out this process. Manual submerged electric arc process (MSEAP) welding may be used where in-trench welding is done.

Pre- and post-heat treatment for welding shall be in accordance with API Std. 1104 if required by same and the Contractor shall provide an approved shield to protect the pipe joint from wind and weather during heat treatment and welding.

3) Line up

Pipes shall be lined up in such a manner as to prevent damage thereto. If the pipe to be used has a longitudinal seam, these seams shall be staggered by not less than twenty degrees and welded sections, or single lengths, shall be assembled in such a manner that this seam shall remain in the top quadrant of the pipe during coating operations and after lowering into the trench.

4) Cleaning of pipe ends

Before welding, all foreign matter shall be removed from the bevelled ends. If any of the ends of the pipe joints are damaged to the extent that satisfactory welding contact cannot be obtained, the damaged pipe ends shall be cut and bevelled with an approved bevelling machine. These field bevels of pipe ends shall be made to the satisfaction of the Engineer. Should laminations, split ends, or other defects in the pipe be discovered, the joints of pipes containing such defects shall be cropped, repaired, or removed from the line as designated by the Engineer.

5) Weather conditions

No welding shall be carried out during rain or high wind unless the welder and joint are adequately protected and sheltered, to ensure that the welding is not impaired.

6) Protection of paintwork

Before welding commences, a suitable apron at least 800 mm wide shall be wrapped around both sides of the area to be welded to ensure that weld spatter or fallout from arc weld does not damage the paintwork.

During the welding of joints, the Contractor shall ensure that either rubber mats or other suitable material is laid in the pipe invert of epoxy lined steel pipes to protect the lining against damage by traffic or fall-out from arc welding at the joint. The mats shall be placed the full distance from the point of access up to the point of weld or weld inspection and shall be of sufficient width.

Workmen shall wear soft rubber soled shoes before entering lined pipes. Care shall be taken not to stroke arcs on the epoxy lined areas adjacent to the weld joint. Immediately before welding of joints, the protective tape between the ends of concrete or epoxy linings and coatings and pipe ends shall be removed.

7) Butt-welding

Pipes and specials to be joined by field welding shall be supplied with ends bevelled for welding. All welding of joints shall comply with API Std. 1104 and only approved type welding rods shall be used.

If backing rings are used, they shall be placed in position and wedged up or adjusted so that the pipe ends are completely circular and properly mated. The space between abutting pipe ends, when aligned for welding, shall be such as to ensure complete penetration without burn-through. For pipes having the same dimensions, the spacing shall be approximately 1,5 mm.

The alignment of the abutting pipe ends shall be such as to minimize the offset between pipe surfaces. For pipes of the same nominal wall thickness, the offset shall not exceed 1,5 mm. Internal line-up clamps shall be used wherever practicable and may be removed after the root bead is 50 % completed, provided that the completed part of the root bead is in segments of approximately equal lengths, spaced about the circumference of the pipe. If conditions make it difficult to prevent movement of the pipe, or if the weld will be unduly stressed, the root bead shall be completed before releasing clamp tension.

External line-up clamps shall be used where it is impracticable to use internal line-up clamps. Partial root beads made when using external clamps shall be uniformly spaced about the circumference of the pipe, and shall have an accumulative length of not less than 50% of the pipe circumference before the clamps are removed.

Tack-welding shall be carried out to maintain the root gap and position of the pipe ends during the welding proper. The number of tack-welds shall be kept to a minimum but shall not be less than four around the circumference of the pipe.

After proper preparation and tack-welding, the root bead shall be carried out followed by successive filler passes, and capper finish pass in accordance with the approved welding procedure.

The filler and finish beads shall be deposited by an acceptable method and each filler bead shall be approximately 3 mm in thickness. Completed welds shall have a reinforcing of not less than 0,8 mm and not more than 1,5 mm above the pipe surface around the entire perimeter of the weld, and the width of the finish or cover shall be not more than 3 mm greater than the original groove.

The number of beads required shall be governed by the wall thickness of the pipe, so that the completed weld will have the reinforcement previously specified; provided, however, that each weld shall consist of at least three beads. No two beads shall be started at the same point. No mitre welds will be permitted, and all welds are to be at ninety degrees (± 5 degrees) to the axis of the pipe. All slag and scale shall be removed from each bead for visual inspection immediately after each bead is run.

In all field butt-welds where it is possible to work inside the pipe, the inside weld shall be done first. The chemical composition of weld metal and parent metal shall be similar and the inner weld metal or reinforcement shall not extend more than 1 mm above the inside metal surface of a pipe or special, and any excess shall be removed by grinding.

Defects caused by stray welding arc flashes shall be removed by grinding, provided that the pipe wall thickness is not reduced to less than the specified minimum thickness, otherwise the portion shall be cut out and repaired.

8) Fillet welding

Welding shall be as for butt-welding as applicable. All pipes of DN 600 and over shall be welded on both the outside and the inside.

9) Welding alongside the trench

The Contractor may butt-weld factory coated and/or lined steel pipes together alongside the edge of the trench to form continuous welded pipeline sections up to a maximum length of 45 m and to lower each section into the trench, provided the pipe, coating and/or lining are in no way damaged during these operations and provided furthermore that the deflection of the pipe barrel at any point during any stage of the operation does not exceed 2% of pipe outside diameter.

The linings and coatings of factory coated and/or lined pipes jointed together outside the trench shall be made good at these joints outside the trench.

C3.3.2.10.4.3.2.5 ZUT 7003.4.3.2.5 Repair of welds

Rectification of defective welds shall be in accordance with API Std. 1104 and to the satisfaction of the Engineer. All costs related to the repair of defective welds shall be borne by the Contractor. Defective welds shall be repaired immediately once they are found to be defective. The Engineer has the right to stop the Contractor proceeding with further pipe laying in the event of the Contractor delaying the rectification of defective welds. Furthermore, no consideration will be given to any claims arising from delays in construction resulting from such action.

C3.3.2.10.4.3.3 ZUT 7003.4.3.3 Installation of specials and fittings

C3.3.2.10.4.3.3.1 ZUT 7003.4.3.3.1 General

Welding shall comply with API Std. 1104. All specials and other fittings shall be installed in accordance with the drawings and instructions of the Engineer. Where "slip-on" or sleeve couplings are to be fitted, all surfaces shall be thoroughly cleaned to a smooth finish, care being taken to remove as little of the protective coating as possible.

C3.3.2.10.4.3.3.2 ZUT 7003.4.3.3.2 Bends

Bends shall be installed true to line, level and deflection and shall be anchored in concrete where required to counteract thrust. Bends shall normally be supplied with "centre planes" marked with two small punch marks close to both ends of the bends to facilitate correct positioning of the bends in laying.

C3.3.2.10.4.3.3.3 ZUT 7003.4.3.3.3 Tees

Tees for air valves shall be installed with branch barrels pointing vertically upwards. Tees for scour valves shall be installed with branch barrels pointing vertically downwards or at the gradients indicated on the drawings. Tees for off-takes shall be installed as shown on the drawings.

Field installation of the off-takes from the pipelines for air and scour valve connections or any other form of off-take shall not be permitted. All tees for these off-takes and connections shall be factory manufactured.

C3.3.2.10.4.3.3.4 ZUT 7003.4.3.3.4 Flanges

All flanges shall be installed with bolt holes off-centre and symmetrically off-set from the vertical centre lines of the flange. Flanges shall be installed truly square to the axis of the pipe.

C3.3.2.10.4.3.3.5 ZUT 7003.4.3.3.5 Insulated flanged joints

Insulated flange joints shall be provided and installed by the Contractor where specified or instructed by the Engineer. The Contractor shall supply all materials, labour and plant required and shall complete and prove that each insulated joint after installation in the pipeline has a resistance well in excess of the resistance to earth of the pipeline on both sides of the insulating joint.

C3.3.2.10.4.3.3.6 ZUT 7003.4.3.3.6 Temporary closure pipes

Temporary closure pieces shall be of the same standard, diameter and wall thickness as the pipeline, except where otherwise specified or instructed by the Engineer.

C3.3.2.10.4.3.3.7 ZUT 7003.4.3.3.7 Permanent closure pipes

Permanent closure pipes shall be provided and installed as pipe laying proceeds. They shall be either butt welded to adjacent pipes, or jointed to access pipes, fittings or specials by means of slip-on couplings.

C3.3.2.10.4.3.4 ZUT 7003.4.3.4 Temporary sealing of pipeline

C3.3.2.10.4.3.4.1 ZUT 7003.4.3.4.1 Night-caps

Metal night-caps shall be used to close off all ends of each laid section of pipework when work is stopped at the end of each day or for longer periods and shall be left on the ends of sections of completed pipework until such sections are tied-in with the remainder of the completed pipeline.

The night-caps shall consist of a steel plate welded into a half slip-on coupling which shall be provided with a sufficient number of lugs to secure the ring and gasket and shall be strong enough to withstand external water and earth pressure in the event of flooding or collapse of earth. The joint shall be watertight.

The Contractor shall also, at his own expense, blank-off all air valve, scour valve and off-take tees with at least 6 mm thick blank flanges which shall be bolted with at least four bolts to tee flanges or shall be fixed to plain ended tee branches by using half couplings welded to the blank flanges. These shall be watertight and shall not be removed until the valves or other fittings are about to be fitted.

Notwithstanding the use of night-caps, the Contractor shall, at his own expense, make good all damage to pipe linings and fittings caused by the ingress of dirty water, silt, sand, debris, vermin, insects and other foreign matter. The Contractor shall, at this own expense and to the satisfaction of the Engineer, clean the interior of the pipeline of such contaminants.

C3.3.2.10.4.3.5 ZUT 7003.4.3.5 Prevention of flotation

Pipes to be encased in concrete shall be prevented from flotation during concreting operations. Apart from this special case during concreting operations, the Contractor shall prevent the flotation of pipe work due to storm runoff or groundwater entering the trench before backfilling has been completed.

Methods adopted to prevent flotation shall not damage coatings or linings and shall be approved by the Engineer. Notwithstanding this the Contractor shall at his own expense repair all damage to pipework caused by flotation and/or by the methods adopted to prevent it.

C3.3.2.10.4.3.6 ZUT 7003.4.3.6 Installation of valves and meters

Unless otherwise specified or directed, gate valves shall be set upright and butterfly valves shall be set with the main shafts horizontal. All valves and meters shall be correctly set, supported, and placed in position as the work proceeds, and shall be properly jointed to their respective pipes.

All valves and fittings shall be left in working order and shall be housed in chambers as shown on the Drawings.

Valves, meter bodies and fittings shall be supplied, painted externally and internally. The Contractor shall thoroughly clean damaged exterior painted surfaces of all valves, meter bodies and fittings of all dirt, rust, grease and other foreign matter by methods approved by the Engineer and shall make good all damaged surfaces in accordance with the requirements of ZUT 0003.

Valves requiring special adjustment after installation such as self-closing valves shall be commissioned by representatives of the valve manufacturers. Similarly, meters shall be commissioned by the respective suppliers after installation by the Contractor.

All valves and meters supplied under separate contracts, which are defective due to circumstances outside the Contractor's control shall be repaired, replaced or modified by the valve suppliers who will also be responsible for commissioning the valves.

The mass of valves or water meters shall at no time be carried by the pipe, the flange or the coupling. Support stools shall be constructed as soon as practicable after the installation of valves and meters, and shall generally be constructed of steel, concrete or masonry work. Where fabricated steel stools are approved or specified they shall comply with the requirements of SANS 10044-3 and shall be fabricated to the Engineer's approval. Supports shall be welded to the pipe only where specified and linings of pipes and specials shall be made good after welding.

Hydrostatic testing of individual sections of the pipeline shall only be carried out when all scour valves, air valves and control valves have been installed, except where otherwise instructed by the Engineer in writing.

Should line control valves or other equipment not be delivered timeously to enable the Contractor to lay continuously and to test the pipeline, the Engineer may order the Contractor to substitute specially made temporary flanged closure pieces. Such temporary closure pieces shall be supplied and installed by the Contractor to enable laying and testing to proceed. Subsequently after installation of the control valves, etc., they shall be removed and shall become the Contractor's property. These temporary closure pipes shall have the same face to face dimensions as the line control valves and shall be fitted with a suitably reinforced control diaphragm plate for sealing of the section of pipeline where it is fitted.

Wall thickness and diameter of the closure pipes shall be the same as the pipeline. A 100 mm nominal bore valve-controlled by-pass shall be fitted externally around the diaphragm plate.

C3.3.2.10.4.3.7 ZUT 7003.4.3.7 Casings, anchor blocks and chambers

C3.3.2.10.4.3.7.1 ZUT 7003.4.3.7.1 Concrete casing

Where the Engineer requires pipes to be encased in concrete, a strength 20 MPa/19 mm, or such other strength as is scheduled, shall be used. The work shall be done as follows:

a) Concrete casing shall be discontinuous at flexible couplings in the pipeline.

b) The pipe trench for the concrete encased pipeline shall be excavated to the depth below the bottom surface of the pipe, as ordered or shown on the drawings, and to sufficient width to allow for the concrete to be placed to the full specified width. The bottom of the trench shall be trimmed true to line and grade.

c) The in situ concrete bed 150 mm thick shall be cast and the pipeline laid thereon true to line and level leaving a gap nowhere less than 50 mm between the pipe and the bed.

d) After jointing the pipes shall be secured to steel loops left in the bed. Concrete shall then be pinned under and around the pipes from one side only until the bottom quarter of circumference of the pipes is in contact with the concrete bed.

e) The pipe shall be tested in accordance with the applicable tests given in Clause 5, care being taken to ensure that the pipe do not move during testing.

f) After the pipeline has been tested, suitable formwork shall be erected and concrete carefully placed and vibrated in position up both sides of the pipe. The concrete level shall be raised equally on both sides of the pipe until encasement is complete and a cover over the surface of the pipe is provided that is nowhere less than that ordered or shown on the drawings.

g) No earth filling over the concrete shall be commenced until at least 7 days after the concrete has been placed.

C3.3.2.10.4.3.7.2 ZUT 7003.4.3.7.2 Anchor blocks

At tees, bends, terminal valves, end caps and where otherwise directed, anchor/thrust blocks shall be constructed to dimensions ordered or shown on the Drawings. Unless otherwise specified or indicated on the Drawings, anchor/thrust blocks and pedestals shall be constructed of 20 MPa/19 mm concrete or such other class as is scheduled.

The concrete shall be well punned round the pipe and, if in trenches, against the undisturbed faces and bottom of the trench. Backfilling behind or under thrust faces will not be permitted. Excess excavation shall be replaced with the prescribed mix concrete given above for anchor/thrust blocks at the Contractor's expense unless an item is scheduled to cover payment for overbreak. Care shall be taken to leave the joints accessible. No anchor/thrust blocks and pedestals shall be concreted until the approval of the Engineer has been obtained.

C3.3.2.10.4.3.7.3 ZUT 7003.4.3.7.3 Valve chambers

Valve chamber shall be constructed as indicated on the Drawings. Concrete chambers shall be constructed in accordance with the relevant clauses of SANS 1200 G or GA.

Lifting and relaying of existing pipes

C3.3.2.10.4.3.8 ZUT 7003.4.3.8 Brickwork in chambers and manholes

Each chamber and manhole shall be built to the details shown on a particular drawing or as shown on the applicable type drawing. The walls shall be constructed in an approved bond comprising header and stretcher courses with the fair face on the inside. No false headers shall be built in and only whole bricks shall be used except where closures are required to form bond.

The bricks shall be well soaked in water immediately before being laid and the course of bricks last laid shall be well wetted before fresh bricks are laid upon it. All walls shall be carried up regularly so that no part of the walling is more than 1,3 m higher than any adjoining wall.

Joints shall be flushed up solid at every course throughout the whole width of each course, which shall be laid on a solid bed of mortar of thickness not exceeding 10 mm, and, when applicable, the joints shall be raked out as the works proceeds to form a key for plaster.

Mortar for brickwork and plasterwork shall be composed of one part of cement to three parts of sand. Sand shall be clean pit sand free from clay and other impurities and, if so directed, shall be properly screened and washed.

If required, step irons for a manhole shall be built into the straight of the wall at 300 mm intervals staggered right and left in vertical rows. Cast iron fittings shall be bitumen painted. Each cast iron cover and frame shall be grouted solidly onto the shaft. Concrete surrounds of each manhole shall be finished off to suit surrounding surfaces.

C3.3.2.10.4.3.9 ZUT 7003.4.3.9 Lifting and relaying of existing pipes

Where shown on the drawings and where scheduled, existing pipes and fittings that are to be removed shall be lifted and the materials recovered as far as is practicable. The pipes and couplings shall be removed from the trench and placed in the Contractor's site store where they shall be cleaned, sorted, and listed. A copy of the list of undamaged material recovered shall be handed to the Engineer.

Unless, in terms of the contract, other pipes are to be laid in the same trench, each trench shall be backfilled as specified in SANS 1200 DB.

Where recovered pipes are scheduled to be re-laid, rubber rings, insertion packings, damaged joints, and rusted bolts shall be replaced.

Before they are repaid, an acceptable number of pipes shall be tested for compliance with the requirements of the application specification for resistance to hydraulic pressure.

C3.3.2.10.4.3.10 ZUT 7003.4.3.10 Disinfection of potable water pipelines

After completion of the laying and testing, each potable water pipeline shall be disinfected. The Contractor will be required to submit a detailed method statement for approval by the Engineer. A minimum requirement will be that the method statement deals with the method of dosing and how the dosing rate will be controlled to ensure a uniform distribution throughout the pipeline to be disinfected, the chemicals to be used, the anticipated range of dosing rates and equipment to be used, and the name and qualification the Contractor's person supervising the disinfection.

Once a successful hydraulic test of the entire pipeline has been achieved and the connections have been completed, the pipeline shall be drained. The pipeline shall then be re-charged in accordance with Clause 5.1.3.5 "Initial Filling of the Pipeline". Whilst being charged, a sodium hypochlorite solution shall be introduced into the pipeline in such a manner as to ensure that a theoretical total chlorine concentration of at least 25 ppm (mg/l) is achieved throughout the pipeline.

Once the entire pipeline has been filled in this manner, it shall be left for a 24-hour period. Thereafter, total chlorine concentrations shall be measured at each scour and off-take point. A concentration of 20 ppm total chlorine will be considered acceptable. Should this concentration not be achieved at all scours and off- takes, the Contractor shall take all steps considered necessary by the Engineer to achieve satisfactory disinfection, at his/her own cost.

Once satisfactory disinfection has been achieved, the pipeline shall be drained via the scour valves (or by other means approved by the Engineer) and sufficient sodium thiosulphate (typically 1 part of total chlorine) shall be dosed into the scour-wet wells to fully neutralise the chlorine before discharging to watercourses.

The pipeline shall then be re-charged in accordance with the stated procedure and, after 24 hours, samples will be taken by the Engineer for analysis (at no cost to the Contractor). Should the following limits not be achieved, the Contractor shall carry out at his/her own cost, all steps deemed necessary by the Engineer to achieve satisfactory disinfection:

a) E.coli: Count = 0
b) Coliforms: Count = 0
c) Faecal Streptocci: Count = 0
d) In addition to a), b) and c), the water quality shall meet the requirements for potable water of the local authority or of the authority supplying such water to the area.

C3.3.2.10.4.3.11 ZUT 7003.4.3.11 Corrosion protection

C3.3.2.10.4.3.11.1 ZUT 7003.4.3.11.1 Final painting

After successful hydrostatic testing of the pipeline, and after completion of all construction work under this Contract, all external surfaces of uncoated steelwork and surfaces of all valves and fittings shall be prepared and painted as specified in the relevant clauses of Specification ZUT 0003. In addition, all surfaces of materials which had received first coats of paint in the course of the Contract in accordance with the specifications shall receive final coats of paint of the same colour or such other colours as may be specified or instructed by the Engineer.

All paint used shall be out of the original containers of the manufacturer and such containers are to be brought onto the site unopened. No adulteration will be permitted and paints shall be used strictly in accordance with the manufacturer's instructions.

Painting shall not be done in wet or humid weather.

C3.3.2.10.4.3.11.2 ZUT 7003.4.3.11.2 Butt-welded steel pipes

As soon as practicable, but not more than 24 h after the welding of joints in the field has been approved and accepted by the Engineer, the internal lining of pipes and specials shall be made evenly continuous over the joints.

Materials for this work shall have the same properties as those used respectively for the adjacent lining or coating and shall be so applied that the finished work over the joint shall have the same quality as specified respectively for the adjacent lining or coating and shall be capable of passing the same tests as specified for adjacent lining or coating.

C3.3.2.10.4.3.11.3 ZUT 7003.4.3.11.3 Metal couplings

In addition, all buried metal couplings and all metal couplings located inside chambers, shall be protected with "Denso" petrolatum as per the requirements of Specification ZUT 0003.

C3.3.2.10.5 ZUT 7003.5 COMPLIANCE WITH REQUIREMENTS

C3.3.2.10.5.1 ZUT 7003.5.1 TESTING

C3.3.2.10.5.1.1 ZUT 7003.5.1.1 General

Testing shall be in accordance with this clause and Specifications ZUT 0003, 7001 and 7002, as relevant.

As the work proceeds, pipelines shall be hydrostatically tested by means of test equipment supplied by the Contractor.

Each test shall be carried out in the presence of the Engineer or his representative. The Contractor shall be responsible for carrying out all tests and for all expenses incurred.
When carrying out the hydrostatic tests, the Contractor shall ensure that all valves, tees, and bends are properly secured and shored to prevent movement of pipes and fittings and, should any such movement occur, the Contractor shall, at his own expense, reposition and, if necessary, repair the pipes and fittings and the securing means.

Until each section of the pipeline has been subjected to the hydrostatic test and has complied with the applicable requirement for leakage rate, the pipeline will not be accepted. The hydrostatic test

shall be repeated until the Engineer is satisfied that the section under test complies with the said requirement.

C3.3.2.10.5.1.2 ZUT 7003.5.1.2 Testing of field welds

C3.3.2.10.5.1.2.1 ZUT 7003.5.1.2.1 Destruction tests

Tests as specified in API 1104 Clause 6.5 shall be carried out and approved prior to any field welding being done.

C3.3.2.10.5.1.2.2 ZUT 7003.5.1.2.2 Radiographic testing

Radiographic tests and adjudication of test records shall be carried out by an Independent Inspectorate, appointed by the Engineer to act on his behalf. The Inspectorate shall be afforded every facility during the course of pipeline construction and testing to enable the inspection to be carried out effectively. 10% of the total length of all manual field butt welds and 2,5% of the total length of field welds done by an approved automatic process shall be examined radiographically with particular reference to weld intersections, using equipment supplied and staffed by the Inspectorate. All welds on critical sections such as river, rail and road crossings shall be 100% radiographically tested.

The Engineer reserves the right to increase the length of welds to be radiographed if results obtained are not satisfactory or to reduce the length of welds radiographed to a minimum of 4% if the standard of welding is sufficiently high to warrant such a reduction.

The Inspectorate shall process and adjudicate radiographs on site. The standard of acceptability shall be in accordance with API 1104. All welds which are found to be unsatisfactory shall be repaired and 100% re- radiographed at the Contractor's expense. The additional radiography of repaired welds shall not be deemed to be included in the overall 10% or 2,5% radiography.

Field welds may be examined by radiographic inspection as stated in API 1104. Should two or more welders participate in making the weld, the welding foreman and the Engineer's Representative shall decide which welder is responsible for the defective work. The Engineer shall be privileged in the judgement of his inspector to cut out welds for further tests. The test welds (except the initial free test referred to in 5.1.2.1) that meet the Engineer's requirements and specifications when properly tested shall be replaced with a satisfactory tie-in at the Employer's expense. Should any test weld cut from the line prove unsatisfactory to the Engineer when properly tested, it shall be replaced at the Contractor's expense. Test welds shall be cut from the line as soon as practicable after completion to avoid unnecessary delay and expense, and shall consist of an annular ring not less than 230 mm long with the weld in the middle.

When welding the line together at places where the test welds have been cut out, one weld will be used if it is practicable to pull the line back into position; otherwise, two welds will be made by setting in a short length of pipe with a minimum length of 750 mm.

The Contractor shall furnish approved types of machines for testing. A record of the results of each test weld shall be made by the Engineer's inspector and jointly signed by the Engineer's Representative and Contractor's Representative. The Contractor will be reimbursed for extra welds at the rates tendered if scheduled in the Contract as a separate item. Extra welds shall be construed to mean those welds cut out at the Engineer's request which, after specified tests, are found to meet the Engineer's specifications, except those free initial test welds referred to herein.

Claims arising from delays in construction caused by justifiable additional radiography which may be ordered by the Engineer or re-radiography of repairs, will not be considered.

C3.3.2.10.5.1.2.3 ZUT 7003.5.1.2.3 Dye-penetrant testing

A 100% dye penetrant test shall be carried out by the Contractor on all field welds except where radiographic testing is undertaken.

The dye-penetrant test shall be carried out in accordance with BS 4416 and as detailed below:

a) The Contractor shall obtain the approval of the Engineer for the group of dye-penetrant and developer that he proposes to use for the test;

b) As pipe laying progresses, field welds shall be subjected to the test soon after each weld is completed;

c) In order to obtain a surface that is dry, clean, and free from scale, dirt and grease, the Contractor may grind but he shall not grit blast the surface;

d) The temperature of the surface to which the developer and the penetrant are applied shall not be below 16˚C or above 52˚C;

e) Observations for indications shall be made not less than 15 minutes and not more than 60 minutes after the application of the penetrant;

f) Any surfaces on which non-relevant indications are observed shall be explored by visual methods and, if considered necessary by the Engineer, such surfaces shall be cleaned and retested; and

g) Welds that show no relevant trace of dye on the developer will be accepted.

C3.3.2.10.5.1.2.4 ZUT 7003.5.1.2.4 Visual testing

All field welds shall be inspected visually throughout their entire length by the Contractor for signs of possible faults. Full records of the testing of each joint shall be kept by the Contractor and his findings reported to the Engineer. The Contractor shall allow the Engineer and/or the Inspectorate to also inspect up to 10% of the number of field welds visually.

C3.3.2.10.5.1.2.5 ZUT 7003.5.1.2.5 Testing of fillet welds

In addition to the dye penetrant tests, each fillet weld on pipes of DN 600 and over shall be air and bubble tested by pumping air into the annular space between the welds to a pressure of at least double the specified working pressure. While this pressure is maintained, all welds and connections shall be tested with soap or primer. Defects found during testing shall be repaired by the Contractor, and testing continued all at the Contractor's expense until a satisfactory result is obtained.

The test tapping point shall then be plugged in an approved manner.

C3.3.2.10.5.1.2.6 ZUT 7003.5.1.2.6 General

The pipeline shall be hydrostatically tested on completion of pipe laying and after installation of all valves and fittings. Test sections shall be blanked off by making use of end-caps. Installed isolating valves within the test section shall not be used as end-caps.

The Contractor shall submit to the Engineer a detailed method statement describing the timing, methodology and scheduling of each hydrostatic pressure test to be undertaken. No test shall proceed before approval of such method statement by the Engineer.

If sections of a pipeline are encased in concrete, or where concrete anchor blocks or other structural concrete structures had been provided, the Contractor shall allow for a minimum concrete setting period of 28 days prior to the hydrostatic test being executed.

The Contractor shall supply water from an approved source for hydraulic testing of the pipeline. Pipelines designed for potable use shall be hydraulically tested and disinfected using potable water. Water used for one filling of the pipeline for hydraulic testing, one filling for disinfection and one filling after draining the disinfection water will be provided by the Employer to the Contractor, free of charge, at the connection points stated in the project specifications. Items have been provided in the Bill of Quantities to cover the cost of receiving and conveying water from the supply point to the test section of pipeline. Additional water supplied by the Employer owing to unsuccessful disinfection and/or hydraulic testing will be charged to the Contractor.

C3.3.2.10.5.1.2.7 ZUT 7003.5.1.2.7 Test pressure and time of test

After the pipe trench has been backfilled the pipeline shall be tested in sections between end caps, blank flanges, or other isolating devices, at the pressures appropriate to the pipeline section under test. The Engineer may require that blank flanges or “spades” be inserted and that the pipeline be tested in reduced lengths and, in addition, at the point of maximum pressure.

Unless otherwise specified, shown on the drawings, or approved by the Engineer, the average test pressure for field testing shall be 1,25 times the pressure rating of the pipe.

Where the pipeline is tested in sections, the Contractor will have the discretion to determine the sections in which the pipeline may be tested provided that:

a) The test sections shall be determined, taking any differences in elevation along the pipeline into account, such that the:
   i) maximum field test pressure at any point along the section is not higher than 1,5 times the pressure rating of the pipe or the maximum field test pressure permitted by the pipe manufacturer; and
   ii) minimum field test pressure at any point along the section is not less than the greater of:
      1) the pressure rating of the pipe, or
      2) 1,25 times the maximum working pressure at these points.

b) The first km (+200m,-100m) of pipeline laid is successfully tested before the subsequent section may proceed.

c) The Contractor shall make due allowance in the construction programme and in the tendered rates for the entire testing operation including for the provision of temporary end stops (flanges or bullnoses) and any other costs associated with testing the pipeline in intermediate sections.

Once filled, the pipe shall be left for 24 hours to permit maximum saturation. The section to be tested shall then be pressurised to the specified pressure and left for a further 24 hours, during which period, the pressure drop (if any) and the quantity of water required to be pumped in to restore the test pressure shall be measured and recorded. In addition, all flexible and flanged joints shall be visually inspected and there shall be no sign of leakage.

At all times when there is water in the pipeline, and particularly during filling, testing and draining of the pipeline, all air valves shall be in operation and their individually isolating valves shall be open.

C3.3.2.10.5.1.2.8 ZUT 7003.5.1.2.8 Visible leaks

a) Except as allowed in b) the specified test pressure shall be maintained for a period of at least 24 hours (or such longer period as is necessary for inspection of the pipeline) during which period all pipes, pipe specials, joints, and fittings shall be carefully inspected for leaks. All visible leaks shall be made good and any pipe, pipe special, or fitting found to be defective shall be removed and replaced at the expense of the Contractor and such replacement material shall, after installation, be tested at the expense of the Contractor.

b) In the case of pipes of DN 400 and under, the test period may be reduced proportionally to the nominal diameter of the pipe, provided that in no case shall the test period be less than 1 hour.

C3.3.2.10.5.1.2.9 ZUT 7003.5.1.2.9 Permissible leakage rates

The test pressure shall be maintained for a further period of 1 hour after the completion of the test period specified in Clause 5.1.3.3, during which time the volume of water required to be pumped into the pipeline for maintenance of the pressure shall be measured.

The permissible leakage for welded and flanged steel pipelines is zero (0) litres.

C3.3.2.10.5.1.2.10 ZUT 7003.5.1.2.10 Initial filling of pipeline

The entire process for filling the pipeline at any time during testing or disinfection shall be carried out under the supervision of the Engineer. Under no circumstances will the Contractor be allowed to carry out filling
of the pipeline without the supervision of the Engineer, neither shall the Contractor permit any other persons to carry out such filling without the written permission of the Engineer.

Unless otherwise specified or approved in writing by the Engineer, filling of the pipeline for hydraulic testing shall be carried out at a velocity in the main pipeline not exceeding 0.5 m/s.

Any damage to the pipeline caused by non-compliance with this clause shall be rectified at the Contractor's expense.

C3.3.2.10.5.1.2.11 ZUT 7003.5.1.2.11 Connections after testing

The connections of the new pipework to the existing pipework shall only be carried out after the pipeline testing has been completed and accepted by the Engineer. For this reason, testing must be carried out against a blank flange or bullnose end cap at these locations.

C3.3.2.10.5.1.2.12 ZUT 7003.5.1.2.12 Remedial measures

In the event that a pipe section fails a test, the Contractor shall carry out all remedial measures necessary to obtain a successful test of each individual section and the entire pipeline, at his/her own expense. Such remedial measures shall in no way compromise the requirements stipulated in the specifications.

C3.3.2.10.5.1.2.13 ZUT 7003.5.1.2.13 Draining of the pipeline

The pipeline may have to be drained to carry out remedial measures and it must be drained before the disinfection process commences. The pipeline shall be drained via the scour valves in a manner that does not cause erosion of the streambeds or negatively impact on the environment in any way. All such drainage of the pipeline shall be carried out under the supervision of the Engineer.

C3.3.2.10.5.1.3 ZUT 7003.5.1.3 Commissioning

The pipeline will be considered to have been commissioned and practically complete once all the associated structures are sufficiently complete to carry out their structural and hydraulic function and the hydraulic test and disinfection of the entire pipeline has been successfully completed.

C3.3.2.10.5.1.4 ZUT 7003.5.1.4 Water tightness testing for chambers

Refer to the SANS 1200 G or 1200 GA, as applicable.

C3.3.2.10.5.1.5 ZUT 7003.5.1.5 Tests on epoxy linings

Once all work in the pipeline has been completed bar the hydrostatic testing and backfilling, the pipeline shall be cleaned by sweeping with a soft broom and rinsing. Access to this section shall be restricted from this point forward and will only be allowed on the written consent of the Engineer.

Holiday detection testing is to be undertaken by the Contractor on the lining in order to ensure that it remained intact during the transport, handling, placing and backfilling processes. Holiday testing may also be undertaken by the Independent Inspectorate. The testing and repair procedures shall be in accordance with the requirements stipulated in Specification ZUT 0003.

C3.3.2.10.5.1.6 ZUT 7003.5.1.6 Pipe coating integrity surveys

The Contractor shall perform the pipe coating integrity survey as defined in the cathodic protection specifications.

C3.3.2.10.5.2 ZUT 7003.5.2 TOLERANCES

C3.3.2.10.5.2.1 ZUT 7003.5.2.1 General

No deviation will be permitted from the minimum pipe cover specified or shown on the Drawings.

C3.3.2.10.5.2.2 ZUT 7003.5.2.2 Control points

For the purposes of this Clause, valves and pipe specials set on the centre line of the pipeline and designated changes in gradient shall be regarded as control points and shall be located with a permissible vertical deviation of ± 100 mm on the centre line. The same deviation will be permissible laterally except where the pipeline is laid at a designated distance from a fence line, kerb line, or boundary, in which case the permissible deviation shall be ± 20 mm.

Unless otherwise directed and subject to a permissible deviation (measured along the centre line) of ± 2 m, scour valves shall be located at the lowest points in pipelines and air valves at the highest points.

C3.3.2.10.5.2.3 ZUT 7003.5.2.3 Alignment

PLAN (horizontal alignment): Unless otherwise directed, the permissible deviation from the defined alignment of the pipeline, when measured on the top centre of the pipeline, shall be ± 100 mm or ± 10% of the nominal diameter of the pipe, whichever is the larger, and the permissible deviation per pipe length shall be ± 20 mm.

LEVEL (vertical alignment): The permissible deviation from the designated level at any point on the invert of the pipeline shall be ± 50 mm or ± 10% of the nominal diameter of the pipe, whichever is the larger.

C3.3.2.10.5.2.4 ZUT 7003.5.2.4 Manholes, valve chambers, etc.

Manholes, valve chambers and the like shall be constructed centrally on the control points and, with the exception of tolerances that affect access to bolts, nuts, etc., with a permissible deviation of ± 50mm on all clearance dimensions. The clearance dimension between the outside of each nut and bolt-head and the inside face of the wall of a structure or any other fitting shall be at least the specified value.

C3.3.2.10.6 ZUT 7003.6 TOLERANCES

Refer to Clauses 4 and 5.

C3.3.2.10.7 ZUT 7003.7 TESTING

Refer to Clause 5.

C3.3.2.10.8 ZUT 7003.8 MEASUREMENT AND PAYMENT

C3.3.2.10.8.1 ZUT 7003.8.1 BASIC PRINCIPLES

C3.3.2.10.8.1.1 ZUT 7003.8.1.1 General

Excavation and backfilling of trenches, and laying of medium-pressure pipelines, will be measured separately under SANS 1200 DB and Clause 8.2 of this Specification.

C3.3.2.10.8.1.2 ZUT 7003.8.1.2 Night-caps

No extra payment will be made for night-caps. The supply and use of night-caps will be held to be included in the unit rate tendered for pipe laying.

C3.3.2.10.8.1.3 ZUT 7003.8.1.3 Permanent closure pipes

C3.3.2.10.8.1.3.1 ZUT 7003.8.1.3.1 Butt welding

Where closures are butt welded to other pipes, the cost of cutting the pipe, preparing the end for welding and welding as specified in SANS 719, repairing the lining and coating as specified in Specification ZUT 0003 will be held to be included in the unit rate for laying of pipes.

C3.3.2.10.8.1.3.2 ZUT 7003.8.1.3.2 Slip-on couplings

Where closures are jointed to either access pipes, fittings or specials by means of slip-on couplings, no additional payment will be made for extra cutting of the pipe, preparing the end for welding, welding on the loose collar (approved 150 x 20 mm mild steel, machined round to suit coupling) or making good the lining.

Unless separately billed, the supply, transport and handling of the collar and slip-on coupling will be held to be included in the unit rate for the supply of pipes, fittings and specials.

C3.3.2.10.8.1.4 ZUT 7003.8.1.4 Extra welds

Payment for all extra welds shall be covered by variation orders showing the location of the welds according to stake value and other necessary details. Such variation orders shall be signed by the Engineer's Representative and the Contractor's Representative in the field on the day the work is done. No payment will be made for test welds not covered by variation orders as stated above.

C3.3.2.10.8.2 ZUT 7003.8.2 BILLED ITEMS

C3.3.2.10.8.2.1 ZUT 7003.8.2.1 Lay and bed steel pipes and specials complete with couplings

a) Pipes……...…….Unit: metre (m)

b) Specials……..…Unit: number

Pipes will be measured linearly as laid in the trench. No deduction will be made for specials and valves. Separate payment will be made for each type, size and class of pipe laid.

Specials will be measured separately by number of each type.

The unit rates tendered in the Bill of Quantities for laying of pipes and specials shall cover the cost of the following:

a) Inspecting, accepting, taking delivery, providing storage, taking delivery from storage on site, transporting, handling, inspecting, stringing alongside trench, forming joint ("fox") holes, laying, jointing, cutting, scarfing, cutting mitre deflections up to 10 degrees (5 degrees per side), bevelling, maintaining line and level, jacking for ovality if necessary, provision and use of shield for heat treatment and welding if required;

b) maintenance of cleanliness including all night caps and temporary blank flanges, etc., necessary to keep the inside of the pipe dry;

c) removal, where necessary, and making good of lining and coating over the joints;

d) radiographic examination of field welds and holiday testing of the lining, visual and dye penetrant testing;

e) testing of welders and issuing of the necessary certificates;

f) making good all linings and coatings;

g) hydrostatic testing, testing equipment and anything required to do this work, including temporary end caps and blank flanges;

h) sterilizing the pipeline where used for potable water;

i) bolts, nuts, washers, gaskets and insulating material;

j) supply and installation of steel and or concrete pipe supports (not necessarily shown on drawings);

k) building in of specials (Refer to Item 8.2.11)

No extra payment over and above the rates tendered in the Bill of Quantities will be made in respect of additional cutting and jointing of pipes required to locate valves, specials, etc., exactly.

No separate payment will be made for the supply and fitting, chipping of lining, cutting, trimming, bevelling and making good on Site of any additional couplings and jointing materials which may be required for the connection of shortened pipe closures, unless specific provision is made in the Bill of Quantities.

The unit rate tendered for laying of steel pipes and specials shall cover the cost of the laying, jointing, etc., as specified and, in addition, for final painting and surface preparation when applicable. No extra-over payment shall be made for protecting metal couplings with petrolatum wrappings as per Specification ZUT 0003.

Notwithstanding the use of night-caps the Contractor shall at his own expense make good all damage to pipe linings and fittings caused by the ingress of dirty water, silt, sand, debris, vermin, insects and other foreign matter. The Contractor shall at his own expense and to the satisfaction of the Engineer clean the interior of the pipeline of such contaminants.

A maximum payment of 85 % of the tendered rate may be made for the completed section of pipeline which has not yet been hydraulically pressure tested and disinfected. A further payment of 10% of the tendered rate will be made upon successful completion of the pressure testing for the relevant section of pipeline. The final 5% of the tendered rate will be made upon completion of disinfection of the pipeline.

C3.3.2.10.8.2.2 ZUT 7003.8.2.2 Extra-over for mitre deflections

Unit:……...number (No.)

Where additional mitre deflections (up to 10 degrees) are ordered by the Engineer, these will be measured by number.

The rate shall cover the all the costs associated with mitre deflections detailed in Item 8.2.1 (a) to (f).

C3.3.2.10.8.2.3 ZUT 7003.8.2.3 Installation of valves and meters

Unit:……...number (No.)

The unit rate for installation of valves and meters shall cover the cost of taking delivery of these items from storage on site, inspecting each item for visible signs of damage, transporting to the laying site, off-loading, installing and, except where separately billed, of testing and commissioning of the valves and meters in position in accordance with the manufacturer's instructions and to the satisfaction of the Engineer.

No extra payment over and above the rate will be made in respect of any additional cutting, turning and jointing of pipes required for the location of a valve, meter, etc. where a precise position is given on the drawings.

The tendered rate shall also cover all jointing materials and, except where separately billed, support pedestals. The rate tendered for installation of valves and meters shall also include the cost of necessary oiling and greasing of moving parts and for minor routine initial maintenance work such as tightening up leaking glands.

The unit rates shall include for the cost of making good and the repair of paintwork and final painting as specified.

C3.3.2.10.8.2.4 ZUT 7003.8.2.4 Recover old pipeline

Unit:…….metre (m)

The total length of the pipeline ordered to be recovered will be measured by length for each stated depth range. No deductions will be made for valves, specials, and the like.

The rate shall cover the cost of the excavation and removal of pipes, valves, and fittings from the trench, the handling and transportation to the Contractor's store on site, the cleaning and listing of the salvaged recovered materials, and the backfilling of the trench.

C3.3.2.10.8.2.5 ZUT 7003.8.2.5 Test and relay recovered pipe

C3.3.2.10.8.2.5.1 ZUT 7003.8.2.5.1 Test recovered pipes on site before relaying

Unit: ……...number (No.)

The rate shall cover the cost of the provision of suitable testing equipment and the carrying out of the specified test.

C3.3.2.10.8.2.5.2 ZUT 7003.8.2.5.2 Relay pipeline

Unit:……..metre (m)

The rate shall cover the cost of transporting, handling, laying, and bedding, as well as the provision of new rubber rings or insertions, as the case may be. Couplings and bolts that have to be replaced will be paid for at daywork rates unless a suitable item such as 8.2.4.3 below has been provided in the Bill or, in the opinion of the Engineer, the need for their replacement arose from the fault or negligence of the Contractor.

C3.3.2.10.8.2.5.3 ZUT 7003.8.2.5.3 Joints and couplings for recovered pipeline (Provisional)

Unit: ……number (No.)

The rate shall cover the provision of complete sets, each comprising a new rubber ring or insertion, as the case may be, as well as all elements of the coupling and bolts that need replacement.

C3.3.2.10.8.2.6 ZUT 7003.8.2.6 Anchor/thrust blocks

a) Dimensions stated or given on drawing – Unit: ……..No. or Sum

OR

b) Where, at the tender stage, no detailed drawings or dimensions are given or where only typical drawings are given:
   Concrete – Unit: m3
   Formwork – Unit: m2
   Reinforcement – Unit: ton

Except where measured by number or sum, anchor/thrust blocks will be measured as the volume of concrete, areas of formwork, and mass of reinforcement, as relevant, placed to dimensions ordered or given on the drawings and schedules of reinforcement. The relevant terms of Clause 8 of SANS 1200 G or SANS 1200 GA, as applicable, shall apply.

Where measured by number or sum, the rate or sum shall cover the cost of excavation and trimming, formwork, reinforcement (if any), and screeding of top surfaces.

C3.3.2.10.8.2.7 ZUT 7003.8.2.7 Concrete casing

Unit:……..……m³

The concrete will be measured net by volume to the specified width and depth in excess of the external volume of the pipe (i.e. the volume of the pipe will be deducted).

The rate shall cover the cost of formwork (including stop ends at flexible joints), reinforcement (if any) and concrete.

C3.3.2.10.8.2.8 ZUT 7003.8.2.8 Valve chambers

Unit: ……...number (No.)

Valve chambers will be measured as complete units.

The rate shall cover additional excavation (see Subclauses 8.2.2 and 8.2.3 of SANS 1200 DB), materials, plant, and labour necessary for the complete construction including the installation of covers, ladders and ancillaries shown on the drawing.

C3.3.2.10.8.2.9 ZUT 7003.8.2.9 Manholes

Unit: ……...number (No.)

Manholes will be measured as complete units for which separate items will be scheduled for each type of manhole and depth categories.

The rate shall cover additional excavation, materials, plant, and labour necessary for the complete construction including the installation of the covers, ladders and ancillaries shown on the drawing.

C3.3.2.10.8.2.10 ZUT 7003.8.2.10 Temporary closure pipes (Provisional)

Unit :…….. number (No.)

Temporary closure pipes will be measured as provisional items by number only where ordered by the Engineer.

The unit rate shall cover the cost of the supply, installation, removal and making good of the pipe.

Excavation, backfilling and supply of bedding material will be measured and paid for separately as specified in SANS 1200 DB and SANS 1200 LB.

C3.3.2.10.8.2.11 ZUT 7003.8.2.11 Items cast or built into concrete

Unit: ……...number (No.)

The building in (or casting into concrete) of the pipes and pipe specials will be measured by the number of each item built in.

The unit rate shall cover the installation of the pipe or pipe special as well as all additional costs of formwork, concreting and fixing of pipes and specials which are not covered by the normal tendered rates for formwork and concrete.

C3.3.2.10.8.2.12 ZUT 7003.8.2.12 Pipe lining integrity tests

Unit: ……..lump sum (Sum) or metre (m)

Payment for tests on linings will include for all labour, the cost of supplying fuel and production related wearing parts (bucket teeth, cutters etc.) for equipment utilised, and materials to perform all tests and repair work as defined in Specification ZUT 0003. Payment for the pipeline section tested and repaired will be certified for payment only on written acceptance of successful testing and repair work as defined in Clause 5.1.6.

C3.3.2.10.8.2.13 ZUT 7003.8.2.13 Concrete/steel valve and pipe supports

Unit: ……..number (No.)

Except where billed separately, payment for the supply and installation of concrete or steel supports to valves, meters, pipe specials, etc. shall be included in the rates tendered for the installation of these items.

Where billed separately, the rate for supports shall cover all material, plant and labour required for the supply and installation of the support, including all anchor bolts and jointing material. In the case of steel supports, the cost of the corrosion protection shall be included in the rate tendered for the support.

Annexures

APPENDIX A. APPLICABLE STANDARDS

API 1104 : Standard for welding of pipe lines and related facilities.

SANS 719 : Electric welded low carbon steel pipes for aqueous fluids (Ordinary duty)

SANS 10044-3 : The fusion welding of steel (including stainless steel):
Tests for approval of welding procedures and production welds.

SANS 1200 G : Concrete (structural)

SANS 1200 GA : Concrete (small works)

SANS 1200 L : Medium-pressure pipelines

SAECC/1

Specification ZUT 7001 : Design and manufacture of medium-pressure steel specials

Specification ZUT 0003 : General corrosion protection for pipelines, water and wastewater works

C3.3.2.11 ZUT 7004 VALVES FOR WATER AND WASTEWATER INSTALLATIONS

C3.3.2.11.1 ZUT 7004.1 SCOPE

ZUT 7004 deals with the design, manufacture, installation and commissioning of all valves and ancillaries for the control of raw water or sewage. It furthermore covers the flange machining standards, dimensions, the range and type of gaskets, corrosion protection and jointing to be used for flange joints.

The installation shall be as shown on any applicable drawings provided with the tender documents.

The scope of work for which the Contractor is responsible is specified elsewhere.

C3.3.2.11.2 ZUT 7004.2 NORMATIVE REFERENCES

Where this specification is required for a project, the following documents shall, inter alia, form part of the Contract Document:

a) Amendments to this Specification.

b) Data Sheets.

c) SANS 936/937, SANS 191, SANS 664, SANS 665, SANS 1849, and SANS 1123

d) ZUT 0001: General Mechanical Requirements.

e) ZUT 0002: Operating and Maintenance Manual.

f) ZUT 0003: General Corrosion Protection for Pipelines, Water and Wastewater Works.

g) ZUT 7015: Metal Seated Wedge Gate Valves.

h) ZUT 7016: Resilient Seal Gate Valves.

i) ZUT 7017: Slanted Seat Check Valves.

j) ZUT 7022: Air Release Valves.

Equipment, materials and operational methods shall comply with the latest edition of relevant national and/or international standards.

C3.3.2.11.3 ZUT 7004.3 DEFINITIONS

For the purpose of this Section the following definitions apply:

a) "**Face to face dimension**" means the distance between the two planes perpendicular to the body axis located at the extremities of the body and ports.

b) "**Nominal pressure (PN)**" is a numerical designation, which is a convenient round number for reference purposes. It is designated by PN followed by the maximum allowable working pressure, of which the flange is intended to be a component, will be subjected under normal working conditions. This definition is in accordance with ISO 7268. All pressure units throughout this specification will be recorded in kilopascals (kPa).

c) "**Nominal size (DN)**" is a numerical designation of size that is common to all components in a piping system other than components designated by outside diameters. It is a

convenient round number for reference purposes and is only loosely related to manufacturing dimensions in millimetres. Nominal size is designated by DN followed by the size in millimetres. This definition is in accordance with ISO 6708.

d) "**Tight shut off valve**" means a valve that has no leakage past the sealing faces in its closed position under test conditions.

e) "**Low leakage rated valve**" means a valve that has an agreed maximum leakage rate past the sealing faces when the valve is in the closed position.

f) "**Regulating valve**" means a valve intended for regulating pressure and flow, and which may have a clearance between the sealing faces when the valve is in the closed position.

g) "**Pressure rating**" is the maximum allowable working pressure of an installation of which the flange is intended to be a component.

C3.3.2.11.4 ZUT 7004.4 MATERIAL SYMBOLS

Where appropriate the following abbreviations shall refer to the material designated:

- austenitic cast iron AI
- spheroidal graphite cast iron SG
- gunmetal GM
- aluminium bronze AB
- phosphor bronze PB
- mild (carbon) steel MS
- stainless steel SS
- nickel copper NC
- integral seat IS
- resilient seat RS
- weld deposited seat WDS
- cast steel CS
- polyterafluoroethylene PTFE

C3.3.2.11.5 ZUT 7004.5 GENERAL DESIGN REQUIREMENTS

C3.3.2.11.5.1 ZUT 7004.5.1 PRECEDENCE

The Project Specification has precedence over this Particular Specification. Any conflict between the technical requirements stated in the Project Specification and the technical requirements of this Specification shall be referred to the Engineer for clarification.

C3.3.2.11.5.2 ZUT 7004.5.2 DEVIATIONS

The Client will not permit any substitution or deviation from the requirements of this Specification without prior approval. Any substitution or deviation from the original Specification shall be submitted to the Engineer for approval. Deviation shall only be considered during the tender stage of the project.

C3.3.2.11.5.3 ZUT 7004.5.3 OPERATING CONDITIONS AND CLIMATE

Valves selected for this Contract shall be designed for various hydraulic conditions and be capable of opening and closing under these conditions. Valves shall be suitable of operating at water temperatures up to 50 °C and the quality of the water shall be assumed to be highly corrosive.

C3.3.2.11.5.4 ZUT 7004.5.4 NOMINAL PRESSURE

Each valve is assigned a nominal pressure (PN) in kPa and shall be tested in accordance with this specified pressure.

C3.3.2.11.5.5 ZUT 7004.5.5 MINIMUM PRESSURE RATING

1000 kPa is considered to be the lowest acceptable pressure rating for any valve and associated equipment irrespective of lower system pressures.

C3.3.2.11.5.6 ZUT 7004.5.6 DESIGN LIFE

All valves and appurtenant fittings shall be designed for a useful life of forty-five (45) years under the operating conditions specified in the Project Specification. The manufacturer would be prepared to guarantee its satisfactory performance for 5 years, if called upon to do so.

C3.3.2.11.5.7 ZUT 7004.5.7 GUARANTEE

All valves shall be guaranteed against faulty design, materials and workmanship for a period of 5 years, from date of issue of the Taking Over Certificate and shall terminate with the issue of the Performance Certificate by the Engineer.

During this period the Contractor shall attend to and rectify at his own cost any defects that can be attributed to faulty design, materials and workmanship. Normal wear and tear, especially applicable to rim seal butterfly valves, but not to vulcanised rubber-lined butterfly valves, shall be excluded.

In order to avoid expiry of the guarantee while these valves are still in storage prior to installation, the Client will request the reinstatement of the guarantee at final commissioning of the Plant.

To promote reinstatement, the Contractor shall, provide the requirements for storage of the valves, prior to installation, in order for him to honour the implementation of the guarantee at a later stage. The Contractor shall inspect and approve the storage area prior to delivery of the valves.

C3.3.2.11.5.8 ZUT 7004.5.8 END CONNECTIONS

All valves shall be double flanged or double spigotted or double socketed end connections as specified in the schedules.

All holes of double flanged valves shall be drilled perpendicular to the face. Cast flanges shall either be machined or spot faced on the bolt head/nut bearing faces.

Sufficient clearance shall be allowed between the body and flange to enable flange bolts to be removed or tightened. Tapped holes shall be permissible only where stiffening ribs or shaft bosses interfere with bolts.

Flanges shall conform to SANS 1123. Flanges shall be thickened at points where tapped holes are necessary. Flanges shall have raised joint faces machined in accordance with the above standard and fitted with ring gaskets.

C3.3.2.11.5.9 ZUT 7004.5.9 FASTENERS AND JOINTING MATERIAL

Valves shall be supplied complete with bolt units, consisting of a standard length bolt, nut and two washers. The stud unit, where applicable, shall be supplied with a standard length stud, nut and washer. Washers shall be fitted under all bolt/screw heads and nuts.

The manufacturer shall specify a fastening sequence for bolts (if applicable) and the torque settings (in Nm) for all bolts. These torque settings and fastening sequences shall be included in the Operation and Maintenance Manual.

In addition each valve shall be supplied with 3mm non-asbestos type gaskets or insulating gaskets complete with explosion-proof spark gap arrestors as indicated on the drawings.

Depending on the valve location in a piping system and the atmospheric conditions, the following specifications will apply:

- Black bolted units: SANS 1700
- Precision bolted units: SANS 136
- Galvanised bolted units: SANS 121 (ISO 1461)
- Stainless steel bolted units: DIN 931 complete with insulating kit (on all stainless steel and 3CR12 piping and specials and where specified).
- Stainless steel set screws: DIN 933

Where shown on the Drawings flange insulating kits shall be supplied with the correct size bolts and nuts together with two insulating washers, and insulating sleeve for each bolt. All insulating gaskets shall be of the full-face type as to prevent foreign material from collecting and creating a bridge, thus shorting out the isolation.

For all valve components, i.e. bonnet covers, glands etc., drilled holes for bolts shall be perpendicular to the flange face.

All bolts and stud units shall be the same length, appropriately sized and where applicable be corrosion protected.

C3.3.2.11.5.10 ZUT 7004.5.10 VALVE SUPPORTS AND LIFTING LUGS

Valves of DN400 and larger shall have supports integrally cast with the valve body. These supports shall be designed for direct grouting or bolting to the plinths where required.

Valves over DN300 or 75 kg mass shall either have two removable eye bolts of the required strength securely attached to the valve body or lifting eyes forming an integral part of the valve body to facilitate easy handling during transport and installation.

C3.3.2.11.6 ZUT 7004.6 CONSTRUCTION

C3.3.2.11.6.1 ZUT 7004.6.1 BODIES

Bodies shall be of sturdy construction, capable of functioning satisfactorily under abnormal operating conditions without distortion of the body or malfunction of component parts and shall be shaped to give minimum change in waterway.

Designs of bodies and components shall be free of pockets that cause eddies or accumulate debris.

Where applicable, access openings and covers shall be well designed and the creation of stress risers shall be prevented. Any gussets applicable to the design of the valve should form an integral part of the casting.

C3.3.2.11.6.2 ZUT 7004.6.2 DOORS AND DISCS

Doors and discs shall, were applicable, be cast or fabricated as a unit with integrally cast hinge lugs.

Doors and discs shall operate freely. Their travel shall however be restricted by the provision of substantial stops, fitted with specified facings to minimize wear and damage to the corrosion protection.

C3.3.2.11.6.3 ZUT 7004.6.3 SEALING FACES

Sealing faces shall be either replaceable stainless rings securely fixed with stainless steel fasteners or stainless steel deposit welded as specified in the Project Specification.

Faces shall be accurately machined and micro finished promoting seal life.

C3.3.2.11.6.4 ZUT 7004.6.4 BEARINGS

Main bearings shall, were applicable, be external and accessible without emptying or removal of the valve body from the line.

Bearings shall be designed to take any unbalanced thrusts on doors or discs.

Bearings shall retain a low co-efficient of friction. Any possibility of bearings becoming tight during service due to ageing shall be eliminated.

Where possible, bearings shall be water lubricated with a proven record of reliable operation of not less than five (5) years.

Details of the type and construction of bearings shall be as specified in the relevant Valve Specification.

Where shafts protrude through the valve at the non-drive end (NDE) they shall be sealed with bolted stainless steel, grade 316, bearing cover plates. Screwed taper plug covers are not acceptable.

Sleeve type bearings shall be fully corrosion resistant and shall be fitted in the hubs in the valve body. Steel back bearings shall not be accepted.

C3.3.2.11.6.5 ZUT 7004.6.5 BEARING AND SHAFT SEALS

Bearing and shaft seals shall be of the "O" ring or radial cup type with machined weep holes or grooves for drainage at the gearbox mounting flange.

C3.3.2.11.6.6 ZUT 7004.6.6 HAND WHEELS

All manually operated valves shall be supplied complete with cast hand wheels of sturdy construction, which shall have the wording, “OPEN” and “CLOSE” together with directional arrows legibly cast in recesses on the upper surface of the rim.
Closure of valves shall be through the clock-wise rotation of hand wheels. Valves shall be capable of being opened or closed under an unbalanced pressure equal to the Nominal Pressure. The effort required on hand wheels to open or close valves under these conditions shall not exceed the following:

VALVE SIZE	SEATING/UNSEATING	INTERMITTENT
Up to and including DN300	500 N	180 N
Above DN300	600 N	220 N

Hand wheels shall be manufactured to ensure a close fit between the hand wheel and the mating spindle head and shall be firmly fixed to the spindle head. Loose fitting hand wheels are not acceptable. Shear pins or torque clutches shall be fitted to prevent damage. Hand wheel diameters shall not exceed the dimensions as shown in the table below:

PRESSURE RATING (kPa)	VALVE SIZE (DN)	HAND WHEEL DIAMETER (mm)
1000	DN100 to DN350	250mm (max.)
	DN400 to DN500	400mm (max.)
	DN600 and larger	500mm (max.)
1600	DN100 to DN350	250mm (max.)
	DN400 to DN500	400mm (max.)
	DN600 and larger	500mm (max.)
2500	DN100 to DN350	250mm (max.)
	DN400 to DN500	400mm (max.)
	DN600 and larger	500mm (max.)
4000	DN100 to DN350	250mm (max.)
	DN400 to DN500	400mm (max.)
	DN600 and larger	500mm (max.)

C3.3.2.11.6.7 ZUT 7004.6.7 LUBRICATING POINTS

All lubricating points for grease gun lubrication shall be fitted with 1/8" BSP stainless steel button head type grease nipples. Nipples shall be painted red for easy identification. Electro-plated nipples will under no circumstances be accepted.

C3.3.2.11.6.8 ZUT 7004.6.8 MARKING

C3.3.2.11.6.8.1 ZUT 7004.6.8.1 Body Marking

All valve bodies shall be permanently and indelibly marked (cast in minimum 15 mm lettering size on castings or welded on fabricated valves) as follows:

- Manufacturer's name;
- Nominal size (DN in mm);
- Nominal pressure (PN in bar);
- Arrow to indicate the direction of flow; and

All the above markings shall be legible after painting.

C3.3.2.11.6.8.2 ZUT 7004.6.8.2 Flange marking

In addition to the above, one of the flanges of the valve shall be clearly marked with a single set of machined notches. (3mm wide x 3mm deep across the width of the flange and painted red).

For wafer type valves, the width and depth of the notch shall be identical to that of the flanged valves. The length of the notch however shall be 12mm long.

- One notch - 1 000 kPa operating pressure
- Two notches - 1 600 kPa operating pressure
- Three notches- 2 500 kPa operating pressure
- Four notches - 4 000 kPa operating pressure
- Five notches - 6 400 kPa operating pressure

C3.3.2.11.6.8.3 ZUT 7004.6.8.3 Gate and body marks

One face of the gate shall be marked, corresponding to a similar mark on the body, to ensure correct replacement after dismantling. The marks shall be visible and clear after coating. The details of the marking shall be shown on the drawings.

C3.3.2.11.6.8.4 ZUT 7004.6.8.4 Identification Plate Markings

Identification plate markings shall be hard-stamped, printed or engraved on a stainless steel nameplate fitted to the valve with stainless steel cap or drive screws. If necessary a boss/raised face shall be cast integrally with the body to fit the nameplates.

Information listed on a name plate shall be as follows:

- Manufacturer's name or trade mark;
- Nominal size (DN) in millimetres;
- Contract number;
- Nominal pressure (PN) in kPa;
- Serial number;
- Date of manufacture; and
- Mass of valve in kg.

C3.3.2.11.6.9 ZUT 7004.6.9 POSITION INDICATORS

Valves of DN 300 and larger shall be fitted with accurate position indicators unless otherwise specified in the Project Specification.

Position indicating plates shall be embossed to clearly show the fully open, ¾, ½, ¼, and closed positions.

The indicator system shall be accurately installed and calibrated to give true linear indication of the valve opening. Calibration of the indicator scale shall be done in-situ to show actual valve position recorded against the actual valve operation.

All pulleys, brackets, pins, cables, counterweights, sleeves, indicator gears and fasteners shall be of stainless steel 304 or better.

Where specified, valves shall be supplied with electrical limit switches for fully open and fully closed positions plus any other I/O requirements as shown on the Drawings and I/O schedule. Limit switches will be connected to 24 V DC PLC input cards by the Contractor or his sub-contractor. The valve manufacturer shall make provision for all cable and wire connections to these limit switches.

Electronic position indicators (proximity switches) for fully open and fully closed position indication are required on all butterfly valves as specified.

C3.3.2.11.7 ZUT 7004.7 TESTING & INSPECTION

C3.3.2.11.7.1 ZUT 7004.7.1 GENERAL

Inspection and quality control shall be in accordance with ISO 9000.

Further specific requirements for quality control and testing of valves given in the following paragraphs:

C3.3.2.11.7.2 ZUT 7004.7.2 PRESSURE TEST REQUIREMENTS

Valves shall be pressure tested by the manufacturer to prove the structural integrity of the body and that the fully assembled valves are capable of functioning satisfactorily under the specified operating conditions. Valid calibration certificates of testing equipment to be used for pressure testing of the valves by the manufacturer should be made available to the Engineer.

C3.3.2.11.7.2.1 ZUT 7004.7.2.1 Pressure Testing

Test flanges shall be used. Tie-bolts or other forms of restraint applied across the blank flanges for the testing of flanged valves will not be permitted except in the case of wafer type valves.

Note:
- Valve undergoing pressure testing shall not be subject to shock loading.
- Valves and connections shall be purged of air prior to pressure testing.

C3.3.2.11.7.2.2 ZUT 7004.7.2.2 Test Fluid

The test fluid for all pressure tests shall be either water with the addition of a corrosion inhibitor, or another non corrosive liquid with a viscosity at ambient temperature equal to or less than that of water.

C3.3.2.11.7.3 ZUT 7004.7.3 TEST PROCEDURES

C3.3.2.11.7.3.1 ZUT 7004.7.3.1 General

Test pressures shall be maintained for not less than five (5) minutes or as otherwise specified by the Engineer and the valves shall be watertight in all respects.

Structural and seat tests shall be executed on both sides of double seated valves i.e. gate valves.

All valves, fully assembled, shall be pressure tested by the manufacturer in accordance with Table 1.

Table 1
APPLICABILITY OF HYDROSTATIC PRESSURE TESTS

TEST	VALVE TYPE	
	TIGHT SHUT-OFF	LOW LEAKAGE
a) Structural • Body • Disc Strength	 ✓ ✓	 ✓ ✓
b) Seat/Seal	✓	N/A

C3.3.2.11.7.3.2 ZUT 7004.7.3.2 Structural Tests

Body Test

This shall be a hydrostatic pressure test at a pressure of 1.5 times the maximum permissible working pressure at ambient temperature.

Testing of the valve bodies shall be carried out without the disc assembled and before valves are coated or lined with materials that are capable of sealing against leakages. Both ends of the body shall be blanked off so that the valve is subjected to the full pressure stresses in all directions induced by the test pressure.

The valve shall be in an open or partially open position during the test. There shall be no visually detectable leakage and/or signs of sweating through the shell of the valve during the test period.

Disc/Gate Test

This shall be a hydrostatic pressure test at a pressure of 1.5 times the maximum permissible working pressure at ambient temperature.

The valve shall be closed in the normal manner and the test pressure applied to one side of the disc with the other side open to atmosphere. There shall be no visible evidence of structural damage to or deformation of the disc or leakage through the disc or gate during the test duration.

Seepage past gland seals during structural tests shall not be cause for rejection, provided that the gland seals are watertight when the internal test pressure is reduced to 1.1 x the maximum permissible working pressure at ambient temperature.

Seat/Seal Test

This shall be a hydrostatic pressure test at a pressure of 1.1 times the maximum permissible working pressure at ambient temperature.

Each assembled valve with corrosion protection completed shall be subjected to open-ended tests for drop tightness at the permissible working pressures at ambient temperature. Valves shall be drop tight over the complete range of pressures. Valves with symmetrical seating and double acting valves shall be tested in both directions.

The maximum permissible leakage shall be as given in Table 2.

Table 2
TEST PRESSURE LEAKAGE RATES

VALVE TYPE	LEAKAGE RATE
Tight shut-off (all valves except wedge gate valves)	Rate 3 * : No visible leakage for duration of test.
Low leakage (wedge gate valves only)	Rate 1 : 0.7 ml/min x DN

*Leakage rates are as defined in BS 5146: Part 2

C3.3.2.11.7.3.3 ZUT 7004.7.3.3 Test Certificate

When a test certificate is issued it shall contain a statement by the manufacturer confirming that the valves have been tested in accordance with this standard and stating the actual pressures and medium used in the test.

C3.3.2.11.7.3.4 ZUT 7004.7.3.4 Anti-static

Valves designated as anti-static shall have electrical continuity between shaft, disc and body when tested in accordance with A.2 of BS 5146: Part 1.

C3.3.2.11.7.3.5 ZUT 7004.7.3.5 Functional Test Requirement

The manufacturer shall do a functional test on each valve. This shall consist of taking the valve through one complete cycle, from fully closed to fully open and back. The manufacturer shall take particular note that the valve position indicator is correctly calibrated.

C3.3.2.11.8 ZUT 7004.8 FASTENERS

Fasteners shall comply with the clause “Fasteners” in ZUT 0001.

C3.3.2.11.9 ZUT 7004.9 HANDLING AND TRANSPORT

All handling and transport of valves shall be done in accordance with the requirements of standard as set out in section of General Mechanical.

In addition the ends of valves and fittings shall be securely blanked off with temporary sturdy plywood blank flanges in order to protect the corrosion protection (lining).

Bolts and other small parts shall be sewn up in strong bags and crated. The bags shall be tagged using metallic tags and indicate the following information:

- Manufacturer's identification and contract number,
- Part numbers,
- Description,
- Sizes and
- Quantities.

Each bag shall have the delivery address listed on a separate metallic tag.

The use of ropes, wire or chains for lifting valves without suitable padding is strictly forbidden. For transport or storage purposes, balks of timber beams shall be used to support the valves on any surface and separate them from each other.

Precautions shall be taken to support and chock the valves to prevent movement when loading onto vehicles. Valves or components of valves shall be firmly lashed or chained with padded lashing supported on sawdust bags. The area of padded surfaces shall be adequate to prevent damage to coatings.

The Site Engineer shall be notified of the delivery date and of any requirements regarding off loading and storage at site.

For Site delivery, the transportation, off-loading of equipment by crane and supervision during off-loading shall be the responsibility of the Contractor. The final inspection and acceptance of equipment supplied will be undertaken on site after off-loading has been completed. Any damage that occurs during the handling, assembly and storage of equipment at the Manufacturer or Contractor's works, including transportation to site, shall be repaired by the Contractor at his own cost, in accordance with the valve specification and to the satisfaction of the Engineer.

C3.3.2.11.10 ZUT 7004.10 INSPECTIONS

The Contractor shall make arrangements for the Engineer to inspect the equipment for compliance prior to payment being made.

If the equipment is manufactured and assembled in South Africa, the Contractor shall make all arrangements and carry all costs for the Engineer to inspect equipment and fabrications in the workshop prior to dispatch to Site. Fabrications shall be inspected prior to corrosion protection.
If the equipment is manufactured and assembled outside South Africa, the Contractor shall make all arrangements and carry all costs for an Engineer approved inspection authority to inspect the equipment in the workshop prior to dispatch. The inspection shall include a full report on compliance of the equipment with this specification and this report shall be submitted to the Engineer prior to dispatch of the unit from the workshop.

C3.3.2.11.11 ZUT 7004.11 OPERATING AND MAINTENANCE MANUAL

This section shall comply with the requirements as specified under ZUT 0002.

C3.3.2.11.12 ZUT 7004.12 MEASUREMENT & PAYMENT

C3.3.2.11.12.1 ZUT 7004.12.2 Supply and Deliver to Site……..Unit: Number (No.)

The rates tendered shall include full compensation for the supply and delivery of the Plant to Site including supply of raw materials and bought-out items and associated operating Plant items; fabrication, manufacture and assembly; quality assurance and quality control; inspection and Factory Acceptance Testing (including attendance on inspections and tests witnessed by the Engineer); type and routine tests; application of finishes (painting and corrosion protection); trial erection and dismantling; preparation and packing for transport; transport from place of manufacture to the Site; insurance, harbour dues etc., during transport; loading and unloading; storage under appropriate conditions from date of delivery until commencement of erection; and any other work as specified. Payment will be made per unit. Payment will only be effected after full compliance of the Plant items with this Section and associated documentation has been approved by the Engineer.

C3.3.2.11.12.2 ZUT 7004.12.2 Installation of Plant……..Unit: Number (No.)

The rates tendered shall include for full compensation for the installation of the Plant on Site including the provision of all labour, transport, materials and Temporary Works necessary to install the complete Works; on-site quality assurance and quality control, inspection, testing (including attendance at tests witnessed by the Engineer); the installation of all auxiliary Plant items; necessary for the operation of the installation until taken over by the Employer; the putting into service of the complete installation of the Plant; and any other work as specified.

The rate shall also include for all commissioning testing and the provision of equipment therefore including all disruptions to installation caused by such testing. Payment will be made per unit. Payment will only be effected after full compliance of the Plant items with this Section and associated documentation has been approved by the Engineer.

C3.3.2.12 ZUT 7005 VALVES FOR WATER AND WASTEWATER INSTALLATIONS

C3.3.2.12.1 ZUT 7005.1 SCOPE

ZUT 7005 specifies the standard corrosion protection requirements for valves.

The installation shall be as shown on any applicable drawings provided with the tender documents.

The scope of work for which the Contractor is responsible is specified elsewhere.

C3.3.2.12.2 ZUT 7005.2 NORMATIVE REFERENCES

Where this specification is required for a project, the following documents shall, inter alia, form part of the Contract Document:

a) Amendments.

b) Data Sheets.

c) ZUT 0001: General Mechanical Requirements.

d) ZUT 0003: General Corrosion Protection for Pipelines, Water and Wastewater Works.

e) ZUT 7004: Valves for Water and Wastewater Installations.

f) ZUT 7005: Corrosion Protection for Steel Pipes and Specials, Cast Iron specials and Valves.

Equipment, materials and operational methods shall comply with the latest edition of relevant national and/or international standards.

C3.3.2.12.3 ZUT 7005.3 GENERAL

All components are intended to have a useful working life of not less than 20 years and the Contractor shall take cognizance of the environment in which the valves will operate and shall ensure that all valves selected for this project are suitably corrosion protected complying, but not limited, to the following requirements:

- the complete valve and all other parts not exposed to friction wear shall be painted;
- the valve shall be completely weather-proof under all weather conditions applicable to the Site in which the particular item of Plant will operate;
- the casting/steelwork designed and detailed so as to obviate the possibility of water or dust entrapment prejudicing the life of the corrosion protection system employed;
- have a finishing paint system which has been proved to be easily repairable;
- have every coat of paint in any one system compatible with every other coat of paint in that system irrespective of the order of application and strictly applied in accordance with manufacturer's product data sheet;
- If dissimilar metals are used coat all surfaces of the whole assembly including the more noble member of the galvanic series.
- Joints and crevices between metals shall be sealed with an approved polyurethane sealer;

The Contractor shall note that damage to paintwork by himself or others during transit, storage and building-in is unavoidable and the application of all protective treatment should be programmed accordingly. Final in-situ painting is therefore necessary.

The Contractor shall also submit his quality plan for corrosion protection to the Engineer for his approval, and no corrosion protection shall proceed without an approved quality plan.

All painting shall be carried out by skilled and experienced painters under constant supervision by qualified staff.

Surfaces to which paint is to be applied shall form a suitable base for the paint and, if a previous paint coat, shall be a continuous pore-free, sound and undamaged paint film.

All paint films shall be free of embedded foreign metallic particles.

On completion of corrosion protection but before the items are dispatched to site, the Contractor shall make provision for a final inspection. This shall include all necessary dry film thickness and pinhole tests.

C3.3.2.12.4 ZUT 7005.4 COMPATIBILITY OF MATERIALS

Prevention of Electrolysis

Where the construction of the valve is such that it is impossible to avoid dissimilar metals of which the potential difference exceeds 0,3 volts, suitable insulation materials shall be used on the contact faces between such dissimilar metals.

If the noble member of the assembly cannot be entirely covered then ensure to:

- keep the anode/cathode ratio as large as possible in the particular component, and
- Use electrical insulators between two metals. Insulation must be complete, i.e. a bolt requires a sleeve as well as washers of an insulation material;

C3.3.2.12.5 ZUT 7005.5 SURFACE PREPARATION

All steel surfaces shall be properly prepared to receive the specified corrosion protection systems by the thorough removal of physically adhering contaminants and chemically bonded contaminants in accordance with ISO 8501 Part A as applicable.

For hot-dip galvanizing, the requirements of BS EN 14713, BS 1461 & BS 7371 shall apply.

Any sharp edges remaining after fabrication shall be rounded and smoothed by grinding and all welds shall, wherever possible, be cleaned with chipping hammer and ground down with abrasive tools prior to overall surface cleaning preparations. All cleaned surfaces shall be completely free from dust, blasting and cleaning debris and other loose contaminants, soil, grease and moisture.

Surface contaminants such as oil and grease shall be removed by solvent cleaning. All other contaminants shall be removed by detergents to SANS 892 and water washing.

The grades of surface preparation for scraping and wire-brushing and for blast cleaning as specified hereinafter, shall be in accordance with the International Standard ISO 8501-Part 1. The metal surfaces shall be grit blasted to SIS Standard SA 3 with a surface profile range of between 50-75 µm.

C3.3.2.12.6 ZUT 7005.6 CORROSION PROTECTION SYSTEMS

C3.3.2.12.6.1 ZUT 7005.6.1 APPLICATION OF SYSTEMS

Application systems shall be suitable of providing adequate protection of the valve against corrosion caused by the quality of water to be transferred. Where corrosion protection of a valve is designated or billed, the valve shall, after proper cleaning, be given whichever of the following treatments is billed:

The following abbreviations are used in the tables:

- ABS : Acrylnitrile-butadiene-styrene
- DCA : Die cast aluminium
- DFT : Dry film thickness
- FBE : Fusion-bonded Epoxy
- FBP : Fusion-bonded Polyester
- GRP : Glass fibre reinforced polyester
- HDG : Hot-dip galvanized
- PC : Polycarbonate

- PVC : Polyvinylchloride
- MS : Mild steel – grade S355JR
- SS : Stainless steel – grades 304, 304L, 316 and 316L
- UV : Ultra Violet
- 3Cr12 : Corrosion resistant steel
- µm : Micrometer

Off the shelve components that are supplied as standard corrosion protected items e.g. gearboxes, actuators etc. shall be accepted provided that they meet with the corrosion protection requirements of this Specification. If this Specification cannot be adhered to, the Contractor **shall submit full details of the equivalent coating systems** at tendering stage for approval by the Engineer.

C3.3.2.12.6.2 ZUT 7005.6.2 VALVES

The following table is an abbreviated guideline and the systems are not listed in order of preference.

ENVIRONMENT	MATERIAL	SURFACE	SYSTEM	MINIMUM DFT (µm)
Immersed	MS SG	Lining	1. Two-pack Epoxy + top coat of pure Aliphatic Polyurethane if req'd	400 + 25
			2. FBE + top coat of pure Aliphatic Polyurethane if req'd	250 + 25
	SS316	Lining	3. Two-pack Epoxy + top coat of pure Aliphatic Polyurethane if req'd	150 + 25
			4. FBE + top coat of pure Aliphatic Polyurethane if req'd	125 + 25
			5. Pickle and passivate*	
Dry	MS SG	Coating	1. Two-pack epoxy plus top coat of re-coatable polyurethane if req'd	250 + 40
			2. Multi-purpose Epoxy plus top coat of re-coatable Polyurethane if req'd	250 + 40
			3. FBE + top coat of re-coatable Polyurethane if req'd	200 + 40
Wet	MS SG	Coating	1. Two-pack Epoxy + top coat of pure Aliphatic Polyurethane if req'd	400 + 25

			2. FBE + top coat of pure Aliphatic Polyurethane if req'd	250 + 25
	SS316	Coating	1. Two-pack Epoxy + top coat of pure Aliphatic Polyurethane if req'd	150 + 25
			2. FBE + top coat of pure Aliphatic Polyurethane if req'd	125 + 25
			3. Pickle and passivate*	

*Uncoated stainless steel only to be used if no galvanic reaction and anaerobic conditions are found.

Refer to the specifications ZUT 0003 for general information on corrosion protection systems and application details.

C3.3.2.12.7 ZUT 7005.7 INSPECTIONS & TESTING

Refer to the specifications ZUT 0003 for information on testing and inspection procedures on corrosion protection for valves.

C3.3.2.13 ZUT 7015 VALVES FOR WATER AND WASTEWATER INSTALLATIONS

C3.3.2.13.1 ZUT 7015.1 SCOPE

ZUT 7015 specifies the standard requirements for metal seated wedge gate valves of a type suitable for raw water and wastewater duties.

The installation shall be as shown on any applicable drawings provided with the tender documents.

The scope of work for which the Contractor is responsible is specified elsewhere.

C3.3.2.13.2 ZUT 7015.2 NORMATIVE REFERENCES

Where this specification is required for a project, the following documents shall, inter alia, form part of the Contract Document:

a) Amendments to this Specification.
b) Data Sheets.
c) ZUT 0001: General Mechanical Requirements.
d) ZUT 0002: Operating and Maintenance Manuals.
e) ZUT 0003: General Corrosion Protection for Pipelines, Water and Wastewater Works.
f) ZUT 7004: Valves for Water and Wastewater Installations.

Equipment, materials and operational methods shall comply with the latest edition of relevant national and/or international standards.

C3.3.2.13.3 ZUT 7015.3 PERFORMANCE REQUIREMENTS

Valves shall be of the rising spindle type unless otherwise scheduled.

Valves shall be drop tight for all specified duties.

Gate spindle seals shall not leak.

Valves shall operate without snatch.

Handwheels shall not require a peripheral force greater than 250 Newtons (i.e. the sum of the forces on both sides shall not be greater than 250 Newtons) at the full differential pressure rating of the valve.

C3.3.2.13.4 ZUT 7015.4 OPERATION AND CONTROL

Actuated valves shall be provided with manual operation override. Electric actuators shall, additionally, be provided with manual start and stop functions on the actuator.

Valves and their method of actuation shall be designed to open and close at a differential pressure equal to the full pressure rating of the valve.

C3.3.2.13.5 ZUT 7015.5 DESIGN AND CONSTRUCTION

Wedge gate valves shall have metal seats and shall be of the double flanged configuration.

The manufacturer's name, size and working pressure shall be cast on the valve body or otherwise permanently indicated on the valve.

The bore shall be straight through.

Position indication shall be provided.

Open and close direction shall be indicated.
Fixing lugs for end of travel limit switches shall be provided.

Valves of size DN 250 and larger shall be provided with a bypass which shall incorporate an isolating wedge gate valve.

Valves of size DN 350 and larger shall be provided with an air release and the body shall be provided with channel guides for gate travel. The wedge shall be provided with shoes which slide within the channel guides. Guides and shoes shall guide the gate along the complete travel distance.

Valves of DN 250 and larger shall be provided with gearboxes. Ingress protection shall be to IP 55 or higher.

The body shall incorporate storage feet.

The body shall incorporate a drain with a stainless steel plug.

Valves shall be designed and constructed to ensure reliable operation after long periods of non-operation.

C3.3.2.13.6 ZUT 7015.6 FASTENERS

All fasteners on the body of the valve shall be of EN Grade 1.4401 (316), or better.

Fasteners shall comply with the clause “Fasteners” in ZUT 0001 – General Mechanical Requirements.

C3.3.2.13.7 ZUT 7015.7 MATERIALS AND CORROSION PROTECTION

Bodies shall be of ductile iron or of cast steel.

Handwheels shall be cast.

The body seat ring shall be of stainless steel or non-ferrous metal (SS preferred for sewage applications).

The wedge seat ring shall be of stainless steel or non-ferrous metal (SS preferred for sewage applications).

The valve stem shall be of stainless steel.

Guides and shoes shall be of a copper based alloy or of engineering plastic or of stainless steel.

Internal and external surfaces of the valve body shall be protected with a water resistant, non-toxic and non-tainting, fusion bonded epoxy pipe coating to a dry film thickness of at least 200 micron. Specialist applied Rilsan coatings will also be acceptable.

Stainless steel valves shall remain uncoated unless colour coding of the body is required.

Corrosion Protection shall comply with ZUT 0003 - Painting and Corrosion Protection for Water and Wastewater Works.

C3.3.2.13.8 ZUT 7015.8 INSTALLATION

Equipment shall be mounted firm and level.

Installation work shall comply with the clause "Installation" in ZUT 0001 – General Mechanical Requirements.

C3.3.2.13.9 ZUT 7015.9 INSPECTIONS

The Contractor shall make arrangements for the Engineer to inspect the equipment for compliance prior to payment being made.

If the equipment is manufactured and assembled in South Africa, the Contractor shall make all arrangements and carry all costs for the Engineer to inspect valves of DN 250 and larger in the workshop during witness testing and prior to dispatch to Site.

If the equipment is manufactured and assembled outside South Africa, the Contractor shall make all arrangements and carry all costs for an Engineer approved inspection authority to inspect the equipment in the workshop prior to dispatch. The inspection shall include a full report on compliance of the equipment with this specification and this report shall be submitted to the Engineer prior to dispatch of the unit from the workshop.

C3.3.2.13.10 ZUT 7015.10 TESTING REQUIREMENTS

The following witness testing shall be done during the factory inspection:

a) The valve body shall be pressure tested to 1,5 times the valve pressure rating.

b) The valve seating shall be drop tight tested to 1,0 times the pressure rating.

The correct operation of the equipment and achievement of the specified performance requirements shall be demonstrated to the Engineer prior to the commissioning of the Works.

C3.3.2.13.11 ZUT 7015.11 GENERAL

The equipment shall have been successfully used in similar applications in South Africa.

C3.3.2.13.12 ZUT 7015.12 MEASUREMENT & PAYMENT

Measurement and payment covered under ZUT 7004.

C3.3.2.14 ZUT 7016 RESILIENT SEAL GATE VALVE

C3.3.2.14.1 ZUT 7016.1 SCOPE

ZUT 7016 specifies the standard requirements for resilient seal gate valves of the type with rubber coated gate.

The numbers and sizing of equipment to be provided are specified in the Amendments and Datasheets.

The installation shall be as shown on any applicable drawings provided with the tender documents.

C3.3.2.14.2 ZUT 7016.2 NORMATIVE REFERENCES

Where this specification is required for a project, the following documents shall, inter alia, form part of the Contract Document:

a) Amendments to this Specification.

b) Data Sheets.

c) ZUT 0001: General Mechanical Requirements.

d) ZUT 0002: Operating and Maintenance Manuals.

e) ZUT 0003: General Corrosion Protection for Pipelines, Water and Wastewater Works.

f) ZUT 7004: Valves for Water and Wastewater Installations.

C3.3.2.14.3 ZUT 7016.3 GENERAL

Gate valves shall be double flanged and be of the resilient seal gate type, the gates of which shall be completely clear of the waterway in the fully open position. Valves shall be of the rising spindle type unless otherwise scheduled.

Valves shall be capable of withstanding the nominal pressure (PN) and specified test pressures from both sides and seal drop tight in both directions at the specified range of differential pressures across the gate.

The valve shall be capable of performing reliably at any point in the specified range.

The valve shall open and close smoothly at a pressure difference across the gate equal to the valves' rated pressure.

The gate liner shall, in accordance with SANS 665-3, be so firmly bonded, vulcanised and accurately moulded that, when the valve is tested, the resilient material shall not become torn, loose or detached. Also in accordance with SANS 665-3, the gate shall ensure drop tightness over the full pressure range of the valve and the lining shall have the capacity to accept foreign matter up to 1 mm in particle size.

Valves shall be designed and constructed to ensure reliable operation after long periods of non-operation.

Valves above DN 150 shall have the manufacturer's name, size and working pressure cast on the valve body.

C3.3.2.14.4 ZUT 7016.4 OPERATION AND CONTROL

The gate valve shall be able to open and close satisfactorily under the specified flow rate and differential pressure. Valves shall close turning the hand wheel in a clockwise direction.

Manually operated valves shall be provided with handwheels of a size and construction which permit easy opening of the gate when subjected to a differential pressure equal to the rated pressure difference across the gate.

Valves shall be provided with an indication of the closing and/or the opening direction.

Actuated valves shall be provided with manual override.

C3.3.2.14.5 ZUT 7016.5 DESIGN AND CONSTRUCTION

C3.3.2.14.5.1 ZUT 7016.5.1 BODY

The valve body shall incorporate a straight unobstructed body passage without pockets and shall have inclined seats and prominent gate guides to eliminate deposits in the valve body.

The guides shall be as deep and as long as possible, but not protruding into the flow path to offer support in all gate positions of the gate.

The rubber coated gate shoes shall accurately fit the body guide profile to allow smooth operation of the gate with minimal shudder.

C3.3.2.14.5.2 ZUT 7016.5.2 GATE

The gate shall be accurately moulded and completely encapsulated in natural or an approved neoprene rubber and accurately moulded to ensure complete corrosion protection and drop tightness over the valve pressure range. The rubber coated gate shall be designed to offer an equal distribution of sealing pressure in all directions with a capacity to accept foreign matter up to 1mm in particle size.

C3.3.2.14.5.3 ZUT 7016.5.3 SPINDLE AND THRUST BEARING

A corrosion resistant spindle seal arrangement shall include a scraper ring to prevent the ingress of foreign matter. A spindle thrust collar shall be installed between thrust bearings or anti-friction materials to ensure low operating forces.

All gate valves shall be fitted with a back seal to permit the replacement of the spindle seals under pressure where appropriate.

C3.3.2.14.5.4 ZUT 7016.5.4 POSITION INDICATOR

All valves of DN300 and larger shall be fitted with a mechanical linear indicator system mounted on the valve spindle to show the position of the gate as scheduled.

C3.3.2.14.6 ZUT 7016.6 MATERIALS

The body and gate shall be of ductile iron (SANS 936).

Cast iron sliding surfaces are not acceptable.

The spindle shall be of EN Grade 1.4401 (316) Stainless Steel, or better.

The spindle nut shall be Bronze (gunmetal).

Handwheels shall be of cast metal.

Manually operated gearboxes shall be provided with a stainless steel grease nipple.

Valves shall comply with SANS 665 where applicable.

C3.3.2.14.7 ZUT 7016.7 FASTENERS

Fasteners on the valve shall be of EN Grade 1.4401 (316) stainless steel.

Flange fasteners shall comply with the specification for the pipeline's flange fasteners.

Fasteners shall comply with the clause "Fasteners" in ZUT 0001 – General Mechanical Requirements.

C3.3.2.14.8 ZUT 7016.8 CORROSION PROTECTION

The specific application shall be taken into account in the corrosion protection of valves under General Corrosion Protection ZUT 0003.

The gate liner shall be of vulcanised EPDM.

Fasteners shall be of EN Grade 1.4401 (316), or better or shall be sealed against ingress by a fully sealed arrangement. This applies to all fasteners on the body of the valve and its gearbox. Flange bolts are specified elsewhere.

Cast iron valve components, including valve bodies, shall be protected internally and externally with a coating in accordance with either sub-clause "Fusion Bonded Epoxy" or sub-clause "Hot Applied Thermoplastic" and shall comply with ZUT 0003. Dry film coating thickness shall not be less than 200 micron.

Metal plating of ferrous materials is not an acceptable corrosion protection system.

C3.3.2.14.9 ZUT 7016.9 INSTALLATION

Valves shall be mounted firm and level.

The weight of the valve shall be fully supported. Spindles shall be vertical unless approved otherwise by the Engineer.

The handwheel shall be easily accessible to the operator.

Installation work shall comply with the clause "Installation" in ZUT 0001 – General Mechanical Requirements and ZUT 7004 – General Valve specifications.

C3.3.2.14.10 ZUT 7016.10 INSPECTIONS

The Contractor shall make arrangements for the Engineer to inspect the equipment for compliance prior to payment being made.

If the equipment is manufactured and assembled in South Africa, the Contractor shall make all arrangements and carry all costs for the Engineer to inspect equipment in the workshop prior to dispatch to Site.

If the equipment is manufactured and assembled outside South Africa, the Contractor shall make all arrangements and carry all costs for an Engineer approved inspection authority to inspect the equipment in the workshop prior to dispatch. The inspection shall include a full report on

compliance of the equipment with this specification and this report shall be submitted to the Engineer prior to dispatch of the unit from the workshop.

C3.3.2.14.11 ZUT 7016.11 TESTING REQUIREMENTS

The Contractor shall arrange for the Engineer to witness the testing of valves of sizes DN 250 and larger and all travel and accommodation costs shall be the responsibility of the Contractor.

The valve shall be tested according to specifications ZUT 7004.

The correct operation of the valve shall be demonstrated to the Engineer prior to the commissioning of the Works.

C3.3.2.14.12 ZUT 7016.12 OPERATING AND MAINTENANCE MANUAL

This section shall comply with the requirements as specified under ZUT 0002.

C3.3.2.14.13 ZUT 7016.13 MEASUREMENT & PAYMENT

Measurement and payment covered under ZUT 7004.

C3.3.2.15 ZUT 7017 SLANTED SEAT CHECK VALVE

C3.3.2.15.1 ZUT 7017.1 SCOPE

ZUT 7017 specifies the standard requirements for Slanted Seat check valves of the swing type disk.

The numbers and sizing of equipment to be provided are specified in the Amendments and Additions and the installation shall be as shown on any accompanying drawings.

C3.3.2.15.2 ZUT 7017.2 NORMATIVE REFERENCES

Where this specification is required for a project, the following documents shall, inter alia, form part of the Contract Document:

a) Amendments to this Specification.

b) Data Sheets.

c) ZUT 0001: General Mechanical Requirements.

d) ZUT 0002: Operating and Maintenance Manuals.

e) ZUT 0003: General Corrosion Protection for Pipelines, Water and Wastewater Works.

f) ZUT 7004: Valves for Water and Wastewater Installations.

C3.3.2.15.3 ZUT 7017.3 GENERAL

Non-return valves of the slanted seat type shall be double flanged and shall offer minimum hydraulic resistance, not be subject to disc flutter and give a quick non-slam closure on reversal of flow.

In the case of tilting disc and swing type non-return valves only designs that allow inspection and or removal of doors, discs and seals without removal of the valve assembly from the line shall be allowed.

The valve shall be suitable for horizontal or vertical mounting, of robust construction, and shall close drop tight at the required operating head.

The valve offered shall have 100% unobstructed flow area, smooth streamlined body contouring and simplicity of one moving part and have full top access covers.

Valves shall be designed and constructed to ensure reliable operation after long periods of non-operation.

Valves above DN 150 shall have the manufacturer's name, size and working pressure cast on the valve body.

The check valve shall be able to open and close satisfactorily under the specified flow rate and differential pressure.

C3.3.2.15.4 ZUT 7017.4 DESIGN AND CONSTRUCTION

C3.3.2.15.4.1 ZUT 7017.4.1 BODY

The design of the body and body seals shall be such that they are free from pockets which may cause eddies or accumulate debris. Special care shall be taken in the design to ensure that foreign objects, like bolts, cannot lodge in pockets on the downstream side of body seats and thereby prevent doors from closing fully.

Access openings and covers shall be of adequate design and the creation of stress risers shall be prevented.

C3.3.2.15.4.2 ZUT 7017.4.2 DISKS

The discs shall be cast as a unit with integral cast hinge lugs allowing free door or disc operation. Their travel shall however be restricted by the provision of substantial stops fitted with rubber facings to prevent wear due to metal contact, and to reduce the closing time of the valve and thereby minimising reversal flow. The rubber facings shall be vulcanised onto the metal and secured by corrosion resistant countersunk screws. The area of contact on the body shall be stainless steel 304L deposit welded.

The doors or discs shall have continuous hinge shafts of grade 316 stainless steel, which shall be supported at their ends with bearings.

Shafts protruding through the valve shall have flanged and bolted stainless steel, grade 316, bearing cover plates.

Shafts entering castings shall be provided with corrosion resistant bushes to prevent galvanic corrosion.

C3.3.2.15.4.3 ZUT 7017.4.3 SEALING FACES

The door/disk shall be fitted with either a zinc-free phosphor-bronze face closing on a corresponding bronze seating in the body or rubber facings vulcanised onto the metal and secured by corrosion resistant countersunk screws closing on nickel weld overlay seat, micro finished.

C3.3.2.15.4.4 ZUT 7017.4.4 BEARINGS

Main bearings shall be external. Preference shall be given to a valve with bearings that are accessible without emptying or removal of the valve body from the line.

Bearings shall be designed to take the unbalanced thrust on doors or discs in the structural test.

Bearings shall preferably be self-lubricated to offer a long life and retain a low coefficient of friction. Bearings shall not become tight during service or due to ageing.

C3.3.2.15.4.5 ZUT 7017.4.5 POSITION INDICATOR

Each door or disc shaft shall extend through a stuffing box on one side of the body only where a stainless steel (Grade 304) position indicator is to be fitted.

C3.3.2.15.4.6 ZUT 7017.4.6 DAMPERS

Where included, dampers shall be designed for optimum performance and soft cushioning of the disc. The design shall be such that the damper can conveniently be dismantled for inspection and repair. The damper shall be made from approved corrosion resistant materials.

C3.3.2.15.5 ZUT 7017.5 MATERIALS

The body shall be of ductile iron (SANS 936) or cast steel (SANS 1465).

The body seat shall be of stainless steel Gr 304 S15.

The valve disk shall be of ductile iron (SANS 936) or cast steel (SANS 1465).

The disk seat shall be of stainless steel (deposit welded) Gr 316 S16.

The disk shaft shall be of stainless steel Gr 316 S16.

The bearing bushes shall be of phosphor bronze (BS EN 1982).

C3.3.2.15.6 ZUT 7017.6 FASTENERS

Fasteners on the valve shall be of EN Grade 1.4401 (316) stainless steel.

Flange fasteners shall comply with the specification for the pipeline's flange fasteners.

Fasteners shall comply with the clause "Fasteners" in ZUT 0001 – General Mechanical Requirements.

C3.3.2.15.7 ZUT 7017.7 CORROSION PROTECTION

The specific application shall be taken into account in the corrosion protection of valves ZUT 7005.

Fasteners shall be of EN Grade 1.4401 (316), or better or shall be sealed against ingress by a fully sealed arrangement. This applies to all fasteners on the body of the valve. Flange bolts are specified elsewhere.

C3.3.2.15.8 ZUT 7017.8 INSTALLATION

Valves shall be mounted firm and level. The weight of the valve shall be fully supported.

Installation work shall comply with the clause "Installation" in ZUT 0001 – General Mechanical Requirements and ZUT 7004 – General Valve specifications.

C3.3.2.15.9 ZUT 7017.9 INSPECTIONS

The Contractor shall make arrangements for the Engineer to inspect the equipment for compliance prior to payment being made.

If the equipment is manufactured and assembled in South Africa, the Contractor shall make all arrangements and carry all costs for the Engineer to inspect equipment in the workshop prior to dispatch to Site.

If the equipment is manufactured and assembled outside South Africa, the Contractor shall make all arrangements and carry all costs for an Engineer approved inspection authority to inspect the equipment in the workshop prior to dispatch. The inspection shall include a full report on compliance of the equipment with this specification and this report shall be submitted to the Engineer prior to dispatch of the unit from the workshop.

C3.3.2.15.10 ZUT 7017.10 TESTING REQUIREMENTS

The Contractor shall arrange for the Engineer to witness the testing of valves of sizes DN 250 and larger and all travel and accommodation costs shall be the responsibility of the Contractor.

Test certificates shall be submitted to the Engineer for all valves.

The valve shall be fully tested according to specifications ZUT 7004.

The correct operation of the equipment and achievement of the specified performance requirements shall be demonstrated to the Engineer prior to the commissioning of the Works.

C3.3.2.15.11 ZUT 7017.11 OPERATING AND MAINTENANCE MANUAL

This section shall comply with the requirements as specified under ZUT 0002.

C3.3.2.15.12 ZUT 7017.12 MEASUREMENT & PAYMENT

Measurement and payment covered under ZUT 7004.

C3.3.2.16 ZUT 7022 AIR VALVES FOR AIR RELEASE AND VACUUM BREAK ON PIPELINES

C3.3.2.16.1 ZUT 7022.1 SCOPE

ZUT 7022 specifies the standard requirements for air valves which are used for air release and vacuum break for pipelines.

The numbers and sizing of equipment to be provided are stated in the Amendments and Additions and the installation shall be as shown on any accompanying drawings.

C3.3.2.16.2 ZUT 7022.2 NORMATIVE REFERENCES

Where this specification is required for a project, the following documents shall, inter alia, form part of the Contract Document:

a) Amendments to this Specification.

b) Data Sheets.

c) ZUT 0001: General Mechanical Requirements.

d) ZUT 0002: Operating and Maintenance Manuals.

e) ZUT 0003: General Corrosion Protection for Pipelines, Water and Wastewater Works.

f) ZUT 7004: Valves for Water and Wastewater Installations.

C3.3.2.16.3 ZUT 7022.3 PERFORMANCE REQUIREMENTS

Valves shall perform in accordance with the air discharge, air inlet and slam-free conditions specified in the Amendments and Additions.

In vacuum break mode, valves shall react immediately in order to prevent the pressure falling to a level which would be unacceptable in terms of the design of the pipeline.

Valves shall be capable of discharging high volumes of air through a large orifice under pressure during filling of the pipeline.

Valves shall be capable of releasing small quantities of accumulated air at all line pressures up to and including the rated working pressure of the valve.

The large discharge orifice shall close at a differential pressure of between 4 and 6 kPa in order to minimise transient pressure effects. The valve shall continue to release air at a lower rate.

Valves shall seal drop tight at all line pressures between 0,45 bar and the rated pressure.

C3.3.2.16.4 ZUT 7022.4 OPERATION AND CONTROL

Valves shall operate autonomously; i.e. a valve shall not require a servo mechanism to control its operation and shall not require an external power supply.

C3.3.2.16.5 ZUT 7022.5 DESIGN AND CONSTRUCTION

C3.3.2.16.5.1 ZUT 7022.5.1 GENERAL

Air release valves for water pipework shall be of the non-slam type, Vent-O-Mat RBX, or ARI or equivalent.

Air release valves for wastewater pipework shall be of the non-slam type Vent-O-Mat RGX, ARI or equivalent. Valves for wastewater and related duties shall be specifically designed for the application.

The manufacturer's name, pressure rating, nominal size and the serial number shall be permanently displayed on the valve, preferably cast into the valve body.

Isolating valve shall be provided and installed so that the air valve can be isolated during full line pressure. The isolating valves shall be as per data sheet and shall have the same pressure rating as specified for the air valve.

The large intake and exhaust orifice of air valves shall be equal to the nominal size of the valve e.g. a 100mm valve shall have a 100mm inlet and outlet orifice. The valve shall incorporate an integral anti-shock (non-slam) orifice mechanism which shall operate automatically to limit transient pressure rise or water hammer induced by closure. An inherent feature of the valve design must be to ensure that the float does not close before all the air has been released.

C3.3.2.16.5.2 ZUT 7022.5.2 HYDRAULIC DESIGN

Valve design and selection shall ensure that pipe collapse does not occur under a "full bore" rupture condition and, additionally, shall comply with the following criteria:

- Air valves on pipe sizes up to DN 600 shall be designed to ensure that the internal pressure does not fall below minus 8 kPa (i.e. a pressure below atmospheric pressure) under a full-bore rupture condition.

- Air valves for pipe sizes larger than DN 600 shall be selected on the basis of a rupture condition which shall be agreed with the Engineer.

The criteria for the valve performance shall have been confirmed by a recognized independent authority.

C3.3.2.16.5.3 ZUT 7022.5.3 CONSTRUCTION

Valves shall be flanged. The flange shall comply with the flange specification for the pipeline.

It shall be possible to remove the valve's working parts without unbolting the bottom flange from the pipeline. Floats and seats shall not, however, require maintenance under normal conditions.

A stainless steel screen shall prevent foreign matter from entering and blocking the air ports.

Valves shall be designed and constructed to ensure reliable operation after long periods of non-operation.

C3.3.2.16.6 ZUT 7022.6 FASTENERS

Fasteners on the valve shall be of stainless steel.

Flange fasteners shall comply with the flange fastener specification for the pipeline.

C3.3.2.16.7 ZUT 7022.7 MATERIALS AND CORROSION PROTECTION

Carbon steel and ductile iron shall be protected with fusion bonded epoxy or Rilsan or equivalent to a dry film thickness of at least 200 micron in accordance with ZUT 0003.

Stainless steel shall be correctly pickled and passivated. All stainless steel surfaces shall be completely clear of ferrous stain upon commissioning.

Floats shall be of HDPE or similar.

Seals shall be nitrile rubber or otherwise approved by the Engineer.

C3.3.2.16.8 ZUT 7022.8 INSTALLATION

Each air valve shall be provided with an upstand tee which shall form an accumulator pocket to capture the air bubbles entrained with the water flow. The upstand shall have a diameter of at least half the pipeline diameter and the upstand height shall be equal to its own diameter or greater. The upstand shall be flanged and shall be provided with a blank flange. The blank flange shall incorporate a flanged riser which is sized for mounting the air valve onto.

Care shall be taken where air valves are mounted on sloping pipes that the air valves are mounted firm and level.
Installation work shall comply with the clause "Installation" in ZUT 0001 – General Mechanical Requirements.

C3.3.2.16.9 ZUT 7022.9 INSPECTIONS

The Contractor shall make arrangements for the Engineer to inspect the equipment for compliance prior to payment being made.

C3.3.2.16.10 ZUT 7022.10 TESTING REQUIREMENTS

The valve body shall be pressure tested to 1,5 times the rated pressure of the valve for two minutes and there shall be no visible leaks.

Valves shall be tested for drop tight sealing at the rated pressure and also at a pressure of 0,45 bar above atmosphere.

A certificate indicating these test results and including the valve's serial number shall be provided to the Engineer.

The correct operation of the equipment and achievement of the specified performance requirements shall be demonstrated to the Engineer prior to the commissioning of the Works.

C3.3.2.16.11 ZUT 7022.11 GENERAL

The equipment shall have been successfully used in similar applications in South Africa.

Valves shall be protected against damage during transport.

C3.3.2.16.12 ZUT 7022.12 OPERATING AND MAINTENANCE MANUAL

This section shall comply with the requirements as specified under ZUT 0002.

C3.3.2.16.13 ZUT 7022.13 MEASUREMENT & PAYMENT

Measurement and payment covered under ZUT 7004.

C3.3.2.17 ZUT 7023 COUPLINGS AND FLANGE ADAPTERS

C3.3.2.17.1 ZUT 7023.1 SCOPE

ZUT 7023 specifies the standard requirements for pipework couplings and flange adaptors.

C3.3.2.17.2 ZUT 7023.2 NORMATIVE REFERENCES

Where this specification is required for a project, the following documents shall, inter alia, form part of the Contract Document:

a) Amendments.

b) Data Sheets.

c) ZUT 0001: General Mechanical Requirements.

d) ZUT 0003: General Corrosion Protection for Pipelines, Water and Wastewater Works.

Equipment, materials and operational methods shall comply with the latest edition of relevant national and/or international standards.

C3.3.2.17.3 ZUT 7023.3 GENERAL

Equipment which has not previously been in common use in South Africa shall not be acceptable unless specifically called for in the specifications or unless the Engineer agrees in writing.

C3.3.2.17.4 ZUT 7023.4 PERFORMANCE REQUIREMENTS

The units shall withstand the pipework pressure rating and shall provide a flexible joint between the two items being connected.

C3.3.2.17.5 ZUT 7023.5 DESIGN AND CONSTRUCTION

Pipe couplings shall be provided where misalignment or dismantling must be allowed for and for possible pipe movement from settlement or other cause. The coupling shall have the same or higher pressure rating than the pipework in which it is installed.

Where the type of coupling is not indicated on the drawing, pipe couplings may be of the mechanical type (VJ coupling or flange adaptor), of the stainless steel bellows type or of the rubber bellows type.

Mechanical couplings shall be of the rubber ring compression type (i.e. VJ type flange adaptors or VJ type couplings) and shall be provided in pairs in order to accommodate axial misalignment and/or settlement. Where harnesses are required, these shall incorporate three tie bars or more. Stainless steel and 3CR12 pipework shall be provided with stainless steel couplings or, where approved by the Engineer, ductile iron couplings protected with fusion bonded epoxy. Low carbon steel pipework shall be provided with low carbon steel or ductile iron couplings protected by fusion bonded epoxy. All fasteners, including studs welded to flanges, shall be of stainless steel.

Suitably rated **rubber bellows** type couplings with metal backing flanges are acceptable for pipe diameters of DN 300 and below. The bellows shall be provided with two backing flanges drilled to match their mating flanges. Bellows for low carbon steel pipework shall be provided with hot dip galvanised flanges (i.e. not zinc plated). Bellows for 3CR12 or stainless steel pipework shall be provided with matching flange material.

Stainless steel bellows type couplings shall be of EN Grade 1.4401 (316), or better, and shall incorporate stainless steel fasteners. The coupling shall incorporate two stainless steel flanges.

C3.3.2.17.6 ZUT 7023.6 FABRICATION

Fabrication shall comply with the clause “Fabrication of Steels” and welding shall comply with the clause “Welding” in ZUT 0001.

Fabrications will generally be inspected by the Engineer after fabrication is complete.

C3.3.2.17.7 ZUT 7023.7 FASTENERS

Fasteners shall comply with the clause “Fasteners” in ZUT 0001.

C3.3.2.17.8 ZUT 7023.8 CORROSION PROTECTION

Corrosion Protection shall comply with ZUT 0003.

Stainless steel shall be correctly pickled and passivated. All stainless steel surfaces shall be completely clear of ferrous stain upon commissioning.

C3.3.2.17.9 ZUT 7023.9 INSTALLATION

Installation work shall comply with the clause “Installation” in ZUT 0001.

C3.3.2.17.10 ZUT 7023.10 INSPECTIONS

The Contractor shall make arrangements for the Engineer to inspect the equipment for compliance prior to payment being made.

C3.3.2.17.11 ZUT 7023.11 TESTING REQUIREMENTS

The correct operation of the equipment and achievement of the specified performance requirements shall be demonstrated to the Engineer prior to the commissioning of the Works.

C3.3.2.17.12 ZUT 7023.12 MEASUREMENT AND PAYMENT

Measurement and Payment is covered under ZUT7004.

C3.3.2.18 ZUT 7024 PIPEWORK SUPPORTS

C3.3.2.18.1 ZUT 7024.1 SCOPE

ZUT 7024 specifies the standard requirements for pipework supports.

The installation shall be as shown on any applicable drawings provided with the tender documents.

The scope of work for which the Contractor is responsible is specified elsewhere.

C3.3.2.18.2 ZUT 7024.2 NORMATIVE REFERENCES

Where this specification is required for a project, the following documents shall, inter alia, form part of the Contract Document:

a) Amendments.

b) ZUT 0001: General Mechanical Requirements.

c) ZUT 0003: General Corrosion Protection for Pipelines, Water and Wastewater Works.

Equipment, materials and operational methods shall comply with the latest edition of relevant national and/or international standards.

C3.3.2.18.3 ZUT 7024.3 PERFORMANCE REQUIREMENTS

Forces from pressure, inertial flow changes and check valves shall be properly restrained.

The supports shall restrain and support the pipework, valves and other heavy fittings and shall prevent loads and thrust forces from being transferred to pump flanges and other equipment which might be damaged or have shortened lifespans.

C3.3.2.18.4 ZUT 7024.4 DESIGN AND CONSTRUCTION

Pipe supports shall be designed and located so that when an item of mechanical equipment, such as a pump or blower, is removed, the associated pipework and equipment is still adequately supported.

Supports shall be provided close to all heavy items such as valves of size DN 300 and larger.

Pipework shall not place any external loads on items of mechanical equipment such as pumps, compressors, etc.

Adequate provision shall be made for expansion and contraction due to variations in temperature or pressure.

Proposed designs of pipe supports shall be submitted to the Engineer for approval prior to manufacture. The calculations for pipe supports designed to withstand the thrust from reducers, bends and check valves shall also be submitted to the Engineer for approval.

Pipe supports which only support the weight of horizontal pipework may be of the sliding type and shall be vertically adjustable.

Pipe supports which resist thrust forces shall incorporate doubler plates on the pipe which are contoured to match the pipe. Other reinforcing designs will also be acceptable. Such pipe supports shall be kept as short as feasible.

Low carbon steel supports shall be fabricated from heavy duty hot rolled steel sections. The complete assembly shall be hot-dip galvanised after all fabrication is completed. Welds shall be continuous “all round”; i.e. no crevices.

Stainless steel supports shall be fabricated of plate with a minimum thickness of 4,5 mm or shall be fully triangulated, boxed or closed sections. Welds shall be continuous “all round”; i.e. no crevices.

At least four anchor fasteners shall be provided for the foot of each pipe support. Anchor fasteners shall be of EN Grade 1.4401 (316) stainless steel.

For cantilevered pipe supports, the spacing between anchor fasteners on the foot shall be not less than one quarter of the cantilevered length. Gussets between the column and the foot are normally required and these shall be positioned so as to minimise the distance between the gusset and the bolt hole. This requirement does not apply to supports which only provide vertical support.

The maximum spacing between pipe supports for steel (including stainless steel) pipe of diameter, d [mm], shall be calculated as follows: Spacing (mm) = 1 000 + 10d. This applies to pipe only. Valves or other heavy fittings which shall be provided for separately as required. (Pipe support spacing distances for non-metallic pipework shall be half of the above.)

The maximum spacing between pipe supports for plastic pipe of diameter, d [mm], shall be calculated as follows: Spacing (mm) = (1 000 + 10d) / 2. This applies to pipe and not to valves or other heavy fittings which shall be provided for separately as required.

Where appropriate, 3 mm thick neoprene strips shall be placed between pipes and supports or clamps to protect the paintwork and to limit corrosion.

Where roller or sliding supports are used to accommodate movement, suitable wear blocks shall be fixed to the pipe to prevent damage.

Floor and wall mounted pipe supports shall be aligned using nuts above and below the foot. A space of at least 20 mm shall be left between the foot and the floor and this space shall be filled using non shrink grout once alignment has been completed. Grouting shall be done in accordance with the manufacturer’s instructions. Alternative designs and installations may be submitted by the Contractor.

Concrete surfaces under foot plates shall be scabbled before the support is placed and shall be blown clean using compressed air immediately before grouting.

Where the Engineer approves the use of concrete pipe supports to be built by a civil contractor under a separate contract, these will be constructed after installation of the pipework and temporary supports shall be provided by the Contractor in positions which will not interfere with the construction of the concrete supports.

C3.3.2.18.5 ZUT 7024.5 FABRICATION

Fabrication shall comply with the clause “Fabrication of Steels” and welding shall comply with the clause “Welding” in ZUT 0001.

Fabrications will generally be inspected by the Engineer after fabrication is complete.

C3.3.2.18.6 ZUT 7024.6 FASTENERS

Fasteners shall comply with the clause “Fasteners” in ZUT 0001.

Nuts for anchor fasteners shall both a spring washer and a flat or fender washer.

C3.3.2.18.7 ZUT 7024.7 CORROSION PROTECTION

Corrosion Protection shall comply with ZUT 0003.

Stainless steel shall be correctly pickled and passivated. All stainless steel surfaces shall be completely clear of ferrous stain upon commissioning.

C3.3.2.18.8 ZUT 7024.8 INSTALLATION

Installation work shall comply with the clause “Installation” in ZUT 0001.

C3.3.2.18.9 ZUT 7024.9 INSPECTIONS

The Contractor shall make arrangements for the Engineer to inspect the equipment for compliance prior to payment being made.

C3.3.2.18.10 ZUT 7024.10 MEASUREMENT AND PAYMENT

Measurement and Payment is covered under ZUT 7001 Design and Manufacturing of Medium-pressure Steel Specials.

C3.3.2.19 ZUT 7028 LEVEL CONTROL VALVE

C3.3.2.19.1 ZUT 7028.1 SCOPE

ZUT 7028 specifies the standard requirements for level control valves of the type with floating ball.

The numbers and sizing of equipment to be provided are specified in the Amendments and Datasheets and the installation shall be as shown on any accompanying drawings.

The installation shall be as shown on any applicable drawings provided with the tender documents.

C3.3.2.19.2 ZUT 7028.2 NORMATIVE REFERENCES

Where this specification is required for a project, the following documents shall, inter alia, form part of the Contract Document:

a) Amendments to this Specification.

b) Data Sheets.

c) ZUT 0001: General Mechanical Requirements.

d) ZUT 0002: Operating and Maintenance Manuals.

e) ZUT 0003: General Corrosion Protection for Pipelines, Water and Wastewater Works.

f) ZUT 7004: Valves for Water and Wastewater Installations.

C3.3.2.19.3 ZUT 7028.3 GENERAL

Level float control valves shall be flanged (raised face flanges) and be either of the hydraulic operated control valve or the mechanical float with arm type, the valve of which shall be completely self-controlled with no external power source required.

Valves shall be capable of withstanding the nominal upstream and downstream pressure (PN) and specified test pressures and seal drop at the specified range of water level within the reservoir.

The valve shall open and close smoothly at any point in the specified range.

Valves shall have the manufacturer's name, size and working pressure cast on the valve body.

BODY

Control valves shall have an open assembly feature, which permits the inspection of the control valve's internal operating mechanism, the seat, plunger, main shaft etc. without the removal of the valve from the pipeline. Stainless steel trimmed control valves including the main valve seat, plunger assembly and shaft with epoxy powder coated steel or cast iron accessories are preferred to bronze trim. Pinned stainless steel valve seats are preferred to epoxy glued seats.

INSTALLATION

The float mechanism shall preferably be installed in a float chamber in the reservoir in order to minimise the effect of waves on the opening/closing action. The inlet to the float chamber shall be proportional in size to the valve chamber. The opening should be large enough to prevent clogging by debris in the system.

Pressure gauges and recorders, where specified, must be permanently mounted up and downstream of the valve.

CAVITATION RESISTANCE

Resistance to cavitation damage is essential and the maximum permissible flow rates through the valves at the respective maximum differential pressures across the control valve, should be quoted. Valves that offer built-in resistance against cavitation damage of the downstream equipment e.g. the valve, pipeline and control circuitry will receive preference.

PRESSURE REDUCTION

Mechanical break pressure devices, i.e. orifices, may be utilised to assist with pressure reduction, provided that this will not have an adverse effect on the discharge rate at the anticipated specified minimum dynamic inlet pressure and result in excessive noise and vibration.

C3.3.2.19.4 ZUT 7028.4 TYPE OF LEVEL CONTROL AND FLOAT VALVES

There are two prominent methods of achieving float/level control duty, by using either of the following:

C3.3.2.19.4.1 ZUT 7028.4.1 HYDRAULICALLY OPERATED FLOAT AND LEVEL CONTROL VALVE

Tree-way pilot valves activated by a small float mechanism shall control the opening and closing cycle duration. If hydraulic float control activators prove impractical, an alternative control pilot system incorporating electric solenoid activators may be considered.

C3.3.2.19.4.1.1 ZUT 7028.4.1.1 System pressures

The upstream pressure of this type of valve can vary from a full static head in a pipeline to the minimum residual static head during the maximum anticipated flow rate. The pilot valve system where applicable shall be capable of functioning efficiently under the full range of inlet pressures.

C3.3.2.19.4.1.2 ZUT 7028.4.1.2 Control characteristics

A linear velocity reduction is required to reduce pressure surges. Alternatively the closing cycle should be inversely proportional to increasing dynamic pressure by means of a pressure sensitive, adjustable automatic control pilot valve assembly. This assembly will induce a reduction in closing speed with increased dynamic inlet pressure preventing continued closing when the inlet pressure exceeds the system design pressure. Closing too slowly, however, will tend to result in excessive velocities at high pressure differentials across the valve seat causing rapid erosion of coating, cavitation damage and possible reservoir spillage.

Configurations including automatic surge suppression and surge relief will be considered an advantage. This type of valve is usually set to operate in an ON - OFF mode and not in a modulating configuration. Where more than one valve is used, the valve can be used to cascade, so that only one valve will operate during lower demands and will, in turn, activate other hydraulically operated float/level control valves in the system as the demand increases.

C3.3.2.19.4.1.3 ZUT 7028.4.1.3 Installation

The valve control system must be designed to be neatly mounted against the valve chamber or reservoir.

C3.3.2.19.4.1.4 ZUT 7028.4.1.4 Body

Diaphragm actuated control valves with single or double diaphragm control chambers will be acceptable, providing that the main shaft is double-guided with suitable renewable bearings preventing excessive wear, during flow velocities exceeding 3 meters per second.

C3.3.2.19.4.1.5 ZUT 7028.4.1.5 Control system

All pilot valves shall be supplied sealed, using sealing wire and lead seals, to prevent unauthorised tampering. All control and pilot valves shall be clearly and permanently labelled.

C3.3.2.19.4.1.6 ZUT 7028.4.1.6 Dirt traps

The control valve should be provided with a dirt trap or strainer system containing a removable 100 - 200 micron stainless steel cartridge and a suitable scour plug to flush accumulated debris, which may accumulate on the upstream side of the valve. The dirt trap should prevent obstruction of the normal functioning of pilot valves and the main valve seat. The free flow area of this unit should be larger than the actual control valve seat area.

C3.3.2.19.4.1.7 ZUT 7028.4.1.7 Maintenance

Pilot valve components subject to wear e.g. valve seats, pressure sensing membranes, shafts, hydraulic seals; resilient seats, etc. shall be readily available as replacement spare parts.

C3.3.2.19.4.1.8 ZUT 7028.4.1.8 Operating instructions

An approved operating instruction notice board made of engraved aluminium with painted lettering shall be supplied with the following indicated thereon:

1. Concise operating instructions;
2. The numbers of the valves and pilot valves;
3. The pilot valve piping

The notice board shall be mounted above the control system and piping.

C3.3.2.19.4.1.9 ZUT 7028.4.1.9 Commissioning

The contractor shall prepare for commissioning by making use of preliminary factory settings of the control and pilot valves. No commissioning shall be permitted unless the contractor is able to convince the Engineer that the required preparation backed by calculations, where necessary, has been made.

C3.3.2.19.4.2 ZUT 7028.4.2 MECHANICALLY OPERATED FLOAT VALVE

A mechanically operated valve mounted at the end of a pipeline relies solely on the action of a lever and float mechanism attached to the valve to operate effectively. The position of the float along the lever arm and associated linkage to the sealing mechanism is critical to ensure a linear pressure reduction in the valve during closure.

C3.3.2.19.4.2.1 ZUT 7028.4.2.1 Installation

The position of the float along the lever arm must ensure that the force exerted on the internal sealing faces of the valve is adequate to overcome the maximum upstream pressure of a given designed system. The prevailing water surface turbulence shall not influence the smooth operation of the valve.

C3.3.2.19.4.2.2 ZUT 7028.4.2.2 Valve design

The design of the valve shall prevent internal cavitation from occurring due to the dissipation of excess energy. The design of a mechanically operated valve shall facilitate a closure characteristic whereby deceleration of the closing rate occurs just before the valve closes to dampen out severe surges when there is a high dynamic differential pressure across the valve.

C3.3.2.19.5 ZUT 7028.5 MATERIALS

Valve components shall be constructed of the material specified in the applicable valve datasheets.

C3.3.2.19.6 ZUT 7028.6 FASTENERS

Fasteners on the valve shall be of EN Grade 1.4401 (316) stainless steel.

Flange fasteners shall comply with the specification for the pipeline's flange fasteners.

Fasteners shall comply with the clause "Fasteners" in ZUT 0001 – General Mechanical Requirements.

C3.3.2.19.7 ZUT 7028.7 CORROSION PROTECTION

The specific application shall be taken into account in the corrosion protection of valves under Corrosion Protection for Valves specification ZUT 7005.

C3.3.2.19.8 ZUT 7028.8 INSPECTIONS

The Contractor shall make arrangements for the Engineer to inspect the equipment for compliance prior to payment being made.

If the equipment is manufactured and assembled in South Africa, the Contractor shall make all arrangements and carry all costs for the Engineer to inspect equipment in the workshop prior to dispatch to Site.

If the equipment is manufactured and assembled outside South Africa, the Contractor shall make all arrangements and carry all costs for an Engineer approved inspection authority to inspect the equipment in the workshop prior to dispatch. The inspection shall include a full report on compliance of the equipment with this specification and this report shall be submitted to the Engineer prior to dispatch of the unit from the workshop.

C3.3.2.19.9 ZUT 7028.9 TESTING REQUIREMENTS

The Contractor shall arrange for the Engineer to witness the testing of valves of sizes DN 200 and larger and all travel and accommodation costs shall be the responsibility of the Contractor.

The valve shall be tested according to specifications ZUT 7004.

The correct operation of the valve shall be demonstrated to the Engineer prior to the commissioning of the Works.

C3.3.2.19.10 ZUT 7028.10 OPERATING AND MAINTENANCE MANUAL

This section shall comply with the requirements as specified under ZUT 0002.

C3.3.2.19.11 ZUT 7028.11 MEASUREMENT & PAYMENT

Measurement and payment covered under ZUT 7004.

C3.3.3 ELECTRICAL

This section is comprised of:

- A project specification which details the electrical scope of works under this Contract.
- Standard electrical specifications

C3.3.3.1 E100 ELECTRICAL INSTALLATION PROJECT SPECIFICATION

C3.3.3.1.1 E100.1 SCOPE OF WORK

This electrical specification covers the electrical works required for the new high lift pumping station, pumping portable water at a flow rate of 2x 200 L/s from the existing Brixton Reservoir into the existing Brixton Tower.

The scope of work for the electrical equipment is the design, supply, delivery, installation, testing, commissioning and upholding during the trial operation period and the defects notification period of the following equipment and materials:

- Low voltage (LV) squirrel cage, induction motors.
- Low voltage (LV) motor control center with electronic VFD starters.
- Field control stations.
- MV and LV power cables.
- Cable supports.
- LV distribution boards.
- Earthing and lightning protection.
- Interior and exterior lighting.
- Power outlets.
- Connections to mechanical equipment.
- A Standby diesel generator and associated fuel tank.
- Mini substation

C3.3.3.1.2 E100.2 GENERAL INFORMATION

a) This Section, Project Specification, shall be read in conjunction with the Standard Electrical Specifications. The Project Specification shall take preference over the Standard Specifications.

b) Only equipment based on proven technology and of high reliability shall be considered for use.

c) All schedules included in the Tender Document shall be completed in full and submitted with the Tender.

d) All relevant technical information regarding each component or item offered shall be included either in the forms to be completed by the Tenderer or as an Appendix to the Tender, in order that the Engineer can make a proper evaluation of the offer.

e) Preference shall be given to locally manufactured equipment and components. Should items not be locally manufactured, Tenderers shall clearly identify these in their Tender. Where

Tenderers choose to offer imports in lieu of locally manufactured items, these shall be offered as an alternative offer, with the local items included in the main offer.

f) Where products of a particular supplier are specified, the supply of equal products from other suppliers may also be supplied if approval for such products is obtained from the Engineer.

C3.3.3.1.3 E100.3 STANDARDS AND REGULATIONS

All materials and equipment shall be new and of the standard and quality specified.

Tenderers shall ensure that they are fully acquainted with the contents of the applicable standard electrical Specifications.
The wiring installation shall comply fully with SANS 10142 as amended.

The design and manufacture of equipment and the complete installation shall be carried out and tested in accordance with the latest issue or amendments of the following regulations, as applicable.

a) SANS 10142 – The Code of Practice for wiring of premises as amended.

b) The Occupational, Health and Safety Act, (Act 85 of 1993).

c) The local Municipal by-laws and regulations and regulations of the local supply authority.

d) The Fire Brigade Services Act, 2000 (Act 14 of 2000).

e) The regulations of Telkom (S.A) Ltd.

f) The National Building Regulations and Building Standards Act, (Act 29 of 1996).

g) The Electricity Act, (Act 88 of 1996).

C3.3.3.1.4 E100.4 ELECTRICITY SUPPLY

The Contractor is responsible for the 400V, 400kVA electricity supply from the local electricity supply authority from City Power for the new pump station at Brixton.

The Contractor shall supply and install the 400V supply cables from the City Power supply point to the LV Main distribution panel at the new Brixton pump station as specified and shown on the drawings

The relevant electrical parameters at the points of supply to the pump station are as follows:

PARAMETER	PUMPSTATION
Supply voltage	415 V
Frequency	50 Hz
Fault level (3 phase)	TBA by City Power
Voltage regulation	± 5%
Voltage dip limit (maximum allowed)	3%

C3.3.3.1.5 E100.5 DRAWINGS, MANUALS, TRAINING, SPARES AND TOOLS

The requirements of Standard Specification E200.7 shall be complied with, as varied or added to by this Project Specification.

C3.3.3.1.5.1 E100.5.1 DRAWINGS

Equipment Drawings shall be submitted in hard copy and electronically in .pdf format as specified in the Standard Specifications.

The approval of Drawings shall not relieve the Contractor of this responsibility to supply the equipment according to the requirements of this Specification.

The following Drawings shall be submitted by the Contractor prior to installation work:

- Motor control schematic diagrams and workshop drawings;
- MCC termination diagrams;
- Field station workshop drawings;
- Mini-substation workshop drawings;
- Standby generator workshop drawings;

The following procedure for the approval of Drawings shall be strictly followed:

- Contractor prepares Drawings for approval;
- Contractor checks Drawings for compliance with all requirements of the Specification and submits 3 copies, signed off as checked, to the Engineer for approval (including one electronic copy);
- Engineer returns 2 copies, stamped as approved or returned for resubmission, to the Contractor;
- Manufacture of equipment commences after approval of Drawings by the Engineer.

A complete set of “As Built” Drawings, certified as accurate, shall be submitted to the Engineer immediately after completion of the Installation (including one set of electronic copies).

Layout Drawings, issued during Tender stage, shall be marked up by the Contractor showing all dimensions to buildings, including the positions of underground cables.

The Specification includes the following Engineer's drawings:

Schedule of Drawings

- Site plan – electrical installation and site lighting
- Electrical equipment layout, cable routes and supports.
- Low voltage single line diagram
- Typical motor control schematic diagram
- Lighting and small power layout
- Earthing layout
- Typical Field Control Station

- Typical Water Tower – Illustration of Aviation Obstruction lights

C3.3.3.1.5.2 E100.5.2 OPERATION AND MAINTENANCE MANUAL

Two copies of the O & M manual shall be issued to the Engineer prior to commissioning of the Works, and the Operational Acceptance Period shall not be deemed to have commenced until the manual has been issued. Before the Certificate of Completion is issued (after the successful completion of the Operational Acceptance Period) seven copies of the final approved version of the O & M manual shall be issued to the Engineer.

The manual shall be of a standard acceptable to the Engineer and shall be subject to his approval. At least one set shall contain original copies.

Binders with hard plastic covers and ring spring clip holders shall be used. To prevent damage to the content binders shall not be over-filled. A spare binder shall be provided for every three used, marked with the contract information.

Title labels which include Contract number, title, location, Contractor's name as well as the plant or process description together with volume number and contents shall be fixed on the front cover as well as on the spine of the binders.

Manuals shall be in English only, with sections of equipment arranged by labelled dividing separator sheets. Where standard literature is obtained from suppliers or manufactures, this shall be neatly photocopied in A4 size, with the applicable sections clearly marked, omitting duplicate sections in languages other than English.

Comprehensive indexes shall be included, with separate sections (with their own index) where required, as follows:

- Contact details of: consulting engineer, main contractor; all relevant sub-contractors.
- Details of the electrical equipment supplied including the name and address of the supplier, as well as descriptive and technical literature, giving performance and service information.
- Full details of control and protection systems including logic sequence charts, logic controller programs, trip settings, etc.
- Circuit diagrams.
- Dimensioned panel layout drawings.
- Cable schedules for power, control and instrumentation cables. This shall include the cable type, start and finish points, route length, duty load, size, voltage drop, number of cores, number of cores used and gland size. For cable voltages above 400 Volts, the schedule shall also include the purchase details, specification, and date of manufacture.
- Record (as-built) drawings referenced to the above.
- Spares list.
- A comprehensive schedule of routine maintenance actions by time period for the system as installed.
- Test certificates for individual items of equipment and for complete sections of the Works as appropriate.

- This includes Certificates of compliance for the electrical installations, Certificate of compliance and test results of earthing installations, etc.

- Comprehensive hazard identification and risk assessment for all equipment and/or substances provided under this contract toward assisting the employer fulfil its responsibilities in terms of the Occupational health and Safety Act (Act No 85 of 1993) and in particular Section 8(2)(d).

C3.3.3.1.5.3 E100.5.3 TRAINING

The Contractor shall arrange for three nominated technical staff members of the Employer to be trained in the operation and routine maintenance of all the electrical equipment provided under this Contract. The training shall be provided by way of on-site formal training sessions by the equipment suppliers, who shall certify that the training has been completed satisfactorily.

C3.3.3.1.5.4 E100.5.4 SPARES AND TOOLS

Spares and tools shall be provided as specified in and as called for in the Project equipment specifications in this Specification.

In addition to any spares specifically called for in this Specification, the Tenderer shall recommend any additional spares which he considers the Employer should hold. The prices of these spares must not be included in the tender price but should be separately listed and priced in the returnable schedules. Prices for these spares shall include delivery to and off loading at the site. Items may be ordered in full or in part before the end of the maintenance period.

C3.3.3.1.6 E100.6 INSPECTIONS, TESTS AND COMMISSIONING

In addition to the requirements of Standard Specification E200.8, the following requirements shall be complied with:

C3.3.3.1.6.1 E100.6.1 INSPECTIONS

a) Inspections of all switchboards and panels may be carried out by the Engineer at his discretion at the following holding points prior to release:
- after sheet metal fabrication, before painting
- after painting, before installation of equipment
- after assembly, before factory testing.

b) All cable trenches in ground shall be inspected by the Engineer prior to cables being laid and trenches being backfilled.

c) For equipment being manufactured in the RSA, the Engineer and a representative of the Employer will carry out factory inspections and the Contractor shall bear all travel and accommodation costs associated with the inspections

d) During construction the onus will be on the contractor to comply with the following:
- Contractor checks and inspects equipment during all stages;
- Contractor presents Engineer with written confirmation that all equipment is in full compliance with the Specification and has been checked, inspected and fully tested. This confirmation, signed and dated by the Contractor, shall accompany a written request for the Engineer to witness final inspection and testing of the equipment (e.g. distribution board);
- During the Engineer's inspections a fault list will be drawn up, if necessary, and handed to the Contractor;
- Only after satisfactory rectification of the fault list and subsequent re-inspection or testing, may the equipment be dispatched to site;

- The Contractor shall ensure that a full copy of the Specification, as well as an approved, signed copy of the Drawings, are at hand during all inspections and testing.

C3.3.3.1.6.2 E100.6.2 TESTS

The tests listed below shall be carried out on Site by the Contractor and witnessed by the Engineer and a representative of the Employer. Pricing items have been included in the Bill of Quantities for site tests. Factory tests shall be carried out in accordance with the Project equipment and material specifications in this Specification, and routine test certificates shall be provided. Type test certificates, issued by internationally accredited test authorities, shall be provided for all MV equipment. The cost of all factory routine and type tests (where existing certification is not available) shall be included in the supply prices for the equipment.

Switchgear:

- visual checks (including paintwork)
- impedance measurements
- insulation resistance measurement
- current and voltage transformer tests
- proving of protection scheme
- high voltage tests
- circuit breaker operation tests
- control scheme test
- load testing.

LV Cables:

- insulation resistance test (after jointing and termination)
- phase rotation test (after jointing and termination).

Earthing:

- earth electrode resistance measurements
- bonding conductor continuity tests
- soil resistivity tests.

Variable frequency converters (VFCs):

- All inspection and testing procedures shall be developed and controlled under the guidelines of the Supplier's quality system and must be registered to ISO 9001 and regularly reviewed and audited by a third-party registrar.
- The VSD shall be factory pre-wired, assembled and tested as a complete package.

Standby Diesel Generators:

- The requirements for site tests are as specified in the requirements of Standard Specification E239 STANDBY DIESEL GENERATOR.

C3.3.3.1.7 E100.7 FIRE EXTINGUISHERS, FIRST AID KITS, DANGER SIGNS AND NOTICES

Danger signs and notices shall be provided in accordance with Standard Specification E200.9.

All danger signs and safety notices shall be in English. Operating notices, signs and labels that are not safety related shall also be in English. Signs / notices with approved symbols may be used in the place of text signs.

A First aid kit shall be provided in the Pump station LV Room at the Brixton pump station in accordance with Standard Specification E200.9.

Fire extinguishers shall be provided in the Pump Room at the pump station in accordance with Standard Specification E200.9.

C3.3.3.1.8 E100.8 MATERIALS, FINISHING AND PAINTING OF MATERIALS AND EQUIPMENT

C3.3.3.1.8.1 E100.8.1 MATERIALS

Materials shall be provided in accordance with Standard Specification E201.

All mild steel shall be hot-dip galvanized after fabrication, and no cutting or drilling shall be done on site.

C3.3.3.1.8.2 E100.8.2 FINISHING AND PAINTING

Finishing and painting shall be in accordance with Standard Specification E202. All 3CR12 material shall be degreased, with any sheared edges, welds or surfaces subjected to any form of heat treatment pickled and passivated. If there is any mill scale on the material, the 3CR12 shall be non-metallic blast cleaned to SA2½, prior to degreasing.
A primer coat of strontium chromate epoxy primer or approved alternative shall be applied to a minimum dry film thickness (DFT) of 30 µm. A final coat of epoxy / polyester powder coating shall be applied by electrostatic spray and baked in accordance with the manufacturer's specification.

This final coat shall be in the colour as specified, with a minimum DFT of 50µm, but not more than 100µm.

The suppliers or manufacturers shall furnish paint thickness test certificates for all materials that are epoxy powder coated.

All galvanizing shall be hot-dip zinc galvanized coating done in accordance with SANS 121.

The hot-dip galvanizers shall be permit holders in terms of the SABS Mark Scheme or equivalent.

C3.3.3.1.8.3 E100.8.3 FIXING OF MATERIALS

Materials shall be fixed in accordance with Standard Specification E203. All fasteners shall be hot-dip galvanized or stainless steel. No electro-plated or zinc plated fasteners will be allowed.

Fixing to structures and concrete shall be affected by stainless steel bolts and nuts, or stainless-steel threaded rod used in conjunction with an approved chemical anchor.

Where there is a possibility of electro-galvanic reaction (e.g. between stainless steel and galvanizing) the Contractor shall make use of suitable insulating washers of rubber, teflon or similar material.

C3.3.3.1.9 E100.9 LV MOTOR CONTROL CENTRES

C3.3.3.1.9.1 E100.9.1 GENERAL

A free-standing LV motor control centre (MCC) shall be provided inside the pump station to serve as both an MCC and the main LV distribution board for the pump station. A single-line diagram and a proposed general arrangement are shown on drawings provided.

C3.3.3.1.9.2 E100.9.2 STANDARD SPECIFICATIONS

The MCC shall comply with SANS 60439-1, SANS 1973-1 and the following Standard Specifications as varied by this Particular Specification:

E204		Enclosure for MCCs
E205	:	LV switchgear and control gear
E206	:	Busbars

E207 : Current transformers

E208 : LV motor protection

E209 : Wiring in MCCs

E210 : Wiring and cable terminations

E211 : Glands and gland plates

E213 : Switchboard accessories

E214 : Nameplate and labels

E215 : Metering and indication equipment

C3.3.3.1.9.3 E100.9.3 ENCLOSURE FOR MCC

The MCC enclosure shall be fabricated fully from 3CR12 sheet metal, with either 3CR12 or cast aluminium frames.

Compartments in the MCC shall be sized in accordance with the proposed general arrangement drawing.
The pump station MCC shall be constructed to From Type 3b or 4a as per SANS IEC 60439-1. Doors shall be provided on the front and back of the pump station MCC.

An interlocking device shall be provided so that the front door of a compartment cannot be opened unless the circuit breaker / isolator is in the off position, and so that the circuit breaker / isolator cannot be switched on unless the door or cover is locked.

The top of the enclosure for the pump station MCC shall be divided into a busbar chamber and a wiring channel in accordance with Clause 2.4(d) of Standard Specification E204.

The pump station shall be constructed for cable entry from below and shall have front and back access.

The ingress protection shall be as follows:
- IP44 with doors closed
- IP2X with doors open
- IP2X between compartments.

C3.3.3.1.9.4 E100.9.4 SWITCHGEAR AND CONTROL GEAR

The motor ratings given on the single line diagram are the Engineer's estimates, which have been used for systems design purposes. Should the ratings of motors offered in the Tender differ from the Engineer's estimates, then the switchgear and control gear shall be sized to suit the motors offered in the tender and priced accordingly.

All MCCBs shall be lockable in the "off" position, but only with the use of an integral locking device.

Selector switches shall be provided on the front door of each drive's compartment: Switchboard Accessories for selecting manual / off / automatic and local / remote (where required) operation modes. In the manual mode the control pushbuttons on the MCC (local) and at field control stations (remote) shall be operational. In the automatic mode, the control pushbuttons shall not be operational, and control of the drives shall be transferred to the remote terminal unit (telemetry), controlling the drives.

Where standby motor-driven equipment is provided, selection shall be done by the remote terminal unit input for duty / standby selection of the drive compartments as required to implement the specified control philosophy.

C3.3.3.1.9.5 E100.9.5 BUSBARS

The busbars in the MCC shall be rated in accordance with the single-line diagram.

The specified covering of the busbars with heat-shrinkable material shall only apply to distribution busbars (i.e. droppers to functional units).

C3.3.3.1.9.6 E100.9.6 MOTOR PROTECTION

All motor starters shall be equipped with the motor protection required in terms of Standard Specification E208, except as varied below.

Earth leakage protection (rated at 250mA) shall be provided on all motor starters for immersible / submersible equipment to operate the shunt trip of the drive's circuit breaker.
Where the thermal overload relays are mounted inside MCC compartments, an electrical reset facility shall be provided with a pushbutton on the front door of the compartment.

Separate thermistor relays and/or RTD controllers need not be provided if the motor protection relays can accept these inputs.

Each motor starter shall provide a supply to the anti-condensation heater of its associated motor (where fitted). The supply shall be taken from a dedicated earth leakage circuit breaker and shall be turned on automatically when the motor is not running.

C3.3.3.1.9.7 E100.9.7 WIRING IN MCCS

The colour of the MCC wiring shall be as follows for circuits other than power circuits:

220 V ac control live	Brown
220 V ac control neutral	Black
+24 V dc control	Orange
-24 V dc control	Violet / Purple
Wiring to lamps	Red
CT circuits	Blue
PLC digital inputs	Grey
PLC digital outputs	Pink
PLC analogue inputs	Red / black (twisted pair)
PLC analogue outputs	White / black (twisted pair)

C3.3.3.1.9.8 E100.9.8 WIRING- AND CABLE TERMINATIONS

Power cables shall be terminated directly onto circuit breakers or contactors (as applicable) and shall not be connected up via separate terminal strips (i.e. Clause 3 of Standard Specification E210 shall not be applicable).

Power cables shall be labelled externally to the MCC to indicate the equipment being fed. Incoming supply cables shall also be labelled to indicate the source of supply.

C3.3.3.1.9.9 E100.9.9 GLANDS AND GLAND PLATES

All cable glands shall be of the nickel-plated brass type and fitted with waterproof neoprene shrouds.

Gland plates in the pump station MCC shall be provided for cable entry from below. Gland plates shall be mounted at 400mm above finished floor level and shall be bolted to robust brackets welded to the framework of the MCC.

Gland plates shall be manufactured with a minimum thickness of 2mm. Where single core cables are terminated, the gland plates shall be manufactured from non-ferrous material of adequate thickness.

C3.3.3.1.9.10 E100.9.10 SWITCHBOARD ACCESSORIES CONTROL PUSH BUTTONS

Motor control compartments shall be equipped with control push buttons as needed.

Control push buttons shall be of the round, flush, spring-loaded type of 22,5mm diameter. Push buttons shall be colour-coded as follows:

Emergency stop	Red
Lamp test	Black
Reset	Blue
Start	Green
Stop	Red
Open / close	Black on White
Up / down / left / right	Black on White
Forward / reverse	Black on White

Indicator Lights

Motor control compartments shall be equipped with indicator lights as needed:

Indicator lights shall have lamps comprising a cluster of four light-emitted diodes in a common housing. A light's lens shall be of the specified colour and shall be least 20mm in diameter. The lights shall be clearly visible through an angle of 180° in a brightly lit room (500 – 600lux) and the contrast between an energized condition and a de-energized condition shall be clearly visible from all sides as well as from the front.

Indicator lights shall be colour-coded as follows:

Indication	Colour	Example / Comment
Local / Auto / SCADA Mode	White	
Busbar Alive	White	
Closed	Red	Valves, penstocks
Differential Pressure – HIGH	Amber	
Differential Pressure – NORMAL	Green	
Earth Fault	Amber	
Emergency stop	Amber	
Mechanical Seal Failure Warning	Amber	Sub- / Immersible Pumps
Moisture in Coolant	Amber	Sub- / Immersible Pumps
Moisture / Water Ingress	Amber	
Motor Winding Over Temperature	Amber	May be flashing AMBER
Open	Green	Valves

Overload	Amber
Running	Green
Starter Alive (Circuit Healthy)	Green
Stopped & Power Available	Red
Tripped	Amber

Name Plates and Labels

The requirements of the applicable SANS specification relating to name plates and labels shall take precedence over the Standard Specification.

Metering and Indication Instruments

Metering and indication instruments shall be provided in accordance with the single-line diagram for the MCCs. The size of ammeters and voltmeters shall be 96mm x 96mm on compartment doors that are 600mm x 600mm or larger in size, and 72mm x 72mm on all smaller compartment doors.

Run hour meters shall be provided for all motor starter compartments to match the ammeters and voltmeters in size. The run hour meter shall count to 99 999.9 before returning to zero, and it shall not be possible to reset the meter.

C3.3.3.1.9.11 E100.9.11 TEST REPORTS

The switchboard manufacturer shall be in possession of a Permit to Apply Certification Mark, issued by the South African Bureau of Standards (or approved equivalent), in terms of the Specific Permit Conditions of SANS 1973-1 and have evidence of all the seven type tests as required in IEC 60439-1 and SANS 1973-1.

Only authorized holders of these test reports may design and construct the switchboards. Copies of relevant test reports shall be made available to the Engineer upon request.

The Contractor shall re-torque the pump station MCC busbars on site once fully populated and connected up, prior to switch-on, and shall issue a certificate to the Engineer confirming that the busbar arrangement is still to the same standards as at the time of the initial construction and is safe for operation.

Suppliers/Manufacturers of switchboards equal to or below 10kA shall be in possession of a Permit to Apply Certification Mark, issued by the South African Bureau of Standards (or approved equivalent), in terms of the Specific Permit conditions of SANS 1973-3.

C3.3.3.1.9.12 E100.9.12 INSTALLATION

The pump station MCC shall be installed over a cable trench on the elevated platform provided with front and back access as shown on the layout drawing.

Cable trench bridging supports shall be provided to support the pump station MCC in accordance with Clause 4 of Standard Specification E204.

C3.3.3.1.9.13 E100.9.13 MEASUREMENT AND PAYMENT

The single-line diagrams, typical motor starter schematic and MCC accessories schedule have been provided to guide the Contractor in his design of the MCCs. However, the prices for the supply of MCCs shall include for all equipment / components / materials required to comply with this Particular Specification and referenced standard specifications.

The price for the installation of the MCC shall include the provision of cable trench bridging supports.

C3.3.3.1.10 E100.10 LV MOTOR STARTERS

C3.3.3.1.10.1 E100.10.1 GENERAL

Three 400V low voltage Variable frequency converters (VFCs) shall be provided for the booster pump motors at Brixton pump station The VFCs shall enable smooth starting of motors up to rated speed which shall be controlled by the PLC via Modbus TCP. The design of the starters shall allow for the supply authority's voltage dip limit to be met, whilst allowing the motor to develop adequate starting and accelerating torque.

The VFCs shall be fed from dedicated motor feeder circuit breakers in the LV switchboard. These VFCs shall be connected as shown on the LV single-line diagrams.

C3.3.3.1.10.2 E100.10.2 EQUIPMENT SPECIFICATION

The scope of works shall include the design, manufacture, factory tests, delivery, installation, on-site tests, commissioning and maintenance for 12-months of two (2) 400V, 150kW variable frequency converter (VFCs) for the new pump motors at the new Brixton Pump station

The VFCs shall be provided in accordance with Standard Specification E234 as varied by this Detailed Electrical Specification. Reference in the Standard Specification to a "variable speed drive" shall be taken as a reference to "variable frequency converter".

The power rating stated above is the Engineer's estimate, and the Contractor shall ensure that the size of the VFC supplied matches the actual size of motor supplied, taking all losses and the motor efficiency into consideration.

The pump sets shall be considered as an S1 (Continuous) type load as defined in SANS 600034.

The Scope of Works shall include, but is not limited to:

- Design, supply, and installation of three (3) variable frequency converter;
- Supply and install LV cables;
- Earthing, bonding, and EMC mitigation;
- Manufacture drawings;
- Quality assurance;
- Undertake and submission of line supply and shaft line design data to demonstrate compliance with quality of supply criteria set by City Power as well as the mitigation of torsion forces on the motor;
- Operating and Maintenance manuals;
- Testing and Commissioning;
- Training of identified number of Employer's operating, technical and technical staff on the operation and maintenance of the VFC drives;
- Issuing test report / certificate of compliance;
- 12-months defects liability period;

- 5-year post installation maintenance contract (if approved by the Employer), and
- Off-site diagnostic monitoring of the VFC installation.

C3.3.3.1.10.3 E100.10.3 ACCEPTABLE MANUFACTURERS

The variable frequency convertors shall either be Emerson, Zest, Mitsubishi, Schneider, Danfoss or equally approved.

C3.3.3.1.10.4 E100.10.4 CONSTRUCTION AND PERFORMANCE

The VFCs will be rated for use with standard squirrel cage induction motors driving centrifugal water pumps. The Contractor shall be responsible for the system (VFC / motor combination) performance, including overload capability, motor and load starting torque and speed holding accuracy.

The minimum acceptable overload capacity shall be at least 110% of the nominal torque continuously. Common mode filters and/or dv/dt filters shall be supplied to minimize shaft bearing currents and ensure that impulse voltages at the motor terminals are slower than the acceptable rise times.

The VFC shall be internally protected so that no damage occurs to it during normal operational faults such as:

- Short circuit or open circuit on the output cables;
- Power supply “dips” or loss of ac supply (including re-application of ac supply);
- Over- and under voltage of the ac supply;
- Motor overload and under load;
- Motor stall;
- Over speed;
- Earth fault; and
- Switching the drive output onto a stationary motor.

The VFC shall employ fully digital, space vector control to ensure optimum response to supply and load transients, maximum motor performance (thermal as well as dynamic) and the most comprehensive fault diagnostics. All drive settings shall be in software and the drive shall not require any pots to be changed on site during commissioning or when any replacement boards are installed.

Incomer sections shall be fitted with disconnectors. Rectifiers shall be fitted with suitable protection; supplier shall state the method of protection. The VFC shall be supplied as cabinet units equipped with an active supply unit and low harmonic line filter.

C3.3.3.1.10.5 E100.10.5 HARMONICS CONTROL

The Contractor shall ensure that the harmonic limits in NRS 048-2 are not exceeded.

In order to achieve the required harmonic limits, either VFCs with active front ends or a combination of VFCs with high-pulse diode front ends and associated harmonic filters shall be provided.

Should DFE VFCs be provided, tuned harmonic filters shall be provided for each VFC individually.

C3.3.3.1.10.6 E100.10.6 MOTOR PROTECTION

The VFC shall provide protection for the motor against the following:
- Thermal overload;
- Locked rotor;
- Under-voltage;
- Short circuit; and
- Earth Fault.

C3.3.3.1.10.7 E100.10.7 COOLING

Tenderers shall state the maximum heat losses and the cooling air requirements for each drive when operating at the duty point. The VFC panels shall be equipped with fans for drawing air in through filtered louvres and discharging the air out the top of the panel.

C3.3.3.1.10.8 E100.10.8 DIP RIDE-THROUGH

The VFCs shall be capable of riding through the following voltage dips below nominal supply voltage:

a) dips of up to 30% and lasting up to 3s; and

b) dips of up to 100% and lasting up to 100ms.

It is accepted that the motor speed and VFC output power may be reduced during the ride- through period. However, the motor shall not be allowed to reach a pullout condition.

Tenderers shall submit with their tender a curve that shows the dip ride-through capability of the offered VFCs.

The VFCs shall also be capable of riding through a loss of auxiliary power for up to 1s.

C3.3.3.1.10.9 E100.10.9 AUTOMATIC RESTART

Should the VFC be subjected to a voltage dip or power interruption of a magnitude and / or duration that causes the VFC to shut down, the VFC shall not automatically restart itself. However, the VFC shall be available to be restarted by the pump station's control system.

C3.3.3.1.10.10 E100.10.10 MOTOR COMPATIBILITY

The VFCs shall be compatible with standard squirrel cage induction motors without derating of the motors being necessary as a result of output harmonics.

Compatibility with standard motors also implies that it should not be necessary to use motors with upgraded insulation. The VFCs shall therefore be designed to limit voltage stressing of the motor winding insulation due to high dV/dt, excessive peak voltage of the output waveform and high common mode voltages to within the voltage stress withstand capability of the motors.

The VFC supplier shall ensure that the maximum allowable increase in the floating neutral voltage does not exceed the following conditions:

Peak Voltage = 1.9 x Vn (rms); and

dv/dt = 7-15 kV/µs.

Where Vn is the rated RMS voltage of the motor.

These values must not be exceeded at any condition of VFC operation. Sine filters are mandatory if there is doubt that these limits are not achievable.

Though the motors should have insulated bearings the contractor shall confirm the bearing insulation. Where the insulation is determined not sufficient the contractor shall supply clamping devices to limit the potential shaft currents through the bearing.

C3.3.3.1.10.11 E100.10.11 CONTROL AND MONITORING

VFCs shall provide feedback, to and be controlled by the pump station's PLC in the automatic mode. Selected signals shall be made available for connecting to the PLC system.

In addition, local control at the VFC shall be possible via a panel mounted keypad, conforming to the following requirements.

The keypad shall be detachable with at least a back lit 4-line, 20-character alphanumeric operating display for programming and control. The displayed messages shall be in user- friendly, descriptive text. Coded messages are not acceptable.

Parameter setting shall be possible using the keypad with user-friendly text messages. Password protection shall be provided to prevent unauthorized tampering with the set parameters.

It shall be possible to set the keypad to display (simultaneously or by continuous scrolling) any three of the following parameters or actual values, as selected by an engineer on site:

- Input Voltage;
- Input Frequency;
- Output Voltage;
- Output Frequency;
- DC Bus Voltage;
- Output power;
- Output Torque;
- Output Current;
- Motor Speed;
- Speed reference;
- Run / Stop / Fault; and
- Remote / Local Control.

At least the following drive functions shall be available from the keypad:

- Run;
- Stop;
- Accelerate;
- Decelerate;

- Set Parameters;
- Scroll through and view actual values; and
- Fault Analysis.

E-stops at the pumps shall be hard-wired to the VFC to isolate power to the pump motors in case of emergency.

C3.3.3.1.10.12 E100.10.12 INSTALLATION

The low voltage VFD-starters shall form part of the MCC which shall be installed inside the pump station, in the positions indicated on the electrical equipment layout, Drawing.

C3.3.3.1.10.13 E100.10.13 MEASUREMENT AND PAYMENT

The price for the supply and installation of the low voltage VFD-starters shall include for all the following which have not been separately measured in the Bills of Quantities:

- Programming software for the motor protection relays, and a data cable for connecting a relay to a laptop PC.
- Factory tests.

C3.3.3.1.11 E100.11 FIELD CONTROL STATIONS

Field control stations which are equipped as specified below shall be provided for the following equipment at the pump station:

LV pump motors : emergency stop pushbuttons

The field control stations shall be constructed in accordance with the typical general arrangement, Drawing and shall be installed in an easily-accessible position alongside the associated equipment.

C3.3.3.1.12 E100.12 LOW VOLTAGE POWER CABLES

C3.3.3.1.12.1 E100.12.1 GENERAL

LV cables shall be provided in accordance with single line diagram for LV MCCs and distribution boards.

The cables shall be supplied and installed in accordance with Standard Specification E231 as varied by this Project Specification.

Should the ratings of LV motors differ from the Engineer's estimates (on which the single-line diagrams are based), then the motor supply cables shall be sized to suit the actual motor ratings. The voltage drop from the MCC to the motor terminals shall not exceed 2% of the motor rated voltage at motor rated current.

C3.3.3.1.12.2 E100.12.2 LV CABLES

LV cables shall be provided as follows:

- From the Mini substation to the LV MCC at the pump station
- From the LV distribution boards to LV loads as indicated on the single-line diagrams.

- The lighting and small power installations in the Brixton Pump Station pump hall shall be watertight industrial type surface mounted installations. All fittings and appliances shall be surface mounted and shall be fed with cables installed on galvanised cable ladders, or in galvanised conduits, fixed on the surface of structures, complete with brass bushes on the ends.

All multicore LV power cables shall be 600/1000V PVC/PVCS/WA/PVC cables with stranded copper conductors.

All MCC cable connections shall be watertight to IP66.

C3.3.3.1.12.3 E100.12.3 INSTALLATION

LV power cables shall be installed on wall mounted cable ladder in cable trenches inside buildings and on vertical / horizontal structure-mounted cable ladder to equipment.

Excavations and the laying of cables, either directly in the ground or in ducts, shall be in accordance with Clause 3 of Standard Specification E231.

All cable routes indicated on the Engineer's drawings are provisional and the final routes shall be confirmed with the Engineer on site before cables are installed.

C3.3.3.1.12.4 E100.12.4 MEASUREMENT AND PAYMENT

- Prices for cable trench excavations and the laying of cables shall be determined in accordance with Clause 3 of Standard Specification E231.
- Prices for the installation of cables in the ground shall include for cable marking tape.
- Prices for the installation of cables on cable ladder / tray shall include for fixing clamps or cable ties.
- Prices for the termination of cables shall include for all material required for the termination.
- Cable lengths given in the Bill of Quantities are provisional and subject to re-measurement on site. Unit prices shall allow for wastage, as only the nett length will be measured for payment purposes.

C3.3.3.1.12.5 E100.12.5 CABLE SUPPORTS

Cable supports (ladder / tray) shall be provided in accordance with Standard Specification E220 and the cable routes and supports layout drawings.

Pricing shall include for the supply and installation of all materials and accessories to provide the complete support installation.

C3.3.3.1.13 E100.13 LOW VOLTAGE DISTRIBUTION BOARDS

C3.3.3.1.13.1 E100.13.1 GENERAL

Low voltage (LV) distribution boards shall be installed in the location shown on the drawings in the Pump station and in the Guard House.

The LV distribution board in the pump station is part of the free-standing LV motor control centre (MCC) which shall be provided inside the pump station to serve as both an MCC and the main LV distribution board for the pump station and although it is described in item 9 above it must also comply with this section.

C3.3.3.1.13.2 E100.13.2 EQUIPMENT

All DBs shall be manufactured from 2mm 3CR12 steel and powder coated to National colour standard SANS 1091:2004, equipped with doors and shall be watertight with a rating of IP65. 'Normal' sections shall be Electric orange
'Standby' sections shall be Signal red

All LV switchgear and control gear shall be suitable for the system fault level indicated on the drawings.

The busbars shall be positioned in such a way to allow for easy extension to the sides by adding additional panels, and to allow for cable entry from the bottom. Their spacing shall be such that the cables can be connected to them in a neat and safe configuration. The busbars shall be rated for the full load capacity of the main switch and shall be capable of withstanding the fault level as indicated on the drawings for 3 seconds.

The ammeters shall be of the maximum demand indicating type.

It shall be possible to lock any motor feeder MCCB in the open position.

The motor feeder circuit breakers shall be of the 'slow curve' type for motor applications with ratings as specified on the drawings.

Surge arrestors shall be complete with failure indication facility. These units shall be installed on all phases plus neutral and shall be as accessible as circuit breakers. Surge arrestors shall be solidly earthed by means of 16 mm² insulated earth wire.

Detachable gland plates suitable for receiving the cable shall be provided at the bottom side of Distribution board with glands.

C3.3.3.1.13.3 E100.13.3 TYPE TESTS

The Contractor shall obtain the Engineer's approval of type test reports for MCCBs and other components used in all distribution boards before commencement of supply.

C3.3.3.1.13.4 E100.13.4 DRAWINGS

The Contractor shall supply all materials and components to provide complete DB's. The Contractor shall submit the detailed drawings along with component details/makes etc. for necessary approval.

C3.3.3.1.13.5 E100.13.5 INSPECTION

All tests and inspection shall be made at the place of manufacturer. The manufacturer shall provide reasonable testing and inspection facilities and co-operation without any charge to satisfy him that the material is being supplied is in accordance with this specification. The proto of distribution boards shall be inspected by employer or his representative for approval before commencement of supply.

C3.3.3.1.13.6 E100.13.6 INSTALLATION

Wall mounted distribution boards shall be mounted with the top of the board not higher than 2100 from finished floor level and with the bottom of the board not lower than 900 from finished floor level.

All boards shall be positioned at a distance no less than the depth of the board from any opening or doorway

All wall mounted distribution boards shall be mounted on P1000 unistrut against the walls. All cable entries into distribution boards shall be from the bottom.

C3.3.3.1.14 E100.14 EARTHING AND LIGHTNING PROTECTION

C3.3.3.1.14.1 E100.14.1 GENERAL

The earthing system which shall be provided at the Brixton Pump station shall comprise the following:

- An earth electrode and associated main earth bar.
- Earthing conductors
- Earth continuity conductors
- Bonding

C3.3.3.1.14.2 E100.14.2 EARTH ELECTRODE AND MAIN EARTH BAR

At the pump station a foundation earth electrode and its associated main earth bar shall be provided in accordance with Standard Specification E216 as qualified in this Project Specification.

The earth electrode shall be a foundation earth comprising copper earth conductor and earth rods buried under the perimeter concrete foundation of the pump station.

A 70mm² bare copper conductor shall be installed as one continuous length with the two ends of the loop brought to the main earth bar.

The indicated number of 16mm diameter 2m long “Copperweld” earthing rods shall be driven vertically into the ground through the blinding layer at the bottom of the foundation trenches, in the positions indicated on the earthing layout drawing. Once all the rods have been fully driven, the copper conductor shall be exothermically welded to the exposed head of each rod.

The tails of the copper conductor shall be run in PVC conduit between the point where the conductor tails rise from the foundation and the main earth bar. The conduit shall be built into the building structure.

At each corner of the building near the “Copperweld” rod, a 2m long bare copper conductor tail shall be exothermically welded to the foundation earth conductor. The free end of each tail shall be run to a position at the outer edge of the concrete skirt around the building and arranged for easy retrieval. These positions shall be clearly marked on the record drawings.

At the indicated main earthing bar position shall be installed horizontally against the cable trench wall. The copper bar shall be mounted on moulded epoxy insulators to space the bar 30 mm from the wall. Each insulator shall be provided with two, moulded-in 12mm brass studs. The stud at the base of each insulator shall be screwed into an internally threaded wall anchor (at least 50 mm long) and the copper bar shall be secured to the remaining stud on each insulator with a brass nut, brass washer and cadmium plated spring washer. The copper bar shall be provided with at least fourteen 13 mm diameter holes at 35mm centres. The two outer holes shall be employed for mounting the bar whilst the remaining holes shall each be fitted with 12mm diameter bolts, nuts, washers and spring washers.

The two ends of the foundation earth conductor shall be fitted with lugs and bolted to the tinned earthing bar.

All earthing conductors shall be continuous lengths without joints between terminations. Any damage to earthing conductors shall be reported in writing to the Engineer and, subject to his approval, shall be repaired by means of exothermic welding. Once the earth electrode has been installed, its resistance shall be measured, and the results shall be submitted in a report to the Engineer. The Engineer will instruct the Contractor if further electrode enhancement is required.

C3.3.3.1.14.3 E100.14.3 EARTHING CONDUCTORS

Earthing conductors shall be installed from the main earth bar to equipment earth bars / terminals.

Earthing conductors shall be PVC-insulated copper conductors or bare copper earth conductor.

C3.3.3.1.14.4 E100.14.4 EARTH CONTINUITY CONDUCTORS

Earth continuity conductors shall be installed with all LV power cables in accordance with Standard Specifications E216 and as shown on the single line diagrams.

C3.3.3.1.14.5 E100.14.5 BONDING

All accessible extraneous part of electrical equipment / electrically-driven equipment shall be bonded in accordance with SANS 10142-1. The roof of the pump station and its steel support trusses shall be bonded to the steel support columns, and the columns shall be bonded to the foundation earth electrode all around the perimeter of the building.

C3.3.3.1.15 E100.15 INTERIOR AND EXTERIOR LIGHTING

C3.3.3.1.15.1 E100.15.1 GENERAL

The lighting installation in the pump station's pump hall shall be a watertight industrial type surface mounted installation. All fittings and appliances shall be surface mounted, and fed with cables installed as follows:

All cabling for the lighting installation shall be installed in galvanised conduits, fixed to the surface of structures, complete with suitable bushes on the ends.

All cables exposed by the removal of the protective sheath, which connect into light fittings, plugs, switches etc. shall be strictly in accordance with the SANS 10142 colour coding:

- All neutral cables shall be black.
- Where blue cables have been supplied, these shall be covered by a black shrink wrap sheath, etc.
- All live cables shall be red.
- All earth cables shall either have a green and yellow sleeve, or the sleeve shall be stripped off to leave bare copper.

Except for the control room and Guard House, the lighting installation in the rest of the pump station shall be an industrial type surface mounted installation. All light switches shall be installed in surface mounted extension boxes. The control room and ablution block installations will be recessed in the walls, with flush wall switches built into conduit boxes.

Aviation Warning Beacons lights shall be mounted on top of the existing water tower as shown on the drawings.

All lamps and control gear shall be rated for the supply voltage of 230V as specified.

C3.3.3.1.15.2 E100.15.2 EQUIPMENT

The lighting installation shall be as indicated on the drawings. Fittings offered by the Contractor shall be as indicated on the drawings or approved equivalent.

Light fittings shall be supplied and installed complete with lamps, electronic control gear, diffusers, mounting facilities, etc., as applicable. All fittings shall be new and unused and shall be delivered to site as packed by the supplier. Fixing of luminaires shall not compromise the protection rating of the luminaire. All bulkhead fittings shall be provided complete with special mounting brackets.

C3.3.3.1.15.3 E100.15.3 INSTALLATION

All light fittings in the pump station shall be connected to a dedicated Pratley type junction box. Disconnection of a light fitting shall not affect the operation of other light fittings on the same circuit. The cable between the junction boxes shall be heat resistant silicon insulated cabtyre.

The permanent luminaires intended for installation shall not be used for temporary lighting during construction. The Taking-Over Certificate for the installation will not be issued unless all light fittings and lamps are in working order.

The operating circuits of discharge type fittings shall be provided with suitable power factor compensation, ensuring a power factor better than 0.9.

The installation shall be reticulated along the cable ladders in positions indicated on the drawings.

The Contractor shall ensure that the integrity of the luminaires, switches and draw boxes shall remain as required (IPX6 etc.) at all times. All bulkhead type fittings shall be equipped with special mounting brackets.

All access holes shall be sealed off with compression glands and other suitable covers to ensure a weatherproof installation, as required.

All lighting switches in the watertight industrial installation area shall be weatherproof, IPX6 rated, ultraviolet (U.V.) protected, noncorrosive types mounted on the surface, suitable for 16Amp, 230Volt, 50Hz and shall be rotary-cam operated.

C3.3.3.1.15.4 E100.15.4 MEASUREMENT AND PAYMENT

- Prices for the supply of light fittings shall be complete with lamps
- Prices for the supply of class1 division1 light fittings shall be complete with appropriate compression gland.

C3.3.3.1.16 E100.16 POWER OUTLETS

C3.3.3.1.16.1 E100.16.1 GENERAL

The small power installation in the pump station's pump area shall be a watertight industrial surface mounted installation. All fittings and appliances shall be surface mounted. All cabling for power outlet installation shall be installed on galvanised cable ladders, or in galvanised conduits, fixed on the surface of structures, complete with brass bushes on the ends.

All power outlets shall be installed in surface mounted extension boxes.

C3.3.3.1.16.2 E100.16.2 EQUIPMENT

The small power installation shall be as indicated on the drawings. Appliances offered by the Contractor shall be as indicated on the drawings or approved equivalent.

In the watertight industrial installation:

- The Contractor shall allow for Industrial type weatherproof 3-Pin switched socket outlets, as shown on the drawings. The switched socket outlets shall be non-corrosive, IPX6, rated at 15Amp, 230Volt, 50Hz, shall have rotary-cam operated switching mechanism and shall be installed on the surface. The switched socket outlet shall be complete with male plug. The configuration shall be the same as the normal 3 pin domestic plugs used South Africa and the unit shall accommodate the watertight as well as the normal sockets.

- The Contractor shall allow for Industrial type weatherproof 3 phase 60Amp, 400Volt, 50Hz, 4 – pole, 5-pin switched socket outlets, rated IPX6. The switched socket outlet shall be complete with male plug. The circuit wiring shall be as indicated on the single line diagrams.

Samples shall be submitted to the engineer for approval.

C3.3.3.1.16.3 E100.16.3 MEASUREMENT AND PAYMENT

Prices for the supply of industrial 3-pin and 5-pin socket outlets shall be for units complete with male plugs.

C3.3.3.1.17 E100.17 LOW VOLTAGE MOTORS

Low voltage motors for the mechanical equipment shall form part of the mechanical equipment and shall comply with Standard Specification E241:

LV motors shall be priced as part of the associated mechanical equipment.

C3.3.3.1.18 E100.18 CONNECTIONS TO MECHANICAL EQUIPMENT

Where the single-line diagrams indicate a local disconnector at the load-end of feeders to mechanical equipment such as a crane and ventilation fans, the feeder cable shall be terminated at a wall-mounted disconnector alongside the mechanical equipment, and the final connection from the disconnector to the equipment shall be made by the installer of the mechanical equipment.

C3.3.3.1.19 E100.19 ENGINE DRIVEN ELECTRICITY GENERATING SET

C3.3.3.1.19.1 E100.19.1 TECHNICAL STANDARDS

The following technical standards shall apply to this scope of work and all work and materials/equipment/services shall comply with every aspect of each of these standards where applicable:

SPEC NO.	TITLE
BS EN 55014-1:1997	Electromagnetic compatibility. Requirements for household appliances, electric tools and similar apparatus. Emission. Product family standard
SANS 10142	The wiring of premises
SANS 342	Automotive diesel fuel
SANS 60947	Low-voltage switchgear and control gear
SANS 60439-1	Low-voltage switchgear and control gear ASSEMBLIES Part 1: Type-tested and partially type-tested ASSEMBLIES
SANS 60186	Voltage transformers
SANS 60044-1	Instrument Transformers Part 1: Current transformers
SANS 10292	Earthing of low-voltage (LV) distribution systems

SANS 156	Moulded-case breakers
SANS 1574	Electric cables - Flexible cords and flexible cables
SANS 8528	Reciprocating internal combustion engine driven alternating current generating sets: Parts 1-7, 9,10,12
SANS 1632	Batteries
SANS 1652	Battery chargers - Industrial type
SANS 60529	Degrees of protection provided by enclosures (IP Code)
SANS 1091	National colour standard

C3.3.3.1.19.2 E100.19.2 REFERENCED DOCUMENTATION

All of the documents/drawings specified under this section shall form part of this specification and must be complied with. Should any ambiguity arise between these documents and this specification, tenderers are obliged to bring such ambiguities to the attention of the Engineer.

C3.3.3.1.19.3 E100.19.3 GENERAL

This specification specifies the standby power requirements for the Brixton pump station.

The standby power system comprises a stationary diesel alternator set to provide standby power for the purpose of running:

- 2 x 132 kW electric motor driven pump sets – Method of starting: VFD Starter
- 8 kW Lighting and General load.

Should the ratings of LV motors differ from the Engineer's estimates (on which the size of the diesel alternator set is based), then the diesel alternator set shall be sized to suit the actual motor ratings.

No redundancy is required on the standby supply and hence a single diesel alternator set shall be provided.

The standby power generator shall be located inside a containerized sound attenuated canopy adjacent to the pump station buildings. The exact position to be determined on site and to be agreed with the Engineer.

Site conditions:

- Ambient temperature: 0-500C.
- Relative humidity: 80% non-condensive
- Altitude: 1782m above sea level
- Environment: Regular

C3.3.3.1.19.4 E100.19.4 SCOPE OF WORK

This section defines the equipment, work and material forming part of the standby power generating plant.

The standby power supply shall consist of a diesel engine driven LV alternating current generating, sound attenuated canopy set as well as all the necessary control and power systems and fuel storage.

For the detail specification of the diesel alternator set refers to the returnable schedules.

All tenderers shall state in writing in their tenders that they comply with every aspect of the specification except for the non-compliances which they should list. Failure to do so may render the tender invalid. The onus rests on the Tenderer to submit a request for clarification if uncertainty regarding the scope or specification exists.

C3.3.3.1.19.5 E100.19.5 INCLUDED IN THE SCOPE OF SUPPLY

Contractors are to note that any omission from the scope as defined below shall not relieve them from the legal obligation to provide a fully functional system, complete in all respects, ready to operate and with the standard guarantees and warranties as contractually agreed in order to fulfil the requirements of this specification as well as good engineering practice and workmanship. The responsibility lies with the contractor to allow for all work, equipment and materials in order to comply and to clarify any uncertainties with the Engineer in writing.

This specification calls for the supply, manufacturing, testing, delivery, installation and commissioning of the following:

A1 Diesel engine complete with all systems, accessories, protection, metering, monitoring, control, labelling etc. as described in detail under Item 2.

A2 Alternator complete with all systems, accessories, protection, metering, monitoring, control, labelling etc. as specified under Item 3.

A3 Mechanical structure and canopy complete including base frame, coupling, vibration dampening, sound attenuation, etc. as specified under Item 4

A4 Fuel system complete including day tank, fuel supply lines, top-up supply line with pump and connector, valves, filters, protection, metering, monitoring, control, labelling, accessories, etc. as specified under Item 5

A5 Exhaust system complete including, pipes/ducting, silencer, expansion bellows, lagging, accessories, metering, monitoring, control, labelling etc. as specified under Item 6.

A6 Switchgear and electrical complete with all systems, accessories, protection, metering, monitoring, control, labelling etc. as under Item 7.

A7 Control complete with all systems, accessories, protection, metering, monitoring, control, labelling etc. as specified under Item 8.

A8 Batteries and battery charger complete with all systems, accessories, protection, metering, monitoring, control, labelling etc. as specified under Item 9.

A9 Earthing system including cables, pre-drilled tinned copper earth bar, earth bar mountings, accessories, labelling etc. as specified under Item 10.

A10 Terminals, wiring and cabling as specified under Item 11 which includes all low voltage power and control cables from the field to the diesel alternator's control panel/s.

A11 Corrosion protection as specified under Item 12.

A13 Spares and special tools as specified under Item14.

A14 All type tests certificates, factory acceptance tests, cold and hot commissioning, operational tests, site test, etc. as specified under Item 15.

A15 All marking, labelling and documentation etc. as specified under Item 16.

A16 All setting up and adjustment of protection, control and operational parameters including software programming of equipment. Protection and other relevant settings shall be in conjunction with the Protection Specialist appointed for the main distribution network.

A17 All relevant signals for monitoring and control required by the plant main process control system shall be commissioned right through from the field equipment to the plant process control system.

A18 All relevant signals for control and interlocking required by the main electrical distribution protection scheme shall be commissioned right through from the field equipment to the relevant switchgear panel terminals.

A19 Developing and coding of any plant control and SCADA software. The software interface shall be the communications network protocol which will be developed in conjunction with the plant control specialist.

A20 Grading of the network protection settings.

C3.3.3.1.19.6 E100.19.6 EXCLUDED FROM THE SCOPE OF SUPPLY

The following items shall be excluded from the scope of supply of this part of the contract and are included elsewhere:

B1 Any civil works including buildings, foundations, plinths, structures, concrete trenches, earthworks, etc. The contractor shall provide all the necessary drawings and information to enable the civil contractor to provide for all the civil and building related requirements of the emergency power supply system.

B2 All external network cabling/fibre from the communications network interface of the standby generator control system to the main plant control system. The interface shall be the cable/fibre connection point on the communications card inside the diesel alternator PLC or control panel.

C3.3.3.1.19.7 E100.19.7 EQUIPMENT

A. Diesel Engine/Alternator Set

The standby generator will only be required during mains power failure conditions. The Contractor shall perform all the necessary calculations/modelling in order to size the generator set for the application. The onus rest on the Contractor to ensure that the standby generator unit selected shall be adequate to ensure that it would be able to start the individual motor loads as specified. Should the unit chosen by the Contractor fail in any aspect it shall be replaced by an adequate unit at the Contractor's own cost. A single generator set shall be offered, as multiple sets operating in parallel will not be considered.

The standby generator set shall be provided with dummy loads and with the associated control gear. The dummy loads must switch in automatically when the generator is tested in the test mode, or either run in the automatic mode when the load on the generator is less than 35% of the standby generator set's rated capacity. The dummy load must not be less than 35% of the engine total output power.

The proposed size of the alternator specified in the detail data schedules is indicative only of the order of magnitude of the unit expected. The Contractor shall under no circumstances be relieved from his responsibility to provide an adequately sized unit due to this specification.

Regarding the alternator protection, the Contractor shall specify in detail all the components required for the complete installation even if they are not included in the scope of supply. This information shall

be made available to the designers/manufacturers of the pump station Main LV and generator control panel. The Contractor shall ensure that proper coordination takes place between the generator supplier and the switchboard manufacturer to ensure that the integrated system will function correctly as specified.

C3.3.3.1.19.8 E100.19.8 MECHANICAL BUILD

A duplex frame has been specified for the diesel engine/alternator unit. The Contractor shall clearly state with motivation if he wishes to propose a different arrangement. However, the diesel engine/alternator unit shall be mounted in such a way that the complete unit can be lifted by crane. It shall also be possible to lift either the alternator or diesel engine separately for replacement purposes e.g. by loosening a joint/s connecting the two units together. Whatever the mechanical design of the frame and engine/alternator coupling, it shall be aimed at minimizing the risk of misalignment between the engine and alternator without requiring extremely sophisticated alignment equipment.

All components of the diesel engine/alternator set system shall be mounted on the base frame except for the day fuel tank. The connections to this system shall be designed in such a way that they can easily be disconnected without risk of damage when the complete diesel engine/alternator unit or the individual diesel engine or alternator units need to be removed.

Vibration dampening mountings shall be adequate to comply with the maximum allowed vibration levels specified in the applicable standards.

Sound attenuation of the engine/alternator unit shall comply with the levels specified in E239 STANDBY DIESEL GENERATOR specifications for maximum outlet noise level. The maximum sound levels specified under this section shall apply anywhere directly outside the generator room. This implies that all components included in the scope of the diesel/alternator supplier shall comply with this requirement. This shall include for any material required for soundproofing of the generator room walls, floor and roof.

C3.3.3.1.19.9 E100.19.9 FUEL SYSTEM

The day tank shall be part of the base frame. The size of the tank as specified in the schedules is the preferred size pending any legal restrictions in volume of flammable substances allowed. Tenderers shall provide a general layout drawing of the tank installation, routing of fuel lines, breather pipe and refuelling line. Any building work or concrete foundation work shall be excluded from the scope.

The material for fuel tanks has been specified as hot dipped galvanised mild steel. The tanks shall be provided with a protective inner lining as specified. Tenderers shall tender according to the specification but may offer alternatives separately priced.

C3.3.3.1.19.10 E100.19.10 EXHAUST SYSTEM

Tenderers are to include for any ducting required to ensure adequate cooling of the engine. Where ducting is required this shall be indicated on the general layout drawing provided by tenderers.

C3.3.3.1.19.11 E100.19.11 CONTROL SYSTEM

This section relates to signals and SCADA requirements with respect to control, monitoring, alarm and trip annunciation. All signals from the standby power plant shall be provided to the communications network. Where a proprietary protocol is provided other than the plant standard protocol selected, a suitable, field tested interface shall be provided for conversion of the protocol.

The interface between the plant control system and the diesel alternator system shall be the diesel alternator set control panel terminal strip, where signals for external control purposes shall be provided in the format dictated by the control systems interface (to be provided after order placement). All external hardware and software shall be excluded from the scope of supply. However, the tenderer

shall allow for specialist resource to develop the system in conjunction with the main distribution network specialist and the main plant control system specialist

C3.3.3.1.19.12 E100.19.12 INTERLOCKING REQUIREMENTS WITH DISTRIBUTION NETWORK

The diesel alternator control and protection system shall make available all the signals and parameters to be measured as specified in this document. The Contractor shall ensure that all the necessary interface equipment shall be provided for this purpose, and the individual components shall be specified to fulfil the requirements of the external control and protection systems. The type, rating and number of contacts required will be specified at a later stage after the main plant protection and control systems interfaces have been specified. All metering, monitoring and alarm input signals shall be provided via the plant communications network interface; however, some signals may have to be duplicated in hardwired format where applicable. The same applies to control output signals.

All potential-free auxiliary contacts required for remote tripping/interlocking/indication of the Alternator 400V circuit breaker inside the pump station Main LV and generator control panel shall be provided. Potential-free auxiliary contacts required for any other remote hardwired tripping, alarm or indication purposes shall be specified and provided. The number of contacts shall be finalized during detail design.

Auto transfer upon mains restoration will be controlled by the pump station PLC which will be provided and programmed under the control and instrumentation portion of the contract.

C3.3.3.1.19.13 E100.19.13 PROPOSED REGULAR TESTING OF EMERGENCY SUPPLY

Regular testing of the emergency supply as prescribed by the manufacturer will be performed at rated load by using the essential equipment as main load. The test sequencing and control shall be provided for in the main plant control system and falls outside the scope of this section. Each tenderer shall specify both the no-load and full-load recommended testing intervals and duration for the diesel alternator set.

C3.3.3.1.19.14 E100.19.14 LOGISTIC SUPPORT

In terms of logistic support, the Tenderer shall provide typical lead times for replacement of the complete unit or alternator or engine or other components; typical lead times to repair the engine, alternator and other components, as well as lead times for spare parts for the engine, alternator and other components. The Tenderer shall indicate for what period of time spare parts will be available for the engine, alternator and other components. The Tenderer shall indicate which repairs can be performed on site and which will require repair at the supplier's workshops; and also provide lead times for collection and delivery of the engine, alternator and other components. The Tenderer shall indicate what the guarantees and warranties are on all repairs. The Tenderer shall indicate what the lead time is for technical support on any aspect of the system and shall also indicate the availability of qualified personnel to assist with problems either remotely or physically on site.

C3.3.3.1.19.15 E100.19.15 MANUFACTURE AND INSTALLATION

Detail layout and general arrangement drawings shall be provided by the Contractor prior to commencement of manufacture of any component and within one month after contract award. All special civil requirements for installation purposes shall be specified in the tender.

No equipment shall be shipped prior to final factory acceptance testing and issue of factory test certificates. As witnessing of these tests by the client's quality control representative/s is compulsory, the contractor shall only commence with shipping after obtaining the proper signed off acceptance certificate. The contractor shall provide a documented quality control trail throughout the manufacturing process all the way through installation, commissioning and operational testing.

Cold commissioning shall be performed prior to energizing of any part mechanically or electrically. Upon completion of hot commissioning, a commissioning test report shall be provided together with a complete set of marked-up as built drawings and documentation.

C3.3.3.1.19.16 E100.19.16 PAYMENT AND MEASUREMENT

Due to the packaged nature of this part of the plant the Contractor shall provide for all materials, components, parts, labour, etc. to completely fulfil the requirements of this specification, the applicable standards and the data schedules. Allowance shall be made for specialist labour to fully integrate the plant into the system. The Tenderer is reminded of the remoteness of the installation site, in order to properly cost for site establishment.

C3.3.3.2 E200 ELECTRICAL INSTALLATION PROJECT SPECIFICATION

C3.3.3.2.1 E200.1 SCOPE OF WORK

C3.3.3.2.1.1 E200.1.1 The Contract Works include the supply, delivery, installation, testing, commissioning and handing over in proper working order of the complete services installation as described in all the constituent parts of this document.

C3.3.3.2.1.2 E200.1.2 The Contractor will be responsible to repair all other existing equipment damaged by him or his employees at his own cost. He shall therefore familiarise himself with the positions of all other equipment before he commences.

C3.3.3.2.2 E200.2 ELECTRICITY SUPPLY

C3.3.3.2.2.1 E200.2.1 Electricity supply will be made available by the Supply Authority at the voltage specified in the Project Specification, and the Contractor shall then deliver the installation in such a manner that it complies with the Supply Authority's requirements regarding voltage, current and frequency and with any other requirements which may be imposed by the Supply Authority.

C3.3.3.2.3 E200.3 GENERAL

C3.3.3.2.3.1 E200.3.1 STANDARD TECHNICAL SPECIFICATION

This Standard Technical Specification specifies the standard of workmanship and quality of material for the services installation further described in the Project Specification, the Drawings and Schedules, and if applicable, in the Schedules of Quantities.

This Standard Specification must be read in conjunction with the Project Specification, which qualifies and amplifies this Standard Specification. In the event of conflict, the Project Specification shall take precedence over this Standard Specification.

C3.3.3.2.3.2 E200.3.2 TENDER DOCUMENTS

Upon receiving a tender document, Tenderers shall ensure that all pages and drawings are included. Should any page or drawing be missing, any doubt or obscurity arise about the meaning of any section of any part of the set of documents, or should any obvious error be apparent, Tenderers shall immediately inform the Engineer for amendment or clarification. Where a Tenderer's entry in a schedule conflicts with the document prepared by the Engineer, the Tenderer shall comply with the document prepared by the Engineer and the conflicting entry shall be invalid.

The main tender shall in all aspects comply with the tender document, however, alternative offers may be made with adequate qualifications of deviations from the Engineer's document. If a main tender is not submitted, any alternative offer will be deemed invalid.

All information and prices shall be submitted with the tender. No price negotiations will be entered into after submission of a tender.

Where this tender document is written in the form of instructions, such instructions are addressed to the Contractor.

C3.3.3.2.3.3 E200.3.3 DEFINITIONS

C3.3.3.2.3.3.1 E200.3.3.1 "Main Contractor", "Building Contractor", or "Builder" shall mean the Principal Contractor, if such exists as stated in the Project Specification.

C3.3.3.2.3.3.2 E200.3.3.2 "Contractor" shall mean the Contractor or Subcontractor, as applicable, appointed in terms of this document.

C3.3.3.2.3.3.3 **E200.3.3.3** "Contract" shall mean the contract or subcontract as applicable in terms of this document.

C3.3.3.2.3.3.4 **E200.3.3.4** "Extra low voltage" shall mean voltages of 50V or less.

C3.3.3.2.3.3.5 **E200.3.3.5** "Low voltage" shall mean voltages not exceeding 1 000V.

C3.3.3.2.3.3.6 **E200.3.3.6** "Medium voltage" shall mean voltages exceeding 1 000V.

C3.3.3.2.3.3.7 **E200.3.3.7** "Isolator" shall mean "switch-disconnector".

C3.3.3.2.3.3.8 **E200.3.3.8** "Main Switch" shall mean "main disconnector" or "local disconnector", as applicable.

C3.3.3.2.3.3.9 **E200.3.3.9** "Supply" shall mean purchase, procure, acquire, store off site as necessary, deliver to site, and off-load, position, stack, and store on site.

C3.3.3.2.3.3.10 **E200.3.3.10** "Install" shall mean set out, erect, mount, align, fix, connect, adjust, test and commission and hand over in proper working order.

C3.3.3.2.3.3.11 **E200.3.3.11** "Provide" shall mean supply and install.

C3.3.3.2.3.3.12 **E200.3.3.12** "Installation" shall mean the electrical installation covered by this document.

C3.3.3.2.3.3.13 **E200.3.3.13** "Approved" shall mean acceptable to the Employer in the sole opinion of the Engineer.

C3.3.3.2.3.3.14 **E200.3.3.14** "Document" shall mean this document which may include Requirements for Tendering, Form of Tender, Conditions of Contract, Technical Specifications, Schedules, Schedules of Quantities and Drawings.

C3.3.3.2.3.3.15 **E200.3.3.15** The use of the triple asterisk is intended as a prompt for the specifier only and does not infer an intention to cross-referencing.

C3.3.3.2.3.3.16 **E200.3.3.16** "Relevant Codes and Specifications" shall refer to those listed in the table contained in Clause E200.5 and the normative references listed in SANS 10142, as applicable.

C3.3.3.2.4 E200.4 COMPLIANCE WITH REGULATIONS AND STANDARDS

C3.3.3.2.4.1 E200.4.1 The electrical installation shall comply with the latest revisions and amendments of the following:

C3.3.3.2.4.1.1 **E200.4.1.1** The South African Bureau of Standards Code of Practice for the Wiring of Premises, SANS 10142, referred to herein as the "Wiring Code".

C3.3.3.2.4.1.2 **E200.4.1.2** The Contractor has to operate strictly in accordance with the Occupational Health and Safety Act and Regulations (Act No 85 of 1993) in its entirety and it is expected of him to:

- Ensure the safe operation and safety of all people on site and to strive for a proper management and clean and safe site.
- Register himself and Sub-Contractors in terms of the Compensation for Occupational Injuries and Diseases Act (Act No 130 of 1993) and to issue a copy thereof to the Employer.

C3.3.3.2.4.1.3 **E200.4.1.3** The Employer, his employees or any of his agents do not accept any responsibility and/or liability of any kind in terms of the clauses and/or prescriptions of the Occupational Health and Safety Act for the Works or any part thereof.

C3.3.3.2.4.1.4 **E200.4.1.4** If the Employer or the Engineer or their representatives stop the work because it is unsafe in their opinion, the Contractor shall not have the right to any claims in this regard.

C3.3.3.2.4.1.5 **E200.4.1.5** The Contractor is fully responsible and/or liable for any act and/or action of his employees and/or equipment that operate or that are used on site. The Contractor shall liaise with the Employer if he should, for whatever reason, be unable to perform in terms of the stipulations of the said Act.

C3.3.3.2.4.1.6 **E200.4.1.6** The Contractor has to appoint in writing a capable person as required by the Occupational Health and Safety Act (Act No 85 of 1993 General Safety Regulation 11.1), and a copy of such an appointment has to be delivered to the Employer. This appointed capable person has to accept the appointment in writing and it has to be clearly indicated in his letter of appointment.

C3.3.3.2.4.1.7 **E200.4.1.7** The Contractor shall annually register with the Electrical Contracting Board of South Africa as required by the Occupational Health and Safety Act 85/1993.

C3.3.3.2.4.1.8 **E200.4.1.8** The Municipal By-laws and Regulations and any regulations of the Supplier of Electricity.

C3.3.3.2.4.1.9 **E200.4.1.9** The Local Fire Office Regulations.

C3.3.3.2.4.1.10 **E200.4.1.10** Regulations of Telkom.

C3.3.3.2.4.1.11 **E200.4.1.11** The relevant codes and specifications as defined under Clause 3.3.16.

C3.3.3.2.4.1.12 **E200.4.1.12** The regulations of the local gas supplier where applicable.

C3.3.3.2.4.1.13 **E200.4.1.13** The standard Regulations of any Government Department or other statutory body where applicable.

C3.3.3.2.4.2 E200.4.2 No claims for extras arising from failure of the Contractor to comply with any of the regulations and standards listed above will be considered.

C3.3.3.2.4.3 E200.4.3 Where conflict appears to exist between any of the regulations and standards listed above and the specification, refer such conflict to the Engineer in writing for his ruling.

C3.3.3.2.4.4 E200.4.4 Immediately after receipt of official appointment as Contractor, and at any time thereafter as may be necessary, the Contractor shall notify all relevant authorities, pay fees and take any other steps which may be required or prescribed to execute the contract works.

The Contractor shall copy related correspondence to the Engineer who shall be kept informed at all times. This shall not, however, release the Contractor of his responsibilities.

Provide, in both official languages, notices and warning signs required by statutory or regulatory requirements.

C3.3.3.2.5 E200.5 STANDARD SPECIFICATIONS

All the equipment and materials shall conform to the relevant SANS, NRS, or IEC Specifications and the latest revisions thereof, where applicable. For equipment and materials not covered by the following table, reference shall be made to the list of normative references in SANS 10142.

DESCRIPTION	SANS	IEC	NRS
SWITCHGEAR AND CONTROL GEAR			
HV switches for rated voltages above 1 kV and less than 52 kV	60265-1		
A.C. metal-enclosed switchgear and control gear for rated voltages above 1 kV and up to and including 52 kV	62271-200		
HV a.c. switch-fuse combinations	62271-105		
HV a.c. contactors and contactor-based motor starters	60470		
Common specifications for HV switch gear and control-gear standards	60694		
A.C. insulation-enclosed switchgear and control-gear for rated voltages above 1 kV and up to and including 52 kV	62271-201		
Metal-enclosed switchgear for rated a.c. voltages above 11 kV and up to and including 36 kV	1885		
HV a.c. circuit breakers	62271-100		
Metal-clad switchgear for rated voltages above 11 kV and up to and including 24 kV - Part 2: Standardized panels			003-2
Moulded-case circuit breakers	156		
LV switchgear and control gear assemblies - Part 1: Type-tested and partially type-tested assemblies above 10 kA	1973-1 60439-1		
LV switchgear and control gear assemblies - Part 2: Busbar trunking systems	60439-2		
LV switchgear and control gear assemblies – Part 3: Type-tested and partially type-tested assemblies up to and including 10 kA	1973-3		
LV switchgear and control gear assemblies – Part 8: Safety of MTAs above 10 kA	1973-8		
LV switchgear and control gear assemblies - Part 5: Particular requirements for assemblies intended to be installed outdoors in public places - cable distribution cabinets	60439-5		
LV switchgear and control gear - Part 2: Circuit breakers	60947-2		
LV switchgear and control gear - Part 3: Switches, disconnectors, switch-disconnectors and fuse-combination units	60947-3		
LV switchgear and control gear Part 4-1: Contactors and motor starters (electro-mechanical)	60947-4-1		
LV switchgear and control gear Part 4-2: Contactors and motor starters (semi-conductor)	60947-4-2		
LV switchgear and control gear Part 5-1: Electromechanical control circuit devices	60947-5-1		
LV switchgear and control gear Part 5-5: Electrical emergency stop device with mechanical latching function	60947-5-5		
LV switchgear and control gear Part 6-1: Automatic transfer switching equipment	60947-6-1		
Earth-leakage protection units - Part 1: Fixed earth-leakage protection circuit breakers	67-1		
RCCBs without integral overcurrent protection for household and similar use - Part 1: General rules	61008-1		
Switches for appliances - Part 1: General requirements	61058-1		
AC disconnectors and earthing switches above 1 kV	62771-102		
Busbars	1195		
Metal-enclosed ring main units for ac voltages 1 kV to 24 kV	1874		
TRANSFORMERS AND MINI-SUBS			
Power transformers	60076		
Dry-type power transformers		60726	
Distribution transformers	780		
Semiconductor converters - Part 1 - 3: General requirements and line commutated convertors - Transformers and reactors	60146-1-3		

Convertor transformers - Part 1: Transformers for industrial applications	61378-1		
Safety of power transformers, power supply units and similar - Part 2 - 4: Particular requirements for isolating transformers in general use	61558-2-4		
Safety of power transformers, power supply units and similar - Part 2 - 6: Particular requirements for safety isolating transformers in general use	61558-2-6		
Safety of power transformers, power supply units and similar - Part 2 - 15: Particular requirements for isolating transformers for the supply of medical locations	61558-2-15		
Miniature substations	1029		
CABLES			
The selection, handling and installation of electric power cables of rating not exceeding 33 kV (Parts 1 to 14)	10198		
Impregnated paper-insulated metal-sheathed cables for rated voltages 3,3 kV to 33 kV	97		
XLPE-insulated cables for voltages from 6,6 kV to 33 kV	1339		
Paper-insulated metal-sheathed cables for voltages up to 18/30 kV - Part 1: Test on cables and their accessories		6055-1	
Paper-insulated metal-sheathed cables for voltages up to 18/30 kV - Part 2: General construction requirements		6055-2	
Electric cables with extruded solid dielectric insulation for fixed installations (300 / 500 V to 1900 / 3300 V)	1507		
Flexible electric cables for use in mines - Part 1: Test on cables and their accessories		6055-1	
Flexible electric cables for use in mines - Part 2: General construction requirements		6055-2	
Electric cables with extruded solid dielectric insulation for fixed installations (300 / 500 V to 1900 / 3300 V)	1507		
Flexible electric cables for use in mines - Part 1: LV (640/1100 V and 1900 / 3300 V)	1520-1		
Flexible electric cables for use in mines - Part 2: HV (6,6 kV to 33 kV)	1520-2		
Flexible cords and cables	1574		
Materials of insulated electric cables and flexible chords (Parts 1 to 7)	1411		
Mechanical cable glands	1213		
Single core arc welding cable	1576		
Lugs and ferrules for insulated electric cables - Part 1: copper conductors	1803-1		
Power cables with extruded insulation and their accessories from 1 kV to 30 kV - Part 4: Test requirements on accessories	60502-4		
Accessories for MV power cables			053
CURRENT AND VOLTAGE TRANSFORMERS			
Instrument transformers - Part 1: Current transformers	60044-1		
Instrument transformers - Part 2: Inductive voltage transformers	60044-2		
Instrument transformers - Part 3: Combined transformers	60044-3		
Instrument transformers - Part 5: Capacitive voltage transformers	60044-5		
EARTHING AND LIGHTNING / SURGE PROTECTION			
Earth rods and couplers	1063		
Design and installation of an earth electrode	10199		
Neutral earthing in MV industrial power systems	10200		
Protection of structures against lightning	10313		

Protection against lightning - Part 1: General principles	62305-1		
Protection against lightning - Part 2: Risk management	62305-2		
Protection against lightning - Part 3: Physical damage to structures and life hazard	62305-3		
Protection against lightning - Part 4: Electrical and electronic systems within structures	62305-4		
Surge protective devices connected to LV power distribution systems - Part 1: Performance requirements and testing methods	61643-1		
Surge arrestors - Part 1: Non-linear resistor type gapped surge arrestors for a.c. systems	60099-1		
Surge arrestors - Part 4: Metal-oxide surge arrestors without gaps for a.c. systems	60099-4		
METERS, INSTRUMENTS AND RELAYS			
Meter cabinets	60439-5		
Electrical instruments and meters		60051	
A.C. electromechanical watt-hour meters	62052-11		
Electrical relays - Part 3: Single input energizing quantity measuring relays with dependent or independent time		60255-3	
Electrical relays - Part 20: Protection systems		60255-6	
Watt-hour meters - A.C. electronic meters for active energy	1799		
Electricity metering equipment – static meters	62053-21 to 23		
CAPACITORS			
Shunt capacitors for a.c. power systems having a rated voltage above 1000V - Part 1: General - Performance, testing and rating - safety requirements - Guide for installation and operation		60871-1	
Shunt capacitors for a.c. power systems having a rated voltage above 1000V - Part 2: Endurance testing		60871-2	
Shunt capacitors for a.c. power systems having a rated voltage above 1000V - Part 3: Protection of shunt capacitors and shunt capacitor banks		60871-3	
Shunt capacitors for a.c. power systems having a rated voltage above 1000V - Part 4: Internal fuses		60871-4	
Shunt power capacitors of the self-healing type for a.c. systems having a rated voltage up to and including 1000V - Part 1 : General - Performance, testing and rating - Safety requirements - Guide for installation and operation		60831-1	

C3.3.3.2.6 E200.6 BUILDER'S WORK

C3.3.3.2.6.1 E200.6.1 BUILDING AND CASTING-IN

The Contractor shall be responsible to place in position all wireways, conduits, conduit boxes, etc., for the Builder to build in or cast in, attend to the Builder during building-in or casting-in, and ensure firm fixings acceptable to the Builder and accurate positioning.

C3.3.3.2.6.2 E200.6.2 CHASING

C3.3.3.2.6.2.1 E200.6.2.1 The Contractor shall chase only where it is impossible to build-, or cast-in.

C3.3.3.2.6.2.2 E200.6.2.2 No face-brick or finished surface may be chased without the permission of the Engineer and the Builder.

C3.3.3.2.6.2.3 E200.6.2.3 No structural concrete may be chased without the permission of the Engineer and Builder.

C3.3.3.2.6.2.4 **E200.6.2.4** The Builder will make good all chases and openings in building work. The Service Contractor shall ensure firm fixing acceptable to the Builder and accurate positioning.

C3.3.3.2.6.2.5 **E200.6.2.5** The Contractor will be held responsible for any damage caused by him to the building work or any other service.

C3.3.3.2.6.3 E200.6.3 DUCTS, SLEEVES AND OPENINGS

C3.3.3.2.6.3.1 **E200.6.3.1** Attend to the Builder with the installation of ducts, sleeves, manholes, openings and any other building work associated with the electrical installation to ensure correct and accurate positioning.

C3.3.3.2.6.3.2 **E200.6.3.2** Do not cut any structural concrete without prior permission of the Builder and Engineer.

C3.3.3.2.6.3.3 **E200.6.3.3** Timeously provide to the Builder dimensions, details and positional information for frames, pipe sleeves, recesses, access ways, servitudes, apertures and openings for equipment installed under this Contract.

C3.3.3.2.7 E200.7 DRAWINGS, MANUALS, LITERATURE, TUITION, SPARES AND TOOLS

C3.3.3.2.7.1 E200.7.1 The Engineer’s drawings covering the various sections of the installation are listed in the schedule of drawings. The working drawings of the Contract shall, however, consist of the following, where applicable:

C3.3.3.2.7.1.1 **E200.7.1.1** The Engineer's drawings;

C3.3.3.2.7.1.2 **E200.7.1.2** The Architect's drawings;

C3.3.3.2.7.1.3 **E200.7.1.3** The Structural Engineer's drawings;

C3.3.3.2.7.1.4 **E200.7.1.4** The Engineer's drawings of the other disciplines, as applicable.

C3.3.3.2.7.1.5 **E200.7.1.5** The drawings of other services installations that are relevant for co-ordination and installation.

C3.3.3.2.7.1.6 **E200.7.1.6** The installation drawings of other Contractors and Subcontractors where applicable.

C3.3.3.2.7.2 E200.7.2 Unless otherwise specified, three sets of the Engineer's drawings will be issued to the Contractor for construction purposes. Any further copies may be purchased from the Engineer.

C3.3.3.2.7.3 E200.7.3 The Contractor shall submit four copies (or as required in the Project Specification) of shop drawings to the Engineer for examination and to demonstrate compliance with the Contract. Shop drawings shall include drawings, diagrams, illustrations, schedules, performance charts, brochures and other data which are prepared by the Contractor, Manufacturer, Supplier or Distributor and which illustrate some portion of the work.

The Engineer's examination of shop drawings or samples shall not relieve the Contractor of responsibility for any deviation from the requirements of this Contract unless the Contractor has informed the Engineer in writing of such deviations at the time of submission of shop drawings or samples and the Engineer has given written approval for the specific deviation, nor shall the Engineer's examination relieve the Contractor of responsibility for errors or omissions in the shop drawings or samples or for responsibility for erection or installation fit.

C3.3.3.2.7.4 E200.7.4 The Contractor shall submit to the Engineer four copies (or as required in the Project Specification) of marked-up structural drawings, or other drawings, showing changes and/or additional

requirements to be made in the structure in order to accommodate equipment installed under this Contract.

C3.3.3.2.7.5 E200.7.5 The Contractor will not be allowed to rely on the Engineer for as-installed information which he may have compiled, to produce record drawings.

C3.3.3.2.7.6 E200.7.6 Drawings to be entitled “Record” shall bear the signature of the Contractor, or his authorised representative, and the date.

C3.3.3.2.7.7 E200.7.7 The Contractor shall obtain from the Engineer, if available, a set of computer stiffy disks containing the Engineers' drawings, which have been drawn on a PC-based CAD system for the preparation of record drawings to be provided by the Contractor. One set of paper prints of the record drawings shall be provided for verification by the Engineer. The stiffy disks containing the record drawings shall be provided upon completion of the contract. Otherwise the Engineer will issue a set of Engineer's drawings to the Contractor at completion of the installation. The Contractor shall mark these drawing to indicate the record of the installation.

C3.3.3.2.7.8 E200.7.8 A set of final layout and schematic record drawings shall be provided in a purpose made holder inside the door of each distribution board and motor control centre, or where no doors are fitted, to the front plate of the cabinet. The frame shall be adequately sized to receive the equivalent of two A1 size drawings folded to a nominal size of A4.

For main boards, supply schematic drawings in aluminium picture frame with glass and sealed rear backing suitable for mounting against the substation wall.

C3.3.3.2.7.9 E200.7.9 The Contractor shall submit to the Engineer two sets of approved microfilm of each of the record drawings, if specified***.

C3.3.3.2.7.10 E200.7.10 The Contractor shall submit to the Engineer four (or quantity as specified in the Project Specification) manuals bound between hard covers including the following: -

C3.3.3.2.7.10.1 E200.7.10.1 Dimensioned drawings of the layout of the equipment and systems.

C3.3.3.2.7.10.2 E200.7.10.2 Wiring diagrams cross referred to the drawings described above, and to the Engineer's layout and schematic drawings.

C3.3.3.2.7.10.3 E200.7.10.3 All Test Certificates for tests done at the factories and on the site.

C3.3.3.2.7.10.4 E200.7.10.4 System and equipment descriptions.

C3.3.3.2.7.10.5 E200.7.10.5 Operating instructions.

C3.3.3.2.7.10.6 E200.7.10.6 Maintenance, adjustment and calibration instructions with preventive maintenance schedule and fault-finding procedures.

C3.3.3.2.7.10.7 E200.7.10.7 Spare parts list with names and address of component suppliers and price list of all components and a list of recommended spare components to be kept in stock.

The Contractor shall submit preliminary copies of the manual to the Engineer for scrutiny.

C3.3.3.2.7.11 E200.7.11 The Contractor shall provide thorough tuition of the Employer's staff in the operating and maintenance of the contract works.

C3.3.3.2.7.12 E200.7.12 When specified in the project specification the Contractor shall allow in his price for the provision of 2 sets of photographs and slides to be taken on monthly basis, for the duration of the contract, of all the areas and equipment where the Contractor is involved. The photographs shall be properly dated with comments e.g. access to substation not possible etc. One set of the

photographs and slides shall be handed each month to the Engineers' Representative at the site meetings. These photographs may be used for the evaluation of claims.

C3.3.3.2.7.13 **E200.7.13** The Contractor shall provide a complete set of tools associated with equipment offered per substation.

C3.3.3.2.7.14 **E200.7.14** The installation shall not be accepted until the manuals have been approved by the Engineer and handed over to the Employer.

C3.3.3.2.8 E200.8 INSPECTION, TESTS AND COMMISSIONING

C3.3.3.2.8.1 E200.8.1 On completion of erection and installation on site the Contractor shall perform all the tests that may be required by the Engineer in his presence to ensure that the Works are ready for handing over and putting into regular use.

C3.3.3.2.8.2 E200.8.2 Near completion, inspect and test the services installation in accordance with the Wiring Code, the Regulations of the Supplier of Electricity and the Occupational Health and Safety Act 85/1993. Record test results on printed test sheets and submit to the Engineer.

C3.3.3.2.8.3 E200.8.3 Testing of the electrical installation shall be in accordance with the Project Specification, but shall include the following:

- Ensure correct polarity, phase rotation and balance load between the phases. Verify polarity and phase identification.
- Continuity and resistance of earth conductor including all bonding conductors.
- Continuity of ring circuit.
- Earth electrode resistance.
- Insulating resistance.
- Earth fault loop impedance test.
- Operation of earth leakage protection devices and circuit breakers.

C3.3.3.2.8.4 E200.8.4 After inspection and testing, timeously arrange for any inspection and test by the Supplier of Electricity if required and assist as necessary the Inspector of the Supplier of Electricity by providing access, tools, instruments and attendance.

C3.3.3.2.8.5 E200.8.5 Replace any portion of the electrical installation that does not comply with the Wiring Code or the Specification. Such replacement shall be done at the Contractor's expense.

C3.3.3.2.8.6 E200.8.6 Submit a "Certificate of Compliance by an accredited person" Annexure 1 in terms of the Occupational Health and Safety Act 85/1993, Electrical Installation Regulation 1992, to the Employer and forward a copy to the Engineer.

C3.3.3.2.8.7 E200.8.7 Carry out additional special tests as required by the Engineer and provide the required test equipment.

C3.3.3.2.8.8 E200.8.8 Timeously advise the Engineer of all inspections and tests as the Engineer reserves the right to witness such inspections and tests.

C3.3.3.2.8.9 E200.8.9 Provide access, tools, instruments and attendance, to assist the Engineer who may perform verification tests at any time.

C3.3.3.2.8.10 **E200.8.10** The Engineer shall have the power at any time to examine any part of the Works or materials intended for use in or on the Works either on site, or at the place of manufacture or storage.

C3.3.3.2.8.11 **E200.8.11** On completion of the works, the Contractor shall submit four indexed volumes of all test certificates to the Engineer for tests done at factories and on site. (To be included in the manuals).

C3.3.3.2.8.12 **E200.8.12** The Contractor shall be responsible to calculate all relay settings. The settings shall be submitted to the Engineer for approval at least 2 weeks before the commissioning of the works commences. The settings shall be substantiated by calculation sheets and graphs where applicable.

C3.3.3.2.8.13 **E200.8.13** The Contractor shall check that all protection relays and overload devices are properly set to protect equipment such as motors, cables and capacitors etc., before the system is energised or any motors are switched on. Where overload devices are overrated or the ranges of relays insufficient to protect equipment, the Engineer shall be informed, and the equipment shall not be energised.

C3.3.3.2.8.14 **E200.8.14** **INSPECTIONS, TESTS AND COMMISSIONING WITH REFERENCE TO MATERIAL AND EQUIPMENT**

C3.3.3.2.8.14.1 **E200.8.14.1** **Factory Tests and Inspections**

The manufacturer shall perform all routine tests in the factory as described by SANS, IEC and/or BSS as well as the manufacturers own standard routine tests on all materials, equipment and auxiliary equipment. Type tests shall be performed as described in the relevant equipment specifications.

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 shall indicate which tests shall be witnessed by a representative of the Employer and the Engineer.

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.

C3.3.3.2.8.14.2 **E200.8.14.2** **Site Tests**

On completion of erection and installation on site the Contractor shall perform all the tests that may be required to ensure that the Works are ready for handing over and putting into regular use.

Contractors shall provide their own test equipment which shall be of accepted standards.

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 test that may be required by the Engineer.

All the tests shall be witnessed by a representative of the Employer and the Engineer.

Four copies of site test certificates shall be submitted to the Engineer within 7 days after completion of each test.

C3.3.3.2.8.14.3 **E200.8.14.3** **Arrangements for Witnessing Tests**

The Contractor shall make arrangements with the Engineer for tests to be witnessed.

Timeous (at least two weeks, or as specified in the Project Specification) notice shall be given to avoid undue delays in the completion of tests.

Arrangements for tests on site shall be made only after the Contractor has pre- commissioned the equipment and satisfied himself that it is in running order.

C3.3.3.2.9 E200.9 FIRE EXTINGUISHERS. FIRST AID KITS DANGER AND INSTRUCTION SIGNS FOR SUBSTATIONS

C3.3.3.2.9.1 E200.9.1 FIRE EXTINGUISHERS

C3.3.3.2.9.1.1 E200.9.1.1 Unless otherwise specified, 5kg type fire extinguishers or nearest standard sizes offered by manufacturers, shall be supplied for substation building.

C3.3.3.2.9.1.2 E200.9.1.2 Fire extinguishers shall be of the CO2 type or of a type approved for the fighting of fires where electrical apparatus and oil fires are involved.

C3.3.3.2.9.1.3 E200.9.1.3 Unless otherwise specified, fire extinguishers shall be provided as follows:

1) Medium voltage switchrooms: One extinguisher per 30m² of floor area.

2) Low voltage rooms One per room.

3) Transformer rooms One per transformer.

C3.3.3.2.9.1.4 E200.9.1.4 Fire extinguishers shall be mounted on suitable wall mounted brackets.

C3.3.3.2.9.1.5 E200.9.1.5 Fire extinguishers shall be installed next to exit doors wherever possible.

C3.3.3.2.9.2 E200.9.2 FIRST AID KITS

C3.3.3.2.9.2.1 E200.9.2.1 Industrial type first aid kits as supplied by St John Ambulance or the South African First Aid Society, shall be provided for substation buildings.

C3.3.3.2.9.2.2 E200.9.2.2 The first aid kit shall be housed in a suitable metal box with internal trays and a metal lid.

C3.3.3.2.9.2.3 E200.9.2.3 The first aid kit shall be mounted on a suitable wall mounted shelf next to the substation main exit door.

C3.3.3.2.9.2.4 E200.9.2.4 One first aid kit shall be provided for every substation building.

C3.3.3.2.9.3 E200.9.3 DANGER SIGNS AND NOTICES

C3.3.3.2.9.3.1 E200.9.3.1 All outside doors of all substations and all substation yard entrance gates shall be provided with a sign showing a lightning strike.

C3.3.3.2.9.3.2 E200.9.3.2 Suitable notices prohibiting unauthorised persons from entering premises shall be provided on all doors and gates of substation buildings and yards.

C3.3.3.2.9.3.3 E200.9.3.3 The following notices shall be provided and mounted against walls inside substation buildings:

1) A notice prohibiting unauthorised persons from handling or interfering with electrical apparatus.

2) A notice containing directions as to resuscitation of persons suffering from the effects of electrical shock.

3) A notice containing directions as to procedure in case of fire.

C3.3.3.2.9.3.4 **E200.9.3.4** One set of notices called for above shall be provided and installed for each substation building

C3.3.3.2.9.3.5 **E200.9.3.5** The notices shall be displayed at a prominent position inside the building.

C3.3.3.2.9.3.6 **E200.9.3.6** The notices shall be made from suitable plastic with engraved lettering.

C3.3.3.2.10 E200.10 NAMEBOARDS

When specified in the project specification name-boards shall be supplied, delivered and erected by the Contractor. The Engineer will indicate the dimensions of the name boards to the Contractor.

The name-boards shall be constructed of timber with masonite front, all of sufficient robustness and rigidity to the satisfaction of the Engineer, and shall be manufactured and finished as set out on the drawing.

The Contractor can purchase the SAACE emblem from the South African Association of Consulting Engineers.

C3.3.3.3 E201 MATERIALS

C3.3.3.3.1 E201.1 Materials and equipment used in this Contract shall, where possible, be of South African manufacture and shall comply with this specification and relevant SANS, BSI and IEC Specifications and shall be approved and installed to the satisfaction of the Engineer.

C3.3.3.3.2 E201.2 The Contractor shall submit samples of all materials and equipment for examination by the Engineer before installation, unless prior consent to the contrary has been obtained in writing from the Engineer. Such samples will be held for comparison with equipment and materials installed and will be released on satisfactory completion of the Contract. Similar equipment and material shall be of the same manufacture and interchangeable and be standard products from established manufacturers.

C3.3.3.3.3 E201.3 Where a certain manufacturer's material or equipment is specified, listed in the Schedules or noted on the drawings, such materials or equipment shall be provided as specified, except where an alternative is allowed

C3.3.3.3.4 E201.4 Where certain products of a specified manufacturer are unobtainable, substitutes may be offered, but shall only be supplied after written consent by the Engineer.

C3.3.3.3.5 E201.5 Where the words 'or approved alternative' follow a manufacturer's name and catalogue reference, the materials shall be of the specified manufacture and reference, or, if Contractor wishes to use a substitute the onus shall be on the Contractor to prove such substitute is equivalent to the specified manufacture and reference. The decision, as to the acceptance of such substitute, shall rest solely with the Engineer, whose decision shall be final. If the Engineer instructs the Contractor to install the materials of the specified manufacture and reference, then no alteration to the Contract Sum or rates shall be permissible.

C3.3.3.3.6 E201.6 The Engineer may instruct the Contractor to supply material or equipment and/or install any other make or manufacture of equipment than that specified and will issue variation orders where such change has cost implications.

C3.3.3.3.7 E201.7 Where a detailed specification for material or equipment is not provided, the Contractor shall select such material or equipment to comply with normal practice and to suit the particular application in all respects.

C3.3.3.4 E202 FINISHING AND PAINTING OF MATERIALS AND EQUIPMENT

C3.3.3.4.1 E202.1 THE CONTRACTOR SHALL SELECT MATERIALS AND THEIR FINISHING TO AVOID CORROSION

Exterior applications within 50km of the coast shall be deemed corrosive.

Aluminium shall be anodised to SANS 999 - 1986 Grade A for exterior and Grade B for interior applications.

C3.3.3.4.2 E202.2 UNLESS OTHERWISE SPECIFIED, FINISH STEEL AS FOLLOWS: -

Interior Applications, And Non-Corrosive Exterior Applications

Galvanise to SANS 763 - 1988, or paint by:

Priming with zinc chromate to SANS 679 Type I of dry film thickness of 25 microns (minimum); and,

Applying two final coats of high gloss enamel paint to SANS 630 Grade 1, each coat of dry film thickness of 25 microns (minimum).

C3.3.3.4.3 E202.3 EXTERIOR CORROSIVE APPLICATIONS

- Hot dip galvanise to SANS 763 - 1988;
- Prepare surface to SANS 064 and prime with calcium plumbate to SANS 912 of dry film thickness of 25 microns (minimum);
- Apply undercoat to SANS 681 Type 2; and
- Apply two final coats of high gloss enamel paint to SANS 630 Grade 1, each coat of dry film thickness of 25 microns (minimum).

NOTE: Measure dry film thickness to SANS Standard Test Method 140 or 141.

Hot dip galvanise steel after all fabrication. Reinstate damaged hot dip galvanising (SANS 763) with hot zinc spraying. Reinstate damaged electro galvanising with two coats of zinc-rich paint.

Any unpainted steel shall be chromium-plated or similarly plated to approval.

C3.3.3.4.4 E202.4 WHERE REQUIRED PAINT ALUMINIUM SURFACES AS FOLLOWS: -

a) Thoroughly clean.

b) Apply a self-etch primer to SANS 723 Plascon Hi-Sheen or approved alternative.

c) Apply two final coats of high gloss enamel paint to SANS 630 Grade 1, each coat of dry film thickness of 25 microns (minimum).

C3.3.3.5 E203 FIXING OF MATERIALS

C3.3.3.5.1 E203.1 Fix luminaires, metal draw boxes on surface, industrial surface mounted switches and plugs, metal channels, wiring troughs or trays, cable trays, saddles, conduit accessories, brackets, braces, trunking and all other surface-mounted material and equipment only as described below:

C3.3.3.5.1.1 E203.1.1 Concrete (in situ) - expanding cast-in, or gun-bolted, metal screw-fasteners.

C3.3.3.5.1.2 E203.1.2 Precast concrete - only with permission of the Engineer.

C3.3.3.5.1.3 E203.1.3 Brickwork - expanding, or built-in metal screw fasteners.

C3.3.3.5.1.4 E203.1.4 Ash brick - "J bolts" or approved alternative.

C3.3.3.5.1.5 E203.1.5 Steelwork - drilled, gun-bolted, or tapped and screwed metal screw fasteners; or steel gun- bolt nails or, where permitted by the Engineer, welding.

C3.3.3.5.1.6 E203.1.6 Woodwork - woodscrews, not nails.

C3.3.3.5.1.7 E203.1.7 Hollow tiles - spring toggles of not less than 6 mm diameter, but only with permission from the Engineer.

C3.3.3.5.1.8 E203.1.8 Exposed to weather - solid brass or stainless-steel screw-fasteners.

C3.3.3.5.2 E203.2 Where any equipment or material is to be mounted on the surface of ceilings, false ceilings, dry wall partitions, gasbeton or other specialised surfaces, mount such equipment or material only as specified by the Engineer or as permitted by the Engineer in writing.

C3.3.3.5.3 E203.3 Where sizes of fasteners etc. are not specified, submit samples and proposals to the Engineer for approval.

C3.3.3.5.4 E203.4 Do not gun-bolt into ash bricks, brickwork, gas-beton or precast concrete, except as permitted by the Engineer in writing.

C3.3.3.5.5 E203.5 The Contractor will be held responsible for any damage to Builder's work due to unauthorised inadmissible gun-bolting.

C3.3.3.5.6 E203.6 Do not use plastic plugs, wooden plugs or any other soft substance type plugs.

"Fischer", or approved alternative hard nylon plugs of not less than 6 mm diameter may be used for fixing light materials to suitable surfaces.

Plugs shall not be installed in mortar joints between bricks.

C3.3.3.5.7 E203.7 Provide suitable washers under screw heads and nuts.

C3.3.3.5.8 E203.8 Install materials in accordance with manufacturer's instructions and recommendations in all respects including type, size and spacing of fixings.

C3.3.3.6 E204 ENCLOSURES FOR DISTRIBUTION BOARDS, MOTOR CONTROL CENTRES AND OTHER BUILDING SERVICES PANELS

C3.3.3.6.1 E204.1 GENERAL

C3.3.3.6.1.1 E204.1.1 This specification covers sheet metal enclosures for distribution boards (DBs), motor control centres (MCCs) and panels for other building services such as telephone, fire detection and intruder alarm systems.

C3.3.3.6.1.2 E204.1.2 This specification shall be read in conjunction with the following standard specifications to provide a complete specification for LV DBs and MCCs:

- E205 : LV switchgear and control gear
- E206 : Busbars
- E207 : Current transformers
- E208 : LV motor protection
- E209 : Wiring in DBs, MCCs and panels
- E210 : Wiring- and cable terminations
- E211 : Glands and gland plates
- E213 : Switchboard accessories
- E214 : Nameplates and labels
- E215 : Metering and indication equipment

C3.3.3.6.1.3 E204.1.3 For MV MCCs, the following specifications shall also be read in conjunction with this specification and those listed under Clause 1.2:

- E225 : MV disconnectors and earth switches
- E226 : MV contactors
- E227 : Voltage transformers
- E228 : MV protection and relays

C3.3.3.6.1.4 E204.1.4 The Project Specification sets out which DBs, MCCs and panels shall be provided under the contract.

C3.3.3.6.1.5 E204.1.5 Unless otherwise stated in the Project Specification, MCCs and floor-standing distribution boards shall be Form 4a to SANS IEC 60439.

C3.3.3.6.1.6 E204.1.6 Enclosures shall be completely vermin-proof and unless otherwise stated in the Project Specification indoor enclosures shall have the following ingress protection:

– IP44 with doors closed

– IP2X with doors open

– IP2X between compartments.

Outdoor enclosures shall have IP65 ingress protection with doors closed.

C3.3.3.6.1.7 E204.1.7 Enclosures containing heat-generating equipment shall be ventilated to prevent thermal damage to any equipment, and to prevent the temperature within the cabinet from exceeding the maximum allowable temperatures of the equipment and materials in the enclosure.

C3.3.3.6.1.8 E204.1.8 Wood or artificial wood products shall not be used inside enclosures as mounting panels or for partitions, except in accordance with Clause 3.1 (e).

C3.3.3.6.1.9 E204.1.9 Sufficient space shall be provided in enclosures for internal wiring, incoming and outgoing cabling, and cabling for any future circuits.

C3.3.3.6.1.10 E204.1.10 Whilst certain equipment may be installed abutting, undue cramping of wiring and equipment is not permitted. A minimum clearance of 75mm shall be maintained between rows of equipment, between equipment and the top, bottom and sides of compartments.
DIN rails shall be installed at least 125mm apart between horizontal centres.

C3.3.3.6.1.11 E204.1.11 For the purposes of evaluating clearances and creepage distances, and hence the size of the enclosure and its compartments, the environment shall be taken as Pollution Degree 3 unless otherwise specified in the Project Specification.

C3.3.3.6.2 E204.2 CONSTRUCTION OF FLOOR-MOUNTED ENCLOSURES

C3.3.3.6.2.1 E204.2.1 Material and Fabrication

a) The enclosure shall be fabricated from 3CR12 sheet metal unless otherwise stated on the Project Specification. Outer panels and doors shall be 2 mm thick and internal partitions 1,6 mm thick.

b) The sheet metal shall be suitably bent, braced and welded where necessary to form a rigid structure. Holes, doors, covers, rails, framework, etc. shall be accurately formed to provide a true and plumb structure when completed. Where welding is necessary the excess material shall be ground to the parent surfaces to present a smooth and blemish-free surface for painting.

c) All screws employed in the manufacture of the enclosures shall be grade 316 stainless steel with machined threads. No self-threading screws or self-setting rivets (pop rivets) will be permitted. Where the thickness of material for screw tapping is less than 5x screw pitch, an externally knurled, threaded insert shall be installed to accept the machine screw. The insert shall be fitted with a hydraulically operated tool, and properly clinched, to ensure it will not rotate in the sheet steel. The inserts shall also be manufactured from grade 316 stainless steel.

   Alternative methods of providing suitable screw anchorages in sheet steel may be considered, such as captured or welded nuts, but the detailed alternatives shall be submitted for consideration at the time of tendering.

d) Enclosures shall be made up of vertically separated sections which shall be divided into compartments to accommodate equipment for motor drives, instrumentation, switchgear for main and sub-main feeder switches, etc.

   Each compartment shall be a minimum of 600 x 380mm totally separated from the adjacent compartments with sheet steel barriers welded or bolted into position and where wiring is required to pass through these barriers, brass crushed holes shall be provided.

e) A complete enclosure shall be mounted on and bolted to a hot-dipped galvanised 100 x 50 x 6 mm channel steel base with mitred external corners. The fixing bolts shall be 316 stainless steel M10 bolts.

f) The height of an enclosure shall not exceed 2 100 mm when mounted on its base.

C3.3.3.6.2.2 E204.2.2 Doors

a) The enclosures shall be fitted with doors on the front, back and ends as called for in the Project Specification.

b) All doors shall be arranged to stand off from the face/rear of the enclosure. Each door shall be properly stiffened and shall be twice returned at the periphery. The second return shall be gusseted in the corners to further brace the door.

c) Large doors (e.g. those fitted to the rear of individual sections) shall be further stiffened with "top hat" section channels welded to the inside of the door.

Each door shall be mounted on pin type hinges and shall be secured by means of a lever operated tapered tongue catch or catches (hinges and catches shall be Perano, Barker Nelson or equal approved). The lever shall be provided with an external stop to prevent rotation in excess of 360° and to provide a padlocking facility (a hole in the stop and a hole in the lever).

d) Where doors are mounted adjacent to one another the spacing shall be arranged to permit each door to open through at least 150°, without fouling the adjacent door. A stop shall be provided which shall prevent the door from opening further to avoid damaged paintwork.

e) Doors fitted with flush mounted equipment shall be properly braced and stiffened to support the equipment. The hinges shall be easily able to support the mass added to the door when the flush fitted equipment is installed.

f) Where cover plates are provided behind the doors, the cover plates shall be adequately recessed to permit the spindle on the lever to drive the tapered tongue catch into a slot in the framework of the board without fouling the cover plate. The space between the back of the door and the face of the cover plate shall be nominally 80mm.

g) Cover plates shall be fabricated as for the doors and shall be further stiffened to compensate for the machine-punched circuit breaker slots. The cover plates shall be secured at the top edge with at least two square key driven catches whilst at the lower edge they shall be located with two 6 mm diameter tapered dowel pins located in holes drilled in the architrave. Each pin shall be fitted with a 1,2mm thick spacer washer. Both the pins and the washers shall be welded to the cover.

C3.3.3.6.2.3 E204.2.3 Corrosion Protection

The enclosures shall be painted with a high-quality polyurethane-based powder coat suitable for interior and exterior conditions and applied by electrostatic spray. The sprayed powder coat shall be baked in accordance with the paint manufacturer's specification.
The enclosures shall be painted white internally and a biscuit colour (B64 to SANS 1091) externally unless otherwise stated in the Project Specification.

The dry film coat shall be as uniform as possible but shall not be less than 50 microns nor more than 100 microns. The finish shall be high gloss with a minimum of surface defects / blemishes, and acceptance shall be at the Engineer's discretion.

C3.3.3.6.2.4 E204.2.4 Busbar Chambers

a) A totally enclosed busbar chamber shall be provided throughout the length of enclosures for main DBs and MCCs. The busbar chamber shall be fitted with front, back and top covers to give full access to the busbars. The top covers shall be bolted on and the front and back covers secured with square-key latches, with one catch per cover being lockable with a padlock.

b) The busbar chamber shall be so positioned at the top that each and every connection is easily accessible and sufficient space is provided to easily operate a torque wrench on each bolt / nut.

c) Dielectric barriers shall be provided in the busbar chamber at every second section. The dielectric may not be split and installed as separate parts but shall instead be slotted to allow the busbars to pass through. The slotted holes shall be fitted with U-shaped rubber gasketing

to ensure a snug fit. These dielectric barriers may not be employed to support the busbars. The dielectric shall be bolted to the sheet steel at the periphery of the busbar chamber.

The penetrations for circuits into or out of the busbar chamber shall also be provided with similar dielectric barriers at the points of penetration.

d) Where specified in the Project Specification the space normally used for the busbar chamber shall be divided into two separate, totally isolated chambers: a busbar chamber and a wiring channel for signal and communication cabling / wiring.

The wiring channel shall be 100mm deep and shall be separated from the busbar chamber with a 1.6mm thick sheet steel partition.

C3.3.3.6.3 E204.3 CONSTRUCTION OF WALL-MOUNTED ENCLOSURES

C3.3.3.6.3.1 E204.3.1 Material and Fabrication

a) Both flush-and surface-mounting enclosures shall consist of a tray and an architrave frame on which the chassis, front panel and any door are mounted, except that surface-mounted enclosures of width and height both not greater than 400mm need not have an architrave frame.

b) Enclosures shall generally be constructed of sheet steel of minimum thickness of 1,2mm except that cabinets of width and height both not greater than 400mm may be constructed of sheet steel of minimum thickness of 0,8mm.

Where called for in the Project Specification, 3CR12 steel shall be used.

c) Wall trays of flush-mounting enclosures shall be fitted with expanded metal spot welded to the rear and metal straps welded to the sides to ensure bonding with the structure of the wall.

d) Trays of surface-mounting enclosures shall be slightly larger than the architrave frame and shall have a return to present a flat surface to the architrave frame.

e) A mounting panel of 20mm thick, fine grade, knot-free pine shall be fitted to the back of panels for telephone and electronic building services.

C3.3.3.6.3.2 E204.3.2 Doors and Cover Panels

a) Doors shall be provided for wall-mounted enclosures unless otherwise stated in the Project Specification.

b) Doors shall be constructed of the same thickness and material as the remainder of the enclosure.

c) Door hinges shall facilitate removal of doors without the use of tools. Hinge or hinge-pins shall not be removable when doors are closed.

d) Unless otherwise specified in the Project Specification, doors shall be fitted with handles and spring-loaded catches without locks.

Where locks are specified, they shall be "Union", "Yale", "Solid" or an approved alternative, with master key facilities for the entire services installation and separate keys for each cabinet. Two keys for each enclosure and four master keys shall be provided.

e) Where doors are fitted with locks, the operating handle or toggle or the main disconnector or local disconnector shall be accessible and operable without opening the door.

f) Cover panels shall be secured by means of catches with square keys, or approved equivalent, quick-release fasteners and shall be fitted with chromium-plated knobs to facilitate removal.

Visible nuts shall be chromium-plated dome nuts. Visible bolts, washers or other fasteners shall be chromium-plated. Self-tapping screws will not be permitted.

g) Cover panels shall have machine-punched openings for instruments and for equipment operating handles and toggles.

Openings shall be provided for spare accommodation which shall be blanked off by escutcheon blanks or clamped steel plates.

C3.3.3.6.4 E204.4 INSTALLATION

a) The Contractor shall check the dimensions of access ways and the space provided for DBs, MCCs and other panels on the latest architectural drawings to ensure that the enclosures are appropriately designed.

b) Unless otherwise stated in the Project Specification, floor-mounted enclosures shall be mounted over cable trenches. Trench bridging supports shall be provided at the ends of the enclosure and at every second section. The supports shall be manufactured in the form of a top-hat section from 3mm thick steel and then hot-dip galvanised.

C3.3.3.7 E205 LOW VOLTAGE SWITCHGEAR AND CONTROLGEAR FOR DISTRIBUTION BOARDS, MOTOR CONTROL CENTRES, CUBICLES AND PANELS

C3.3.3.7.1 E205.1 GENERAL

Switchgear, control gear and instrumentation shall be rated for the system voltage, frequency and number of phases and for the load current and applicable maximum prospective fault current as specified on the drawings and the Project Specification.

C3.3.3.7.2 E205.2 SURGE ARRESTERS

C3.3.3.7.2.1 E205.2.1 Surge arresters shall be provided for each phase in all boards, connected to each phase of the incoming cables.

C3.3.3.7.2.2 E205.2.2 Surge arresters shall conform to the relevant SANS codes and other Specifications, shall bear the SABS mark, and shall be solidly earthed directly onto the cubicle earth bar by means of a copper strap and be as short and straight as possible.

C3.3.3.7.3 E205.3 AIR CIRCUIT BREAKERS (ACBs)

C3.3.3.7.3.1 E205.3.1 ACBs shall be of the metal-clad, withdrawable type complying with the relevant codes and specifications. Unless otherwise stated in the Project Specification, the ACBs shall be three pole.

C3.3.3.7.3.2 E205.3.2 ACBs shall have an adjustable thermal overload trip unit and an adjustable magnetic short-circuit trip unit. All trip units shall be direct acting. Both trip units shall be replaceable by units of different ratings.

The ACBs noted on the drawings as "selective" shall incorporate an adjustable time- delay on the magnetic short-circuit trip unit.

C3.3.3.7.3.3 E205.3.3 ACBs shall be designed for trip-free manual closing and electrical tripping of the type specified in the project specification or drawings, e.g., shunt, remote or under voltage tripping; delayed contacts; AC or DC coil voltage.

C3.3.3.7.3.4 E205.3.4 Interlocking shall be provided to ensure that an ACB is fully isolated before access to any live terminals can be obtained.

C3.3.3.7.3.5 E205.3.5 ACBs shall be horizontally withdrawable allowing full maintenance and tests without the breaker having to be removed from the withdrawal mechanism.

C3.3.3.7.3.6 E205.3.6 Interlocks shall be provided to allow an ACB to be operated in the withdrawn maintenance/test position, and to prevent the circuit 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, it shall be provided with the circuit breaker.

C3.3.3.7.3.7 E205.3.7 Lockable safety shutters shall be provided to screen the fixed contacts and shall operate automatically with the movement of the circuit breaker.

C3.3.3.7.3.8 E205.3.8 All non-current-carrying metal parts of the circuit breaker shall be solidly interconnected and connected to an earth contact which shall engage with a copper plate connected to the main earth bar of the cubicle, and the arrangement shall be such that the circuit breaker frame is earthed before the circuit breaker contacts engage with the live fixed contacts.

C3.3.3.7.3.9 E205.3.9 A mechanically operated "ON/OFF" or ("I/O") position indicator shall be incorporated.

C3.3.3.7.3.10 **E205.3.10** Facilities for padlocking in the "off" position shall be provided.

C3.3.3.7.3.11 **E205.3.11** Two normally open and two normally closed spare auxiliary contacts shall be provided, unless otherwise noted. It shall also be possible to install a change-over contact if required at a later stage. Auxiliary contacts shall be capable of making and carrying continuously 1A AC or DC. They shall be capable of breaking 500VA AC at 0,2 PF and 20watts DC at an L/R of < 40ms.

C3.3.3.7.3.12 **E205.3.12** Where noted on the drawings special purpose interlocking (key/mechanical/electrical) shall be provided between ACBs.

C3.3.3.7.3.13 **E205.3.13** Unless otherwise stated in the Project Specification, the ACBs shall have a one second fault withstand rating.

C3.3.3.7.4 E205.4 MOULDED CASE CIRCUIT BREAKERS (MCCB's)

C3.3.3.7.4.1 E205.4.1 Moulded case circuit breakers shall comply with the relevant codes and specifications. MCCB's shall be of flush panel mounting type.

C3.3.3.7.4.2 E205.4.2 MCCB's with ratings of 100A and less shall be suitable for mounting on a DIN rail.

C3.3.3.7.4.3 E205.4.3 MCCB's with ratings in excess of 100A for distribution networks shall each have an adjustable thermal overload trip unit and an adjustable magnetic short-circuit trip unit. Both trip units shall be replaceable by units of different ratings. MCCB's for motor starter circuits shall be of the current limiting type with an adjustable magnetic short circuit trip unit.

C3.3.3.7.4.4 E205.4.4 MCCB's with ratings of 600A or more shall have extension type operating handles, which shall be interlocked with the enclosure compartment doors to prevent the door being opened unless the MCCB is in the off position.

C3.3.3.7.4.5 E205.4.5 Mechanically coupled single-pole circuit breakers used as double or triple-pole circuit breakers are not acceptable unless overload releases are internally coupled.

C3.3.3.7.4.6 E205.4.6 The fault current interrupting rating of MCCB's shall not be less than the maximum prospective fault current and not less than 5kA.

C3.3.3.7.4.7 E205.4.7 Neutral bars associated with each bank of MCCB's shall be positioned below each bank and shall be wired in the same sequence as the MCCB's.

C3.3.3.7.4.8 E205.4.8 MCCB's with shunt release shall have an auxiliary contact arranged to interrupt the shunt release current at the end of the opening operation. MCCB's with an under-voltage release shall be equipped with a time delay relay when specified.

C3.3.3.7.4.9 E205.4.9 MCCB's shall be fitted with the specified number of spare auxiliary contacts. Where spare auxiliary contacts are not called for, it shall nevertheless be possible to fit at least one normally open and one normally closed contact or a change-over contact at a later stage. Auxiliary contacts shall be capable of making and carrying continuously 1A ac or dc. They shall be capable of breaking 500VA ac at 0,2 PF and 20 watts dc at an L/R of < 40ms.

C3.3.3.7.4.10 **E205.4.10** Where called for, MCCB's shall be capable of remote closing using the specified control voltage.

C3.3.3.7.4.11 **E205.4.11** MCCBs shall be lockable in the "off" position. A separate locking device may be used for this facility if so, stated in the Project Specification.

C3.3.3.7.4.12 **E205.4.12** Current limiting MCCB's will not be allowed unless otherwise stated in the Project Specification.

C3.3.3.7.4.13 **E205.4.13** Where MCCB's are of the current limiting type the Contractor shall determine and offer suitable ratings in collaboration with the MCCB supplier, to ensure discrimination and adequate short-circuit current capability. Calculations shall be submitted with the tender indicating the degree of current limiting and discrimination achieved as well as techniques used. Full details shall be submitted of the current limiting characteristics of each MCCB rating offered.

C3.3.3.7.4.14 **E205.4.14** MCCB's for DC application shall be of the current limiting type and shall have at least one pole in the positive and one pole in the negative circuit. Where additional poles are required in series to meet requirements of the specified application, the series connections between poles of like polarity shall be such that they cannot be removed without special tools.

C3.3.3.7.5 E205.5 DISCONNECTORS

C3.3.3.7.5.1 E205.5.1 All disconnectors shall be of the "load-break-fault-make" type i.e. be switch disconnectors complying with the relevant SANS specification.

C3.3.3.7.5.2 E205.5.2 The disconnectors shall have the ratings specified on the drawings.

C3.3.3.7.5.3 E205.5.3 The handle of the disconnector shall form part of the panel door. It shall not be possible to close the disconnector without the door being closed and it shall not be possible to open the door without the disconnector being switched off.

C3.3.3.7.5.4 E205.5.4 Disconnector handles shall have an integral key lock or padlocking facility.

C3.3.3.7.5.5 E205.5.5 The fault carrying capability of the disconnectors shall be equivalent to or higher than the fault level of the associated busbar but not less than 5kA.

C3.3.3.7.6 E205.6 SWITCHES AND SELECTOR SWITCHES

C3.3.3.7.6.1 E205.6.1 Switches and selector switches shall be switch disconnectors complying with the relevant SANS specification.

C3.3.3.7.6.2 E205.6.2 Switches and selector switches shall be capable of carrying, making and breaking the full rated current and of making onto the maximum prospective fault current.

C3.3.3.7.6.3 E205.6.3 The fault rating of switches and selector switches shall not be less than the maximum prospective fault current and not less than 6kA.

C3.3.3.7.6.4 E205.6.4 The operating knob and indicator plate shall be manufactured of insulating material and the switch positions shall be clearly and indelibly marked thereon.

C3.3.3.7.6.5 E205.6.5 The switches and selector switches shall be provided with substantial contacts and the terminals shall be clearly marked and arranged for easy wiring.

The voltmeter or ammeter selector switch shall be mounted directly below the associated volt or ammeter.

C3.3.3.7.6.6 E205.6.6 Voltmeter selector switches shall be arranged so that voltages between phases, and phases to neutral, can be read. Voltmeter selector switches shall be of the break-before- make type.

The voltmeter selector switch shall have one "off" and six "metering" positions and shall be suitable for panel mounting in such a way that the operation knob and indicator plate can be mounted on the front of a panel and the switch itself at the back of the panel.

C3.3.3.7.6.7 E205.6.7 Ammeter selector switches shall be of the make-before-break type with one "off" and four "metering" positions arranged to read the current in each phase and in the neutral. 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.

C3.3.3.7.6.8 E205.6.8 Switch enclosures shall be provided with an interlocked cover to ensure that the switch is in the "OFF" position before the cover can be opened for inspection or fuse removal. It shall not be possible to close the switch without the cover being closed.

C3.3.3.7.6.9 E205.6.9 Switches shall be provided with a clear "ON/OFF" or "I/O" position indicator.

C3.3.3.7.7 E205.7 BUS-SECTION SWITCHES

C3.3.3.7.7.1 E205.7.1 Bus-section switches shall be interlocked with the incoming switchgear by means of special-purpose key interlocking facility when specified.

C3.3.3.7.7.2 E205.7.2 Bus-section switches of rating less than 1 000A shall comprise isolators.

C3.3.3.7.7.3 E205.7.3 Bus-section switches of rating of 1 000A and higher shall be air circuit breakers incorporating magnetic short-circuit trip units without thermal overload trip units.

C3.3.3.7.7.4 E205.7.4 Busbar selector or change-over switches shall be provided with suitable position indicators.

C3.3.3.7.8 E205.8 TIME SWITCHES

C3.3.3.7.8.1 E205.8.1 The contacts shall be silver-to-silver or other approved single-pole changeover contacts rated at 16A and operated by a spring-driven clockwork, electrically wound with a spring reserve of 8 hours minimum.

C3.3.3.7.8.2 E205.8.2 Time switches shall be fitted with a manual overriding switch.

C3.3.3.7.8.3 E205.8.3 An external bypass switch shall be provided in each time switch circuit.

C3.3.3.7.8.4 E205.8.4 Time switches shall have the following features:

- daily programmable with minimum 30 minutes "on" and "off" control facilities.
- weekly programmable with day omission facilities of minimum 12 hours, i.e. mornings or afternoons;

C3.3.3.7.8.5 E205.8.5 The whole mechanism shall be totally enclosed in a dust-proof enclosure.

C3.3.3.7.9 E205.9 PHOTO SWITCHES

C3.3.3.7.9.1 E205.9.1 Photo switches shall comply with the relevant codes and specifications.

C3.3.3.7.9.2 E205.9.2 Photo switches shall have silver to silver or other approved single-pole changeover contacts rated to switch a reactive load of 1800VA at 230V and 50Hz.

C3.3.3.7.9.3 E205.9.3 An external bypass switch shall be provided in each photo switch circuit.

C3.3.3.7.9.4 E205.9.4 The photo-electric cell shall switch streetlights "ON" when daylight drops to approximately 40 lux and it shall switch "OFF" at approximately 80 lux.

C3.3.3.7.9.5 E205.9.5 The photo-electric cells shall have a time delay of not less than 30 seconds.

C3.3.3.7.9.6 E205.9.6 Photo-electric cells shall be completely waterproof and shall be of robust construction.

C3.3.3.7.9.7 E205.9.7 The material of the cover shall not crack, deform or deteriorate in any way whatsoever and shall be colour-fast in all weather conditions.

C3.3.3.7.9.8 E205.9.8 The photo-electric cells shall be provided with built-in lightning arresters.

C3.3.3.7.9.9 E205.9.9 Samples of photo-electric cells shall be submitted to the Engineer for approval prior to the ordering thereof.

C3.3.3.7.9.10 E205.9.10 The prices for the erection of photo-electric cells shall include the supply and delivery and the connection of cables, etc., from the photocells to LV cubicles, DB's or mini-subs.

C3.3.3.7.10 E205.10 COMBINATION FUSE-SWITCH (CFS) UNITS

C3.3.3.7.10.1 E205.10.1 The fuse-switch units shall comply with the relevant codes and specifications and shall be fitted with high rupturing capacity (HRC) cartridge type fuses-links complying with the relevant codes and specifications.

C3.3.3.7.10.2 E205.10.2 Fuse-switches shall be capable of braking the full rated current and shall have a fault current rating of not less than the maximum prospective fault current and not less than 10 kA for one second.

Fused isolators, i.e. fuse-switches which rely on the fuses to reduce the fault current through the switch portion to provide a higher fault current rating, are not permitted.

C3.3.3.7.10.3 E205.10.3 Fuse-gear with the fuses mounted in the cover of the unit, with one cover forming the operating lever, are not permitted.

C3.3.3.7.10.4 E205.10.4 Fuse-switch units shall have chassis and be designed to accommodate HRC fuse links. 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.

C3.3.3.7.10.5 E205.10.5 The fixed contacts shall be shrouded and arranged so that when the switch is in the open position the double-break isolates the HRC fuse links so that they can be replaced in complete safety.

C3.3.3.7.10.6 E205.10.6 Fuse-switch units shall be triple-pole units and neutral links shall be provided inside the back of the distribution boards to facilitate routine testing.

C3.3.3.7.10.7 E205.10.7 All components shall be capable of continuously carrying rated current without excessive temperature rise.

C3.3.3.7.10.8 E205.10.8 Fuse-switch units shall be provided with interlocks such that:

a) The cover panel cannot be opened whilst the switch is closed; and

b) the unit cannot be operated with the cover open unless an interlock is purposely defeated.

C3.3.3.7.10.9 E205.10.9 The fuse-switch shall have a handle and an ON/OFF position indicator mechanically operated by the moving contacts to ensure accurate and positive indication.

C3.3.3.7.10.10 E205.10.10 Provide facilities for padlocking in the "off" position.

C3.3.3.7.10.11 E205.10.11 In all cases, the top terminal of fuses shall be the live terminal.

C3.3.3.7.10.12 E205.10.12 Six spare fuses shall be provided for each rating fitted.

C3.3.3.7.11 E205.11 FUSE LINKS AND HOLDERS

C3.3.3.7.11.1 E205.11.1 Fuse links shall be high-rupturing capacity (HRC) cartridge type fuse links conforming to the relevant codes and specifications.

C3.3.3.7.11.2 E205.11.2 HRC fuse link holders shall be of the withdrawable bakelite type and shall conform to the relevant codes and specifications.

C3.3.3.7.11.3 E205.11.3 Each fuse link and holder shall incorporate a visual inspection eye for fault location.

C3.3.3.7.11.4 E205.11.4 Fuses protecting a specific instrument shall be mounted as a group in close proximity to the relevant instrument.

C3.3.3.7.11.5 E205.11.5 A label with the rating of each fuse shall be mounted in close proximity to the relevant fuse holder or fuse switch.

C3.3.3.7.11.6 E205.11.6 Striker pin switches shall be provided if specified in the project specification in order to trip the associated breaker or contactor to prevent the occurrence of single phasing.

C3.3.3.7.11.7 E205.11.7 Six spare fuses shall be provided for each rating fitted.

C3.3.3.7.11.8 E205.11.8 The spare fuses shall not be used by the Contractor during erection, commissioning, or maintenance.

C3.3.3.7.12 E205.12 EARTH LEAKAGE PROTECTION UNITS

C3.3.3.7.12.1 E205.12.1 Earth leakage protection units shall conform to the relevant codes and specifications.

C3.3.3.7.12.2 E205.12.2 All single and three phase socket outlets shall be provided with earth leakage protection devices unless specifically excluded in the Code of Practice for the Wiring of Premises.

C3.3.3.7.12.3 E205.12.3 All units shall have test push buttons and, unless otherwise specified the sensitivity shall be 30 mA.

C3.3.3.7.12.4 E205.12.4 Earth leakage shall be arranged to disconnect the faulty circuit from both phase and neutral of a single-phase system, and from all three phases of a three-phase system.

C3.3.3.7.13 E205.13 CONTACTORS

C3.3.3.7.13.1 E205.13.1 All contactors for low voltage shall be of the electro-magnetic operated air-break type with specific requirements as specified in the project specification or drawings e.g. AC or DC coil voltage; dip-proofing, latched contacts etc.

C3.3.3.7.13.2 E205.13.2 Contactors shall be in accordance with the relevant codes and specifications. Category AC3 or DC2 shall in general be used, whichever is applicable. Category AC4 and DC3, whichever is applicable, shall be used for heavy plugging and inching duty systems, e.g. cranes, etc.

C3.3.3.7.13.3 E205.13.3 Contactors shall have suitable capacities for direct-on-line starting, star delta starting or any other form of starting, whichever is specified in the project specification and the drawings. The contactors shall be rated for at least 130% of the associated load current.

C3.3.3.7.13.4 E205.13.4 Each contactor shall be provided with at least two normally open and two normally closed auxiliary contacts, unless otherwise specified.

C3.3.3.7.13.5 **E205.13.5** Contactors shall be suitable for remote and automatic operation where specified. 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 on additional contactor, shall be provided.

C3.3.3.7.13.6 **E205.13.6** Each contactor shall be capable of carrying, making and breaking overcurrent's during the operating time of its own overcurrent tripping devices at a recovery voltage of 90% of the specified system voltage.

C3.3.3.7.13.7 **E205.13.7** **Motor starting applications**

All Contactors for starting squirrel-cage motors direct-on-line shall be rated to break 10 times the full-load running current of the motor.

C3.3.3.7.13.8 **E205.13.8** The contactor shall be co-ordinated with the short circuit protective device to ensure adequate protection for the specified operational current, voltage and the corresponding utilization category according to Type 2 Co-ordination as per IEC 947, i.e. that, under short-circuit conditions, the contactor or starter shall cause no danger to persons or installation and shall be suitable for further use.

C3.3.3.8 E206 BUSBARS

C3.3.3.8.1 E206.1 Busbars, metal-enclosed busbar trunking systems and connections shall comply with the relevant codes and specifications.

C3.3.3.8.2 E206.2 The main busbars, distribution busbars, risers and droppers shall be of hard drawn high conductivity copper, having a constant rectangular cross section throughout. They shall be rated as specified in the Project Specification, but the rating shall not be less than specified for the main incoming circuit breaker or isolator. Where busbars are fed directly from a transformer, the busbar rating shall be 125% of the transformer rating.

C3.3.3.8.3 E206.3 The busbars shall be designed to withstand for 3 seconds the mechanical and thermal stresses associated with the prospective short-circuit current specified in the Project Specification.

C3.3.3.8.4 E206.4 Where busbars terminating at the end of switchboards are intended for future extension, these busbars shall be predrilled to accommodate the extension. Where prefitted space is specified for future equipment, the busbars in the proposed position shall be predrilled and nuts and bolts shall be provided to accommodate the future busbars or cables feeding the equipment.

C3.3.3.8.5 E206.5 The main busbars shall be mounted horizontally with the longer dimension in the vertical plane. The main busbars shall be arranged in stepped formation, with the red phase at the top rear and the neutral at the bottom front. Joints in busbars shall be avoided as far as possible, but where they are necessary, the joint shall be formed by offsetting one of the bars by a deviation equal to its own thickness to overlap the adjoining busbar. The length of the overlap shall be equal to twice the width of the bar, and the joint shall be secured with a minimum of 4 hexagon-headed bolts, washers (plain and spring) and nuts. All joints shall be tightened to the correct torque before the DB or MCC is delivered to site, and again checked just prior to commissioning.

C3.3.3.8.6 E206.6 Spacing of busbars shall not be less than twice the longer dimension of the busbar and not less than 50mm between busbars, and 150mm to the enclosure.

C3.3.3.8.7 E206.7 Busbars shall be mounted on substantial moulded epoxy or resin insulators fixed with robust steel brackets. Bare 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. Parallel busbars shall be separated by a minimum distance equal to the thickness of each single busbar. Parallel busbars shall be connected together at spacing's of not more than 450mm to equalise current distribution.

C3.3.3.8.8 E206.8 The minimum clearances between current carrying parts and between current carrying parts and other metal parts shall be in accordance with the relevant codes and specifications.

C3.3.3.8.9 E206.9 All busbars shall be covered with coloured heat-shrinkable material. The colour shall correspond to the colour of the supply phase. Busbars may alternatively be covered with two coats of coloured insulation paint. Busbar joints shall be covered with a suitable non-hardening compound and then taped with coloured PVC tape. Busbars shall be radius-edged where they change direction. PVC tape shall not be allowed for phase identification.

C3.3.3.8.10 E206.10 The following colours shall be used:

NUMBER OF PHASES	PHASE COLOUR	NEUTRAL COLOUR	EARTH COLOUR	SPECIAL PURPOSE COLOUR
1	Red	Black	Green/Yellow	Orange
2	Red and White	Black	Green/Yellow	Orange
3	Red, White and Blue	Black	Green/Yellow	Orange
4 and more	Any base colour except Green, Yellow and Orange with serial numbers (numerals or words)	Numbered as for the phase colours	Green/Yellow	-

C3.3.3.8.11 E206.11 The switchgear manufacturer shall provide necessary copper flexible or bar connections between the riser terminals and the cable terminals. The switchgear riser terminals shall be properly tinned.

C3.3.3.8.12 E206.12 Connections to the busbars shall be affected by means of the correct clamps or lugs with soldered connections or with connections crimped with the correct equipment.

C3.3.3.8.13 E206.13 The neutral busbar cross-section shall be equal to that of the phase busbars and may not be reduced without the approval of the Engineer.

C3.3.3.8.14 E206.14 Unless fully tested in accordance with SANS IEC 60439-1, the current density of copper busbars shall not exceed 2A/mm² for currents up to 1600A, or 1.6A/mm² for currents above 1600A.

C3.3.3.8.15 E206.15 All terminations onto busbars and busbar interconnections shall be bolted with cadmium-plated high tensile bolts, washers, spring washers and nuts. In corrosive areas, substitute lock nuts for spring washers. The largest possible size bolt that will fit into holes in lugs and fixing holes of equipment shall be used in every instance. Bolts shall be of sufficient length that at least two but not more than five threads protrude beyond the nut. 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.

C3.3.3.8.16 E206.16 The maximum current density in busbars and connections shall be such that in no part of the switchgear equipment including circuit breakers, isolating equipment, busbars, current transformers, cable boxes, and connections shall exceed a temperature of 60°C i.e. a temperature rise of 20°C at an ambient temperature of 40°C.

C3.3.3.8.17 E206.17 Busbars shall be properly insulated and sufficiently supported to withstand the maximum fault current at the points where they pass through panels or partitions of the switchboard. This shall preferably be achieved by means of resin bound synthetic wood or similar material with cut-outs which fit tightly around the busbars. The insulating panel shall be firmly bolted to the frame. Busbars or "droppers" that pass through internal partitions in the switchboard shall be similarly insulated and supported.

C3.3.3.8.18 E206.18 EARTH BARS

A main earth bar shall be mounted at the bottom along the full length inside the switchboard and may be bolted to the framework of the switchboard. For back access switchboards, the earth bar shall be mounted at the rear. The steelwork of a switchboard and in particular gland plates shall be solidly and effectively bonded to the main earth bar. Earth bars shall have sufficient ways for all the earth conductors, and, in addition, 30% spare space shall be provided.

Switchboards with short-circuit ratings in excess of 5kA shall be equipped with a copper earth bar with a cross section not less than S = 0,006 x I mm² where “S” is the area in mm², and “I” is the maximum prospective fault current in Amps. However, in main DBs and MCCs, the earth bar shall not be less than 70mm x 8mm in cross-section and shall be fitted with earthing studs in each section of the enclosure.

Switchboards with short-circuit ratings not exceeding 5kA shall be equipped with an earth bar comprising box terminals with pressure shoes on a rectangular copper bar measuring at least 2.5mm x 12.5mm mounted on insulating pedestals. An earthing stud shall be welded to the metal tray of the distribution board. An earthing conductor equal in cross-sectioned area to the incoming earthing conductor shall connect this earthing stud to the earth bar.

C3.3.3.8.19 E206.19 BUS-TRUNKING

The neutral bar shall have a cross- sectional area equal to the phase bars. An earthing bar shall be provided.

The busbar trunking shall be finished in the colour as specified in the Project Specification.

The busbar trunking shall be vermin-proof and noiseless under load and completely maintenance-free.

Busbar trunking shall have rated short-time withstand current for one second equal to the indicated maximum prospective fault current.

The Contractor shall submit type tests for current rating, rated short-time withstand current, and impedance characteristics to the Engineer.

Pressure test low voltage busbar trunking after installation and before commissioning at 2kV for one minute between phases, between phases and neutral and between phases and earth.

Confirm route access and dimensions on site and compile shop drawings. Submit shop drawings to the Engineer.

Bus trunking installed outdoors, in hostile or hazardous environments shall be IP65 enclosed or as specified.
Epoxy or polyester moulded, enclosed bustrunking shall be subject to the Engineers approval. Test certificates according to the relevant cables and specification shall be submitted as required.

The Contractor shall allow in the pricing for a complete system including all inter-connectors, flexible links, terminations and suitable brackets to fix the busbars to structures.

C3.3.3.9 E207 CURRENT TRANSFORMERS

C3.3.3.9.1 E207.1 Current transformers shall comply with the relevant codes and specifications and shall be marked clearly and indelibly as specified therein on a rating plate securely attached to the transformer.

C3.3.3.9.2 E207.2 Each panel shall be equipped with the current transformers as specified in the Project Specification and or drawings.

C3.3.3.9.3 E207.3 Current transformers shall be suitable for a system with an effectively earthed neutral or a non- effectively earthed neutral as specified in the Project Specification.

C3.3.3.9.4 E207.4 For current transformers with a system voltage less than 3,6kV the insulation level shall be determined by the rated short duration power frequency withstand voltage e.g. 2kV for a 400V system.

C3.3.3.9.5 E207.5 Current transformers with system voltages greater than 3,6kV shall be insulated to withstand test voltages defined by the rated lightning-impulse and short-duration-power-frequency voltages and shall be as follows for indoor switchgear:

HIGHEST VOLTAGE FOR EQUIPMENT R.M.S.	RATED LIGHTING-IMPULSE WITHSTAND VOLTAGE	RATED POWER-FREQUENCY SHORT DURATION WITHSTAND VOLTAGE
kV	(Peak) kV	(r.m.s.) kV
3.6	40	10
7.2	60	20
12	95	28
24	125	50
36	170	70

C3.3.3.9.6 E207.6 The short-time thermal and dynamic current rating of current transformers shall not be less than that of the associated circuit breaker, isolator or busbar.

C3.3.3.9.7 E207.7 The rated primary currents of current transformers shall be 10, 15, 20, 30, 50 and 75 Amperes or their decimal multiples.

C3.3.3.9.8 E207.8 The current transformers secondary ratings shall be 5A unless otherwise specified.

C3.3.3.9.9 E207.9 Current transformers shall be accessible and easily removable. All current transformers of any one type and rating shall be identical and interchangeable with one another.

C3.3.3.9.10 E207.10 The class of insulation of current transformers shall be Type A (maximum temperature rises 60□k) unless otherwise specified.

C3.3.3.9.11 E207.11 Protection current transformers shall be of the low reactance type having toroidal cores with fully distributed secondary windings. Turns compensation shall not be utilized on protection current transformers.

C3.3.3.9.12 E207.12 The error in turns ratio on any tapping of a Class X current transformer shall not exceed ±0,25%.

C3.3.3.9.13 E207.13 The same set of current transformers shall not be used for both indication instruments and protective relays, separate cores having a low saturation factor (<than 5 preferably) shall be used for metering.

C3.3.3.9.14 E207.14 The VA ratings shall be sufficient to operate the various metering equipment and relays but shall not be less than 10 VA.

C3.3.3.9.15 E207.15 The accuracy limit factor of the protection current transformers shall be 15 unless otherwise specified.

C3.3.3.9.16 E207.16 The following classes of current transformers shall be used.

FUNCTION	DESCRIPTION	CLASS
1. Metering	kVA, kW and KWh meters	0,5
2. Indication	Ammeters	1,0
3. Protection	Over-current, earth fault and thermal overload	10 P
4. Special Protection	Differential protection, Restricted earth fault and pilot wire protection	X

C3.3.3.9.17 E207.17 The arrangement of the current transformer cores with respect to the primary terminals and mechanism of the circuit breaker shall be approved by the Engineer prior to manufacture.

C3.3.3.9.18 E207.18 Where it is not possible to easily read the rating plates of current transformers, additional rating plates shall be located on the rear inner panel of the breaker cubicle relay compartment for each current transformer where they can be easily read. These shall be a duplicate of the rating plates which appear on each current transformer. In addition, the phase colour with which each current transformer is associated shall appear beneath each rating plate. Information shall be provided on the above rating plates to indicate which secondary terminals are associated with which winding. This information shall be in addition to that called for in the relevant codes and specifications.

The information on the additional plates shall include the relative arrangement of the current transformer cores with respect to the circuit breaker terminals and shall also indicate their polarity.

C3.3.3.9.19 E207.19 Secondary windings of current transformers shall be earthed to the approval of the Engineer at one point only. Each group of current transformers (i.e. protection, metering, etc.) shall be earthed directly to the earth bar by way of isolating links of the type where the link cannot be removed from the terminal. These links shall be readily accessible and safe with the circuit breaker in the isolated position. They shall not be in a live compartment.

C3.3.3.9.20 E207.20 All current transformer connections shall be brought to a terminal block in an easily accessible position inside the switchgear relay panel.

If remote metering is specified in the project specification, then the metering current transformer shall also be wired to an easily accessible terminal block at the back of each panel. A metering test block with special links shall be provided to make changes to the remote metering circuits possible without the danger of opening the CT's on load.

C3.3.3.9.21 E207.21 Each LV current transformer shall be of the ring type and be provided with a robust mounting bracket and approved terminal studs on the circumference of the coil for the connections. The current transformers shall be mounted on rigid supports in such a manner that the axis of the coil is in a vertical plane to facilitate the threading through of the interconnecting wiring to the relevant switchgear.

C3.3.3.9.22 E207.22 CURRENT TRANSFORMER TESTING

Test certificates shall be submitted to the Engineer and be included in manuals. Test shall be executed in accordance with the relevant codes and specifications.

C3.3.3.9.22.1 E207.22.1 Type Tests

Type tests are not required if the manufacturer holds certificates of type tests on a similar transformer. Type test certificates shall be provided upon request by the Engineer.

C3.3.3.9.22.2 E207.22.2 Routine Tests: General

C3.3.3.9.22.2.1 E207.22.2.1 Verification of terminal markings and polarity tests.

C3.3.3.9.22.2.2 E207.22.2.2 Insulation test shall be made on the windings as specified as follows:

- Power frequency tests on primary windings and measurements of partial discharges.
- Power frequency tests on secondary windings and between sections of primary and secondary windings.
- Overvoltage interturn tests.

C3.3.3.9.22.3 E207.22.3 Additional Routine Tests for Measuring Current Transformers

- Tests shall be performed to verify limits of current error and phase displacement.

C3.3.3.9.22.4 E207.22.4 Additional Routine Tests for Protection Current Transformers: Class 10 P

- Tests shall be performed to verify limits of current error and phase displacement.
- Tests shall be performed to verify limits of composite error.
- Secondary winding resistance corrected to 75□C.

C3.3.3.9.22.5 E207.22.5 Additional Routine Tests for Special Purpose Current Transformers: Class X

Routine tests shall be performed to verity and establish the following:

- Rated knee-point e.m.f.
- Exciting current.
- Secondary winding resistance corrected to 75□C.
- Turn ratios.

A magnetizing curve shall also be provided to the Engineer for Class X current transformers prior to the installation of current transformers in the switchgear.

C3.3.3.9.23 E207.23 WITNESSING OF TESTS

It should be noted that inspection and witnessing of tests shall not relieve the Contractor of his responsibilities for meeting all the requirements of the specification, and it shall not prevent subsequent rejection if such material or equipment is later found to be not in compliance with the specification.

C3.3.3.9.24 E207.24 ADDITIONAL INFORMATION TO BE SUBMITTED WITH THE TENDER

The manufacturer shall submit with the tender the following additional information:

- A typical drawing showing the assembly of the current transformer and its core and winding.

C3.3.3.9 E208 LOW VOLTAGE MOTOR PROTECTION AND RELAYS

C3.3.3.9.1 E208.1 MOTORS UP TO AND INCLUDING 55KW

C3.3.3.9.1.1 E208.1.1 All three phase motor contactors shall be provided with three pole thermal overload relays which are selected for the applicable motor ratings as specified.

C3.3.3.9.1.2 E208.1.2 The overload relays shall have inverse time current characteristics which comply with the relevant codes and specifications. Where motors have exceptional long starting times the trip class shall be selected to ensure that tripping doesn't occur during motor starting.

C3.3.3.9.1.3 E208.1.3 The overload thermal relays shall be phase loss sensitive and shall be provided with a manual reset button.

C3.3.3.9.1.4 E208.1.4 All three phase motors shall be provided with suitable phase failure relays providing protection against:

- Single phasing.
- Phase reversal.
- Phase angle errors.
- Unbalance supply voltage.

C3.3.3.9.1.5 E208.1.5 When motors for pumping installations or submersible pumps are specified, an underload or undercurrent relay with suitable current transformers shall be provided.

C3.3.3.9.1.6 E208.1.6 Where relays are mounted inside panels and the trip indicators on the relays are disabled due to the loss of control voltage when cubicle doors are opened, additional signal lamp indicators shall be provided on the cubicle doors otherwise the relays shall be flush mounted on the doors.

C3.3.3.9.2 E208.2 MOTORS LARGER THAN 55KW

C3.3.3.9.2.1 E208.2.1 Motors larger than 55kW shall be protected with electronic motor protection relays (MPR). The relay shall make provision for the minimum protection functions as follows:

- Thermal overload with thermal capacity memory.
- Single phasing.
- Phase sequence.
- Restart control (The cooling characteristics of the motor shall be accurately simulated to block starting until the motor has cooled down sufficiently for both hot and cold starts).
- Stall protection.
- Underload or undercurrent protection shall be provided for all motors used for pump installations. Where this feature does not form part of the relay a separate relay providing an underload function shall be provided.
- When earth fault and short circuit functions are specified the trip signals shall be wired to trip the backup circuit breaker unless positive proof exists that the contactors are capable of breaking the present and future fault currents. Otherwise these trip signals

shall be delayed by the MPR to ensure that the fuses blow before the contactor is tripped.

- Special care shall be taken in the selection of motor protection relays when reduced current starters, e.g. soft starters or variable speed drives are specified. Contractors shall submit to the Engineer written confirmation obtained from the manufacturer of the relay that the relay offered is suitable for the application.

- Where relays are mounted inside panels and the trip indicators on the relays are disabled due to the loss of control voltage when cubicle doors are opened additional signal lamp indicators shall be provided on the cubicle doors otherwise the relays shall be flush mounted on the doors.

C3.3.3.9.2.2 E208.2.2 When specified that the motor windings are equipped with thermistors a suitable thermistor overload relay shall be provided (motors between 55kW and 150kW). Care shall be taken that the total resistance of the thermistors when connected in series do not exceed the tripping range of the relay.

The relay shall have contacts for a manual reset button and a LED display trip indicator which shall be mounted on the front of the panel.

Unless otherwise specified the thermistor overload relay shall be suitable to function in conjunction with thermistors with a temperature reference value of 140°C (Class B motor winding temperature rise).
When thermistors are specified for winding temperature alarms the thermistor overload relay shall be suitable to function in conjunction with thermistors with a temperature reference value of 130° {Class B motor winding temperature rise}.

C3.3.3.9.2.1 E208.2.1 When specified in the Project Specification that the motor windings and the bearings are equipped with platinum resistance detectors (RTD's) Pt-100 Ω (Usually specified for motors above 150kW), a suitable temperature controller for each RTD shall be provided with the following features:

- Adjustable present process temperature value and adjustable set temperature value in separate four-digit LCD displays.

- An adjustable alarm output with indicator.

- Temperature range 0 - 150°C.

- Trip indicator.

- Relay control and alarm outputs.

- Dielectric strength: 2kV for 1 minute.

Unless otherwise stated the temperature controllers for the windings shall be set for the protection of a class B motor winding temperature rise.
i.e. Alarm : 130°C
Trip : 140°C

The bearing temperature controllers shall be set as follows:
i.e. Alarm : 85°C
Trip : 90°C

When specified the unit shall be provided with a 4 - 20mA output to transmit the process value or other output as may be required.

All the temperature controllers specified for one motor shall all be mounted in a 19inch rack as a unit and shall be flush mounted on the cubicle door of the relevant motor.

The unit shall be provided with an override key switch to facilitate the exchange of a temperature controller without causing the motor to trip.

Temperature controllers shall be equipped with 2 pole "two in one" 3 wire surge arresters providing protection from phase to earth and from neutral to earth. Surge arresters shall comply with the relevant codes and specifications.

C3.3.3.10 E209 WIRING IN DBS, MCCS AND PANELS

C3.3.3.10.1 E209.1 In general all internal wiring in the cubicles shall be carried out in 600V PVC insulated copper multi-strand conductors. If the internal ambient temperature of the cubicle is likely to exceed 50□C silicon rubber insulated stranded copper conductors shall be used. The minimum cross-sectional area for control circuits shall be 1,5 square mm and 2,5 square mm for load and CT circuits. The current carrying capacity of conductors shall be determined in accordance with the relevant codes and specifications taking the appropriate correction factors for ambient air temperatures, grouping and condition of use into account.

C3.3.3.10.2 E209.2 Where several conductors are used, these shall be neatly grouped and bound together in groups not exceeding 10 conductors and shall be arranged in neat vertical or horizontal rows or installed in PVC trunking with slotted sides. Wiring shall follow the board construction features as far as possible without the twisting or crossing of conductors.

C3.3.3.10.3 E209.3 No joints will be allowed in internal wiring, and all connections to busbars or earth bars shall be made with approved tinned copper cable lugs soldered or crimped to the ends of the conductors and bolted to busbars by means of cadmium-plated high tensile steel bolts and nuts provided with spring washers.

Connections of conductors to equipment i.e. circuit breakers, isolators or contactors shall be made by a ferrule of correct size or by the soldering of the end of the conductor. Conductors connected to terminal blocks need not to be soldered or ferruled.

Conductors terminating on meters, fuse holders and other equipment with screwed terminals shall be fitted with pre-insulated lugs. The lugs shall be soldered or crimped to the end of the conductor. The correct amount of insulation shall be stripped from the end to fit into the terminal. Strands may not be cut from the end of the conductor.

Crimping tools used shall be of the ratchet type and indent an identifying symbol on the terminal insulation.

C3.3.3.10.4 E209.4 All wiring is to be kept free and away from any exposed terminals or other uninsulated current carrying parts. Wiring shall also be kept free from metal edges and shall be protected where they cross metal edges. Grommets shall be installed in each hole in the metalwork through which conductor's pass. Connections to equipment on swing doors shall be arranged so as to give a twisting motion and not a bending motion to the conductors.

C3.3.3.10.5 E209.5 Only wires of the same potential shall be grouped together, and power control circuit wiring shall be in separate wiring channels. Wiring channels shall not be more than 60% full.

C3.3.3.10.6 E209.6 Wires shall be clearly marked at all termination points in accordance with the numbering of the board manufacturer's wiring diagram, by means of suitable markers.

C3.3.3.10.7 E209.7 Additional red cable markers marked "T" in white shall also be fitted on wires associated with trip circuits.

C3.3.3.10.8 E209.8 When the board main disconnector or local disconnector is switched off, no live incoming or other wiring shall be accessible. The incoming terminals shall be screened or inaccessible. Where connections are taken from the incoming sides 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.

C3.3.3.10.9 E209.9 All control terminals shall be accessible from the rear, except in the case of front access boards.

C3.3.3.10.10 E209.10 Where neutral connections are looped between the terminals of instruments a common lug or ferrule shall be used to ensure that the neutral is not broken when the instruments are removed.

C3.3.3.10.11 E209.11 The supply end connections to all equipment shall always be at the top and the load end connections at the bottom.

C3.3.3.10.12 E209.12 Solid copper busbars shall be used to connect equipment to the main busbars where the current rating exceeds 200A and shall be insulated by means of at least two half lapped layers of PVC tape.

C3.3.3.10.13 E209.13 A maximum of two conductors shall be used per equipment terminal.

C3.3.3.10.14 E209.14 Where small leads are connected directly onto busbars, such as for voltmeters, etc. they shall be provided with a 20A fuse mounted directly on the busbar and a 2Amp fuse at the piece of equipment on the front of the panel.

C3.3.3.10.15 E209.15 Unless otherwise approved the following insulation colours shall identify wiring:

- Red phase of 3-phase circuits - red
- White phase of 3-phase circuits - white
- Blue phase of 3-phase circuits - blue
- Live of single-phase circuits - red
- Neutral - black
- Earth - green/yellow
- Alarm circuits - orange
- AC control circuits - red
- DC control circuits - blue
- Instruments - grey

C3.3.3.10.16 E209.16 In DBs and MCCs, accessible PVC wireways shall be provided for wiring between compartments. Signal cabling shall be run in galvanised steel conduit.

C3.3.3.10.17 E209.17 Internal wiring shall be kept separated from external wiring and, as far as possible, the internal serving of cables entering the enclosure shall be left around conductors until the cable enters the compartment to which it is connected.

C3.3.3.10.18 E209.18 Low current signal cables shall be kept separate from power cables up to the point where the conductors are connected to the terminals on the equipment. Where required, sheet metal wireways shall be provided to ensure this separation.

C3.3.3.11 E210 WIRING- AND CABLE TERMINATIONS AND TEST TERMINAL BLOCKS

C3.3.3.11.1 E210.1 GENERAL

C3.3.3.11.1.1 E210.1.1 Electrical terminal blocks shall comply with the relevant codes and specifications and shall be indelibly marked as stated in this specification in respect of ratings, conductor sizes and identification symbols.

C3.3.3.11.1.2 E210.1.2 Terminal metal parts, bolts and screws shall be of non-corrosive material, enclosed in fire resistant, moulded plastic insulating bodies. No metal part shall project beyond the insulating material to ensure protection against accidental contact by personnel, against short circuits and tracking.

C3.3.3.11.1.3 E210.1.3 The terminal blocks shall have a temperature rating of at least T40 for indoor and T55 for outdoor switchgear.

C3.3.3.11.2 E210.2 RAIL-MOUNTED WIRING TERMINAL BLOCKS

C3.3.3.11.2.1 E210.2.1 The construction of the terminal blocks and mounting rail shall be of robust construction as to ensure a firm and positive location of the terminal blocks. It shall be possible to add additional terminal blocks or replace blocks within the terminal sequence without having to disconnect or dismantle the terminal block or adjacent terminal blocks or having to loosen any fastening device at the rear of the mounting rail. The terminal blocks shall be held in position by means of an end barrier or a shield to insulate the open end.

C3.3.3.11.2.2 E210.2.2 It shall be possible to use terminals for different sizes of conductors on the same mounting rail. Where smaller terminal blocks occur adjacent to larger terminal blocks, suitable shielding barriers shall be inserted to cover the terminals that might otherwise be exposed.

C3.3.3.11.2.3 E210.2.3 Terminals shall be sized and rated to match the conductors that are connected to them.

C3.3.3.11.2.4 E210.2.4 Each terminal block shall have provision for clip-in numbering or labelling strips to be installed, together with clear protective caps and shall be clearly marked in accordance with the Board Manufacturer's drawings and wiring diagrams.

C3.3.3.11.2.5 E210.2.5 All outgoing circuits of the switchboards shall be provided with suitable terminal strips of the shoe clamping type, a rating of at least 15A and wired in such a manner that all incoming cables installed at the site can easily be connected. Terminals which rely on pinch screws rotating on wire strands shall not be acceptable.

C3.3.3.11.2.6 E210.2.6 Terminal strips for auxiliary power, control alarm and trip circuits etc. shall be kept separate to ensure that cables can be made off without disturbing power cables.

C3.3.3.11.2.7 E210.2.7 Full details and samples of terminal strips shall be submitted to the Engineer for prior approval.

C3.3.3.11.2.8 E210.2.8 Petroleum-jelly filled pilot cables shall be terminated and jointed in moisture-proof, blocking type terminations/joints which shall prevent the ingress of moisture, as well as the escaping of petroleum-jelly from the cable. Epoxy-filled terminations and joints will be acceptable. However, prior approval of terminations and joints shall be obtained from the Engineer.

C3.3.3.11.3 E210.3 POWER CABLE TERMINALS

C3.3.3.11.3.1 E210.3.1 The terminal strip shall consist of a metal mounting strip onto which cable connecting modules are fixed. The terminals for power cables shall be have bolt fixing, complete with arc shields and suitably rated for the applicable cable sizes. For cables up to and including 10mm²,

clamp type terminals may be provided, but the type where the clamp screws are in direct contact with the conductor will not be acceptable.

C3.3.3.11.3.2 **E210.3.2** The terminals for power cables shall be large enough for the terminating lugs of the cable sizes specified.

C3.3.3.11.3.3 **E210.3.3** Terminals for power circuits, including the neutral connection, shall be arranged in a straight horizontal line with adequate clearance between live and earth connections with the cable lugs fitted. Rigid barriers, not the thin flexible type, shall be provided between terminals.

C3.3.3.11.3.4 **E210.3.4** Diagonal or vertical arrangement of terminals for power circuits will not be accepted.

C3.3.3.11.3.5 **E210.3.5** Where aluminium core cables are used, suitable tinned, copper or aluminium lugs with Densal paste shall be used for the termination.

C3.3.3.11.3.6 **E210.3.6** The cost for the supply and delivery of lugs and paste shall form part of the price for the erection of the cabinets.

C3.3.3.11.3.7 **E210.3.7** The terminal strip for power cables shall be positioned at least 50mm from the gland plate. The terminals to which a cable will be connected, shall be directly above/below the specific cable gland for bottom/top entry respectively.

C3.3.3.11.3.8 **E210.3.8** Where terminals are mounted more than 400mm from the gland plate, provision shall be made for bracing and for fixing the leads of smaller cables to prevent vibration.

C3.3.3.11.3.9 **E210.3.9** The terminals of each individual circuit shall be clearly labelled with the circuit name and number.

C3.3.3.11.4 E210.4 TEST TERMINAL BLOCKS

Switchboards shall be equipped with a test terminal block, when specified in the Project Specification. 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.

C3.3.3.12 E211 GLANDS AND GLAND PLATES FOR PVC AND PILOT CABLES

C3.3.3.12.1 E211.1 GLANDS

C3.3.3.12.1.1 E211.1.1 Mechanical cable glands and flameproof glands shall comply with the relevant codes and specifications.

C3.3.3.12.1.2 E211.1.2 When specified in the project specification glands shall be weatherproof, dust ignition proof, hose-proof or for use on type 'e' enclosures i.e. use in explosive gas atmospheres.

C3.3.3.12.1.3 E211.1.3 Glands shall be provided with brass locknuts and double outer sealing in corrosive environments. Areas which are classified as highly corrosive shall be equipped with H-C (Hydrocarbon resistant) or UV-C (Ultra-Violet and chemical resistant) seals as may be applicable.

C3.3.3.12.1.4 E211.1.4 Glands and components shall be manufactured of non-corrosive material such as nickel-plated brass.

C3.3.3.12.1.5 E211.1.5 Adjustable cable glands of the correct size designation shall be provided in switchboards for all cable types as specified.

C3.3.3.12.1.6 E211.1.6 Glands shall be equipped with cable or armour gripping devices as may be applicable and shall be constructed to ensure electrical earthing continuity between the armour of the cable and the gland plate or the metallic structure. Glands shall be provided with an earthing bond attachment of acceptable rating.

C3.3.3.12.1.7 E211.1.7 It shall be possible to convert glands for armoured cables to be suitable for unarmoured cables by replacing the cone bush and compression ring with a rubber compression bush and rings.

C3.3.3.12.1.8 E211.1.8 Where cables with metal screens or metal sheaths are specified the gland shall be designed to earth the screen or sheath through the gland on the earth bar. It shall be possible to bring earth continuity conductors through glands for ECC cables without having to cut grooves in the barrel or cone bush. Suitable replacement parts shall be used.

C3.3.3.12.1.9 E211.1.9 Glands for outdoor use shall be equipped with a waterproofing shroud and an inner seal kit.

C3.3.3.12.1.10 E211.1.10 All pilot cable ends shall be made off in glands as prescribed by the manufacturer, of correct size and complete with neoprene shrouds if used outdoors at minisubs or outdoor cubicles. The armouring shall be clamped between substantial tapered sections, which form an integral part of the gland, secured by lock nuts to give a earth connection.

C3.3.3.12.2 E211.2 GLAND PLATES

C3.3.3.12.2.1 E211.2.1 Gland plates for cable entries to boards will be from above and/or from below as specified in the drawings of project specifications.

C3.3.3.12.2.2 E211.2.2 Gland plates shall be at least 200mm above the normal floor level.

C3.3.3.12.2.3 E211.2.3 Gland plates shall be from non-magnetizing material where single core cables are terminated to the boards.

C3.3.3.13 E212 CABLE TERMINATIONS, JOINTS, CABLE END BOXES, ENCLOSURES AND CLAMPS FOR CABLES RATED 3,3 KV AND ABOVE

C3.3.3.13.1 E212.1 Cable terminations and enclosures shall comply with the relevant codes and specifications.

C3.3.3.13.2 E212.2 Suitable cable end boxes or terminations and clamps shall be provided for the types and sizes of cables as set out in the project specification.

C3.3.3.13.3 E212.3 The Contractor shall confirm with the Engineer the size and type of cable end box or termination to be used, depending on the choice of PILC cable or cross-linked polyethylene cable and copper or aluminium core cable before the manufacture of the panels or switchboards.

C3.3.3.13.4 E212.4 The type of termination kits and joints used on paper insulated or XLPE cables shall be those recommended and accepted by the cable manufacturers.

C3.3.3.13.5 E212.5 If approved by the Engineer, heat shrink type cable terminations and joints may be provided.

C3.3.3.13.6 E212.6 Tender prices for switchgear shall include for the supply of wooden cable clamping blocks to support the cable inside the switchgear panel where heat shrink terminations are used.

C3.3.3.13.7 E212.7 The switchgear manufacturer shall provide the necessary copper flexible or bar connections between the riser terminals and the cable end box terminals. The switchgear riser terminals shall be properly tinned.

C3.3.3.13.8 E212.8 Heat shrink terminations shall be completely non-tracking and U.V. stabilized to ensure long life.

C3.3.3.13.9 E212.9 Outdoor heat shrink terminations shall be equipped with sheds to increase flashover distances as recommended by the supplier for the specific voltage.

C3.3.3.13.10 E212.10 Where XLPE cables are used, the switchgear manufacturer shall provide suitable tinned lugs, bolts, nuts and washers for the sizes of cables specified.

C3.3.3.13.11 E212.11 Where paper insulated cables are used, the switchgear manufacturer shall provide suitable cast aluminium or sheet steel fabricated compound filling cable end boxes suitable for the sizes of cables specified.

C3.3.3.13.12 E212.12 Where applicable cable end boxes with sealed stem bushings shall be provided. Cable boxes shall be large enough for phasing out cables. Special manufactured cable end boxes shall be used for cables larger than 120mm².

C3.3.3.13.13 E212.13 Terminations or joints shall be packed as complete kits, clearly marked in respect of suitability for cable type, insulation, construction and voltage. Each kit shall be accompanied by a detailed set of the manufacturers' installation instructions. The terminations and joints shall be made off strictly in accordance with these instructions with the correct tools.

C3.3.3.13.14 E212.14 The Contractor, at the time of Tendering, and in the appropriate schedule, shall state the equipment with which each jointer will be equipped. Failure to complete this schedule may prejudice the Contractor's offer.

C3.3.3.13.15 E212.15 Only electricians who can provide a Certificate of Competence issued by the manufacturer of the accepted termination and joint kits shall be allowed to make off terminations and joints. Costs incurred due non-compliance shall be borne by the Contractor.

C3.3.3.13.16E212.16 The Engineer reserves the right at any stage during the contract to instruct that any completed joint be opened for the purpose of carrying out an interior inspection. Should the workmanship of the joint be such that it fails to pass an inspection, the remaking of the joint shall be carried out at full cost to the Contractor. Should the workmanship pass the inspection the cost of making good the opened joint shall be to the Employer's account.

C3.3.3.13.17E212.17 A loop of approximately 7,0metre long shall be left, where possible, at each cable end where high voltage cables are laid underground for distances exceeding 60metres.

C3.3.3.13.18E212.18 Conductor joints shall preferably be done by means of suitable ferrules which shall be properly sweated onto the conductors. Crimped ferrules will only be allowed if the crimping tools and workmanship are approved by the Engineer. Suitable ferrules flux shall be used for aluminium cables.

C3.3.3.13.19E212.19 On underground through joints, suitable ferrules shall be used for connecting the cores together. The strands shall be thoroughly tinned before being sweated onto the ferrules. In the case of aluminium cores, the strands shall be thoroughly tinned and sweated into the ferrules using suitable solder flux.

C3.3.3.13.20E212.20 The joining of copper conductors to aluminium conductors shall be achieved by the use of properly tinned and sweated cores and ferrules respectively. The correct type of ferrules shall be used.

C3.3.3.13.21E212.21 All cable joints shall be of the water blocking type for the prevention of the ingress of moisture from one cable to the next through the joint.

C3.3.3.13.22E212.22 The electrical continuity of all the conductors, screen and armouring shall not be impaired by cable 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.

C3.3.3.13.23E212.23 Cable ends shall be long enough for the making off of cable ends into cable through-joint boxes and/or cable end boxes. Excessive waste shall be avoided by the Contractor.

C3.3.3.13.24E212.24 Cable connections throughout the system shall follow the same phase rotation, and all cores on the system shall follow the undernoted identification:

Red Phase	:	Core No. 1
Yellow Phase	:	Core No. 2
Blue Phase	:	Core No. 3

C3.3.3.13.25E212.25 Where paper-insulated cables are made off into cable end boxes, the lead cover and armouring shall both be made off into a wiped joint. A 70mm² stranded copper conductor shall be connected to the cable armouring inside the wipe. The copper conductor and armouring shall be properly cleaned and tinned before the connection is made. The other end of the copper conductor shall be connected to the earthing system by means of a suitable tinned lug. Wiped joints may be replaced by a mechanical assembly approved by the Engineer.

C3.3.3.13.26E212.26 Compound shall conform to the relevant codes and specifications. Oil filling compounds shall not be acceptable.

C3.3.3.13.27E212.27 Where anti-electrolytic cables are used the cable joint boxes shall be insulated from earth by means of rigid PVC pipes to be put over the joint boxes. The open ends of the pipes shall be sealed with a hard-setting bitumastic compound. Where the environment is sandy, the pipes with joint boxes shall be put onto reinforced concrete slabs.

The costs for the supply, delivery and installation of the pipes and/or concrete slabs shall be included in the prices for making off the joints.

C3.3.3.13.28 E212.28 Lead sheets, or other approved material, approximately 75 mm wide, shall be clamped around the high voltage cables at every cable end box and cable joint box and underneath every cable marker. The following information shall be engraved on the sheets.

a) Voltage, e.g. : 11kV
b) Sizes, e.g. : 185mm² Al or Cu.
c) Designation, e.g. : Substation 1 - Substation 2

Only the designation shall be engraved if the manufacturer has already printed the other information on the cable.

C3.3.3.13.29 E212.29 The installation Contractor shall pre-plan the laying of high voltage cables in order to avoid the installation of a through-joints inside premises. No joints inside premises shall be allowed.

C3.3.3.13.30 E212.30 SEALING OF CABLE ENDS

The ends of cables which are cut shall immediately be sealed by means of plumbed lead end caps should there be a delay before jointing is to take place.

The sealing of cable ends by means of rubber or bituminized tapes shall not be allowed. Heat shrink caps may be used provided the seal is correctly applied. Where cable ends were left open for 24 hours or more, the cable ends shall be tested for moisture ingress.

C3.3.3.14 E213 SWITCHBOARD ACCESSORIES

C3.3.3.14.1 E213.1 CONTROL PUSH BUTTONS

C3.3.3.14.1.1 E213.1.1 GENERAL

C3.3.3.14.1.1.1 E213.1.1.1 Push buttons shall comply with the relevant codes and specifications.

C3.3.3.14.1.1.2 E213.1.1.2 Push buttons shall be provided by a single reputable supply and shall be selected for the required rating, contact action, duty, environmental conditions e.g. temperatures and vibrations and mounting characteristics e.g. flush mounted, enclosed, self-contained, illuminated, etc.

C3.3.3.14.1.1.3 E213.1.1.3 All push buttons shall be of the same physical dimension and shall be interchangeable between normally open and normally closed contacts. Push buttons shall preferably also be interchangeable with indicator lamps, key switches, etc. All push buttons shall be provided with replaceable lenses.

C3.3.3.14.1.1.4 E213.1.1.4 Push button terminals shall be suitable for conductor sizes to be used. Push button assemblies mounted on doors of control boards shall be enclosed to prevent inadvertent contact with the terminals and when the doors are open.

C3.3.3.14.1.1.5 E213.1.1.5 Contacts shall be silver-tipped or be constructed of an approved high-quality material.

C3.3.3.14.1.1.6 E213.1.1.6 Push buttons shall be labelled by means of removable legend plates clearly indicating its function. Legend plates shall be interchangeable.

C3.3.3.14.1.1.7 E213.1.1.7 When specified keylock push buttons shall be supplied with duplicate keys. The removal action of the key shall suit the application.

C3.3.3.14.1.1.8 E213.1.1.8 Illuminated push buttons shall comply with the specification for indicator lamps and lights.

C3.3.3.14.1.2 E213.1.2 MOTOR CONTROL CENTRES

C3.3.3.14.1.2.1 E213.1.2.1 All motor control cubicles shall be provided with "STOP/START" push buttons as follows (or as specified in the Project Specification):

- Start button: Green
- Stop button: Red

C3.3.3.14.1.2.2 E213.1.2.2 When specified in the Project Specification or indicated on drawings the following push buttons shall be provided:

- Trip reset button: Black
- Emergency stop button: Red with yellow background
- Lamp test button: White
- Any other function button: Pale Blue

C3.3.3.14.1.2.3 E213.1.2.3 Start push buttons shall have normally open contacts. Stop push buttons shall have normally closed or normally open contacts, as may be required.

C3.3.3.14.1.3 E213.1.3 SWITCHGEAR

When specified in the Project Specification or indicated on drawings push buttons shall be provided as follows:

Electricity Controlled Switchgear

- Open button: Green (O)
- Close button: Red (I)
- Reset button: Black
- Lamp test button: White
- Any other function button: Pale Blue

C3.3.3.14.2 E213.2 SIGNAL LIGHTS

C3.3.3.14.2.1 E213.2.1 GENERAL

C3.3.3.14.2.1.1 E213.2.1.1 Indicator lights shall comply with the relevant codes and specifications.

C3.3.3.14.2.1.2 E213.2.1.2 Indicator lights shall be provided as specified in the Project Specification and indicated on drawings.

C3.3.3.14.2.1.3 E213.2.1.3 Similar cluster multi-led (8 chip) long life signal lamps shall be provided for all indications.

C3.3.3.14.2.1.4 E213.2.1.4 LED's shall be selected and rated for the specified control voltage and shall be equipped with a suitable current limiting protection resistor. Each LED shall be provided with a Zener transient protection diode. Suitable LED's are type MDA 22 for AC applications under 110V and DC applications, and type MAC 22 for AC applications above and including 110V as obtainable from Mimic Crafts. Equivalents shall be submitted for approval by the Engineer.

C3.3.3.14.2.1.5 E213.2.1.5 Indicator light lenses shall be of the same size, shall have a minimum diameter of 22mm and shall be of the front removable screw type. The lamps shall be replaceable from the front of the panel without the use of tools. Indicator light construction shall be suitable for the operating environment and shall be equipped with interchangeable lenses.

C3.3.3.14.2.1.6 E213.2.1.6 Indicator lights shall be labelled by means of a removable legend plate clearly indicating its function. Legend plates shall be interchangeable.

C3.3.3.14.2.1.7 E213.2.1.7 Two spare lamps shall be provided for each type and colour lamp used on the boards unless otherwise specified.

C3.3.3.14.2.1.8 E213.2.1.8 The spare lamps shall not be used by the Contractor during erection, commissioning, or maintenance.

C3.3.3.14.2.2 E213.2.2 MOTOR CONTROL CENTRES

C3.3.3.14.2.2.1 E213.2.2.1 When specified in the Project Specification or indicated on the drawings, the following indicator lights shall be provided:

- Drive stopped, power available: White
- Drive running: Green
- Drive tripped: Red
- Emergency stop activated: Yellow

– Moisture ingress: Blue

C3.3.3.14.2.3 E213.2.3 SWITCHGEAR

C3.3.3.14.2.3.1 E213.2.3.1 The following lens colours shall be used:

– Circuit breaker, isolator closed or abnormal state: Red

– Circuit breaker tripped (caution): Yellow

– Circuit breaker open (ready for operation): Green

– Interlocking: White

– Other functions: White

Painted lenses shall not be acceptable.

C3.3.3.14.2.3.2 E213.2.3.2 Where indicating lamps are supplied from the substation batteries, it shall be separately wired to an easily accessible terminal block at the back of the board and shall not form part of the wiring of the spring charge mechanisms of equipment or tripping circuits. The indicator lights shall be wired to a lamp test push button mounted on one of the cubicles, preferably a bus-coupler or an incomer. The lamp test circuit shall be equipped with a timer (0-10min) to prevent the unnecessary drainage of batteries.

C3.3.3.14.2.3 E213.2.3 SEMAPHORES

C3.3.3.14.2.3.1 E213.2.3.1 Semaphores shall be provided if specified in the project specification.

C3.3.3.14.2.3.2 E213.2.3.2 Semaphores shall be of the electrically operated, totally enclosed type, suitable for the operation with the specified control voltage.

C3.3.3.14.2.3.3 E213.2.3.3 The semaphores shall be of the continuously energised type which will take up an abnormal position when de-energised, e.g. 45 deg. to the horizontal.

C3.3.3.15 E214 NAME PLATES AND LABELS

C3.3.3.15.1 E214.1 NAME PLATES

All equipment shall be provided with a manufacturer's name plate/plates fixed in an easily accessible and readable position on equipment or inside cubicles showing the following data.

C3.3.3.15.1.1 **E214.1.1** The manufacturers name or trademark.

C3.3.3.15.1.2 **E214.1.2** Type, designation or identification number or other means of identification making it possible to obtain relevant information from the manufacturer of equipment.

C3.3.3.15.1.3 **E214.1.3** SANS or IEC Designation.

C3.3.3.15.1.4 **E214.1.4** Rated operational voltage.

C3.3.3.15.1.5 **E214.1.5** Short circuit strength in kA.

C3.3.3.15.1.6 **E214.1.6** Degree of protection IP rating.

C3.3.3.15.1.7 **E214.1.7** Maximum current carrying capacity of busbars.

C3.3.3.15.1.8 **E214.1.8** Maximum current carrying capacity of equipment.

C3.3.3.15.1.9 **E214.1.9** Voltage transformer ratio (where applicable).

C3.3.3.15.1.10 **E214.1.10** Current transformer ratio, burden, class and knee point voltage (where applicable).

C3.3.3.15.1.11 **E214.1.11** Current transformer connection instructions for various CT ratios (where applicable provide separate nameplate close to the relevant terminal blocks).

C3.3.3.15.2 E214.2 LABELLING

C3.3.3.15.2.1 **E214.2.1** Labels shall generally have black lettering on a white background. Danger and safety notices shall have red lettering on a white back- ground and be in both official languages.

C3.3.3.15.2.2 **E214.2.2** Labels shall be engraved "trafolite", aluminium or an approved alternative secured with screws, not glue, or in an approved aluminium guide rail.

C3.3.3.15.2.3 **E214.2.3** Lettering shall generally be 6mm high except that of "main switch" and "local switch" which shall be 10mm high. The lettering of labels indicating names of panels shall be 20 mm high.

C3.3.3.15.2.4 **E214.2.4** Each cubicle shall also be provided with labels of similar wording at the back of the cubicle.

C3.3.3.15.2.5 **E214.2.5** Where possible labels shall not be fixed to removable panels or doors.

C3.3.3.15.2.6 **E214.2.6** The manufacturer shall consider the wording on the drawings as preliminary only and shall obtain the correct final wording from the Engineer before the labels are manufactured.

C3.3.3.15.2.7 **E214.2.7** All equipment situated inside the board, e.g. contactors, relays, fuses, timers and time switches, shall be clearly labelled indicating function and circuit controlled.

C3.3.3.15.2.8 **E214.2.8** Typical labels are as follows:

C3.3.3.15.2.8.1 **E214.2.8.1** Cabinet: cabinet description.

C3.3.3.15.2.8.2 **E214.2.8.2** Incoming cables/busbar: size and origin.

C3.3.3.15.2.8.3 **E214.2.8.3** Main disconnector: "main switch" and danger notice.

C3.3.3.15.2.8.4 **E214.2.8.4** Local disconnector: "local switch" and danger notice.

C3.3.3.15.2.8.5 **E214.2.8.5** Fuses and combination fuse switches: circuit designation and fuse rating.

C3.3.3.15.2.8.6 **E214.2.8.6** Circuit breakers: circuit designation and overcurrent adjustment where applicable.

C3.3.3.15.2.8.7 **E214.2.8.7** Earth leakage protection units: circuit designations.

C3.3.3.15.2.8.8 **E214.2.8.8** Contactors, relays, time-switches, timers, control fuses, etc: designation of control circuit and circuits controlled, function and fuse ratings.

C3.3.3.15.2.8.9 **E214.2.8.9** Push buttons: circuit designation and function.

C3.3.3.15.2.8.10 **E214.2.8.10** Indicating lamps: circuit designation and condition.

C3.3.3.15.2.8.11 **E214.2.8.11** Instruments and selector switches: circuit designation and phase colour.

C3.3.3.15.2.8.12 **E214.2.8.12** Meters (kVA and/or kWh): circuit designation and phase colours where applicable, reading description, and a single multiplication factor for each reading.

C3.3.3.15.2.8.13 **E214.2.8.13** Terminal blocks: terminal designations and function.

C3.3.3.15.2.8.14 **E214.2.8.14** Current transformers: ratios and terminal designations.

C3.3.3.15.3 E214.3 LEGEND CARDS FOR DISTRIBUTION BOARDS OR CUBICLES AND MOTOR CONTROL CENTRES

Install an index card in a holder, with a 2mm thick transparent acrylic panel, screwed or welded inside a door, or where no doors are fitted, to the front plate of the cabinet. The legend card shall list the outgoing circuit designations in accordance with the layout and schematic drawings, functions and outlet locations.

C3.3.3.16 E215 METERING AND INDICATION EQUIPMENT

C3.3.3.16.1 E215.1 GENERAL

C3.3.3.16.1.1 E215.1.1 All meters and indicating instruments shall be of the flush mounted type. Meters not designed for flush mounting, shall be mounted on suitable brackets inside the equipment panel for relay panels, control panels and distribution boards. A suitable door with a glass- covered window shall then be provided in front of the meter.

C3.3.3.16.1.2 E215.1.2 Metering and indicating instruments shall be mounted at between 1,2m and 2m above floor level, except where the dimensions, type and mounting position of the panel make this impossible.

C3.3.3.16.1.3 E215.1.3 All meters shall be protected with suitable fuses.

C3.3.3.16.2 E215.2 AMMETERS

C3.3.3.16.2.1 E215.2.1 Ammeters shall be of the flush mounted, 96 mm square, quadratic scale type unless otherwise approved by the Engineer.

C3.3.3.16.2.2 E215.2.2 Ammeters shall comply with the relevant codes and specifications.

C3.3.3.16.2.3 E215.2.3 All ammeters shall be of the combined instantaneous and 15-minute integrating time lag thermal demand type unless otherwise specified in the project specification. The instantaneous movement shall be of the moving iron type to Accuracy Class 2,5 of BS 89. The accuracy of the thermal demand movement shall be within 3%.

C3.3.3.16.2.4 E215.2.4 The ammeter full scale reading shall correspond with the rated primary current of the associated current transformer with an extended scale to at least 120 % of the full-scale value.

C3.3.3.16.2.5 E215.2.5 The scale plates of ammeters shall be marked with a red line at the full load current of transformers and motors, and at the associated current transformer primary rating in all other cases.

C3.3.3.16.2.6 E215.2.6 Ammeter movements shall be suitable for use in either 1A or 5A current transformer secondary circuits as specified in the project specification.

C3.3.3.16.2.7 E215.2.7 Ammeters shall be fitted with zero adjustment screws.

C3.3.3.16.2.8 E215.2.8 Each ammeter shall be clearly marked with the appropriate colour of the phase to which it is connected.

C3.3.3.16.2.9 E215.2.9 Where ammeters are to be used with dual ratio current transformers, loose scale plates shall be supplied for each ratio. The ratio shall be indicated on the scale plate.

C3.3.3.16.2.10 E215.2.10 Ammeters shall be mounted in a horizontal line on cabinets and cubicles.

C3.3.3.16.3 E215.3 VOLTMETERS

C3.3.3.16.3.1 E215.3.1 Voltmeters shall be of the suppressed zero, 96mm square, quadratic scale, flush mounted type, unless otherwise specified.

C3.3.3.16.3.2 E215.3.2 Voltage transformers will not be used on 400/231V systems. On all higher voltage systems, the voltmeters shall be supplied from voltage transformers with 110V secondary windings.

C3.3.3.16.3.3 E215.3.3 Voltmeters shall comply with the relevant codes and specifications and shall be of Accuracy Class 2,5.

C3.3.3.16.3.4 **E215.3.4** Voltmeter scales shall extend to at least 115% of the nominal system voltage. The nominal system voltage shall be clearly marked with a red line on the scale plate.

C3.3.3.16.3.5 **E215.3.5** All voltmeters shall be fitted with zero adjustment screws.

C3.3.3.16.3.6 **E215.3.6** All voltmeters shall be equipped with a voltage selector switch. This selector switch shall be suitable for phase to phase selection on high voltage three-wire systems and for both phase to phase and phase to neutral selection on low voltage four-wire systems. The selection switch shall be mounted directly underneath the voltmeter.

C3.3.3.16.4 E215.4 kWh, kW MAXIMUM DEMAND, kVA MAXIMUM DEMAND AND COMBINED kWh / kVA MAXIMUM DEMAND METERS

C3.3.3.16.4.1 **E215.4.1** Three and single-phase kWh meters, up to 80A shall be directly-operated types and those above 80A shall be operated through current transformers.

C3.3.3.16.4.2 **E215.4.2** kW and kVA Maximum demand meters and combined kVA/kWh meters shall be operated through current transformers.

C3.3.3.16.4.3 **E215.4.3** All the above types of meters shall be of the directly-operated voltage type for voltages up to 400/230V unless otherwise specified. Meters to be used on higher voltage systems shall be operated through voltage transformers with 110V secondary windings.

C3.3.3.16.4.4 **E215.4.4** kWh-Meters shall have cyclometer dials and shall be direct reading without the use of a multiplication factor. kWh-Meters or combined kWh/kVA maximum demand meters can, however, be of the non-direct reading type, but in this case, only one multiplication factor shall be used to obtain both the kWh and kVA readings.

C3.3.3.16.4.5 **E215.4.5** Any multiplication factor applicable to any meter shall be clearly indicated on the meter, or on a label adjacent to the meter, in unit form and not as a combination of several factors. The manner in which this factor is calculated shall however also be displayed indicating the CT and VT ratios used.

C3.3.3.16.4.6 **E215.4.6** All meters shall be fitted with security seal fitting facilities.

C3.3.3.16.4.7 **E215.4.7** Maximum demand indicators shall be resettable from the front without the removal of any covers being necessary and shall have security seal facilities.

C3.3.3.16.4.8 **E215.4.8** The integrating period on all maximum demand meters shall be 30 minutes, unless otherwise specified.

C3.3.3.16.4.9 **E215.4.9** Combined kVA maximum demand and kWh meters shall be the relevant codes and specifications suitable for the type of system in which it is to be used.

C3.3.3.16.4.10 **E215.4.10** Meters shall comply with the relevant codes and specifications. with Class 2,0 accuracy, unless otherwise specified.

C3.3.3.16.5 E215.5 POWER FACTOR INDICATORS

C3.3.3.16.5.1 **E215.5.1** Power factor meters shall comply with the relevant codes and specifications.

C3.3.3.16.5.2 **E215.5.2** The meter shall be suitable for use on 3-phase, 3 or 4 wire system. Unbalanced conditions shall be allowed for.

C3.3.3.16.5.3 **E215.5.3** Where power factor indication is specified in the project specification, only one meter shall be provided on each circuit where indication is required. The meter shall be installed on the

Yellow phase circuit.

C3.3.3.16.5.4 **E215.5.4** The meter shall be suitable for operation with the current and voltage transformers specified.

C3.3.3.16.5.5 **E215.5.5** The scales of power factor indicators shall be calibrated at least from 0,6 leading to 0,6 lagging, or a wider range.

C3.3.3.16.5.6 **E215.5.6** Power factor indicators shall be of the 96mm square, or larger, flush mounted type.

C3.3.3.17 E216 EARTHING

C3.3.3.17.1 E216.1 GENERAL

Bond and earth the services installation and extraneous conductive parts. The design and installation of an earth electrode shall be in accordance with the relevant codes and specifications. The services installation shall be bonded by means of earth conductors to the earth electrode via the earth bar.

C3.3.3.17.2 E216.2 EARTH ELECTRODE

C3.3.3.17.2.1 E216.2.1 ARRAY OF EARTH RODS

Earth rods shall be at least 16mm diameter and at least 1,5m long and shall be of solid copper. Install each earth rod in a pre-drilled 50mm diameter hole. Fill with mud slurry after installation.

An array of earth rods shall be interconnected with 70mm² bare, stranded copper conductors buried 700mm underground. The earth rods shall be spaced at least 1,5 m apart and not less than the depth of the rods below final ground level.

Unless otherwise noted, the array of earth rods shall consist of five rods, four in the form of a 3m square with a fifth in the centre. The interconnections shall form the sides of the square and shall form a cross thus connecting the centre earth rod.

C3.3.3.17.2.2 E216.2.2 TRENCH EARTHS

Trench earths shall comprise 70mm² bare, stranded copper conductors buried underground at a depth of a least 700mm below finished ground level.

Unless otherwise noted the trench earth shall comprise conductors extending 50m in four directions at right angles to each other and connected at the centre.

C3.3.3.17.2.3 E216.2.3 EARTH MAT

An earth mat shall comprise 70mm² bare, stranded copper conductors buried underground at a depth of at least 700mm below finished ground level in the form of a flat spiral of 24 turns spaced 25mm from each other thus approximate a circle of 1.75m diameter.

C3.3.3.17.3 E216.3 EARTH BAR

C3.3.3.17.3.1 E216.3.1 Provide an earth bar in each LV switchroom for the bonding of the earth electrode, main distribution board earth bar, water mains, any Supplier's earth terminal, any transformer's neutral terminal and tank earth terminal and any HV switchgear frame.

The earth bar shall comprise a 50mm x 6.3mm copper section 500mm long with pre- drilled 10mm holes for connection bolts. Mount the earth bar in the cable trench on spacers away from the wall.

Connect the earth conductors to the earth bar by means of soldered or crimped lugs and 10mm diameter cadmium-plated steel bolts.

C3.3.3.17.3.2 E216.3.2 The earth conductors to the earth bar from the main distribution board, earth electrode, water mains, and transformer tank shall comprise 70mm² bare stranded copper conductor. The earth conductor to any transformer's neutral terminal shall comprise a 70mm² PVC- insulated copper conductor.

C3.3.3.17.4 E216.4 EARTH CONTINUITY

C3.3.3.17.4.1 E216.4.1 Provide earth continuity conductors to earth outlet and each metallic appliance and luminaire.

C3.3.3.17.4.2 E216.4.2 The earth continuity conductors shall be separate bare or green PVC-insulated copper conductors when associated with wiring in wireways.

C3.3.3.17.4.3 E216.4.3 2.5mm² Earth continuity conductors shall be green/yellow PVC-insulated.

C3.3.3.17.4.4 E216.4.4 With a multi-core cable circuit, the earth continuity conductor may be a separate core of a multi-core cable identified with green sleeves at each end.

C3.3.3.17.4.5 E216.4.5 Where earth continuity conductors are looped between outlets the looped ends shall be twisted and ferruled without breaking the electrical or mechanical continuity of the earth conductor.

C3.3.3.17.5 E216.5 BONDING

C3.3.3.17.5.1 E216.5.1 Bond the water main to the earth bar where non-metallic pipes are used and connect the water meter and valves to the earth bar.

C3.3.3.17.5.2 E216.5.2 Bond metallic cold and hot water pipes, waste pipes, sanitary appliances, ventilation pipes and ducts by means of 12mm x 0,8mm solid or perforated copper tape (not wire) clamped by means of brass screws and nuts.

C3.3.3.17.5.3 E216.5.3 Bond metallic roofs, gutters and downpipes to earth by means of 12mm x 0,8mm solid or perforated copper tape clamped by means of galvanised bolts and nuts.

C3.3.3.17.5.4 E216.5.4 Do not use self-tapping screws for any earthing or bonding functions.

C3.3.3.17.5.5 E216.5.5 Complete bonding work before painting.

C3.3.3.17.5.6 E216.5.6 Route copper bonding conductors on the outside of the building in securely fixed galvanised pipe from 2,000mm above ground level to 300mm below ground level.

C3.3.3.17.6 E216.6 TESTING

C3.3.3.17.6.1 E216.6.1 Measure the resistance between the earth electrode and the mass of the earth by one of the methods described in the relevant codes and specifications.

C3.3.3.17.6.2 E216.6.2 Test the earth and bonding continuity in accordance with the Wiring Code.

C3.3.3.17.6.3 E216.6.3 Submit all test results to the Engineer in a written report before any permanent paving is provided over the earth electrode.

C3.3.3.17.7 E216.7 EARTHING OF FENCES

Earth the fence of outdoor transformer and/or switchgear installations by means of a 70mm² bare, stranded copper conductor 400mm below ground level and 500mm outside the fence around the whole perimeter of the fence. At each corner, bond the perimeter conductor to the fence pole and to a 1.8m earth rod by means of a 70mm² bare, stranded copper conductor.

Bond the perimeter conductor to the main earth bar by means of a 70mm² bare, stranded copper conductor.

C3.3.3.18 E217 WIREWAYS

C3.3.3.18.1 E217.1 GENERAL

Metallic wireways shall be electrically continuous and the maximum resistance between any two parts shall not exceed 1 ohm.

Wireways shall be mechanically continuous providing a degree of protection of at least IP3 X (that is providing protection against the entry of solid objects exceeding 2,5mm diameter).

Unless otherwise required conduit installations shall provide a degree of protection of IP44, that is dust and splashproof. Exterior conduit installations shall provide a degree of protection of IPW65 (that is dust-tight, and hose and weatherproof).

Where cabling is to be installed afterwards by others, provide galvanised steel draw wires in the wireways.

Space metallic wireways at least 160mm and non-metallic wireways at least 300mm away from gas, steam, hot water or similar piping. Prevent wireways from contacting piping so as to avoid electrolytic corrosion.

C3.3.3.18.2 E217.2 CONDUIT

C3.3.3.18.2.1 E217.2.1 GENERAL

No conduit shall be smaller than 20mm diameter.

C3.3.3.18.2.2 E217.2.2 TYPES OF CONDUIT AND APPLICATIONS

C3.3.3.18.2.2.1 E217.2.2.1 Black Enamelled Steel Conduit

Black enamelled steel conduit shall comply with the relevant codes and specifications for both screwed metal conduit and plain ended metallic conduit.

Black enamelled steel conduits may generally be used except: -

a) where exposed to the weather

b) where cast into concrete slabs in contact with the soil

c) where exposed to damp or corrosive environments

d) where "U" traps are formed

e) within 50km of the coast

f) in kitchen and boiler rooms (in which locations galvanised steel shall be installed)

g) in animal houses

h) where protecting underground earthing conductors.

i) in plenums containing humidified air.

C3.3.3.18.2.2.2 E217.2.2.2 Galvanised Steel Conduit

Galvanised steel conduit shall comply with the relevant codes and specifications screwed metal conduit and plain ended metallic conduit and shall be hot dip galvanised to the relevant codes and specifications.

C3.3.3.18.2.2.3 E217.2.2.3 PVC Conduit

PVC conduit shall comply with the relevant codes and specifications and shall be installed strictly in accordance with manufacturer's recommendations. All PVC conduit and associated fittings and accessories shall be of one manufacture.

PVC conduit may only be used strictly in accordance with SANS 10142 and where: -

a) specifically noted or permitted by the Engineer,

b) not exposed to temperatures in excess of 50ºC,

c) not exposed to mechanical damage, and

d) not used to support any loads.

C3.3.3.18.2.2.3 E217.2.2.3 Flexible Conduit

Flexible conduit shall comply with the relevant codes and specifications and shall be constructed of metal-reinforced self-extinguishing plastic metallic flexible conduit with a sheath of self-extinguishing plastic. The internal diameter shall not be less than 15mm. Flexible conduit connectors shall securely grip the conduit and be manufactured of zinc, or cadmium Plated steel, or brass.

Where flexible conduit is run in ceiling spaces which form air conditioning plenums, the flexible conduit shall be of galvanised, corrugated steel construction with no PVC components.

Flexible conduit shall terminate on a conduit box unless a draw box exists within 2 metres.

C3.3.3.18.2.3 E217.2.3 INSTALLATION OF CONDUIT

C3.3.3.18.2.3.1 E217.2.3.1 General

The interior surface of conduits shall have no sharp protrusions. Fit brass bushes to steel conduit ends. Bond metallic conduit installations to earth and ensure earth continuity not exceeding 1 ohm. Fit lock nuts to running joints. Swab conduit cast into concrete to remove all traces of moisture.

Plug open conduit ends and exclude ingress of dirt and moisture.

C3.3.3.18.2.3.2 E217.2.3.2 Concealed Conduit

Unless otherwise specified, conduits shall be concealed by being cast into concrete or built into brick or blockwork as applicable. Chasing may only be carried out with the express permission of the Engineer and builder.

Route conduits in structural concrete as close as possible to the neutral axis and secure the conduits against movement.

C3.3.3.18.2.3.3 E217.2.3.3 Surface Mounted Conduit

Where surface mounted conduit is specified, it shall be fixed with spacer bar saddles. The maximum distance between saddles shall not exceed 2m for steel conduit and 1m for PVC conduit. A saddle shall be installed within 100mm of a conduit box.

Remove labels from surface mounted conduit.

C3.3.3.18.2.3.4 E217.2.3.4 Routing of Conduit

Conduit in roof spaces, ceiling voids and exposed areas shall be routed parallel and at right angles to structural elements with no diagonal routing.

Wherever possible, conduits shall be run in straight lines with easy curves and shall be drained. Manufactured bends except for 50mm diameter conduit, and joints at bends, shall be avoided. The minimum radius of a bend shall be four times the conduit diameter.

C3.3.3.18.2.3.5 E217.2.3.5 Terminations of Conduit

Terminate conduits to luminaires, appliances, conduit boxes and bonding trays as follows: -

a) Concealed Steel Conduit:
   i) with two locknuts and a brass bush, or,
   ii) with one locknut and a brass bush nut.

b) Surface mounted Steel Conduit:

With a coupling on the outside and a locknut and a brass bush or a brass bush nut on the inside.

c) PVC Conduit:

With a PVC threaded adapter and lock nut with no stress on termination.

C3.3.3.18.2.3.6 E217.2.3.6 Corrosion Protection of Conduit

Paint exposed running threads of black-enamelled steel conduit to be cast or built in with two coats of red lead primer or lap with PVC-insulation tape.

Paint exposed running threads of galvanised steel conduit with two coats of zinc- rich paint.

Provide at least 25mm of cover to conduits cast into concrete.

Where the paintwork of black-enamelled steel conduit is damaged, prepare the surface and apply two coats of zinc-chromate primer.

Where the galvanising of galvanised steel conduit is damaged, prepare the surface and apply two coats of zinc-rich paint.

C3.3.3.18.2.3.7 E217.2.3.7 Future Extensions

Provide galvanised steel conduit where future extensions are required. In roof spaces, terminate conduit stubs 40mm above tie beams and where 900mm clearance exists.

In concrete terminate conduit 150mm beyond the concrete in the required direction and provide a draw box within 2metres. Thread conduit ends and screw on a coupling and brass plug.

Where conduits are exposed, prepare the surface and apply two coats of calcium plumbate primer.

C3.3.3.18.3 E217.3 CONDUIT BOXES

C3.3.3.18.3.1 E217.3.1 GENERAL

Conduit boxes and their cover plates shall comply with the relevant codes and specifications as applicable. Strong mounting lugs and sufficient conduit knockouts shall be provided.

Metallic conduit boxes may be malleable iron or pressed steel and shall be galvanised where used with galvanised steel or PVC conduit.

Where conduit boxes are installed on the exterior they shall be galvanised, primed and painted steel, or malleable iron, or of suitable non-metallic construction and shall be dust, hose and weatherproof to IP65.

Where the temperature may exceed 60□C, for instance where incandescent or other luminaires are mounted against an outlet box, ordinary PVC boxes shall not be installed but steel, or heat-resistant non-metallic boxes shall be installed.

C3.3.3.18.3.2 E217.3.2 BLANK COVER PLATES

Fit blank cover plates to draw boxes and unused outlet boxes

The finish of blank cover plates to wall-mounted boxes shall match that of switch and socket outlet plates.

Install cover plates to ceiling-mounted boxes accurately flush with the ceiling and before painting of ceilings.

Install suitable brass cover plates to floor-mounted boxes accurately flush with the floor finish. The brass cover plates shall be sufficiently thick and reinforced to be rigid, shall be secured with countersunk brass screws and shall be sealed with a gasket

Fit non-metallic cover plates with nylon screws to PVC conduit boxes.

Where boxes have been installed with fixing lugs below the finished wall surface fit spacers of coiled steel wire or of pipe as necessary.

C3.3.3.18.3.3 E217.3.3 DRAW BOXES

Provide draw boxes to facilitate the drawing in of cables and particularly: -

1) after 180º of bends, and

2) after every 15m of straight runs.

Locate draw boxes to avoid spoiling the appearance of the building. The location of draw boxes shall be accepted by the Engineer.

Where several conduits on the same route require draw boxes a single, large draw box shall be provided.

C3.3.3.18.3.4 E217.3.4 EXPANSION JOINTS

Ascertain the location of structural expansion joints and install conduit expansion joints where conduits have to cross structural expansion joints.

The conduit expansion joints shall be arranged with a draw box as shown on the attached drawing.

Where several conduits on the same route cross a structural expansion joint a single, large draw box shall be provided.

The gap between the inner conduit and outer conduit sleeve shall be sealed with a suitable sealing compound.

C3.3.3.18.3.5 E217.3.5 CONDUIT BOXES RELATED TO ARCHITECTURAL FEATURES

Where conduit boxes are to be mounted on wall or ceiling panels, tiled surfaces, panelling or other finishes, ensure that such boxes are installed symmetrically. Measure and co-ordinate such positions on site. It will not be sufficient to scale such positions off the drawings.

Where several outlets are close to each other, space them evenly and align them.

C3.3.3.18.4 E217.4 TRUNKING

C3.3.3.18.4.1 E217.4.1 GENERAL

Metallic trunking shall comply with the relevant codes and specifications.

Steel trunking shall be manufactured of at least 1,6mm thick steel and galvanised to the relevant codes and specifications as appropriate. Where painting is required, prepare, apply a calcium plumbate primer and apply two coats of high gloss enamel paint, or apply a powder coating. All the painting shall be done in accordance with the relevant codes and specifications.

Where steel trunking is cut to length on site, render the edges smooth, prepare the surface, apply two coats of zinc-rich paint, and if painted, reinstate the paint system.

Light steel trunking may only be installed where specified and shall be manufactured of are least 0.8mm thick steel epoxy polyester powder coated to the relevant codes and specifications.

Unless otherwise specified, provide bridges of 32mm dia. conduit for each compartment between trunking routes and between trunking and distribution boards, telephone and communications panels. Aluminium trunking shall be anodised to the relevant codes and specifications.

C3.3.3.18.4.2 E217.4.2 INSTALLATION

Install trunking complete with end caps, outlets, internal splices, covers, internal partitions, 2 clips, knockouts, adaptors, cable retainers, suspension rods, fixings, brackets, clamps, hangers, nuts, bolts, washers, screws and all other accessories required to complete the installation.

Install cable retainers at spacings of not more than 1 metre.

At changes of direction (elbows, tees, cross-overs, etc.), provide internal splices and exterior covers to present a smooth appearance.

Snap-in covers may be used on trunking up to 70mm wide. Trunking wider than 70 mm shall be fitted with machine screws secured with retained nuts at sufficient points to prevent distortion of the cover.

Support trunking to prevent deflection beyond 1/180th of the span or beyond 3 mm whichever is the lesser.

Provide partitions to separate different services as required.

C3.3.3.18.4.3 E217.4.3 POWER SKIRTING

Power skirting shall have 3 partitioned compartments unless otherwise specified.

Power skirting shall allow access to the telephone compartment without any danger of contact with live parts.

Provide cabling throughout power skirting and with sufficient slack to facilitate the addition and repositioning of outlets.

Power skirting shall be finished in the scheduled colour.

C3.3.3.18.4.4 E217.4.4 UNDERFLOOR DUCTING

Underfloor ducting shall have 3 partitioned compartments unless otherwise specified.

Outlets shall allow access to the telephone compartment without any danger of contact with live parts.

Samples, shop drawings and complete technical literature with approvals, shall be submitted to the Engineer.

Install the underfloor ducting within an accuracy of ± 12mm from the positions shown on the drawings. Prepare dimensioned "as-built" drawings of the installation.

Install the underfloor ducting complete with elbows, tees, cross-overs, outlets, outlet pedestals, end caps, adapters, fixings, and all other accessories required to complete the installation.

Provide cabling throughout underfloor ducting and with sufficient slack to facilitate the addition and repositioning of outlets.

The installation shall provide a degree of protection of IP 67 (that is dust and watertight) to IEC Publication 162 and be watertight to 12mm water gauge.

C3.3.3.18.5 E217.5 BUILDING ELEMENTS AS WIREWAYS

With the express approval of the Engineer, suitable building elements, such as hollow mullions may be used as wireways provided that:

a) the wiring is not exposed,

b) metallic building elements are bonded to earth,

c) the building elements are non-inflammable or self-extinguishing, and

d) re-wire ability is facilitated.

C3.3.3.19 E218 CIRCUITRY

C3.3.3.19.1 E218.1 MINIMUM SIZES

The following minimum wiring and cable sizes apply, unless otherwise specified:

i) PVC-insulated wiring and cabling for single-phase power and lighting – 2.5mm²

ii) PVC-insulated wiring and cabling for signal, control, alarm, and communication – 1.5mm²

iii) PVC/PVC/SWA/PVC cabling for three-phase circuits – 1.5 mm²

C3.3.3.19.2 E218.2 NEUTRAL CONDUCTOR

A neutral conductor, equal in size to the phase conductors shall be run to each three-phase outlet and appliance unless otherwise specified.

C3.3.3.19.3 E218.3 SEGREGATION OF CIRCUITS

Separate wireways, or separate compartments of multi-compartment wireways shall be provided for the following circuits:

1) normal power and lighting circuits

2) emergency power and lighting circuits

3) standby power and lighting circuits

4) low voltage (50V to 1 000V) control, instrument, signal, and alarm circuits

5) extra low voltage (up to 50V) control, instrument, signal, alarm, fire detection, intercommunication circuits

C3.3.3.19.4 E218.4 IDENTIFICATION COLOURS

The following colours shall be used to identify wiring and cable cores:

- red phase of three-phase circuits - red
- white phase of three-phase circuits - white
- blue phase of three-phase circuits - blue
- live of single-phase circuits - red
- neutral - black
- earth - green/yellow
- alarm circuits - orange
- AC control circuits - red
- DC control circuits - blue
- instrument circuits - grey

Where the colour of conductor insulation is unobtainable, fit correctly coloured sleeves to each end of the conductor.

Three-phase circuits shall be terminated with the red phase on the left, white phase central and blue phase on the right viewed from the front of the switchgear.

C3.3.3.20 E219 WIRING IN WIREWAYS

Unless otherwise specified, wiring shall comprise copper conductor PVC-insulated cable complying with the relevant codes and specifications bearing the SABS mark and rated for 660V general service.

PVC-insulated cable may only be used where the ambient temperature does not exceed 50□C. Use heat-resisting cable complying with SANS 529:1977 where:

1) temperatures exceed 50°C

2) directly terminated to a water heater, or any other appliance or luminaire which operates at temperatures in excess of 50°C.

Take care not to apply excessive tension to wiring when drawing in and not to cut or abrade cabling.

Where wiring is installed in trunking, ensure it is located in its appropriate compartment to prevent cross-overs. Strap cables together in groups of not more than ten at spacings not exceeding 1,000mm by means of suitable strapping.

No joints may be made in PVC/insulated cable except at the distribution board, outlet, appliance or luminaire. Any joints specified or permitted by the Engineer shall comprise sufficiently rated brass terminals in porcelain-insulated shrouds.

Install wiring in wireways after the completion of wireway installation and plaster work but before painting has commenced.

Not more than two circuits of a similar nature will be allowed in one conduit unless otherwise specified.

The wiring of circuits shall be arranged in the loop-in system and not more than four cable ends may be terminated at a termination point.

Cutting away of cable strands or insulation is not allowed.

Where installed in vertical wireways, support the weight of the wiring by means of clamps at spacings not greater than 5m. In conduit such clamps shall be located in conduit boxes.

Where wireways pass through a fire wall, provide a fire barrier.

C3.3.3.21 E220 CABLE TRAYS AND LADDERS

C3.3.3.21.1 E220.1 GENERAL

Steel cable trays and ladders shall be galvanised.

Where painting is required, apply a calcium plumbate primer and apply two coats of high gloss enamel paint to SANS 630, or apply an epoxy-polyester powder coating to SANS 1274.

Cable trays and ladders and their accessories shall be pre-manufactured. On site fabrication will not be allowed without the express permission of the Engineer. Where standard lengths are cut on site, render smooth the cut edges, prepare the surface, apply two coats of zinc-rich paint and if painted, reinstate the paint system.

C3.3.3.21.2 E220.2 INSTALLATION

Install cable trays and ladders complete with cross-overs, tees, reducers, bends, elbows, cornices, splices, traying arms, fixings, brackets, "unistruts", clamps, hangers, nuts, bolts, washers, screws and all other accessories required to complete the installation.

Support cable trays and ladders to prevent sagging beyond 1/180th of the span or 3mm whichever is the lesser. Each length shall be supported in at least two places along the length. The diameter of expanding bolts, studs, etc., and nuts, bolts and patent fixings, etc., securing the trays and ladders shall not be less than 10mm.

C3.3.3.21.3 E220.3 HEAVY DUTY CABLE LADDERS

Cable ladders unless otherwise specified, shall be heavy duty manufactured of sheet steel at least 2.0mm thick with shoulders at least 76mm high. Cable ladders and accessories shall be hot-dip galvanised to SANS 121.

Rungs shall be spaced at intervals not greater than 300mm. Bends, tees, elbows, cross-overs and reducers shall have minimum radii of 450mm.

Support cable ladders on traying arms of length to suit ladder width and fitted with end caps. Cable ladder lengths over 3m shall be supported in at least three places along the length.

Bolts, nuts and washers securing splice pieces shall be at least 6mm diameter.

Where cable ladders ramp slightly so that a bend is not required provide hinged splice pieces hinging on 8mm nuts, bolts and washers and with radiused corners.

C3.3.3.21.4 E220.4 LIGHT DUTY CABLE LADDERS

Light duty cable ladders may only be installed where specified or where expressly permitted by the Engineer. These cable ladders shall be manufactured of sheet steel with shoulders comprising 41.3mm x 10mm x 1.6mm pressed steel channels. Cable ladders and accessories shall be hot dip galvanised to SANS 121. Rungs shall be spaced at intervals not greater than 300m. Bends, tees, elbows, cross-overs and reducers shall have minimum radii of 300mm. Support cable ladders on traying arms of length to suit ladder width and fitted with end caps. Cable ladder lengths over 3 m shall be supported in at least 3 places along the length. Changes of direction shall be undertaken with manufactured elbows hinged horizontal splices or hinged vertical splices. Bolts, nuts and washers securing splices shall be at least 10mm diameter.

The hinge pin of the hinged horizontal splice shall be at least 8mm diameter.

Hinged horizontal or vertical splices may be used for elbows and bends up to 45°. Manufactured elbows and bends shall be used for elbows and bends over 45°.

C3.3.3.21.5 E220.5 HEAVY DUTY CABLE TRAYS

Cable trays, unless otherwise specified, shall be heavy duty manufactured from perforated sheet steel at least 2.5mm thick with shoulders at least 76mm high. Heavy duty cable tray and accessories shall be hot-dip galvanised to SANS 121.
Provide cornices at changes of direction to allow minimum bending radii of cables.

Support heavy duty cable trays on traying arms of length to suit tray width and fitted with end caps.

C3.3.3.21.6 E220.6 LIGHT DUTY CABLE TRAY

Light duty cable trays may only be installed where specified or where expressly permitted by the Engineer and shall be manufactured from perforated sheet steel at least 1,2mm thick with shoulders at least 19mm high. Light duty cable trays and accessories shall be galvanised to SANS 121.

Provide cornices at changes of direction to allow minimum bending radii of cables. Support light duty cable trays on traying arms of length to suit tray width.

C3.3.3.22 E221 ACCESSORIES: LIGHT SWITCHES AND SOCKET OUTLETS

C3.3.3.22.1 E221.1 LIGHT SWITCHES

C3.3.3.22.1.1 E221.1.1 General

Wall switches shall comply with SANS 163 and bear the SABS mark and shall be of the tumbler-operated microgap type. Submit samples to the Engineer for approval.

Wall switches shall be rated for 250V 16A. Install wall switches with the centre 1 350 mm above finished floor level

Switch boxes and cover plates shall comply with SANS 1085 and SANS 1084.

Multiple switches may be allowed only if the switches control the same circuit. Switches controlling separate circuits on different phases shall be installed in separate boxes.

Switch toggles or rockers shall operate in a vertical direction.

Where indicating lights are specified, they shall form an integral part of the switch and shall have neon lamps or light-emitting diodes.

Light switches shall be finished as scheduled.

Metallic switch plates shall be secured with two chromium plated countersunk screws. Non- metallic switch plates shall be secured with two nylon countersunk screws.

C3.3.3.22.1.2 E221.1.2 Flush Wall Switches

Where conduit is routed flush, install flush wall switches built into conduit boxes.

C3.3.3.22.1.3 E221.1.3 Surface-mounted Flush-Pattern Switches

Where flush-pattern switches are to be mounted on the surface they shall be mounted in 100mm x 50mm or 100mm x 100mm by 35mm deep extension boxes.

C3.3.3.22.1.4 E221.1.4 Industrial Surface-mounted Switches

The box and cover plate shall be constructed of steel fitting together to make a dustproof assembly, IP44 to IEC Publication 162. The switch toggle or rocker shall be shrouded where it protrudes through the cover plate.

Where required, dustproof industrial surface-mounted switches shall incorporate hinged and sprung dust-proof flaps over the switches.

C3.3.3.22.1.5 E221.1.5 Hose-proof Switches

Switches designated hose-proof, weather-proof or waterproof shall be of non-metallic construction and hose-proof to IPW65 of IEC Publication 162. Operation may be rotary, or rocker through a membrane.

C3.3.3.22.1.6 E221.1.6 Ceiling Switches

Ceiling switches shall be rated for 250V, 10A (amp) shall be installed on a round conduit box. The base shall be bakelite and the cover of bakelite with a brass screw ring insert.

Provide a 1.25m length of nylon cord.

C3.3.3.22.2 E221.2 SOCKET OUTLETS

C3.3.3.22.2.1 E221.2.1 General

Socket outlets shall comply with SANS 164:1953 and bear the SABS mark or with SANS 1239:1979 and IEC 309 as applicable. All socket outlets shall be earth leakage protected. Submit samples to the Engineer for approval.
Unless otherwise specified, socket outlets shall be rated for 250V (phase to neutral) 16A, shall be switched and have safety shutters on the phase and neutral contact tubes.

Where indicating lights are specified, they shall form an integral part of the socket outlet and shall have neon lamps or light-emitting diodes.

Install socket outlets with the centres at the following heights above finished floor level unless otherwise noted: -

a) generally, unless otherwise specified : 300mm

b) hospitals, clinics etc. : 450mm

c) kitchens, laboratories, industrial areas, plant rooms and over work tops : 1,200mm
Socket outlets shall be finished as scheduled.

Metallic socket outlet plates shall be secured with two countersunk chromium-plated screws. Non-metallic plates shall be secured with two countersunk nylon screws.

C3.3.3.22.2.2 E221.2.2 Flush Single-phase Socket Outlets (16A)

Flush single-phase socket outlets shall be rated for 250V 16A and incorporate three contact tubes. They shall be mounted in 100mm x 100mm conduit boxes.

C3.3.3.22.2.3 E221.2.3 Surface-mounted Flush-pattern Single-phase Socket Outlets

Where flush-pattern single-phase socket outlets are to be mounted on the surface they shall be mounted in 100mm x 50mm or 100mm x 100mm extension boxes.

C3.3.3.22.2.4 E221.2.4 Industrial Surface-mounted Single-phase Socket Outlets

The box and cover plate shall be constructed of steel fitting together to make a dust-proof assembly, IP44 to IEC Publication 162. The switch toggle or rocker shall be shrouded where it protrudes through the cover plate.

Where required, dust-proof industrial surface-mounted socket outlets shall incorporate hinged and sprung dust proof flaps over the switches and contact tubes.

C3.3.3.22.2.5 E221.2.5 Moulded Case Circuit Breaker Single-phase Socket Outlets

These socket outlets shall comprise a miniature moulded case circuit breaker and a 250V, 16A 3-contact tube socket outlet mounted in a standard 100mm x 100mm box. The miniature MCCB shall be Heinemann AM1-21 or approved alternative and shall be rated at 10A unless otherwise noted. The assembly shall be Hain catalogue reference SGNY-lO or approved alternative.

C3.3.3.22.2.6 E221.2.6 Hose-proof Socket Outlets

Socket outlets designated hose-proof, weather-proof or water-proof shall be hose-proof to IPW65 of IEC Publication 162 when the plug is removed and with the plug inserted.

C3.3.3.22.2.7 E221.2.7 Three-phase Socket Outlets

Three-phase socket outlets shall be of the CEE 17, 380V, 6h pattern with 5 contact tubes for three-phases, neutral and earth. Each outlet shall incorporate a switch which can only operate with the plug inserted. Unless otherwise specified, the outlets shall be rated at 16A.

C3.3.3.22.2.8 E221.2.8 Stove Connectors

Stove connectors shall be rated for 433/250V, 15A with four contact tubes for three-phases and neutral. Earth continuity shall be provided through the metallic casing of the socket outlet to the metallic casing of the plug by means of a screwing ring.

Stove connectors shall comply with the Appendix referred to in Regulation 707 (13) of the Standard Regulations for the Wiring of Premises.

C3.3.3.22.2.9 E221.2.9 5A Single-phase Socket Outlets

5A single-phase socket outlets shall be un-switched, rated for 250V, and have 3 contact tubes with shuttered live and neutral tubes. The socket outlets may be mounted in pre- punched trunking, 63mm dia., 100mm x 50mm or 100mm x 100mm conduit boxes.

C3.3.3.22.2.10 E221.2.10 Shaver Socket Outlets

Shaver socket outlets shall comply with BS 3052 and shall incorporate a double-wound isolating transformer rated at least 20VA and providing 115V and 230V.

The socket contacts shall be suitable for 115V North American pattern plug tops and 230V European pattern plug tops. Insertion of a plug top shall switch on the transformer primary and removal of the plug top shall switch it off.

Overload protection shall be included.

C3.3.3.22.2.11 E221.2.11 13A Single-phase Socket Outlets

13A single-phase socket outlets shall comply with SANS 1363.

C3.3.3.22.3 E221.3 ISOLATORS (SWITCH DISCONNECTORS) FOR BUILDING SERVICES APPLICATIONS

Isolators shall comprise air-break switch disconnectors complying with SANS 152-1977, be double-pole for single-phase circuits and triple-pole for three-phase circuits and be rated for 433/250V.

The current rating shall be 63A unless otherwise specified.

Isolators for single-phase appliances with loads less than 2,5kVA may have current ratings of 13A.

Where the final connection from the isolator comprises a flexible cord, the isolator assembly shall incorporate an indicating light, a grommet and cord grip or a compression gland, and a fuse rated to protect the cord.

Metallic cover plates shall be secured with two countersunk chromium-plated screws and non- metallic cover plates with two countersunk nylon screws.

The isolators shall be finished as scheduled.

Where indicating lights are specified, they shall form an integral part of the isolator assembly and shall have neon lamps or light-emitting diodes.

Isolators up to 63A current rating shall be installed in 100mm x 100mm conduit boxes.

C3.3.3.23 E222 LUMINAIRES

C3.3.3.23.1 E222.1 GENERAL

Provide all luminaires listed in the Schedule and shown on the Drawings including procurement, delivery, acceptance, storage, installation, aiming, adjustment, testing and commissioning.

Luminaires shall be installed complete with mounting accessories, brackets, poles, stirrups, baseplates etc.

Excavate, backfill and consolidate as necessary for luminaires.

Luminaires shall include lamps, indicator lamps, control gear, power factor correction equipment, electro-magnetic interference suppression equipment and all other accessories necessary to render the luminaires fully operative.

Luminaires shall not emit electro-magnetic or radio/television interference in excess of the limitations stipulated by the Department of Posts and Telecommunications.

Luminaires shall have internal wiring of copper conductors of not less than 0,5mm², with suitable heat-resistant wiring to SANS 529. PVC insulated wire shall not enter luminaires with polycarbonate components. A terminal block shall be fitted to each luminaire. Luminaires shall each have an earth terminal and shall be bonded to earth.

Each luminaire shall be labelled next to the lamp holder and on the control gear with the following information: -

a) voltage rating;

b) lamp type

c) lamp wattage (for incandescent lamps, the maximum wattage).

Control gear shall be power factor corrected to at least 0,9 lagging, shall have a circuit efficiency of not less than 0,85 and shall be silent in operation.

Capacitors shall comply with SANS 1250:1979.

On request of the Engineer, submit luminaire details (including photometric data, and noise level reports) prepared by an accredited laboratory.

On request of the Engineer, remove any luminaire from site and submit luminaire to tests required by Engineer.

Luminaires shall be designed and installed to avoid excessive temperatures. Components and materials shall be so selected that they are not adversely affected by the operating temperature.

The harmonic distortion of a lamp circuit shall not exceed 30%.

C3.3.3.23.2 E222.2 INSTALLATION

C3.3.3.23.2.1 **E222.2.1** Refer to Section: "Fixing of Materials" of this Specification.

C3.3.3.23.2.2 **E222.2.2** Install luminaires in accordance with the manufacturer's recommendations.

C3.3.3.23.2.3 **E222.2.3** Mount luminaires after the first coat of paint has been applied. Await final coat of paint, before completing installation of luminaires.

C3.3.3.23.2.4 **E222.2.4** Fix luminaires equal to or narrower than 225mm at the centre and two outer positions. Fix luminaires wider than 225mm at the centre and at the four corners.

C3.3.3.23.2.5 **E222.2.5** Where luminaires butt, fix them together with brass bushes and lock nuts.

C3.3.3.23.2.6 **E222.2.6** Screw conduits directly to exterior luminaires and to luminaires with a degree of protection in excess of IP44.

Provide gasketting and sealants between luminaires and surface to which they are mounted. For wall-mounted luminaires, the conduit shall enter the luminaire at a slight downward angle to the horizontal.

C3.3.3.23.2.7 **E222.2.7** Where luminaires are mounted on, or in, ceilings made of panels, mount the luminaires symmetrically. Where the mass of the luminaires exceeds the load carrying capability of the ceiling systems, install suitable hangers.

Connections to luminaires mounted on or in ceilings shall comprise metallic conduit, flexible conduit (without a PVC sheath), or silicone rubber flexible cord. Co-ordinate such connections with the Contractors installing the ceiling, air conditioning and other services.

C3.3.3.23.3 E222.3 EXTERIOR LUMINAIRES

Exterior luminaires shall have a degree of protection of at least IPW65 of IEC-162. Lenses shall be resistant to degradation and discolouration from ultra-violet radiation. Materials shall be corrosion-resistant and selected to avoid electrolytic corrosion. Luminaires constructed of sheet steel or sheet aluminium are not acceptable.

The bodies shall be painted cast-iron; painted, or anodised (Class C), die-cast LM6 aluminium; glass-reinforced polyester; or polycarbonate.

Gaskets shall be silicone rubber or neoprene.

Lenses shall be polycarbonate or heat-resistant glass. Lens, or lens-frame, securing screws shall be stainless steel.

Floodlight luminaires shall incorporate calibrated horizontal and vertical angle scales.

C3.3.3.23.4 E222.4 SHEET METAL WORK AND PAINTING

C3.3.3.23.4.1 **E222.4.1** Sheet metal work shall be constructed from cold-rolled, rust-proofed sheet steel not less than 0.8mm thick suitably reinforced and braced for rigidity.

C3.3.3.23.4.2 **E222.4.2** Degrease, de-rust and then phosphate with a light-weight hot phosphating solution in accordance with Section 2.4 of SANS 064:1960.

C3.3.3.23.4.3 **E222.4.3** Prime with an epoxy zinc-chromate primer. Lightly sand and paint with two or more coats of white acrylic baking enamel and then bake to comply with Type 1 SANS 663:1959.

C3.3.3.23.4.4 **E222.4.4** An approved epoxy-polyester baked powder coating process SANS 1274:1979 may be substituted for the painting specified above in clause 20.4.3.

C3.3.3.23.4.5 **E222.4.5** Paint finish shall be smooth, glossy and free from imperfections.

C3.3.3.23.5 E222.5 EMERGENCY AND STANDBY LUMINAIRES

C3.3.3.23.5.1 E222.5.1 EMERGENCY FLUORESCENT LUMINAIRES (WITH INTEGRAL BATTERY)

Each emergency fluorescent luminaire with integral battery shall incorporate a mains-failure relay, battery charger, nickel cadmium battery, and inverter which shall provide emergency lighting by means of one lamp operating at 100% light output for at least one hour. The battery charger shall fully recharge the batteries within 24 hours.

C3.3.3.23.5.2 E222.5.2 MERCURY VAPOUR LUMINAIRES ON EMERGENCY AND STANDBY CIRCUITS

Each mercury vapour luminaire on an emergency or standby circuit shall incorporate a mains failure relay, change-over switchgear, a photo switch and quartz halogen lamp. The quartz halogen lamp shall operate on mains failure until the mercury vapour lamp has run up when the photoswitch shall extinguish the quartz-halogen lamp.

C3.3.3.23.5.3 E222.5.3 HIGH-PRESSURE SODIUM LUMINAIRES ON EMERGENCY AND STANDBY CIRCUITS

Each high-pressure sodium luminaire on an emergency or standby circuit shall have a lamp with a run up time of not less than 20 seconds.

C3.3.3.23.5.4 E222.5.4 EXIT SIGNS

Each exit sign with integral battery shall incorporate two fluorescent lamps each with its own separate control gear, mains failure relay, battery charger, nickel cadmium battery and inverter which shall provide emergency lighting by means of one lamp operating at 100% light output for at least one hour. The battery charger shall fully recharge the batteries within 24 hours.

Exit sign lettering shall be at least 150mm high.

Exit signs shall comply with BS 5266 and BS 2560. Surface-mounted exit signs shall incorporate an aperture of at least 200mm x 50mm with prismatic diffuser to provide downward light.

C3.3.3.23.6 E222.6 FLUORESCENT LUMINAIRES

C3.3.3.23.6.1 E222.6.1 GENERAL

Interior fluorescent luminaires shall comply with SANS 1119:1976.

C3.3.3.23.6.2 E222.6.2 CONSTRUCTION

Provide three 20mm diameter knockouts in the backplate, one in the centre and one at each end. Each knockout shall have accompanying slots for screws to fit a standard round conduit box and arranged so that the luminaire can be turned through an angle of 90°C. The backplate shall extend the entire length of the luminaire. Luminaires shall be so constructed that it is possible to reach the control gear without disconnecting any wiring and without removing the luminaire from its installed position.

C3.3.3.23.6.3 E222.6.3 CHANNEL LUMINAIRES

Fluorescent channel luminaires shall consist of a ventilated rectangular wiring channel.

C3.3.3.23.6.4 E222.6.4 LENSES. DIFFUSERS AND LOUVRES

Lenses, diffusers and louvres shall be sufficiently strong and rigid to resist distortion and breakage during normal operation and maintenance.

Lenses, diffusers and louvres shall be constructed of:

a) flame-retardant acrylic (methacrylate),

b) flame-retardant, UV and light stabilised polystyrene, or

c) UV and light stabilised polycarbonate.

C3.3.3.23.6.5 E222.6.5 COMPONENTS

Ballasts shall comply with SANS 890:1967. Unless otherwise specified ballasts shall be switch-start. Switch-start ballasts shall be wound length-wise around pre-assembled laminations crimped into a steel channel. No compound shall be required.

Starters shall comply with BS 3772/IEC-55 and be accessible for replacement with the lamps in position.

Lamp holders shall be telescopic or hinged sprung-ratchet.

C3.3.3.23.6.6 E222.6.5 LAMPS

Lamps shall comply with SANS 1041:1975. Lamps shall have an average life of at least 7500hours on a 3 hour on/off switching cycle. On request submit to the Engineer the light output of the lamps at 100hours and 2000hours. The light output at 2000hours shall not be less than 80% of the output at 100hours.

No lamp flicker of lamps shall be visible under normal operation after initial stabilisation period of 100hours. Lamp colour shall be SANS colour reference 2 unless otherwise specified. 18W, 36W, and 58W fluorescent lamps (26mm diameter) shall be "colour 84" unless otherwise specified.

C3.3.3.23.7 E222.7 INCANDESCENT LUMINAIRES

Lamp holders shall be porcelain.

Lamp holders for lamps of 150W and higher rating shall be Edison Screw (E.S.).

The operating temperature within the luminaires shall be limited to avoid any adverse effects on any components.

C3.3.3.23.8 E222.8 GAS-DISCHARGE LUMINAIRES

Ballasts shall comply with SANS 1266:1979. Ballasts shall be cast in epoxy-resin and provided with heat sinks, cooling fins, etc., to limit the operating temperature to avoid any adverse effects to any components.

Interior luminaires shall comply with SANS 1278:1980.

Mercury vapour lamps shall be of the colour corrected, high pressure, fluorescent type. High pressure sodium vapour lamps shall be of the colour enhanced type.

C3.3.3.24 E223 LIGHTNING PROTECTION

C3.3.3.24.1 E223.1 SCOPE OF WORK

The following sections of work are included in the lightning protection installation:

C3.3.3.24.1.1 E223.1.1 Air terminations (other than metallic roofs).

C3.3.3.24.1.2 E223.1.2 Down conductors (other than reinforcing steel and metallic columns).

C3.3.3.24.1.3 E223.1.3 Earth terminals.

C3.3.3.24.1.4 E223.1.4 Earth conductors and associated excavations and backfilling.

C3.3.3.24.1.5 E223.1.5 Bonding.

C3.3.3.24.2 E223.2 GENERAL

C3.3.3.24.2.1 E223.2.1 DEFINITIONS

"Air termination" - The part of a lightning protective system that is intended to intercept lightning discharges (Air terminations include masts, metallic roofs, roof conductors and finials).

"Down conductor" - A conductor that connects an air termination to the earth terminal. "Earth terminal". The above ground terminal of the earthing system.

"Earthing system" - That part of the lightning protective system that is intended to discharge lightning currents into the general mass of the earth.

"Finial" - An air termination consisting of a metal rod with a rounded end.

C3.3.3.24.3 E223.3 COMPLIANCE WITH REGULATIONS AND STANDARDS

The lightning protection installation shall comply with SANS Code of Practice 03 and 03A.

C3.3.3.24.4 E223.4 DRAWINGS

C3.3.3.24.4.1 E223.4.2 Submit shop drawings of the following:

C3.3.3.24.4.1.1 E223.4.2.1 Details of reinforcing steel bonding terminals.

C3.3.3.24.5 E223.5 MATERIALS

C3.3.3.24.5.1 E223.5.1 CONDUCTORS

C3.3.3.24.5.1.1 E223.5.1.1 Conductors above ground may be of copper or of a suitable corrosion resistant aluminium alloy.

C3.3.3.24.5.1.2 E223.5.1.2 Aluminium conductors may not be installed in direct contact with concrete of plaster but shall be installed with suitable insulating sleeves and stand-off brackets.

C3.3.3.24.5.1.3 E223.5.1.3 Aluminium conductors may only be connected to copper with cadmium-plated or heavily tinned connectors.

C3.3.3.24.5.1.4 E223.5.1.4 Copper conductors may only be connected to galvanised steel via a heavily tinned connector above ground.

C3.3.3.24.5.1.5 E223.5.1.5 Underground connections shall only be made between similar metals.

C3.3.3.24.5.1.6 E223.5.1.6 Avoid copper conductors in the vicinity of underground galvanised steel services.

C3.3.3.24.5.1.7 E223.5.1.7 Avoid galvanised steel conductors in the vicinity of underground copper services.

C3.3.3.24.5.1.8 E223.5.1.8 Stainless steel components shall be Type 304 or approved alternative.

C3.3.3.24.5.1.9 E223.5.1.9 Aluminium may not be installed underground except in short lengths completely protected by a plastic sleeve with both ends above ground and facing downwards.

C3.3.3.24.5.1.10 E223.5.1.10 Any steel components shall be hot dip galvanised to SANS 763.

C3.3.3.24.6 E223.6 FIXING OF MATERIALS

C3.3.3.24.6.1 E223.6.1 CONDUCTOR FASTENINGS

C3.3.3.24.6.1.1 E223.6.1.1 Conductors shall be securely fastened at spacings of not less than 1.5m.

C3.3.3.24.6.1.2 E223.6.1.2 The fastenings shall allow for thermal expansion and contraction and prevent direct contact between aluminium and concrete or plaster.

C3.3.3.24.6.1.3 E223.6.1.3 The fastening system shall comprise components selected to avoid corrosion, and deterioration from weather, ultra-violet radiation, moisture, heat and cold.

C3.3.3.24.7 E223.7 TESTING

C3.3.3.24.7.1 E223.7.1 Provide permanent testing joints between each down conductor and it associated earth conductor.

C3.3.3.24.7.2 E223.7.2 Test and submit test record to Engineer, as follows:

C3.3.3.24.7.2.1 E223.7.2.1 Earth resistance of earth conductor.

C3.3.3.24.7.2.2 E223.7.2.2 Continuity of any trench earth.

C3.3.3.24.7.2.3 E223.7.2.3 Continuity of overhead system by measuring between one down conductor and each of the remaining down conductors with the earth conductors disconnected.

C3.3.3.24.8 E223.8 ROOF CONDUCTORS, FINIALS AND DOWN CONDUCTORS

C3.3.3.24.8.1 E223.8.1 These shall comprise strip, rod, tube or stranded conductor of at least 50mm² cross- sectional area, of copper, brass, phosphor-bronze, aluminium, stainless steel or galvanised steel.

C3.3.3.24.8.2 E223.8.2 Galvanised steel, however, may not be used within 50km of the coast.

C3.3.3.24.9 E223.9 REINFORCING STEEL CONNECTIONS

Where reinforcing steel is to be connected to the lightning protective system, provide a corrosion resistant terminal embedded in the concrete, the terminal being connected internally to the reinforcing steel by means of a robust conductor clamped to the reinforcing steel.

C3.3.3.24.10 E223.10 JOINTS

Join lengths of tube, rod or stranded conductor with suitable crimped ferrules.

Join lengths of strip by double riveting, two nuts and bolts with washers, brazing, welding, or by clamping. Rivets, nuts, bolts and washers shall be of the same material as the conductor. Self- tapping screws or pop rivets may not be used for any joints.

Joint surface shall be prepared by thorough cleaning and coating with suitable compound. Riveted, screwed or bolted joints shall be painted or coated with compound.

C3.3.3.24.11 E223.11 EARTH RODS

C3.3.3.24.11.1 E223.11.1 Single earth rods shall be installed at a depth of at least 1,5m below final ground level.

C3.3.3.24.11.2 E223.11.2 An array of earth rods shall be installed at a depth of at least 0,9m below final ground level.

C3.3.3.24.12 E223.12 BONDING

Bond any metallic objects within 500mm of a roof or down conductor. (Such objects include antennae, pipes, stairways, balustrades and sun screening).

Bond at least one earth terminal or down conductor to any metallic water main.

Bond all metallic finials, ducts, vent pipes that are on, or project above, the roof to a roof or down conductor. Bond any metallic foil or wire netting immediately under the roof to a roof or down conductor at least two points.

C3.3.3.24.13 E223.13 ANTENNAE EARTHING

Bond antennae via a down conductor to an earth terminal and to any metallic water main.

C3.3.3.25 E231 MEDIUM VOLTAGE (UP TO 33 KV), LOW VOLTAGE AND PILOT CABLES

C3.3.3.25.1 E231.1 GENERAL

C3.3.3.25.1.1 E231.1.1 The Contractor shall supply and install cables as specified in the Project Specification and indicated on the drawings.

C3.3.3.25.2 E231.2 CABLE CONSTRUCTION

C3.3.3.25.2.1 E231.2.1 MEDIUM VOLTAGE CABLES

C3.3.3.25.2.1.1 E231.2.1.1 Paper-insulated Cables

1) Heavy duty, mass-impregnated, belted, non-draining, paper-insulated, lead-covered, steel wire armoured, unearthed, stranded 3-core cables, shall be supplied, which shall conform to the latest issue of SANS 97. If steel tape armouring and/or screened cables are preferred, it will be specified*** in the project specification.

2) Cables shall have an outer serving of PVC, unless otherwise specified.

3) Anti-electrolytic cables, where called for, shall finally be served with PVC. The following information shall be printed on the outer PVC sheath, in the factory, where possible: -

Voltage, e.g.	:	11kV
Size, e.g.	:	185 Cu or 185 A1.
Name of Client	:	If required in Project Specification

The abovementioned information shall be printed on the cable at reasonable intervals.

4) The cores of cables shall be stranded copper or aluminium conductors as specified or as alternatively offered.

C3.3.3.25.2.1.2 E231.2.1.2 Cross-linked Polyethylene Cables

1) Cross-linked polyethylene (XLPE), 3-core, steel wire armoured, or un-armoured cables of an approved manufacture shall be used when specified, provided that full technical information is submitted with the tender. All XLPE insulated cables offered shall comply with SANS 1339. Cores shall be individually screened.

2) The type of cable required shall be specified in the Project Specification.

3) The following information shall be printed on the outer PVC sheath, in the factory, where possible: -

Voltage, e.g.	:	11kV
Size, e.g.	:	185 Cu or 185 A1.
Name of Client	:	If required in Project Specification

The abovementioned information shall be printed on the cable at reasonable intervals

C3.3.3.25.2.2 E231.2.2 LOW VOLTAGE CABLES (1000V)

C3.3.3.25.2.2.1 E231.2.2.1 Cables

1) All low voltage cables shall be polyvinyl chloride insulated with steel wire armouring or strip aluminium armouring, as specified, and served overall with a final layer of polyvinyl chloride.

2) Cables shall be round with the number of cores specified and suitable for general service as prescribed in SANS 1507.

3) The cores shall be stranded copper or solid shaped aluminium.

4) The cables with stranded copper cores shall be armoured with single steel wire armouring, unless otherwise specified.

5) The cables with solid aluminium cores shall be armoured with strip aluminium armouring or steel wire armouring as specified.

6) Cables with tinned copper earth continuity conductors as part of the armouring shall only be provided when specified in the project specification.

C3.3.3.25.2.3 E231.2.3 PILOT CABLES

C3.3.3.25.2.3.1 E231.2.3.1 Specification and Core Sizes

Pilot cables shall comply with the applicable SANS.

Pilot cable cores shall be 0,9mm diameter unless otherwise specified.

C3.3.3.25.2.3.2 E231.2.3.2 Working Conditions

The pilot cables may be installed in the same trenches as low voltage or high voltage power cables at depths varying between 0,8 and 1,5m. Pilot cables may also be installed directly underneath and parallel with overhead power lines.

Pilot cables shall be used for protection applications, as well as speech and data communications.

C3.3.3.25.2.3.3 E231.2.3.3 Electrical Requirements

1)	Continuous working voltage	:	250V, 50Hz between cores
2)	Maximum loop resistance	:	56 ohm/km
3)	Minimum insulation resistance	:	30 000 megaohm/km
4)	Mutual capacitance of pair	:	60 nanofarad/km maximum at 800Hz
5)	Capacitance unbalanced	:	600 pF/km maximum at 800Hz
6)	Overvoltage withstand capabilities	:	5kV between any two cores; 10kV between any core and any metal work that may be earthed
7)	General	:	Pilot cables shall be designed to ensure the minimum crosstalk level and maximum immunity against induced effects

C3.3.3.25.2.3.4 E231.2.3.4 Mechanical Requirements

1) Unless otherwise specified, pilot cables for outdoor use shall be petroleum-jelly filled. Contractors may offer cables with a polyethylene/ aluminium laminated sheath as alternative for consideration by the Engineer.

All pilot cables shall in any case be fully waterproof, even when operating for extended periods of time fully submerged in water or waterlogged soil.

2) Cable insulation shall be polyethylene.

3) Bedding layers shall be polyethylene.

4) Galvanized steel wire armouring shall be provided.

5) The outer sheath of the cable shall be PVC and an overall conductive coating of colloidal graphite or other conductive material shall be applied to the serving to facilitate voltage testing to earth.

6) All cores shall be clearly and indelibly identified by means of numbers or a colour code.

7) Contractors may offer alternative cables, but full constructional detail shall be submitted with tenders.

C3.3.3.25.2.3.5 E231.2.3.5 Tests and Inspections

1) All pilot cables offered shall in all respects comply with applicable international and/or Telkom Specifications.

2) Tender prices shall include for the costs of performing the following tests on each drum of cable:

   a) Conductor resistance test

   b) Overvoltage tests

   c) Capacitive tests

3) The Engineer shall be notified at least two weeks in advance of when such tests are to be performed. The Engineer reserves the right to witness all such tests.

4) Test certificates of all tests shall be submitted to the Engineer prior to or with the delivery of the cables.

C3.3.3.25.2.3.6 E231.2.3.6 Pilot Cable Terminal Boxes

1) The multicore cables shall be connected to the panels and equipment via terminal strips in terminal boxes in all substations when specified in the project specification.

2) The Contractor shall allow for the supply and installation of centrally situated, wall mounted terminal boxes when applicable.

3) The terminal boxes shall be manufactured from mild steel of minimum thickness of 2mm. A steel frame shall be used to ensure rigidity where necessary. The terminal boxes shall be fitted with front opening hinged lockable doors.

4) All doors shall be of a neat dustproof fit, and the enclosures shall be completely vermin proof.

5) The terminal boxes shall be adequately ventilated for the prevention of condensation.

6) The terminal boxes shall be wall mounted.

7) The terminal strips inside the terminal box shall comply with the standard specification.

8) Terminal blocks shall have separate terminals for incoming and outgoing wires, and not more than two wires shall be connected to any one terminal. Insulating barriers shall be provided between adjacent pairs of terminals. The height of the barriers and the spacing of the terminals shall be such as to give adequate protection while allowing easy access to terminals. The connections shall be suitable for the cables provided.

C3.3.3.25.3 E231.3 EXCAVATIONS AND LAYING OF CABLES

C3.3.3.25.3.1 E231.3.1 GENERAL

1) 11kV Cables, low voltage cables, pilot cables, telecommunication cables and pipes shall be laid in the same trenches, where applicable, and in the positions as shown on the drawings.

   The rates for the laying of cables shall include for the laying of cables over or under other services.

2) The spacing between cables shall be exactly as shown on the drawings. The positions of cables shall always be measured from boundary lines of stands, unless otherwise specified.

3) After all cables have been laid and correctly spaced, they shall be inspected and approved by the Engineer before trenches are backfilled. In the event of the Contractor not notifying the Engineer well in advance of an inspection, the Contractor shall then open sections of the trenches for inspection at his own cost.

4) The tender prices for excavations shall include the following:

   a) Excavations of cable trenches.

   b) Levelling of the bottom of trenches.

   c) Supply and laying of a 75mm minimum layer of sifted soil.

   d) Supplying and covering of the cables with a 75mm layer of sifted soil after the cables have been laid and spaced and after the inspection and approval by the Engineer.

   e) The backfilling and consolidation of trenches with soft soil.

   f) The removal of all surplus materials from the sites.

   g) Finishing and levelling of sites where excavations were done.

5) Cables shall be drawn off drums in the same direction where more than one drum is involved in a cable laying route. The drums shall be suitably placed along the cable route. All drums shall be rolled as indicated by the arrows marked on the drums.

6) No crossing of cores shall be permitted in cable boxes.

7) The quantities of cable trench excavations as set out in the Bills of Quantities are estimated quantities. The Contractor will be paid according to the actual quantities as measured on site after the cable trenches have been excavated, measured, the cables laid, and the trenches backfilled.

8) All cable trenches and especially road crossings shall be properly consolidated. All road surfaces shall be reinstated to the original condition, unless otherwise specified.

9) The widths of cable trenches which will be used for the purpose of measurements, where applicable, will be determined by the combination of the number of cables and/or pipes as specified in the Project Specification and as shown on the drawings.

C3.3.3.25.3.2 E231.3.2 TRENCH PREPARATION

Once the trench has been basically excavated, trimmed and levelled, the bed of the trench shall receive the following treatment:

C3.3.3.25.3.2.1 E231.3.2.1 Trenching in Hand-Pickable Ground

1) The bed of the trench shall be checked for the presence of loose rocks or sharp objects. All loose foreign materials shall be removed, leaving the bed of the trench clear.

2) The cleared bed of the trench shall be lined with a layer of backfill screened through a 4mm mesh, to a depth of 75mm.

The bed of the trench shall be levelled in a manner which will prevent the cable riding high at any point along its installation. River sand or mine dump scrap will not be accepted as cable trench bedding.

C3.3.3.25.3.2.2 E231.3.2.2 Trenching in Ground requiring Rock-Breaking or Blasting

Where the cable trench has to be cut through ground requiring compressor drilling, rock breaking and/or blasting, the bottom screened soil backfill shall be laid so that 100mm of screened backfill covers rocky protrusions. All jagged edges of rock, and foreign materials such as loose rocks and sharp objects shall be removed so as to present no risk of subsequent damage to the cable.

C3.3.3.25.3.2.3 E231.3.2.3 Trench Backfilling

1) Upon completion of the cable laying, the cable shall be covered with a layer of 75mm of backfill screened through a 4mm mesh.

2) Subsequent backfilling, above the 75mm layer mentioned above, shall be screened through a 40mm mesh.

3) Cable protective slabs (only if specified) shall be placed over a minimum backfill of 75mm above the cables.

4) Excavated ground backfill shall follow upon Item 2 above, the backfill being consolidated at 300mm levels. The backfill shall be consolidated to at least the same compaction of the original surrounding soil, but to the satisfaction of the Engineer.

   Backfilling and consolidation shall be in accordance with SANS 1200.

5) The backfilled trench shall be domed so as to provide drainage, the dome being 150mm above the surrounding ground level.

C3.3.3.25.3.3 E231.3.3 ROAD AND RAILWAY CROSSINGS

C3.3.3.25.3.3.1 E231.3.3.1 General

The Contractor shall allow in his price for the complete installation of the road and railway crossings as indicated on the drawings.

1) The crossing installations shall be in accordance with the detail drawings included in the contract.

2) All excavations, unless otherwise specified in the tender documents, shall be constructed at right angles to the roads and/or railway servitudes.

3) Rigid PVC or asbestos cement pipes shall be used for the crossings. The pipes shall be properly joined. The open ends of spare pipes shall be sealed with easily removable caps or plugs.

4) All crossings, their construction and implementation, shall be carried out in accordance with the requirements laid down by the Local Authorities, the Provincial Roads Department, and the Department of Transport, the Transnet and others.

5) The rates for the laying of cables shall include the pulling through of cables through sleeve pipes in road crossings.

C3.3.3.25.3.3.2 E231.3.3.2 Road Crossings

1) Excavations across roads shall be carried out with the minimum inconvenience to the public and the authorities.

2) Excavations across main roads where the width of the road between kerbs is 9 meters or more, shall be carried out in half road widths so that the flow of traffic can be maintained.

3) Where tarred road surfaces are cut, such cuts shall be neat and straight, and no jagged edges shall be tolerated.

4) Road crossings in townships shall always be opposite a stand boundary peg unless otherwise shown.

5) The excavations shall be of such depth that the dimension from the top of pipe ducts to the road surfaces shall not be less than 1.2m, or as otherwise specified on detailed drawings.

6) The Contractor shall be responsible for the provision of road warning signs, road barriers, the stringing of danger tapes and the positioning of warning lamps between sunset and sunrise. Flashing type warning lamps shall also be positioned at strategic points in the construction areas to caution motor vehicle traffic.

C3.3.3.25.3.3.3 E231.3.3.3 Cable Pipe Ducts

1) Concrete, asbestos cement, polyethylene or PVC pipes shall be used for cable pipe ducts which shall comply with the relevant SANS specification. Suitable approved joints shall be used for the pipes.

2) The cable pipe ducts shall protrude not less than 750mm and not more than 1000mm on either side of the street kerbing.

3) The pipe ducts shall be neatly trimmed at the ends after laying, and a heat-shrinkable duct end cap shall be fitted over each and every open end through which no cable is installed. Where the size of the duct does not permit the fitting of these covers, then the open ends shall be sealed by means of a weak cement mix of 7 sand to 1 cement. Polystyrene plugs of suitable size may also be used.

4) All pipe ducts shall be fitted with galvanized steel draw wires.

5) The ducts shall be laid as shown on the enclosed drawings, the required depths and distances between duct centre lines being shown.

C3.3.3.25.3.3.4 E231.3.3.4 Trench Backfilling and Compaction

1) Only material which is compactable shall be used for the backfilling of road crossing excavations. At the discretion of the Engineer, suitable soil shall be imported for the backfill material. No rocks shall be included in the backfill.

2) The backfilling shall be carried out in 150mm layers (after compaction), each layer being compacted by means of a compacting machine. Each layer so backfilled shall have a sufficient moisture content to ensure that solid binding of the material is obtained. The backfill shall be compacted to modified AASHTO as specified in SANS 1200.

3) Tar re-instatement shall be carried out within four days of completing the trench backfilling. At this stage, the trench excavation shall be trimmed so as to permit the full thickness of tar re-instatement.

C3.3.3.25.3.3.5 E231.3.3.5 Railway Crossings

1) Crossings of railway tracks shall be carried out in accordance with the latest requirements as set out in the approvals received from the South African Transport Services (Transnet) and the requirements of SANS 15589 for cathodic protection of buried and submerged pipelines.

2) Railway crossings shall comply with the detail drawings issued in regard to main dimensions and installation details.

3) The installation Contractor shall fully familiarise himself with the railway's operational procedure, and the necessary forward planning shall be carried out by him for the safe execution of the work.

C3.3.3.25.3.3.6 E231.3.3.6 Types of Crossings and Duct Sizes

The crossings consist of the following:

1)	High voltage cable crossings	:	The cables shall be laid in 150mm dia. pipes. One spare pipe shall be installed for each high voltage cable, unless otherwise specified.
2)	Low voltage cable crossing	:	The main low voltage cables and street-light cables shall be laid in 100mm dia. pipes. No spare pipes are required for low voltage cables.
3)	Low voltage service connection cable crossings	:	These are crossings between minisubs or cubicles on the one side of the road reserve to low voltage connection boxes or service connection on the opposite side of the road reserve. More than one cable can be laid in the same 100mm dia. pipes. No spare pipes are required. These pipes shall be installed from the cable reserve on one side of the road reserve to the cable reserve on the opposite side of the road reserve with the ends of the pipe 0.5m from the stand boundaries.
4)	Special crossings	:	Cable crossings below motor highways and wide railway reserves are special cases and will be specified separately.

C3.3.3.25.3.4 E231.3.4 CLASSIFICATION OF EXCAVATIONS

C3.3.3.25.3.4.1 E231.3.4.1 Tenders shall submit rates for excavations in the following soil types

1) Excavations in Soft Materials

Excavations which can, in the opinion of the Engineer, be carried out by pick and shovel or a machine shall be considered as excavations in soft material. The classification definition for "soft excavations" and "intermediate excavations" as set out in SANS 1200, are combined in this specification document as "excavations in soft materials".

2) Hard Rock Excavations

Excavations in formations that require blasting or wedging and splitting, will be classified as hard rock excavations. The rates shall include the removal of rock from site.

3) Boulder Excavations, Class "A"

Excavations in material containing by volume more than 40% boulders ranging in size from 0,03m³ to 2,0m³ in a matrix of soft material, will be classified as boulder excavations, Class "A". The rates shall include the removal of rock from site.

4) Boulder Excavations, Class "B"

Excavations in material containing by volume 40% or less boulders ranging in size from 0,03m³ to 2,0m³ in a matrix of soft material, will be classified as boulder excavations, Class "B". The rates shall include the removal of rock from site.

C3.3.3.25.3.4.2 E231.3.4.2 The excavations will be measured as set out in SANS 1200. Excavations in soft materials will be measured on a linear basis.

The measurement for the following excavations will be on a volumetric basis and it will be considered as an extra over rate:

1) Hard rock excavations

2) Boulder excavations, Class "A"

3) Boulder excavations, Class "B"

C3.3.3.25.3.4.3 E231.3.4.3 The Engineer's decision as to the type of excavations excavated shall be final and binding, and the Contractor shall be paid in accordance with the classification by the Engineer.

C3.3.3.25.3.4.4 E231.3.4.4 Jointing Pits

The Contractor shall provide workable jointing pits where cables are to be jointed. The costs of jointing pits are to be included in the normal excavation rates of cable trenches.

C3.3.3.25.3.5 E231.3.5 CABLE TRENCH LAYOUT

The standard minimum cable trench depths are as follows unless otherwise specified:

1) 11kV Cables only, or 11kV plus LV cables : 1.0m deep
2) Pipes for cables underneath road surfaces : 2m to top of pipe measured from lowest point of final road surface
3) LV cables and streetlight cables : 800mm deep
4) Cables through premises and property
   a) 11kV only, or 11kV plus LV or LV Ma Cables : 1,000mm deep plus slabs
   b) Service connection cables : 800mm deep without slabs

Widths of cable trenches which will be used for the purpose of measurements, where applicable, are determined by the combination of the number of cables and/or pipes as specified in the Project Specification and as shown on the drawings.

C3.3.3.25.3.6 E231.3.6 CABLES IN SERVITUDES INSIDE STANDS

The Contractor shall conform to the following requirements where cables are laid in servitudes inside stands:

1) The cable trenches shall be 1,0m deep or as specified and as close as possible to the stand boundary, but inside the servitude.

2) The cable shall be laid on a 75mm bedding of sifted soil.

3) The cable shall be covered with a 75mm layer of sifted soil.

4) Concrete slabs shall be laid above the cable on top of the sifted soil covering mentioned in Item (3) above, for the full length of the stand. PVC marker tape shall be laid on top of the concrete slabs.

5) The trench shall be back-filled and consolidated as previously specified, and the site shall be levelled. All surplus materials shall be removed.

6) The costs of the concrete slabs shall be included in the prices for the laying of cables unless separate pricing is requested.

C3.3.3.25.3.7 E231.3.7 CABLE CROSSINGS

1) Where power cables cross communication cables and/or pipes and vice versa, the crossings shall be done in accordance with the requirements of Telkom. The power cables shall be laid underneath the communication cables and concrete slabs shall be laid above the power cables to separate the power and telecommunication cables.

2) Where power cables cross each other, the cables shall not be laid directly on top of each other but shall be separated with a 100mm layer of sifted soil. Where the cables cross, they shall not be bent with less than the minimum allowable radius.

3) After completion of the work the Contractor shall certify in writing that he complied with all the requirements specified by the authorities.

C3.3.3.25.4 E231.4 LAND SURVEYOR PEGS

C3.3.3.25.4.1 E231.4.1 Stand boundary pegs which were installed by the Land Surveyor shall under no circumstances be removed or shifted.

C3.3.3.25.4.2 **E231.4.2** Any stand boundary pegs which are found missing by the Contractor during the execution of his contract works, shall immediately be reported to the Engineer. If the Contractor does not report missing stand pegs when cables are laid and the cables are laid in wrong positions, then the Contractor shall re-lay the cables at his own cost.

C3.3.3.25.4.3 **E231.4.3** The Contractor shall immediately notify the Engineer if any pegs are removed or shifted by the Contractor. In such cases these pegs shall not be reinstated by the Contractor.

C3.3.3.25.4.4 **E231.4.4** The pegs will be reinstated by a Land Surveyor at the cost of the Contractor.

C3.3.3.25.4.5 **E231.4.5** On completion of the contract the Contractor shall provide a Land Surveyor certificate to the effect that all pegs along the routes where the Contractor had worked are intact. For this reason, Contractors are advised to ensure that all pegs are in position when taking over the site unless otherwise approved by the Engineer.

C3.3.3.25.5 E231.5 BUSH CLEARING

The absolute minimum number of bushes and trees shall be cleared by the Contractor for the purpose of laying cables.

C3.3.3.25.6 E231.6 CABLE MARKERS

C3.3.3.25.6.1 E231.6.1 MARKING TAPE

Yellow PVC marking tape, 150mm wide, with the wording "Buried Electric Cable - Caution" in both English and Afrikaans, printed in red or black, shall be laid approximately 300mm below ground level above the high voltage cables. One marking tape shall be laid for every two high voltage cables installed.

C3.3.3.25.6.2 E231.6.2 CABLE MARKERS

Cable markers shall be installed if specified in the Project Specification. Cable markers shall be approved by the Engineer prior to installation.

C3.3.3.25.7 E231.7 DAMAGES TO FENCES, WALLS, STREET SURFACES, KERB STONES AND PROPERTIES

C3.3.3.25.7.1 **E231.7.1** Before the Installation Contractor commences with any excavation work, he shall submit a detailed list of all existing damages to fences, walls, street surfaces, kerb stones, properties, etc. to the Engineer who will inspect and verify the list.

C3.3.3.25.7.2 **E231.7.2** After the completion of all backfilling and compaction of cable trenches, the Installation Contractor may request an inspection to have all the damages brought about by his operations listed and verified by the Engineer.

C3.3.3.25.7.3 **E231.7.3** The Installation Contractor shall then at his own, or his insurer's cost, be responsible for all such damages, except for damages so listed previously.

C3.3.3.26 E234 VARIABLE SPEED DRIVES (VSDS)

C3.3.3.26.1 E234.1 GENERAL

C3.3.3.26.1.1 **E234.1.1** The VSD shall comply with the Project specification and other sections of the Standard specification where applicable with special reference to cubicle construction, wiring of cubicles and accessories.

C3.3.3.26.1.2 **E234.1.2** The supplier of the VSD shall be responsible to ensure that the variable speed drive system, the motor and feeder transformer are fully compatible as a system. If the motor is supplied under a separate contract it shall be the responsibility of the supplier of the VSD to obtain all the relevant information from the motor Contractor.

C3.3.3.26.1.3 **E234.1.3** Unless otherwise specified the VSDs shall be suitable for centrifugal pumps with a squared torque characteristic.

C3.3.3.26.1.4 **E234.1.4** Where VSDs are offered which operate at other voltages than the motor or the system, step down or step up transformers shall form part of the offer. The ratings of the transformer shall be compatible with the drive requirements taking harmonics into account.

C3.3.3.26.1.5 **E234.1.5** Only very high reliability and availability of equipment shall be acceptable. This shall be achieved by state-of-the-art designs, high quality control standards, first class workmanship, best available materials and components, sufficient redundancy and adequate derating factors. Materials shall be capable of withstanding the variations in temperature arising under working conditions without distortion or deterioration.

C3.3.3.26.1.6 **E234.1.6** Components which are standard for number of product ranges of the manufacturer shall be used.

C3.3.3.26.1.7 **E234.1.7** The colour of the VSD shall be specified in the project specification.

C3.3.3.26.1.8 **E234.1.8** The availability of spares shall be guaranteed for 10 years after the contract is accepted.

C3.3.3.26.2 E234.2 PULSE WIDTH MODULATED DRIVES (PWM DRIVES) FOR INDUCTION MOTORS

C3.3.3.26.2.1 **E234.2.1** This specification covers VSDs incorporating a method where a variable frequency and variable voltage shall be applied to a standard squirrel cage induction motor in order to vary the speed of the motor.

C3.3.3.26.2.2 **E234.2.2** The method of operation shall be as follows: A 380 to 1000V AC/50 Hz supply shall be converted into dc via a transistor controlled converter and a dc capacitor after which the dc current shall be inverted to VAC by means of a thyristor and diode controlled inverter. This ac current shall then be fed the induction motor.

C3.3.3.26.2.3 **E234.2.3** The rectifier and converter shall be 6 or 12 pulse as specified.

C3.3.3.26.3 E234.3 POWER SUPPLY DETAILS

The VSD shall be suitable for continuous operation when fed via a step-down transformer if specified in the project specification from a 3-phase power supply having the following characteristics:

- System voltage : Specified in the project specification.
- Motor voltage : Specified in the project specification.
- Voltage fluctuations : +10% to 15%

- Nominal frequency : 50Hz, ±2½%
- Phase rotation : R-Y-B-R anti clockwise
- System fault level : Specified in the project specification.

C3.3.3.26.4 E234.4 SUPPLY INTERRUPTIONS AND DISTORTIONS

C3.3.3.26.4.1 E234.4.1 The VSD shall be capable of operation without damage and without interruption under the following power supply distortions and interruptions.

- Total interruptions and restoration after 300 milliseconds.
- Loss of one phase and restoration after 300 milliseconds.
- Reduced phase voltage of one or more phases by up to 30 (thirty) per cent below nominal for up to 3 seconds.
- Negative phase sequence voltage of 2½ per cent (continuous).
- Supply voltage total harmonic distortion of 3 (three) per cent with individual voltage harmonic distortion of one per cent.

C3.3.3.26.5 E234.5 HARMONICS

The harmonics generated by the VSD shall be compensated if necessary, not to exceed the following levels:

- Any individual harmonic voltage may not exceed 1%.
- The total harmonic voltage may not exceed 3%.
- The current harmonics may not exceed 5% of the current rating of the equipment.

The Contractor shall also carry out a system study to determine filter requirements so as to limit the distortion to the 11kV system, as measured at the 11kV system, to the specified levels.

Any equipment which is sensitive to harmonics shall be designed to function under voltage conditions which may have up to 5% total harmonic voltage distortion and up to 2% individual harmonic voltage content.

C3.3.3.26.6 E234.6 RATINGS

C3.3.3.26.6.1 E234.6.1 The electronic devices of the variable speed drive shall be continuously rated for a motor shaft output of 15% in excess of the power required by the pump at any speed over the whole speed range. The details of the motor are specified in the project specification if not forming part of the contract.

C3.3.3.26.6.2 E234.6.2 Each VSD shall be capable of continuous duty at full rating (24hrs/day, 365days/annually) under the specified power supply conditions.

C3.3.3.26.7 E234.7 SPEED RANGE REQUIREMENTS

The speed of the variable drive shall be continuously variable between the lower and upper speed limits. The lower speed limit of the VSD shall be at least 10 per cent below the minimum and 10present above the maximum speed required for the driven pump. The speed range of the VSD are specified in the project specification.

The drive system shall also have the facility to inhibit operation at pre-determined speeds to prevent system resonance.

The speed control stability tolerance shall be better than 1.0 per cent of the set point.

C3.3.3.26.8 E234.8 VSD ELECTRONIC EQUIPMENT AND COMPONENTS

C3.3.3.26.8.1 E234.8.1 The control circuitry shall consist of independent electronic control and protective circuits arranged on separate PCB's. This circuitry shall be isolated from the mains supply by means of isolating constant voltage transformers (CVT's) in order to limit malfunctions due to transients and voltage dips on the system.

C3.3.3.26.8.2 E234.8.2 The electronic equipment shall be of modular construction mounted on plug-in boards. Modules shall be easily removable to ensure rapid rectification of faults by module replacement. Such modules shall be suitably coded so as to prevent insertion into wrong sockets.

C3.3.3.26.8.3 E234.8.3 The material used for the printed circuit boards shall be of the best quality.

C3.3.3.26.8.4 E234.8.4 The connections to the printed circuit boards shall, wherever possible, be made by means of suitable connectors with gold-plated contacts that are designed to be soldered to the tracks of the printed circuit board.

C3.3.3.26.8.5 E234.8.5 The printed circuit board assembly shall be protected from deposits of dust and moisture by coating with suitable material (e.g. conformal coating material complying with BS 5917).

C3.3.3.26.8.6 E234.8.6 Means shall be provided for mounting the printed circuit board assembly inside the enclosure so as to facilitate easy insertion and withdrawal of the assembly. The assembly shall be mechanically secured so as to prevent vibration.

C3.3.3.26.8.7 E234.8.7 The printed circuit board assembly shall be designed with suitable means of self-diagnostic indication of faults and indication of status for the purposes of setting up easy service and maintenance or shall be provided with easily accessible test points to facilitate diagnostic tests for faults. Suitable test equipment shall form part of the contract.

C3.3.3.26.8.8 E234.8.8 The power supply to electronic control equipment shall be provided with an electrostatic screen between the primary and secondary windings. The screen shall be connected directly to earth.

C3.3.3.26.8.9 E234.8.9 Electrolytic capacitors used in the dc application of electronic equipment (e.g. filter circuits) shall be of the long-life grade complying with IEC Publication 384-4.

C3.3.3.26.8.10 E234.8.10 All semiconductor devices, power transformers, chokes and other components forming necessary parts of the drive equipment shall be suitable for the particular application with respect to their rated voltages, rated currents, temperature rise and service life.

C3.3.3.26.8.11 E234.8.11 Solid state electronic components shall be used.

C3.3.3.26.9 E234.9 DIGITAL TECHNOLOGY

Digital control based on the latest microprocessor technology shall be used. However, standard products and components shall be used, and purpose made systems shall not be acceptable.

C3.3.3.26.10 E234.10 MODBUS RTU INTERFACE PROTOCOL

When specified in the project specification the VSD shall be equipped with MODBUS RTU interface protocol with facilities to report all fault conditions on a first in first out basis as well as control functions and the parameters during normal running condition. A suitable data storage buffer shall be provided

of sufficient capacity to ensure a real time record of the above information and of any other variables the Contractor consider necessary for fault diagnostics.

C3.3.3.26.11 E234.11 CONTROL CARD MONITORING

All control cards shall be provided with suitable monitoring, either by means of on-board identification, or if specified via the modbus interface to permit identification of and replacement of faulty control card with a minimum of drive downtime.

C3.3.3.26.12 E234.12 HARDWIRE TRIP INTERLOCKS

C3.3.3.26.12.1 E234.12.1 Protection devices in the VSD shall be hardwired to ensure that an electrical fault within the controller trip the transformer feeder circuit breaker.

C3.3.3.26.12.1 E234.12.1 Electrical interlocks shall be provided to trip the VSD in the event the access doors to the power section and the DC sections of the drive being opened.

C3.3.3.26.13 E234.13 MAIN POWER EQUIPMENT

The main power equipment unit shall comprise the following:

C3.3.3.26.13.1 E234.13.1 AC power supply incorporating a fused isolating switch. It shall be possible to visually observe the isolator contacts in the open position from the front of the panel.

C3.3.3.26.13.2 E234.13.2 The contactor unit.

C3.3.3.26.13.3 E234.13.3 Rectifying transistors and inverting thyristors.

C3.3.3.26.13.4 E234.13.4 A choke in series with the rectifying transistors (input) shall be installed to limit the inrush current.

C3.3.3.26.13.5 E234.13.5 By-pass switch if specified in the project specification.

C3.3.3.26.13.6 E234.13.6 Auxiliary power supply equipment.

C3.3.3.26.13.7 E234.13.7 Step down transformers if required.

C3.3.3.26.14 E234.14 CUBICLE ARRANGEMENT

C3.3.3.26.14.1 E234.14.1 Smaller VSD's shall be mounted into a free-standing MCC panel suitable for floor fixing.

C3.3.3.26.14.2 E234.14.2 The Contractor shall confirm within two weeks after appointment that the cubicle as offered by the Contractor can be installed in the MCC room by studying the appropriate construction drawings.

C3.3.3.26.14.3 E234.14.3 The VSD equipment e.g. fused isolator, contactor, thyristor stock, control circuitry, etc., shall be housed in separate compartments or cubicles.

C3.3.3.26.14.4 E234.14.4 When more than one cubicle/panel is provided, the cubicles shall form a straight line and be of the same height. All cubicles shall be braced and of modular bolted construction to form a rigid assembly. They shall be provided with a substantial channel iron base which shall prevent distortion transportation and installation.

C3.3.3.26.14.5 E234.14.5 The equipment shall be arranged so that the various parts of the drive are easily accessible.

C3.3.3.26.14.6 E234.14.6 The instrument and control panel shall be flush mounted on the front of the cubicle at a comfortable height from the ground.

C3.3.3.26.14.7 E234.14.7 The main isolator handle shall be mounted on the front of the cubicle and shall be door inter-locked.

C3.3.3.26.14.8 E234.14.8 IP54 enclosure protection shall be provided unless otherwise specified in the project specification.

C3.3.3.26.14.9 E234.14.9 The VSD unit shall conform with the rest of the MCC panel e.g. colour shall be matched, labels shall be matched, etc.

C3.3.3.26.14.10 E234.14.10 The cable entry shall be below unless otherwise specified.

C3.3.3.26.15E234.15 VENTILATION

The temperature in the MCC room may rise to 45°C unless otherwise specified*** and the equipment shall be rated to operate at this temperature.

C3.3.3.26.15.1 E234.15.1 The transistors/thyristors shall be forced air cooled by means of fans.

C3.3.3.26.15.2 E234.15.2 The fans shall be mounted directly above the transistor/thyristor stacks on top of the cubicle. The fans shall be suitably electrically protected with miniature circuit breakers. Fans shall have an associated air differential pressure gauge to ensure that the drive shall be tripped on cooling system failure. A standby fan shall be provided, operating automatically on failure of the duty fan.

C3.3.3.26.15.3 E234.15.3 Replaceable air filters shall be provided at the air-intake of the cubicle.

C3.3.3.26.15.4 E234.15.4 The hot air shall be exhausted into the room.

C3.3.3.26.16E234.16 PROTECTION

Variable speed A.C. drives shall be provided with the following integral protection features. A separate motor protection relay shall be provided if these features are not part of the VSD protection features. The Contractor shall explain how each requirement is met in his drive and shall supply detailed supporting literature for each item.

C3.3.3.26.16.1 E234.16.1 THERMAL OVERLOAD

The relay shall have current time characteristics matched to the thermal damage curve of the drive motor.

C3.3.3.26.16.2 E234.16.2 VSD AND MOTOR SHORT CIRCUITS AND EARTH FAULTS

The drive and the motor shall be fully protected against internal and external short circuits and earth faults on the supply connections, transformers, the DC link, or on the motor. This protection shall preferably be instantaneous in operation and arranged to trip the supply. It shall not operate incorrectly if the drive is able to feed current to a supply side fault unless the condition is sustained for long enough to damage the drive components.

C3.3.3.26.16.3 E234.16.3 NEGATIVE SEQUENCE VOLTAGES

The motor shall be protected against negative sequence currents resulting from the presence of negative sequence voltages on the supply lines, or produced by unbalanced operation of inverters, etc., protection shall be provided which detects the condition and stops the drive before it or the motor can be damaged. The drive shall be able to operate continuously at the rated output if the negative sequence voltage on the supply does not exceed 2.5%.

C3.3.3.26.16.4 E234.16.4 LOSS OF SUPPLY VOLTAGE

If the positive sequence voltage to the drive should fall below 85% for longer than 1 second, the drive shall be disconnected without any damage to the rectifiers, thyristors, or any other components in the drive liable to adversely affected by a low supply voltage condition.

An under-voltage trip which is pre-settable to a minimum of 15% voltage drop shall be provided.

If the voltage drops more than the pre-set voltage above the drive shall trip automatically. In the event of the supply voltage returning to a value which is greater than the pre-set voltage in less than 2 seconds, which is also pre-settable, the drive shall automatically start up. A facility to enable the flying start, shall be provided on the drive.

The variable speed drive system shall be able to tolerate a sudden total loss of power without any damage to the drive. See 4.1

C3.3.3.26.16.5 E234.16.5 OVER TEMPERATURE INSIDE CUBICLE

In the case of drives above 100kW, RTD temperature protection with alarm and trip set points shall be provided in the cubicle and be arranged to stop the drive for high cooling air temperatures. Indication of over temperature shall be provided on the front of the panel and one spare set of potential free contacts shall be provided for alarm purposes.

C3.3.3.26.16.6 E234.16.6 HIGH SUPPLY VOLTAGE

If the supply voltage should rise above 110% for more than the safe withstand time for all components in the drive, it shall be disconnected automatically.

C3.3.3.26.16.7 E234.16.7 ELECTRONIC EQUIPMENT

This shall be provided with all protection equipment necessary to ensure that diode over voltages, over-currents, or other transient conditions will not result in component failure. Such protection shall be arranged to disconnect the drive, where necessary for its safety.

C3.3.3.26.16.8 E234.16.8 LOSS OF PHASE

Loss of a supply phase shall cause the drive to be disconnected sufficient rapidly to prevent damage.

C3.3.3.26.16.9 E234.16.9 INCORRECT PHASE ROTATION

The drive controls shall be capable of detecting this condition and preventing start-up.

C3.3.3.26.16.10 E234.16.10 The drive shall also be protected against the following faults:

- Over voltage in the dc link
- Under voltage in the dc link
- Overcurrent in the inverter
- Motor stalling
- Transient surges dv/dt and di/dt
- Overspeed
- Open motor circuit

– Transistor over currents by means of HRC fuses

C3.3.3.26.16.11 E234.16.11 Audible and visible indication shall be provided for all trip and alarm functions.

C3.3.3.26.16.12 E234.16.12 INDICATIONS AND TRANSDUCERS

All protection functions shall be complete with the necessary current and voltage transducers and the condition that originated any drive shutdown shall be indicated clearly on approved operation indicators.

The following are examples of indications to be displayed on the panel door. Contractors shall provide information of fault indications offered applicable to the equipment.

1) Overspeed trip.
2) Instantaneous overcurrent trip.
3) Inverse time overcurrent trip.
4) Converter over temperature trip.
5) Earth fault trip.
6) Converter ventilation fan failure trip.
7) Cooling fan failure.
8) Power supply low voltage trip.
9) Back-up electronic trip.
10) Supply phase-loss and incorrect phase rotation protection trip.
11) Stator winding over temperature alarm/trip.
12) Bearing over temperature alarm/trip.
13) Earth alarm/trip.
14) External fault.
15) Long starting time.
16) Over temperature (Transformer).
17) Surge arrestor (Converter).
18) Surge arrestor (Motor).
19) Under speed trip.
20) DC current monitor.

C3.3.3.26.16.13 E234.16.13 REMOTE INDICATION

A potential free contact wired to terminals at the back of the panel shall be provided to indicate a system fault for remote indication.

C3.3.3.26.17 E234.17 CONTROL INDICATION AND INSTRUMENTATION

The following minimum controls and instrumentation shall be provided on the front panel of the electronic compartment:

C3.3.3.26.17.1 E234.17.1 CONTROLS

a) Start/Stop push buttons for local operations.

b) Emergency stop push button:

The push button for the emergency stop shall be red, only manually resettable and will prevent the motor from starting from the local or any remote position. (Parallel circuitry to a terminal block to be provided for a similar switch at the motor).

c) Local/Remote switch shall be provided.

d) Test/Off/Normal: This switch shall operate with a key removable only in the normal position. In the test position the complete starting and tripping sequence shall be operational for testing without applying power to the motor.

e) Protection trip reset push buttons.

f) Indication test push button to test lamps.

g) Speed control.

C3.3.3.26.17.2 E234.17.2 SIGNAL LAMPS AND PUSH BUTTONS

The following main colour-codes shall be used for signal lamps and push buttons.

a) Signal Lamps

Trip	:	Red
Run, Ready	:	Green
Speed Control Healthy	:	White

b) Push Buttons

Stop Emergency	:	Red
Run	:	Green
Trip Reset	:	Blue
Lamp Test	:	White
Siren Mute	:	Yellow

C3.3.3.26.17.3 E234.17.3 INSTRUMENTATION

a) LCD Display.

b) Ammeter on all the phases with instantaneous reading and over scale facility.

c) Speed meter.

d) Voltmeter with selector switch for phase to phase and phase to neutral readings.

e) Ammeters for the heater circuits.

f) Non-resettable running hour meter.

C3.3.3.26.17.4 E234.17.4 REMOTE CONTROL AND INDICATIONS (WHEN SPECIFIED IN PROJECT SPECIFICATION)

The variable speed drives shall be suitable for future remote-control operation and monitoring. All the required functions and signals shall be wired to terminal blocks which are easily accessible. The following functions control signals are considered as a minimum. The design will however be finalised with the successful Contractor:

a) Control functions:
- ON/OFF
- Start to minimum speed
- Speed control (4 - 20mA signal)
- Stop

b) Indications:
- Machine ready
- Speed indication (4-20mA)

- Temperature trip
- Common protection trip
- External trip
- Local control
- Cubicle overtemperature
- By-pass closed (if applicable)
- Emergency stop
- Amps (load current)
- Volts

C3.3.3.26.18E234.18 TRAINING

The Contractor shall allow for two on-site training sessions. The sessions shall last at least one full day and include programming and setting up procedures of the VSDs.

C3.3.3.27 E237 STREET- AND SECURITY LIGHTING

C3.3.3.27.1 E237.1 GENERAL

Street and security lighting shall in general conform to SANS 098, unless otherwise specified.

C3.3.3.27.2 E237.2 STEEL POLES FOR STREETLIGHTING

C3.3.3.27.2.1 E237.2.1 GENERAL

All steel streetlighting poles shall be properly treated against corrosion. Painting and/or galvanising shall be carried out in accordance with Specification E202.

C3.3.3.27.2.2 E237.2.2 DESIGN

1) All steel poles shall be designed to withstand all static and dynamic loads on the pole, fittings and street lighting brackets with a minimum factor of safety of 2,5 in compliance with the Occupational Health and Safety Act (85/1993).

2) The pole shall be designed to withstand a wind speed of 120km/h (unless otherwise specified in the project specification) at a height of 10m above ground level and exerted on the projected area of the pole, fittings and street lighting brackets.

C3.3.3.27.2.3 E237.2.3 BASE PLATE

1) Each steel pole shall be equipped with a suitable base plate, at least 350mm in diameter or square plates with an equal or larger surface area.

2) The base plates shall be held in position by means of steel hook bolts to be hooked into the steel pole. The plates are not to be welded to the steel pole. The base plate shall have the same finish as the pole.

C3.3.3.27.2.4 E237.2.4 STEEL SLEEVE

1) All steel streetlighting poles shall be provided with a 6mm thick and 1,0m long steel sheath, if specified in the Project Specification.

2) The sleeve shall extend 500mm above and 500mm below ground level after installation.

3) The steel sleeves are to be welded or shrunk onto the poles.

C3.3.3.27.2.5 E237.2.5 PROTECTION OF POLES AGAINST CORROSION

1) Poles shall be completely galvanised and/or painted as specified in the Project Specification. Galvanising and painting shall be done in accordance with the Standard Specification E202. The interior of poles to be used at coastal areas, or if specified in the Project Specification shall in addition be coated with at least one coat of suitable bituminous paint.

2) The lower 2.0m of the pole including the base plate, shall be painted on the outside with two coats of suitable bituminous paint.

3) After erection on site a final coat of paint shall be applied to the pole if specified in the project specification.

C3.3.3.27.2.6 E237.2.6 SIZE OF SPIGOTS

Contractors shall ensure that the diameters and lengths of the pole spigots shall suit the types of luminaires offered.

C3.3.3.27.2.7 E237.2.7 CABLE ENTRIES

1) Each steel pole shall be provided with a suitable cable entry hole. The hole shall be so located that after erection the entry hole shall be approximately 700mm below ground level.

2) The edges of the cable entry hole shall be smooth to prevent damage to cables.

3) The dimensions of the entry hole shall be such that two 25mm², 4-core PVC insulated steel wire armoured cables can be easily installed. The project specification will state whether ECC cables shall be used.

C3.3.3.27.2.8 E237.2.8 CABLE TERMINATION COMPARTMENT

1) Each pole shall be provided with a suitable cable termination compartment with a bracket complete with a 5A, 5kA miniature circuit breaker mounted on the bracket. Each luminaire shall be protected by a circuit breaker on double outreach installations.

2) An earthing stud welded to the inside of the pole shall also be provided inside the compartment. The earth conductors of the incoming cable and the earth conductor from the luminaire shall be terminated on the same earthing stud.

3) The cover of the compartment shall be watertight and sealed with a gasket. It shall be retained by a lug and secured by a bolt with a seven-sided shrouded head.

4) The compartment shall incorporate a suitable gland plate for the termination of the incoming cables.

C3.3.3.27.2.9 E237.2.9 POLE MOUNTED PROTECTION BOXES

Where steel streetlighting poles are to be used in an overhead reticulation system, the pole shall be provided complete with a pole mounted weatherproof PVC circuit breaker box with tripping lever fitted with a 5A, 5kA single phase miniature circuit breaker.

C3.3.3.27.3 E237.3 WOODEN POLES FOR STREETLIGHTING

C3.3.3.27.3.1 E237.3.1 Wooden poles shall be suitably treated and shall comply with SANS 753 or 754.

C3.3.3.27.3.2 E237.3.2 The dimensions and classes of wooden poles required shall be as specified in the Project Specification.

C3.3.3.27.3.3 E237.3.3 Wooden poles shall be equipped with either "Pratley" type underground cable T-off boxes or galvanised junction boxes to be mounted above ground level as specified in the Project Specification.

C3.3.3.27.3.4 E237.3.4 Where underground "Pratley" type boxes are specified for use or where poles are to be used in an overhead distribution system, the wooden poles shall be provided with a pole mounted weather-proof circuit breaker box with tripping lever fitted with a 5A, 5kA single phase miniature circuit breaker.

C3.3.3.27.3.5 E237.3.5 Where an above ground termination box is specified, Contractors shall allow for the provision of this box in their tender prices. The box shall be galvanised and fitted to the pole with galvanised clamps. The box shall be equipped with a 5A, 5kA miniature-circuit breaker. The lid of the

box shall be fixed with countersunk bolts. The box shall be watertight and shall be mounted approximately 500mm above ground level.

C3.3.3.27.3.6 E237.3.6 In the case of 3.4 above galvanised steel pipe shall be provided against the pole to serve as a cable protection sleeve. The diameter of the pipe shall be suitable to allow easy installation of a 25mm², 3-core steel wire armoured PVC insulated cable. The pipe shall be fixed to the pole with suitable clamps at intervals of not more than 500mm. The pipe shall extend 2,0meter above ground level and 500mm below ground level.

C3.3.3.27.3.7 E237.3.7 In the case of 3.5 above where an above ground termination box is called for, a cable sleeve as specified above shall be provided above the box. Two similar galvanised pipes, each suitable for a 25mm², 4-core cable shall be provided below the box. The pipes shall fit over the cable glands complete with neoprene covers suitable for the cable sizes. The pipes shall extend 500mm below ground level.

C3.3.3.27.4 E237.4 MIDHINGE TYPE MASTS

C3.3.3.27.4.1 E237.4.1 GENERAL

1) The masts shall be similar or equal to the scissor type as manufactured by Sectional Poles Africa.

   The Engineer shall decide whether any mast offered complies with this requirement.

2) The masts shall comply with the relevant clauses as specified for steel poles, above.

C3.3.3.27.4.2 E237.4.2 CONSTRUCTION

1) The lower half of the masts shall be divided into two fully enclosed half sections, which shall form an octagonal section in the operating position with no unsightly steps or protrusions.

2) The pivot shall be located approximately at the mid-point of the mast and shall consist of two full length stainless steel sleeves and not a shaft and hinge plates.

3) The pivoting half of the mast base section shall be securely bolted to the base plate by means of an adequately designed vandal proof securing system. A special socket type spanner shall be provided for this securing system.

4) Street light brackets for mounting of luminaires, shall be provided as specified in the relevant clauses for street poles as specified above.

5) The pivoting half of the base section shall be balanced in such a manner that lowering can easily be done by one person using a nylon or stainless-steel rope without additional equipment being required. The lowering of the pivoting section of the masts shall not be by a winch, power tool or bolt type lowering mechanism.

6) A safety chain shall connect the pivoting half with the fixed half to prevent accidental lowering or damage to the trailing cable.

7) A galvanised or stainless-steel wire rope shall be affixed to the top and bottom of the masts on the inside to allow the electrical cable to be strapped to it.

8) The fixed part of the mast shall be provided with a cable termination compartment as specified in the relevant clauses for steel poles as specified above.

C3.3.3.27.4.3 E237.4.3 FOUNDATION

1) A concrete foundation shall be provided for each mast unless otherwise specified.

2) The foundation designs shall be submitted with the tender/quotation and the successful Contractor shall provide foundation drawings.

3) Adequately designed foundation bolts, made from mild steel, shall be provided with each mast together with templates.

C3.3.3.27.4.4 E237.4.4 CORROSION PROTECTION

1) The mast shall be corrosion protected to comply where applicable.

2) All materials used in the pivot construction shall be of AISI grade 316ℓ stainless steel.

3) Steel used for the construction of the masts shall be SAE 950X grade B and shall be a high tensile low carbon type or equivalent.

C3.3.3.27.4.5 E237.4.5 DESIGN

1) The design of the mast shall comply with the relevant clauses or specification for steel poles, above.

2) The mast shall be capable of withstanding the loads impacted on it when being lowered.

3) The following design calculations shall be submitted:
   a) The mast in wind conditions;
   b) The mast during lowering.

C3.3.3.27.5 E237.5 HIGH MASTS

C3.3.3.27.5.1 E237.5.1 High masts shall be provided in the positions as indicated on the drawings.

The positions indicated on the drawings are only approximate positions: The Contractor shall ascertain from the Engineer what the final positions are on site and shall peg the positions prior to commencing excavation work for the bases.

C3.3.3.27.5.2 E237.5.2 CONSTRUCTION

1) The masts shall be manufactured from mild steel in accordance with SANS 1431, which shall be of a grade suitable for the working loads.

2) A base plate of suitable thickness shall be welded to the bottom end of the mast and shall be suitably pre-drilled for the foundations bolts. Gussets shall be provided between the bolt holes for increased structural strength.

3) All welding shall be subject to SANS inspection and acceptance certificates shall be provided to the Engineer.

4) The selected cross-section and wall thickness of the masts shall be based on working load calculations.

The design shall be approved by a Professional Structural Engineer appointed by the Contractor for this purpose.

5) The masts shall give an overall floodlight mounting height as specified*** in the project specification.

C3.3.3.27.5.3 E237.5.3 WORKING LOADS

1) The design of the masts shall comply with the relevant clauses as specified for steel poles, above.

   The design shall take into consideration the increase in wind speed with height and a design based on a constant wind loading over the entire length will not be accepted.

2) The Contractor shall ensure that the design is carried out in accordance with:

   SANS 0160 - 1980 : Code of Practice for the General Procedure and Loading to be adopted for the Design of Buildings.

   SANS 0162 - 1989 : Code of Practice for Structural Steelwork.

3) The Contractor shall, prior to commencing with the construction of the masts, submit to the Engineer his approved design drawings, detailed design calculations and any other substantiating data to prove that the requirements of the specification have been met.

4) In addition to the above, information relating to the following shall be submitted with tenders:

   a) Dynamic behaviour of the masts with respect to wind-induced oscillations and resonance.

   b) Deflection of masts and resultant stresses and bending moments over the entire length of the structure at maximum wind loading.

C3.3.3.27.5.4 E237.5.4 LUMINAIRE CARRIAGE AND RAISING AND LOWERING MECHANISM

1) The masts shall be fitted with a luminaire carriage suitable for carrying the specified luminaires and which, when raised to the operating position, shall always be correctly aligned. Indication shall be provided to show when the carriage is in its fully raised position.

2) An electrically operated raising and lowering mechanism shall be provided for the luminaire carriage.

   Where a separate unit has to be used for the raising and lowering operation, only one unit shall be provided for all the masts.

C3.3.3.27.5.5 E237.5.5 ACCESS OPENING

An access opening suitably designed to maintain the mast strength shall be provided 600 mm above the base plate and shall be fitted with a hinged weatherproof door. The door shall be fitted with a lock suitable for preventing vandals from gaining access to the electrical equipment housed in the mast.

The electrical equipment for controlling the luminaire shall be readily accessible for operating and maintenance through the access opening.

C3.3.3.27.5.6 E237.5.6 CORROSION PROTECTION

1) The mast shall be corrosion protected to comply where applicable with the relevant clauses as specified for steel poles, above.

2) All parts of the mast and the luminaire carriage which are not manufactured from stainless steel shall be hot-dip galvanised to SANS 763-1977 and inspection certificates shall be provided.

C3.3.3.27.5.7 E237.5.7 ELECTRICAL CONTROL EQUIPMENT

1) Each mast shall contain a glass fibre distribution board (DB) mounted inside the mast shaft opposite the access door.

2) Each phase of a multiple phase connection shall be protected by a single phase 5kA miniature circuit breaker and a lightning arrester. The DB shall further contain the electrical control equipment as shown on the drawings or specified in the project specification. A suitable supply connection for the hoist unit shall also be provided.

C3.3.3.27.5.8 E237.5.8 LIGHTNING PROTECTION AND EARTHING

1) Each mast shall be fitted with a lightning spike projecting above the head assembly to protect the luminaires.

2) An earth stud shall be provided near the base and connected to an earth rod and the distribution board earth bar.

C3.3.3.27.5.9 E237.5.9 MAST FOUNDATIONS

1) A reinforced concrete base shall be provided for each mast as generally shown on the drawings.

2) The base shall be designed by a Professional Structural Engineer appointed by the Contractor. The Contractor shall measure the soil bearing pressure at each location prior to the bases being designed.

3) When the bases are cast, test cubes shall be taken and submitted to an approved test laboratory. The results shall be submitted to the Structural Engineer for his approval.

4) After the masts have been installed on their bases a final inspection shall be carried out by a Structural Engineer and the installation shall be approved in writing.

5) After casting of the foundation base, the slab shall be covered with earth which shall be properly compacted. The area around the base shall be brought to the original level and shall be left neat and tidy with no excess soil.

C3.3.3.27.6 E237.6 LUMINAIRES

C3.3.3.27.6.1 E237.6.1 High masts and poles shall be fitted with luminaires as specified further herein and in the Project Specification.

C3.3.3.27.6.2 E237.6.2 The final adjustment of the luminaires shall be done on site to provide area lighting to the Engineer's satisfaction.

C3.3.3.27.6.3 E237.6.3 Luminaires shall consist of a cast aluminium or aluminium alloy or fiberglass reinforced polyester housing, high quality non-deteriorating reflectors and an acrylic lens. The lens material shall not discolour or lose its translucence with time. Polycarbonate is not acceptable. The complete fitting shall be corrosion resistant.

C3.3.3.27.6.4 E237.6.4 Where control gear is required for operation, the control gear housing shall form an integral part of the luminaire. Intertap chokes, to enable optimum operation from 200V to 250V, shall be provided if specified in the Project Specification.

C3.3.3.27.6.5 E237.6.5 The luminaires shall be fully gasketed to eliminate the ingress of dirt and moisture.

C3.3.3.27.6.6 E237.6.6 All luminaires offered shall be of high quality and of a type approved by the Engineer.

C3.3.3.27.6.7 **E237.6.7** Unless otherwise specified the types of luminaires offered shall be in accordance with the types recommended in SANS Code of Practice 098, 1277 and 1279 for the various types of roads and classes of installations.

C3.3.3.27.6.8 **E237.6.8** The type of lamps is specified in the Project Specification and Contractors may offer alternative wattage lamps that will provide the specified lighting levels.

C3.3.3.27.7 E237.7 PHOTO-ELECTRIC CELLS FOR STREETLIGHTS AND HIGH MASTS (REFER TO CLAUSE E205)

Where photo-cells are called for in the Project Specification for the control of streetlighting, the photocells shall comply with the following requirements:

C3.3.3.27.7.1 **E237.7.1** The photocell shall be mounted on the pole nearest to the mini-sub, substation or low voltage distribution cubicle.

C3.3.3.27.7.2 **E237.7.2** All photo-electric cells shall be provided with suitable mounting brackets to mount these on the streetlight pole.

C3.3.3.27.7.3 **E237.7.3** The photo-electric cells shall be so mounted that light of the streetlight fitting shall not interfere with the proper functioning of the photo-cell.

C3.3.3.27.8 E237.8 STREETLIGHTING ARMS

C3.3.3.27.8.1 **E237.8.1** Streetlight brackets shall be used for the mounting of luminaires on wooden poles and steel poles where the arms do not form an integral part of the pole.

C3.3.3.27.8.2 **E237.8.2** The brackets shall be galvanised and, if called for, painted as specified in the Standard Specification E202.

C3.3.3.27.8.3 **E237.8.3** The brackets shall consist of a tubular section with suitable struts and braces to ensure sufficient mechanical strength and rigidity as shown on the drawings.

C3.3.3.27.8.4 **E237.8.4** The dimensions of the spigot shall be suitable for the type of luminaires offered.

C3.3.3.27.8.5 **E237.8.5** The bracket shall be fixed to the pole by means of at least two clamps with bolts, nuts and washers. All parts shall be galvanised.

C3.3.3.27.8.6 **E237.8.6** The tubular section shall be such that the cable entry opening faces downwards to prevent the entry of water into the arm and luminaire.

C3.3.3.27.9 E237.9 INSTALLATION OF STREETLIGHTING

C3.3.3.27.9.1 **E237.9.1** Contractors shall allow in their tender prices for the following:

1) Pole hole and/or foundation excavations.

2) Concrete foundations for mid-hinge and high masts.

3) Erecting, backfilling, and consolidating. This includes the ensuring that poles are plumbed and aligned.

4) Terminating of the underground streetlighting cables where applicable.

5) Connection of the cable earthing conductors to the earthing studs by means of bare copper earth wires and crimped ferrule connections.

6) Mounting of luminaires, brackets, miniature circuit breakers, connection boxes, cable protection sleeves, etc.

7) Supply and installation of internal 3x 4mm² PVC insulated copper conductors from the connection box to the luminaires on steel poles. On double outreach standards, each luminaire shall be separately wired to its miniature circuit breaker.

8) Supply, installation, and termination of 4mm², 3-core PVC insulated cable on wooden poles.

9) Supply, installation, and termination of three 4 mm² PVC insulated copper conductors from overhead lines to pole mounted miniature circuit breakers and to luminaires.

10) Supply, installation, and termination of cable internally installed in high masts.

11) Balancing the load evenly over all three phases.

12) Testing and commissioning of the complete assembly.

C3.3.3.27.9.2 **E237.9.2** All luminaires shall be installed complete with the types of lamps specified.

C3.3.3.27.9.3 **E237.9.3** All luminaires, steel brackets and poles shall be properly earthed.

C3.3.3.27.9.4 **E237.9.4** Where painting of streetlighting poles are called for, a final coat shall be applied after erection.

C3.3.3.28 E238 MASTS: MANUFACTURING AND INSTALLATION

C3.3.3.28.1 E238.1 SCOPE

This section of the specification covers the execution of work entailed in the manufacture and installation of free-standing poles and masts.

C3.3.3.28.2 E238.2 INTERPRETATIONS

C3.3.3.28.2.1 **E238.2.1** Supporting Codes and Specifications. Where this specification is required for a project, the following specifications and codes shall, inter alia, form part of the contract document.

1) Project specification.

2) SANS 0225 - The design and construction of lighting masts. Refer also to normative references.

3) 1200A or SANS 1200AA as may be applicable.

4) SANS 0162 Code of practice for the structural use of steel.

5) SANS 0161 Design of foundation of Buildings.

6) SANS 1200G and 1200GA Concrete (structural and Small works).

7) SANS 1200H and 1200HA Structural steel work.

C3.3.3.28.2.2 E238.2.2 APPLICATION

This specification contains clauses that are generally applicable to the design, fabrication and installation of free-standing pole and mast contracts. Interpretations and variations of the specifications are set out in the project specification which precedes this specification in a contract document.

C3.3.3.28.3 E238.3 DESIGN CONSTRUCTION

The Contractor shall appoint the structural Engineer who shall be responsible for all detail design work, approval of work and inspections as specified in SANS 0225.

Any approval given by the Engineer relates to structural adequacy and does not absolve the Contractor from responsibility for dimensional accuracy.

C3.3.3.28.4 E238.4 MATERIALS

Steel used in the fabrication of masts shall comply with the requirements of SANS 0225 for the grade of steel specified in the project specification or stated on the drawings.

C3.3.3.28.5 E238.5 PAINTS AND PROTECTIVE COATINGS

Unless otherwise specified in the project specification, the masts shall be hot-dip galvanised in accordance with Standard Specification E202.

C3.3.3.28.6 E238.6 ELECTRICAL INSTALLATION

Internal wiring of masts shall be to an approved wiring diagram and under the supervision of a registered electrician.

The following shall be construed as the minimum requirements unless otherwise specified in the project specification:

C3.3.3.28.6.1 **E238.6.1** The following:

1) Adequately rated incoming isolator.

2) Adequately rated circuit breakers for each phase.

3) Adequately sized neutral and earth bars.

4) Adequately rated multi-pin plug and socket if cable is to be disconnected for maintenance purposes.

5) Earth leakage protected switch socket outlet if a power unit is required for maintenance purposes.

C3.3.3.28.6.2 **E238.6.2** Wiring to the Mast Top shall incorporate:

1) Weatherproof splitter box with adequately rated terminals for interconnections.

2) Glands to all exposed connections.

3) Adequately rated UV resistant cab tyre wiring to be used to connect luminaires, etc.

4) Adequately rated cables to distribution board at mast base to be of trailing type if it is required to flex or support its own weight.

C3.3.3.28.6.3 **E238.6.3** Earthing:

Earthing shall be provided via driven earthing rods or trench earth system. Either system shall be connected to the mast by a 70mm^2 copper conductor and shall provide a maximum resistance of 20 Ohms unless otherwise stated in the project specification.

C3.3.3.28.7 E238.7 TESTING

Test certificates shall be submitted for all tests as specified in SANS 0225.

C3.3.3.29 E239 STANDBY DIESEL GENERATOR

C3.3.3.29.1 E239.1 GENERAL

The specification covers the supply, delivery, complete installation and commissioning on site in full working order of an emergency diesel generator to provide emergency electrical power for the 132kW water pumps, PLC panels, partial light circuiting, UPS systems, computer hardware, etc.

Full particulars, performance curves and illustrations of the equipment offered must be submitted with the tender. Tenderers may quote for their standard equipment complying with the specification and any deviation from the specification must be fully detailed.

The set shall be fully automatic i.e., shall start when any one phase of the mains supply fails and shall shut down when normal supply is re-established. The set shall be capable of delivering the specified output continuously under the site conditions, without overheating.

Tenderers must confirm that the space is sufficient for the installation of the generator set, fuel tank and the control board and shall indicate the proposed layout of their equipment on the drawing in red ink.

The tenderer must furnish detailed description and illustration of the equipment offered and must complete the RETURNABLE SCHEDULES following this specification.

Failure to submit any of the information asked for may disqualify the tenderer.

C3.3.3.29.2 E239.2 INSTALLATION

Except for those items specifically excluded, tenderers must include for the complete installation and wiring of the plant in running order.

C3.3.3.29.3 E239.3 WARNING NOTICES

Tenderers must include in their tender for all notices that are required under the safety acts applicable to the area in which the installation is carried out.

C3.3.3.29.4 E239.4 DRAWINGS

The successful tenderer must, within two weeks after receipt of an order, submit detailed drawings and wiring diagrams of the plant and switchgear.

C3.3.3.29.5 E239.5 GUARANTEE

The successful tenderer will be required to guarantee the complete plant for a period of 12 months from the date it has been taken over by the client in running order.

If during this period the plant is not in working order, or not working satisfactorily owing to faulty material, design or workmanship, the contractor will be notified and immediate steps shall be taken by him to rectify the defects and/ or replace the affected parts on site, at his own expense.

C3.3.3.29.6 E239.6 OPERATIONAL INSTRUCTION

After completion of the installation, and when the plant is in running order, the successful tenderer will be required to instruct an attendant in the operation of the plant, until he is fully conversant with the equipment and handling thereof.

Three copies of maintenance, fault–localizing and operating manuals are to be handed over to a representative of the client.

C3.3.3.29.7 E239.7 TESTS

Tests are to be carried out at the supplier's premises, before the generating set is delivered to site, at which time a representative of the client will be present to ensure that the generating set complies with the specification and delivers the specified output.

C3.3.3.29.8 E239.8 ENGINE

The engine must comply with the requirements laid down in SANS ISO 8528 and must be of a solid injection, compression ignition type, running at a speed not exceeding 1500 rpm. 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 taking over the specified load by the generating set in two steps shall not exceed 20 seconds. The tenderer shall specify the initial one-step load capability of the generating set.

The engine shall be capable of delivering an output of 110% of specified output for one hour in any period of 12 hours consecutive running, in accordance with SANS ISO 8528.

Curves furnished by the engine maker, showing the output of the engine offered against the speed, for both intermittent and continuous operation, as well as fuel consumption figures, must be submitted with the tender.

C3.3.3.29.8.1 E239.8.1 LUBRICATION

Lubrication of the main bearings and other important moving parts shall be a force-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.

C3.3.3.29.8.2 E239.8.2 FUEL PUMP

The fuel injection equipment must be suitable for operation with commercial brands of diesel fuel normally available in South Africa.

C3.3.3.29.8.3 E239.8.3 COOLING

The engine must be a water-cooled type, with a built-on heavy duty, tropical type radiator.

All air ducts for the cooling of the engine are to be allowed for. The air shall not be allowed to re-circulate in the plant room and an air duct shall be supplied from the radiator face to discharge louvres in the plant room wall.

C3.3.3.29.8.4 E239.8.4 GOVERNOR

The speed of the engine shall be controlled by a governor in accordance with SANS ISO 8528 if not otherwise specified in the detail specification. When the initial one step load is suddenly switched on or full load off the temporary speed variation shall not exceed 10%. The permanent speed variation shall not exceed 1% of nominal engine speed. The governor shall be electronic.

C3.3.3.29.8.5 E239.8.5 DERATING

The engine must be derated for the site conditions as set out in the detail specification.

The derating of the engine shall be in accordance with the engine manufacturers derating curves. Copies of these derating curves or tables must be included with the tender response.

C3.3.3.29.8.6 E239.8.6 STARTING AND STOPPING

The engine shall be easily started from cold, without the use of any special ignition devices, under summer as well as winter conditions.

Tenderers must state what arrangements are provided to ensure easy starting in cold weather.

The electrical circuits for heaters shall be taken from the control panel and must be protected by a suitable circuit breaker.

Besides the automatic starting and stopping, provision must be made on the control board for manual starting and stopping of the set.

The automatic control shall make provision for three consecutive starting attempts of 10 seconds with 10 second intervals. Thereafter the set must be switched off and the starter failure relay on the switchboard must give a visible and audible indication of the fault.

C3.3.3.29.8.7 E239.8.7 STARTER BATTERY

The set must be supplied with a new fully charged maintenance free lead-calcium type battery. The battery must have sufficient capacity to provide the starting torque stipulated by the engine maker, and for at least six consecutive starting attempts. The battery must be housed on a suitable tray or stand.

C3.3.3.29.8.8 E239.8.8 EXHAUST SILENCER

It is essential to keep the noise level as low as possible. An effective exhaust silencing system of the residential type is to be provided to limit the noise level to approximately 75dBA @ 7metres from the exhaust outlet or as specified in the detailed specification.

The exhaust pipe must be flexibly connected to the engine to take up vibrations transmitted from the engine, which may cause breakage. The exhaust pipe and silencer inside the plant room must be lagged to reduce heat and noise transmission.

C3.3.3.29.9 E239.9 ALTERNATOR

The alternator shall be of the self-excited brushless type, with enclosed drip - proof housing, and must be capable of supplying the specified output continuously with a temperature rise not exceeding class H as laid down in BS 5000 for rotor and stator 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. Windings shall be fully impregnated for tropical climate and must have an oil resistant finishing varnish.

C3.3.3.29.9.1 E239.9.1 ALTERNATOR PROTECTION

On the switchboard a multi-pole circuit breaker with instantaneous short circuit trips and thermal overload trips must be installed for protection of the alternator against short circuit and overload.

C3.3.3.29.9.2 E239.9.2 REGULATION

The steady state voltage regulation must not exceed ± 1% of nominal voltage specified between no load and full load with the power factor between unity and 0.8 lagging and within the driving speed variation of 4.5%.

C3.3.3.29.9.3 E239.9.3 PERFORMANCE

Following the application of 70% of full load, or the initial one step load capability of the engine, the transient voltage shall not exceed 15% and will recover to the nominal voltage within 500ms.

C3.3.3.29.9.4 E239.9.4 OUTPUT VOLTAGE

The set shall have a site output as set out in the detail specification.

C3.3.3.29.10E239.10 OPERATION SELECTOR

A four-position selector must be provided on the control panel marked “AUTO”, “MANUAL”. “TEST” and “OFF”.

With the selector on “AUTO” the set shall automatically start and stop according to mains supply being available or not.

With the selector on “TEST” it shall be possible to start and stop the set with the push buttons but the running set shall not be switched to the load, UNLESS the mains supply fails during this test, in which case the set will be switched to the load.

With the selector on “MANUAL” the set must take load when started with the push button, but it must not be possible to switch the set onto the mains or the mains onto the running set.
With the selector on” OFF” the set shall be completely disconnected from automatic controls for cleaning and maintenance of the engine.

C3.3.3.29.11 E239.11 BYPASS SWITCH AND COMBINED MAINS ISOLATOR

The switchboard must be equipped with a manually operated on-load by-pass switch, which shall either connect the incoming mains to the automatic control gear or directly to the outgoing feeder. In the latter position the automatic control gear, including the Change-over gear shall be isolated for maintenance purposes.

It is required that the bypass switch isolator be mechanically isolated from the automatic control gear preferably in the lower portion of the switchboard cubicle.

C3.3.3.29.12 E239.12 BATTERY CHARGING

Equipment must be provided on the switchboard for charging the battery from the Mains. The charger shall be constant voltage, current limiting, operate automatically in accordance with the state of the battery and be capable of a continuous RMS current of at least 6 amps with an AC ripple content of less than 1% in order to prolong the life of the battery.

A flush mounted ammeter, suitably scaled, reading the charging current and a flush mounted voltmeter indicating the battery voltage must be provided on the switchboard. An engine driven alternator must be provided for charging the battery during operation of the set.

C3.3.3.29.13 E239.13 STARTING AND STOPPING DELAY

When the main supply is interrupted on one or all phases, the voltage sensors shall initiate the starting cycle. A 0-15 seconds adjustable start delay timer shall be provided to prevent start up on short power interruptions.

A stop delay timer is required to keep the set running for a period of 0-5 minutes, adjustable, after the main supply returns. After changing back to the main supply, a 0-5 minutes timer shall be provided to keep the set running for a cooling period at no load before stopping.

C3.3.3.29.14 E239.14 MAINS FAIL SIMULATION KEY SWITCH

A main supply failure simulation key switch with TEST and NORMAL positions must be installed in the switchboard. In the TEST position, set must be operated as if mains had failed, start and take load.

C3.3.3.29.15 E239.15 COUPLING

The engine and alternator must be directly coupled by means of a high-quality flexible coupling for double bearing alternators, or a flexible plate supplied by the alternator manufacturer in the case of a single bearing alternator.

C3.3.3.29.16 E239.16 FUEL TANK

The tank shall have sufficient capacity to run the engine on full load for a period of 8 hours, providing the following capacities are not exceeded: 200 litres for freestanding day tanks, or 900litres for set-mounted tanks. A 110% catch tank shall be installed under the fuel tank if floor standing or as required by local authorities.

The tank shall be fitted with a suitable filter, a full height protected, and sight glass calibrated in percentage, shut off valve and low-level alarm at 30%, giving an audible and visible signal on the switchboard.

For sets rated at more than 100kVA an electrically operated pump with a suitable length of oil resistant hose must be supplied, for filling the fuel tank from 200 litre drums or as required by the detailed specification. For smaller sets a manually operated wing pump is to be supplied.

The inter-connecting fuel piping shall consist of black steel and connection to vibrating components shall be flexible tubing. A water trap shall be provided in the fuel pipeline between the tank and engine. A drain valve must be fitted to the underside of the fuel tank.

C3.3.3.29.17 E239.17 BASE FRAME

The engine and the alternator of the set shall be built together on a common base frame, of simplex/duplex type. For set mounted panels a Duplex frame will be preferred, consisting of a heavy-duty inner frame on which the alternator and engine are secured with an outer floor standing frame between which purpose made anti-vibration mountings in “V” formation are mounted. The Panel will be mounted on the floor standing frame. The Simplex type base frame will consist of a heavy-duty steel frame on which the alternator and engine are secured fitted with floor standing spring type anti-vibration mountings. The set must be placed direct on the concrete floor. A drip tray must be fitted under the engine. The tray must be large enough to catch a drip from any part of the engine.

C3.3.3.29.18 E239.18 SWITCHBOARD

A switchboard must be supplied for the set and is to incorporate all equipment necessary for control and protection of the generating set, the automatic change over and battery charging equipment.

The switchboard shall be a totally enclosed unit and shall consist of steel panels.

The steelwork of the boards must be thoroughly de-rusted, primed with zinc chromate and finished with two coats of signal red enamel, or baked epoxy powder coating.

Suitable rated terminals must be provided for all circuits. Where cable lugs are used, these shall be crimped. Screwed terminals shall prevent spreading of the strands.

All wiring shall have each wire fitted with a cable or wire marker of approved type and the numbering of these markers must be shown on a wiring diagram of the switchboard.

The automatic control and protection control equipment shall be mounted on a separate easily replaceable small panel and shall preferably be designed and manufactured in the RSA. The automatic control shall be microprocessor based and shall be programmable, unless otherwise specified.
The manufacturer shall guarantee the availability of compatible exchange control units for at least 10 years.

All equipment on the switchboard, such as contactors, isolators, busbars, etc. shall have ample current carrying capacity to continuously handle at least 110% of full load alternator current without overheating.

Wiring between stationary and hinged panels or doors shall be made between terminal blocks or clamped in such a manner as to afford flexibility without damage to the wires. The wires shall be neatly bundled, and tie wrapped.

C3.3.3.29.18.1 E239.18.1 EARTHING

An earthing bar must be fitted in the switchboard to which all non-current carrying metal parts shall be bonded.

The neutral point of the system must be solidly connected to this bar. Suitable terminals must be provided on the earth bar for connection of the main earth conductors, which will be supplied and installed by others or as specified in the detailed specification.

C3.3.3.29.18.2 E239.18.2 THE FOLLOWING EQUIPMENT IS REQUIRED IN THE BOARD

a) One flush 96 mm square dial voltmeter, scaled, reading the alternator voltage.

b) One flush voltmeter selector switch with 6 metering and one-off position, connecting the voltmeter to phase and neutral.

c) One flush 96 mm square dial indicating type frequency meter, indicating the alternator frequency.

d) An hour meter with cyclometer counter, reading the number of hours the plant has been operating. The smallest figure on this meter is to read 1/10th hour.

e) One set of fuses or cb's for potential circuits of the meters.

f) Flush 96mm square dial maximum demand ammeters for measuring the alternator current, scaled to suit complete with necessary current transformer with resettable pointer.

g) One isolator for the mains isolation (check detailed specification for requirement).

h) Automatic – change over control equipment. (check detailed specification).

i) One circuit breaker for alternator protection against overload and short circuit conditions (check detailed specification for requirement).

j) One four-position operation selector switch.

k) Two push buttons or one switch marked "Start" and "Stop" for manual starting and stopping the set.

l) Battery charging equipment as specified, complete with flush ammeter and voltmeter.

m) Relays with re-set pushes as specified, for engine protection and warning.

n) Fault indicating lights.

o) Mains fail simulation key switch.

p) Switch for fuel pump.

q) Warning hooter.

r) Bypass switch.

s) Test pushbutton to test all indicator lamps.

t) Suitable terminals for incoming main and alternator cables, for the outgoing feeder and for the earth connection.

u) Any other equipment necessary for the correct and safe operation of the installation.

C3.3.3.29.18.3 E239.18.3 PROTECTION AND ALARM DEVICES

Relays with reset push buttons are required to give a visible and audible signal and stop the engine when any of the protective devices operate.

Protection must be provided for high engine temperature, low lubrication oil pressure, over speed / under speed, start failure, low water level, overload, low fuel, battery charger fail, faulty switch position, emergency stop and abnormal voltage.

A potential free common alarm contact for remote monitoring must be supplied, unless otherwise specified in the detailed specification.

C3.3.3.29.19E239.19 MAINTENANCE

The tender is inclusive of all breakdown maintenance, 24hour emergency callout and four preventative maintenance visits during the first 12 months calculated on standby use of the generating set, excluding consumables such as oil and filters. A fully priced pro-forma maintenance agreement must be submitted with the tender, catering for four preventative visits per annum and 24hour emergency callout facility. The number of bona-fide service technicians employed by the tenderer and stationed in Gauteng will be stated in the tender response.

C3.3.3.30 E241 LOW VOLTAGE ELECTRIC MOTORS

C3.3.3.30.1 E241.1 GENERAL

C3.3.3.30.1.1 E241.1.1 This specification covers low voltage (below 1000V), 3-phase a.c. squirrel cage induction motors.

C3.3.3.30.1.2 E241.1.2 The motors shall be designed, manufactured, tested, delivered, erected, and commissioned in accordance with:

SANS 60034: Rotating Electrical Machines, Parts 1 to 18

SANS 60072: Dimensions and output series for rotating electrical machines.

SANS 1804 : Induction Motors, Parts 1 to 4

Where reference is made to a code, specification or standard, the reference shall be taken to be the latest edition, including addenda, amendments and revisions thereto.

All deviations from these specifications shall be clearly pointed out at tender stage as deviations not indicated, will not be accepted.

C3.3.3.30.1.3 E241.1.3 Motors of the same manufacture shall be used throughout the Contract unless otherwise approved by the Engineer.

C3.3.3.30.1.4 E241.1.4 Motors shall be designed for fixed speed or variable speed operation as specified in the Project Specification.

C3.3.3.30.2 E241.2 QUALITY OF MATERIALS

C3.3.3.30.2.1 E241.2.1 All materials shall be new, of the best quality and of the class most suitable for the application. All parts shall be capable of withstanding variations of temperature arising under working conditions without distortion, deterioration or setting up of undue stress in any part.

C3.3.3.30.2.2 E241.2.2 Quality control shall be in accordance with ISO 9001.

C3.3.3.30.2.3 E241.2.3 Mild steel plate for fabricated parts shall be of weldable quality in accordance with SANS 1431. No welding, burning in, filling, plugging up or metal deposition to correct defects in any component will be permitted unless agreed to by the engineer in writing, following an inspection on the defect.

C3.3.3.30.3 E241.3 INTERCHANGEABILITY

C3.3.3.30.3.1 E241.3.1 Motors of the same rating shall be interchangeable without them having to be modified.

C3.3.3.30.3.2 E241.3.2 The corresponding parts of motors that are identical, for all practical purposes, shall be interchangeable without them having to be modified. The same requirement applies to spare parts.

C3.3.3.30.4 E241.4 DRAWINGS AND INFORMATION FOR APPROVAL

The following drawings and information shall be submitted for approval before manufacture commences:

C3.3.3.30.4.1 E241.4.1 Dimensioned outline and required foundation drawings of the motors. (Shaft diameter, shaft height and motor mass to be clearly shown).

C3.3.3.30.4.2 **E241.4.2** Cross-sectional dimensioned drawings of the terminal boxes.

C3.3.3.30.4.3 **E241.4.3** Detailed drawings of the motor base plate showing full constructional details with dimensions.

C3.3.3.30.5 E241.5 INSPECTION OF MANUFACTURED EQUIPMENT

C3.3.3.30.5.1 **E241.5.1** The Engineer, or his appointed representative, reserves the right to inspect the motors or associated parts at any stage of manufacture.

C3.3.3.30.5.2 **E241.5.2** The Contractor shall ascertain at what stages inspections will be carried out and shall give the Engineer not less than seven days' notice of when the inspections may be undertaken.

C3.3.3.30.6 E241.6 GUARANTEE AND MAINTENANCE

C3.3.3.30.6.1 **E241.6.1** All motors provided under the Contract shall be fully guaranteed for a period of twelve months from the date of handing over.

C3.3.3.30.6.2 **E241.6.2** A full maintenance service shall be provided during this period. The Tenderer shall indicate with his tender what duties have been included and the time intervals between services. Should the Tenderer fail to provide this information, the Engineer will lay down the duties as well as time intervals with which the Contractor shall comply.

C3.3.3.30.7 E241.7 MOTOR RATINGS

C3.3.3.30.7.1 **E241.7.1** Motors shall have continuous maximum ratings not less than the following:

- 50kW or under: 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 unless otherwise specified.
- Where operating at other than continuous running duty is required, (i.e. short time or intermittent periods, as for valve actuators, hoists, etc.), motors shall have appropriate ratings in respect of output, duty and starting class.

C3.3.3.30.7.2 **E241.7.2** The motor shall develop adequate torque to accelerate the driven equipment to full speed, within an acceptable time, using the starting method specified in the Project Specification. For direct-on-line (DOL) starting the motor voltage shall be taken to be 85% of the rated voltage. For other starting methods the motor voltage shall be taken to be the output voltage of the reduced-voltage starter.

C3.3.3.30.7.3 **E241.7.3** Motors shall be designed to allow 6 starts per hour, of which two shall be consecutive.

C3.3.3.30.7.4 **E241.7.4** Rated voltage shall be 400 / 525 / 690V as specified in the Project Specification.

C3.3.3.30.7.5 **E241.7.5** Rated frequency shall be 50Hz.

C3.3.3.30.7.6 **E241.7.6** The motors shall be capable of operating with Zone A combined voltage and frequency variations as defined in SANS 60034-1.

C3.3.3.30.7.7 E241.7.7 Rated speed shall be nominal 1500rpm unless otherwise specified in the Project Specification and the operating speed range shall be as required by the driven equipment.

C3.3.3.30.7.8 E241.7.8 Motors shall be rated for continuous running i.e. Duty S1 to SANS 60034-1 and shall have a service factor of 1.

C3.3.3.30.8 E241.8 MOUNTING

C3.3.3.30.8.1 E241.8.1 The motors shall be mounted to suit the driven equipment. The mounting arrangement shall be as stated in the Project Specification***.

C3.3.3.30.8.2 E241.8.2 Motors shall be mounted on common base-plates 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. Baseplates shall be provided with the driven equipment unless otherwise stated in the Project Specification.

C3.3.3.30.8.3 E241.8.3 Motor feet shall be fitted with Grade 316 stainless steel jacking screws for both horizontal and vertical adjustment.

C3.3.3.30.8.4 E241.8.4 Mounting bolts shall be included in the motor's price, unless otherwise stated in the Project Specification.

C3.3.3.30.9 E241.9 ENCLOSURES AND COOLING

C3.3.3.30.9.1 E241.9.1 Motors shall be totally enclosed with a protection rating of IP55 in accordance with SANS 60034-5, unless otherwise stated in the Project Specification.

C3.3.3.30.9.2 E241.9.2 The cooling system shall be in accordance with SANS 60034-6 and the cooling method (IC Code) shall be as specified in the Project Specification.

C3.3.3.30.9.3 E241.9.3 Ambient and cooling temperatures shall be in accordance with SANS 60034-1, unless otherwise stated in the Project Specification.

C3.3.3.30.9.4 E241.9.4 Noise levels shall not exceed the levels permitted in SANS 60034-9.

C3.3.3.30.10 E241.10 WINDINGS

C3.3.3.30.10.1 E241.10.1 Unless otherwise specified in the Project Specification, thermal class and temperature rise of the motor winding insulation system shall be in accordance with SANS 60034-1 (i.e. Class F insulation, but Class B temperature rise).

C3.3.3.30.10.2 E241.10.2 With self-ventilated cooling systems, allowance shall be made for the speed dependency of heat transfer.

C3.3.3.30.10.3 E241.10.3 Converter-fed motors (variable speed drives) shall be rated to allow for additional harmonic losses in accordance with SANS 60034-17.

C3.3.3.30.10.4 E241.10.4 For converter-fed motors (variable speed drives), the motor manufacturer shall check the voltage stress withstand capability of the motor against the converter supplier's specification. To ensure that no service lifetime reduction of the motor insulation occurs, the actual stress due to converter operation shall be lower than the repetitive voltage stress withstand capability of the motor winding insulation system.

C3.3.3.30.10.5 E241.10.5 Functional evaluation of the winding insulation systems shall be carried out in accordance with SANS 60034-18 - 31. In the case of converter-fed motors, special attention is required because of the additional stress factors produced, such as increased voltage stress and high frequency repetition rate, additional heating as a result of harmonic losses, and mechanical vibrations.

C3.3.3.30.11 E241.11 BEARINGS

C3.3.3.30.11.1 E241.11.1 TYPE

Bearings shall be of the rolling- or sliding-element type as appropriate. Vertical shafts shall have approved thrust and guide bearings. Grease-lubricated bearings shall be sealed or re-greaseable.

Rolling-element bearings shall be loaded conservatively, in order that the grease may be renewed at intervals of not less than 4000 hours and they shall be equipped with grease nipples.

Where bearings are oil-lubricated, they shall be provided with a readily accessible filler and clearly visible oil level indicator. For large motors, forced lubrication may be provided as an alternative and details of the system shall be submitted with the tender.

Sliding-element bearings shall be fitted where rolling-element bearings cannot be fitted because of high speed, torque and/or bearing loads. Motors having sliding-element bearings shall be designed to allow measurement of bearing wear with a minimum of dismantling being necessary.

Sliding-element bearings shall be of the plain journal type, and not of the segmental type, and they shall be automatically lubricated by at least two oil rings or a single disc integrally mounted on the shaft, running in an oil bath of adequate capacity. The oil bath shall be fitted with a drain plug and an external oil level indicating device which is readily accessible or visible.

For sliding-element bearing motors employing forced oil lubrication, full particulars of the proposed lubricating system shall be submitted.

Care shall be taken that bearings are properly sealed in order to prevent ingress of bearing lubricant into windings and cores. For purpose of maintenance, end-shield bearings are preferred. A minimum L10 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.

C3.3.3.30.11.2 E241.11.2 INSULATION

To prevent damage by any shaft currents which may be produced (e.g. on converter-fed motors), the bearings and their lubricating and cooling systems, shall be insulated from the bed-plate or frame. Although both bearings shall be insulated, the drive-end bearing insulation shall be shorted out with a copper earth strap to prevent the build-up of static electricity on the rotor.

C3.3.3.30.11.3 E241.11.3 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.

C3.3.3.30.12 E241.12 TEMPERATURE DETECTORS

All motors 55kW and larger but smaller than 150kW shall be provided with two PTC thermistors per winding suitable for class B temperature rise protection i.e. with reference temperature of 140°C. The terminal blocks in the terminal box. (1 per winding connected to terminal blocks shall be spare).

C3.3.3.30.12.1 E241.12.1 All motors of 150kW and larger shall be provided with two platinum resistance detectors (RTD's) of type PT 100ohm per winding and one per bearing. The bearing detectors shall touch the outer bearing race and shall be spring loaded and of the screw type with weatherproof die cast alloy heads. The RTD's shall be of the three-wire type with a stainless-steel sheath and mineral insulation. When specified in the Project Specification the bearing RTD's shall be provided with 2 wire transmitters with a 4 - 20mA output terminated in a die-cast cap.

C3.3.3.30.12.2 E241.12.2 The wires of all detectors must be wired to a terminal strip in a suitable terminal box on the motor.

C3.3.3.30.12.3 E241.12.3 When specified in the project specification the motor manufacturer shall provide a 1-inch BSP threaded hole in the motor casing to enable the installation of a bearing temperature probe by others.

C3.3.3.30.13E241.13 ANTI-CONDENSATION HEATERS IN MOTORS

C3.3.3.30.13.1 E241.13.1 Anti-condensation heaters shall be built into the stators of motors and rated for a single-phase power supply of 230V AC 50Hz.

C3.3.3.30.13.2 E241.13.2 The terminals of the heaters shall be wired to a heater terminal box.

C3.3.3.30.14E241.14 TERMINAL BOXES AND TERMINATIONS

C3.3.3.30.14.1 E241.14.1 The terminal box for the main supply cable(s) shall be adequately sized for the cables specified in the Project Specification and shall have a removable cover and gland plate. The degree of protection shall not be less than IP55.

C3.3.3.30.14.2 E241.14.2 Phase segregation shall be provided to prevent flashover, if the air and creepage distances between phases, and phases to earth are not adequate.

C3.3.3.30.14.3 E241.14.3 All terminals must be properly and permanently marked for easy identification.

C3.3.3.30.14.4 E241.14.4 Terminal boxes shall be on the left-hand side if viewed from the drive end, unless other specified in the Project Specification.

C3.3.3.30.14.5 E241.14.5 An explosion-relief diaphragm shall be provided to direct high-pressure gases away from personnel who may be near the motor in the event of a terminal box fault.

C3.3.3.30.14.6 E241.14.6 Terminal boxes shall be fault-tested for both a through-fault and a short-circuit in the terminal box, based on the maximum fault level at the point of connection.

C3.3.3.30.14.7 E241.14.7 The terminal box shall be suitable for the cable termination method specified in the Project Specification.

C3.3.3.30.15E241.15 INFORMATION PLATES FOR MOTORS

C3.3.3.30.15.1 E241.15.1 In addition to the information required by SANS 60034-1, the following shall also be marked on the name plates:

C3.3.3.30.15.1.1 E241.15.1.1 Year of manufacture

C3.3.3.30.15.1.2 E241.15.1.2 The order number

C3.3.3.30.15.1.3 E241.15.1.3 Total mass of motor in kg

C3.3.3.30.15.1.4 E241.15.1.4 Diagram indicating the number, type and positions of heaters and temperature detectors if applicable.

C3.3.3.30.15.1.5 E241.15.1.5 Bearing types and sizes

C3.3.3.30.15.1.6 E241.15.1.6 Bearing grease interval or bearing replacement interval where pre-packed bearings are used.

C3.3.3.30.16 E241.16 COUPLINGS AND DIRECTION OF ROTATION

C3.3.3.30.16.1 E241.16.1 Couplings between the motors and the driven equipment will be provided with the driven equipment unless otherwise stated in the Project Specification.

C3.3.3.30.16.2 E241.16.2 The motor's direction of rotation shall be to suit the driven equipment, and the motor terminals shall be marked in accordance with SANS 60034-8.

C3.3.3.30.17 E241.17 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.

The permitted levels of vibration generated within the motors shall not exceed the values given in SANS 60034-14.

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 limits.

The motors shall have a suitable margin of safety between critical speed and normal running speed. The first critical speed shall be not less than 120 percent of nominal speed.

C3.3.3.30.18 E241.18 TESTING

Motors shall be tested at the manufacturer's works, with the scope of the tests depending on whether the motors have been built to a new or proven design as set out below.

Four copies of all test certificates shall be submitted to the Engineer no later than when the motors are delivered.

C3.3.3.30.18.1 E241.18.1 NEW DESIGNS (TYPE TESTS)

Any single motor, or the first motor of any batch of identical motors, shall be subjected to the following tests:

a) Resistance measurement (cold) of all windings and auxiliary devices

b) Load test

c) Temperature rise at full load and hot resistance of windings

d) Speed / torque and speed / current curves

e) Vibration and noise levels

f) Verification of dielectric properties

g) No load test

h) Locked rotor test

i) Measurement of starting, pull-up and breakdown torque

j) Verification of degree of protection

k) Overspeed test (if application can result in overspeed).

The remaining motors shall be tested as for motors built to a proven design.

C3.3.3.30.18.2 E241.18.2 PROVEN DESIGNS (ROUTINE TESTS)

All motors that have been built to a proven design shall be subjected to the following tests:

a) Resistance measurement (cold) of all windings and auxiliary devices

b) No load test

c) Verification of dielectric properties

d) Insulation resistance test.

Type test certificates shall be provided for the motors that are only subjected to routine tests.

C3.3.3.30.19 E241.19 INSTALLATION

a) The motors shall preferably be installed by the motor supplier and shall be installed strictly in accordance with the supplier's installation instructions.

b) To allow for interchangeability of motors, the motors shall be installed on 2mm thick corrosion-resistant shims to allow for shaft height variation.

c) The motor frame shall be insulated from the baseplate if necessary, to prevent circulating bearing currents with converter-fed motors. The coupling shall similarly be insulated if required.

d) The motor shall be aligned to the driven equipment using laser aligning equipment or approved equivalent. Final alignment shall be done before commissioning may start and shall be witnessed by the Engineer. Alignment shall be within the tolerances specified for the shaft coupling.

C3.3.3.30.20 E241.20 COMMISSIONING

Once the motor and driven equipment have been aligned successfully, the following minimum commissioning checks shall be carried out.

a) Ensure that the switchgear controlling the motor, and any associated protection and metering circuits, have been checked fully. It is imperative to ensure that any trip and emergency shutdown circuits are working correctly before the circuits are energized.

b) The motor windings shall be checked for dryness and also that the insulation resistance and polarization indexes have acceptable values, as recommended by the motor manufacturer.

c) Check the earth connections to the motor frame and terminal box for tightness.

d) Check all auxiliary services, such as oil and water for lubrication and cooling to ensure that there is adequate flow and that interlocks and protection circuits are operational.

e) Check that all hazard warning signs, guards and covers are in position and securely fastened.

f) Check separately-driven motor cooling fans for correct operation and rotation, and to ensure that interlocks and protection circuits are operational.

g) Ensure that phase rotation of supply to motor has been checked. If there is any doubt and any risk of damage to the driven equipment, the coupling should be split, and the motor run alone.

h) Check that direction of rotation matches the marking on the motor to ensure correct functioning of shaft-mounted fan.

i) Check shaft bearing and motor footing insulation if provided.

Should dampness in the windings be detected through the measurement of low insulation resistance (Item b above), then the motor shall be dried out and a withstand voltage test carried out at 80% of the test voltage recommended in SANS 60034-1 for factory testing (i.e. 80% of 2 VR + 1 kV).

It is recommended that the test voltage for measuring insulation resistance be limited to 500V dc, and the minimum acceptable insulation resistance shall be 1.5MΩ.

The method adopted for drying-out shall be by applying heat, preferably by circulating current through the windings or, alternatively, by means of space heaters located in and around the machine.

Insulation resistance measurements and temperature readings shall be taken regularly every half hour at the start of dry-out until the motor attains an even temperature and thereafter every hour. The characteristic dry-out curve of insulation resistance versus temperature shall be plotted and dry-out may be considered complete when the required polarization index is achieved.

All equipment and the personnel required for the drying out operation, shall be provided by the Contractor. The onus remains on the Contractor to satisfy himself that a motor is dry before it is connected to the supply. Any motor which fails as a result of being commissioned in a damp condition, shall be repaired free of charge by the Contractor.

C3.3.4 CONTROL AND INSTRUMENTATION WORKS

This section is comprised of:

- A project specification which details the control and instrumentation (electronics) scope of works under this Contract and;
- Standard control and instrumentation specifications.

C3.3.4.1 CI100 CONTROL AND INSTRUMENTATION PROJECT SPECIFICATION

C3.3.4.1.1 CI100.1 GENERAL

The Brixton pump station will consist of two duty and one standby pump that will draw water from the existing reservoir and pump into the water tower. JW requirements dictate that the normal operation of the system will entail:

- Feeding the reservoir from the incoming RW off-take.
- Pumping from the reservoir into the water tower
- Gravitating water into the 'Water Tower Zone'.
- Furthermore, the 'Reservoir Zone' will be directly gravity fed from the reservoir.

Control and instrumentation (C&I) requirements are to ensure system functioning and protect the pump sets. To achieve these requirements, the following control parameters shall be measured:

- Bearing temperatures on the pumps (DE & NDE)
- Bearing temperatures on the motors (DE & NDE)
- Vibration of the pump sets (DE motor & pump)
- Motor winding temperatures 2 per phase
- Delivery side flow
- Delivery side pressure
- Reservoir and water tower levels – ultrasonic with back-up float mechanisms.

Feed to the reservoir (normal operation) and direct feed to the water tower (emergency operation) will be controlled using hydraulic valves (i.e. with pilot lines).

Instruments shall be located in accessible positions to facilitate maintenance. Pump duty point control will be achieved via variable frequency drives.

C3.3.4.1.2 CI100.2 SCOPE

The scope of works for the control and instrumentation installation section of the project shall include, but is not limited to the design, supply, delivery, installation, testing and commissioning of an integrated PLC control system comprising the following:

- SCADA system to include the monitoring and control of Brixton Tower pump station and Reservoir
- Surge protection
- The instrumentation and cabling

- A communication system linking all electrical equipment to telemetry

C3.3.4.1.3 CI100.3 CONTROL PHILOSOPHY

In order to limit the number of pump starts a modulating flow to the tower shall be used.

A minimum level in reservoir will be set below which the pumps will not operate. This low-level trip will be generated from the level probe but backed up by the level switches.

Pump start will be dictated by the level in the water tower. Pump stops will be dictated by a high level in the water tower

VSD setting will be controlled to achieve the required duty point and to reduce the number of starts.

VSDs will be used to achieve stable pump starts whereby a slow ramp up will be employed to protect the infrastructure.

C3.3.4.1.3.1 CI100.3.1PUMP SET CONTROL

This section describes basic control and monitoring of each pump set.

Each pump set will be equipped with the following instrumentation as a minimum:

- Motor winding temperature two per phase
- Motor bearing temperature on both drive and non-drive end bearings
- Motor Vibration for the X and Y planes on both drive and non-drive end bearings
- Pump bearing temperature on both drive and non-drive end bearings
- Pump Vibration for the X and Y planes on both drive and non-drive end bearings
- Pump suction and discharge pressure
- Flow switch on the pump discharge side
- Isolation valves open and closed position feedback switches

The common manifold will have the following instrumentation:

- Instantaneous and cumulative flow measurement
- Pressure monitoring

All motor and pump temperatures and vibrations will be wired to the telemetry system for monitoring and trending. Each temperature and vibration will be equipped with a programmable relay output. All relay outputs on a pump set shall be wired in series and connected directly as an external interlock to the motor protection relay under the electrical scope.

All bearing temperatures, vibrations, flows, pressure and isolation valve position feedback signals shall be wired to a junction box alongside the pump set. Temperature and vibration transmitters will be installed inside the junction box. All signals shall be hardwired through a multipair cable to a telemetry panel.

C3.3.4.1.3.1.1 CI100.3.1.1 Interlocking pump set:

Pump set will be stopped or not allowed to start under the following conditions:

- Reservoir level Low (to be defined at commissioning stages)
- Tower level High (to be defined at commissioning stages)
- Isolation valve closed signal active for longer than 5 seconds
- Low flow detected for longer than 5 seconds while pump is running (running is defined as telemetry system having received a run feedback signal from the motor control center)
- Discharge pressure is lower than a set value (to be defined at commissioning stages) for longer than 5 seconds while pump is running – burst pipe detection / pump failure

- Discharge pressure is higher than a set value (to be defined at commissioning stages) for longer than 5 seconds while pump is running – blocked pipe detection / closed discharge valves with faulty limit switches
- High (OEM recommended values to be used) motor/pump bearing temperature
- Excessive (OEM recommended values to be used) motor/pump vibration detected
- Fault status received from the motor control center Communications with the motor protection relay will be via Modbus TCP.

C3.3.4.1.3.2 CI100.3.2VALVE CONTROL

All valves shall be equipped with open and closed position feedback switches. Failure to reach any of these positions after a set period of time (time period to be determined during commissioning) from receiving a request by the control system shall cause the valve to trip and indicate the error to the operator. A fault will be indicated to the operator if any of the feedback limits fall away without a request from the control system to change position.

C3.3.4.1.3.3 CI100.3.3FILLING OF THE TOWER

The Brixton tower will be equipped with three level switches namely:

- High Level
- Control Low, and
- Low Low Level

Control Low will start one of the two pumps, starting of the pumps will alternate between the two pumps. Should the water in the tower reach a low low level the duty pump will be started. High level in the tower will stop the pump.

The duty pump will ramp up to the required pump duty point and then modulate to achieve a stable duty point and tower level. If one pump cannot achieve a stable level and the level is decreasing, then the second pump will be started.

C3.3.4.1.3.4 CI100.3.4POWER FAILURE CONTROL

The diesel generator will only be started when both the following conditions are true:

- No electrical power and
- Control low switch is made.

Communication to the generator's control panel will be via Modbus TCP.

C3.3.4.1.4 CI100.4 ELECTRICAL SUPPLY

Electrical supply for this project is covered in the Electrical Project Specification

C3.3.4.1.5 CI100.5 DRAWINGS

The following drawings are provided for reference:

- Piping and Instrumentation Diagram

- Cable Block Diagram (1)
- Cable Block Diagram (2)

Detailed shop drawings and wiring diagrams are to be supplied by the Contractor for approval by the Engineer before construction can commence.

C3.3.4.1.6 CI100.6 MATERIAL, FINISHING AND PAINTING OF MATERIALS AND EQUIPMENT

The environment is not extremely corrosive, and the following materials shall therefore be used:

Junction Boxes / Instrument Transmitter Enclosures: 3CR12 or hot-dip galvanized indoors and outdoors.

C3.3.4.1.7 CI100.7 CABLE SUPPORTS

Where cables have to be installed on cable supports, (i.e. where the cables are not buried in the ground) the cable supports shall be heavy duty cable ladder type.

Where power cables and communication/instrumentation cables are installed in the same trench or cable rack, a minimum clearance distance of 200mm shall be kept between the power and communication cables. Cables shall be supported on trays / ladders in accordance with Standard Electronic Installation Specification.

C3.3.4.1.8 CI100.8 CONTROL AND INSTRUMENTATION CABLES

Control and instrumentation cables shall conform to the following specification:

	Cables on Racks	Buried Cables
Rating	600/1000 V	600/1000 V
Conductors	Twisted Pairs/Triads	Twisted Pairs/Triads
Insulation	PVC/PVC	PVC/PVC
Screening	Individual and Overall Screening	Individual and Overall Screening
Armouring	Aluminum Polyethylene Laminate	Galvanized Steel Wire
Serving	PVC	PVC

Cables shall be sized in accordance with the cable block diagrams. A preliminary cable schedule is provided in Appendix C of this Specification.

C3.3.4.1.9 CI100.9 JUNCTION BOXES

The junction boxes shall be stand-mounted alongside the pump set or meter chambers and shall be used to connect all electronic equipment in the vicinity.

Junction boxes shall be provided for connecting integral control and instrumentation cables of equipment / instrumentation to the control and telemetry panels. The integral cables shall be connecting to conventional cables via terminal strips in the junction boxes.

Junction boxes shall be manufactured from non-corroding material and shall have a minimum environmental protection rating of IP65. The control and instrumentation contractor shall produce all shop drawings for approval by the Engineer.

C3.3.4.1.10 CI100.10 FIELD INSTRUMENTATION

Cable block diagrams sets out the overall connection of field instrumentation.

The control and instrumentation contractor shall produce connection diagrams, which set out the detailed connection of the instrument to its control and telemetry device via all associated terminations, marshalling and intermediate junction boxes.

The connection diagrams, loop drawing, shall be issued for approval by the Engineer before the instruments can be installed on site.

C3.3.4.1.10.1 CI100.10.1 FLOAT SWITCHES

Float switches shall be used for tower level sensing.

The floats shall be of the Flygt type or similar approved and shall each be supplied with an internal 10m cable, which shall be terminated in a local instrument junction box. The floats shall be suspended from a hot-dip galvanised chain mounted in the tower.

The excess cable shall be coiled and suspended from a hot-dip galvanised pig tail bolt fixed to the inner wall of the tower near the cable entry ducts.

C3.3.4.1.10.2 CI100.10.2 PROXIMITY SWITCHES

Proximity switches will be provided for monitoring the valves at each reservoir and on the pump suction and discharge. Valves will be monitored for fully opened and closed conditions. The proximity switches will be supplied with the valves under mechanical scope of supply.

The proximity switches shall be capable of handling 24VDC 2-wire operation.

C3.3.4.1.10.3 CI100.10.3 PRESSURE INDICATING TRANSMITTERS

These units shall be installed on the delivery and suction side of each pump as well as on the delivery line from the pump station. They shall be loop powered 4-20mA units, conforming to the Standard Specification for Instrumentation and the relevant datasheet.

C3.3.4.1.10.3.1 CI100.10.3.1 Differential pressure indicating transmitters

These units shall be installed on the three screens to detect a blocked screen. They shall be loop powered 4-20mA units, conforming to the Standard Specification for Instrumentation and the relevant datasheet.

C3.3.4.1.10.4 CI100.10.4 ELECTROMAGNETIC FLOW METERS

One Electromagnetic flow meter shall be supplied in accordance with Standard Specification for Instrumentation and the relevant datasheet.

C3.3.4.1.10.5 CI100.10.5 THERMAL FLOW SWITCHES

These 24 VDC units shall be installed on the pump delivery sides for low / no flow detection and shall have an adjustable trip point. All flow monitors shall conform to the relevant datasheets.

C3.3.4.1.10.6 CI100.10.6 VIBRATION TRANSMITTER

Vibration transmitters shall be used on all pumps and motors. All vibration instruments shall be supplied in accordance with original equipment manufacturer (OEM) specification and relevant datasheets.

C3.3.4.1.10.7 CI100.10.7 TEMPERATURE TRANSMITTER

Temperature transmitters shall be used for monitoring of electrical motor & pump bearing and motor winding temperatures. The transmitters must be able to accept a PT100 signal and must be DIN rail mounted.

Single-channel or multi-channel configurations are acceptable, to suit the application. The control unit shall be microprocessor based and have a programmable normally open and normally closed relay contact.

Temperature transmitters shall be supplied in accordance with relevant datasheets; all PT100 sensors will be supplied by others, as part of pump or electrical motor.

C3.3.4.1.11 CI100.11 TELEMETRY

One telemetry panel shall be provided and installed in the pump station in accordance with the plant Control System Architecture drawings and Johannesburg Water specification. Automatic local control of the pump station will be executed by a PLC with remote control via the Remote Terminal unit (RTU) inside the telemetry panel. Manual operation of the pump station shall be made available via a panel mounted HMI coupled to the PLC.

C3.3.4.1.11.1 CI100.11.1 EQUIPMENT SPECIFICATION

The offered equipment shall be similar to the equipment currently used on all Johannesburg water pump stations. Radio/GPRS shall be used and provision shall be made for a radio license.

C3.3.4.1.11.2 CI100.11.2 INPUTS AND OUTPUTS (I/O)

Digital I/O shall be capable of accepting 24 V dc input and output signals and analog I/O shall be suitable for 4-20mA current loops.

Appendix C of this Detailed Specification lists as a guideline the minimum I/O that shall be provided. The Control and Instrumentation contractor shall determine and provide actual I/O requirements, and Tenderers shall be deemed to have allowed in their tenders for all required I/O plus 20% spares.

C3.3.4.1.11.3 CI100.11.3 SCADA PROGRAMMING

All telemetry signals shall be displayed and historized via the existing Adroit SCADA system.

The control and instrumentation contractor shall produce a functional description specification, which sets out how the SCADA mimics will be implemented, for approval by the Engineer before the SCADA is programmed.

The mimics shall include pages for detailed views (indicating all measured values) and an overview pages (indicating pump and tower status). Alarming strategy and available trends that can be stored shall be included as part of the functional description specification.

C3.3.4.1.11.4 CI100.11.4 INSTALLATION, INSPECTION AND TESTING

The telemetry panel shall be installed in a separate section of the MCC which is suitably separate from the main low voltage switchgear and shall include a marshalling section for connection to all signals related to the plant equipment and instrumentation.

The telemetry panel shall also house 230 V AC / 24 V DC power supplies as well as all interposing control relays, surge protection equipment and instrumentation interfaces.

C3.3.4.1.12 CI100.12 UNINTERRUPTIBLE POWER SUPPLIES (UPS)

A panel mount UPS shall be provided in the control panel and shall provide power to the RTU, PLC, HMI and all field instrumentation.

The UPS shall comply with SABS IEC 6204-3 and this Specification.

C3.3.4.1.12.1 CI100.12.1 UPS SPECIFICATION

Type of configuration	:	Single UPS with bypass
Bypass to	:	Primary power
Standby power generator	:	No
Nominal input voltage	:	230V ± 10%
No of phases	:	Single
Nominal input frequency	:	50Hz ± 2%
Harmonics compatibility levels	:	Nominal service conditions in SANS IEC 62040-3
Load type	:	Electronic Equipment
Rated output power	:	To suit load plus 20%
No of output phases	:	Single
Output voltage	:	230V ac
Nominal output frequency	:	50Hz
Rated stored energy time	:	12 hours
Interfaces required	:	hard wired statuses

The UPS shall be installed in the telemetry panel.

C3.3.4.2 CI101 SUBMITTAL PROCEDURES

C3.3.4.2.1 CI101.1 GENERAL

C3.3.4.2.1.1 CI101.1.1 RELATED DOCUMENTS

Drawings and general provisions of the Contract, including Conditions of Contract and other Division Specification Sections, apply to this Section.

C3.3.4.2.1.2 CI101.1.2 SUMMARY

a) This Section includes administrative and procedural requirements for submitting:

1) Shop Drawings.

2) Product Data.

3) Samples.

4) Method Statement and plans.

5) Other miscellaneous submittals.

b) Related Sections include the following:

1) Division 01 Section "Project Management and Coordination" for submitting Coordination Drawings.

2) Division 01 Section "Construction Progress Documentation" for submitting schedules and reports, including Contractor's Construction Program and the Submittals Schedule.

3) Division 01 Section "Quality Requirements" for submitting test and inspection reports and Delegated-Design Submittals and for erecting mock-ups. (if any)

4) Division 01 Section "Product Requirements" for submitting Product List.

c) Shop Drawings: include but are not limited to the following:

1) Fabrication Drawings

2) Builders Work Drawings

3) Installation Drawings

4) Setting diagrams

5) Shop work manufacturing instructions

6) Templates and patterns

7) Design mix formulas.

d) Standard information prepared without specific reference to the project is not considered to be shop drawings.

e) Coordination drawings are a special type of shop drawings that show the relationship and integration of different construction elements that require close and careful coordination during fabrication or during installation to fit in the restricted space provided or to function as intended.

f) Product data include, but are not limited to, the following:

1) Manufacturer's product specifications

2) Manufacturer's installation instructions

3) Standard colour charts

4) Catalogue cuts

5) Roughing-in diagrams and templates

6) Standard wiring diagrams

7) Printed performance curves

8) Operational range diagrams

9) Mill reports

10) Standard product operating and maintenance manuals

g) Samples include, but are not limited to the following:

1) Partial sections of manufactured or fabricated components

2) Small cuts or containers of materials

3) Complete units of repetitively used materials

4) Swatches showing colour, texture, and pattern

5) Colour range sets

6) Components used for independent inspection and testing.

h) Method Statement and Plans: The Contractor will provide within 28 days after the date of the Letter of Acceptance his program for the provision of detailed Method Statements and detailed plans for review by the Engineer, including but not necessarily limited to:

1) Logistics and protection of adjacent works.

2) Plan for usage of Main Contractor's facilities and other temporary works and Contractor's Equipment.

3) Safety.

4) Fire prevention and control.

5) Temporary services layout, distribution, and maintenance.

6) Security.

7) Trash removal and control.

8) Space arrangement for workshops, storage, offices, mock-ups, laboratories, parking, etc.

9) Other items as required by the engineer and/or the Contract Documents.

C3.3.4.2.1.3 Cl101.1.3 DEFINITIONS

a) Action Submittals: Written and graphic information that requires Engineer's responsive action.

b) Informational Submittals: Written information that does not require Engineer's approval. Submittals may be rejected for not complying with requirements.

C3.3.4.2.1.4 Cl101.1.4 SUBMITTAL PROCEDURES

a) General: Electronic copies of CAD Drawings of the Contract Drawings will not be provided by the Engineer for the Contractor's use in preparing submittals.

b) Coordination: Coordinate preparation and processing of submittals with performance of construction activities.

1) Transmit each submittal sufficiently in advance of performance of related procurement and construction activities, allowing ample time for review and resubmitted if necessary, in order to prevent delays to the Works.

2) Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.

3) Coordinate transmittal of different types of submittals for related parts of the Works so processing will not be delayed because of need to review submittals concurrently for coordination.

- Engineer reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.

c) Submittals Schedule: Comply with requirements in Division 1 Section "Construction Progress Documentation" for list of submittals and time requirements for scheduled performance of related construction activities.

d) Processing Time: Allow enough time for submittal review, including time for resubmitting, as follows. Time for review shall commence on Engineer's receipt of submittal.

1) Initial Review: Allow 14 days for initial review of each submittal. Allow additional time if processing must be delayed to permit coordination with subsequent submittals. Engineer will advise Contractor when a submittal being processed must be delayed for coordination.

2) Concurrent Review: Where concurrent review of submittals by Consultants, Employer, or other parties is required, allow 35 days for initial review of each submittal.

3) If intermediate submittal is necessary, process it in same manner as initial submittal.

4) Allow 7 days for processing each re-submittal.

5) No extension of the Time for Completion will be authorized because of Contractor's failure to transmit submittals to Engineer sufficiently in advance of the work to permit processing, and re-submittal if necessary.

e) Identification: Place a permanent label or title block on each submittal for identification.

1) Indicate name of firm or entity that prepared each submittal on label or title block.

2) Provide a space approximately 100 x 125 mm on label or beside title block to record Contractor's review and approval markings and action taken by Engineer.

3) Include the following information on label for processing and recording action taken:

- Project name.
- Employer's name.
- Date.
- Name and address of Engineer.
- Name and address of Design Consultant.
- Name and address of Contractor.
- Name and address of subcontractor.
- Name and address of supplier.
- Name and address of manufacturer.
- Unique identifier, including revision number.
- Number and title of appropriate Specification Section.
- Drawing number and detail references, as appropriate.
- Any other necessary identification.

f) Deviations: Highlight, encircle, or otherwise indicate and identity on Submittal documents any deviations from the Contract Documents on submittals.

g) Additional Copies: Unless additional copies are required for final submittal, and unless Engineer observes noncompliance with provisions of the Contract Documents, initial submittal may serve as final submittal.

1) For submittals requiring concurrent review, submit one extra copy in addition to specified number of copies to Engineer.

2) Additional copies submitted for maintenance manuals will not be marked with action taken and will be returned.

h) Transmittal: Package each submittal individually and appropriately for transmittal and handling. Transmit each submittal using a transmittal form attached to a cover letter. Engineer will discard, without review, submittals received from sources other than Contractor.

1) Cover Letter: On attached, numbered, separate sheet(s), prepared on Contractor's letterhead, record relevant information, requests for data, revisions other than those requested by Engineer on previous submittals, and deviations from requirements of the Contract Documents, including minor variations and limitations. Include the same label information as the related submittal.

- Include Contractor's certification stating that information submitted complies with requirements of the Contract Documents.

2) Transmittal Form: Use a form acceptable to and approved by Engineer. Provide locations on form for the following information:

- Project name.
- Employer's name.
- Date.
- Destination (To:).
- Source (From:).
- Names of subcontractor, manufacturer, and supplier, as applicable.
- Category and type of submittal.
- Submittal purpose and description.
- Submittal and transmittal distribution record.
- Remarks.
- Signature of transmitter.

i) Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, and installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.

j) Use for Construction: Permit only final submittals with appropriate approved stamp, or other mark indicating action taken by Engineer, to be used in connection with construction.

C3.3.4.2.2 CI101.2 PRODUCTS

C3.3.4.2.2.1 CI101.2.1 ACTION SUBMITTALS

a) General: Prepare and submit Action Submittals required by individual Specification Sections.

1) Number of Copies: Submit copies of each submittal, as follows, unless otherwise indicated:

- Initial Submittal: Submit a preliminary single copy of each submittal where selection of options, colour, pattern, texture, or similar characteristics is required. Engineer will return submittal with options selected.
- Final Submittal: Submit three copies, unless otherwise indicated. Submit two additional copies where copies are required for operation and maintenance manuals. Engineer will retain one copy; remainder will be returned. Mark up and retain one returned copy as a Project Record Document.

b) Product Data: Collect information into a single submittal tor each element of construction and type of product or equipment.

1) If information must be specially prepared for submittal because standard printed data are not suitable for use, submit as Shop Drawings not as Product Data.

2) Mark each copy of each submittal to show which products and options are applicable.

3) Include the following information, as applicable:

- Manufacturer's written recommendations.
- Manufacturer's product specifications.
- Manufacturer's installation instructions.
- Standard colour charts.
- Manufacturer's catalogue cuts, in hard copy and digitally scanned soft copies in JPEG or PDF format.
- Wiring diagrams showing factory-installed wiring.
- Printed performance curves.
- Operational range diagrams.
- Mill reports.
- Standard product operating and maintenance manuals.
- Compliance with recognized trade association standards.
- Compliance with recognized testing agency standards.
- Application of testing agency labels and seals.
- Notation of coordination requirements.

c) Shop Drawings: Produce newly prepared, project-specific, information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data. Shop drawings should be stamped "COORDINATED" before submission for Engineer's approval. This shall mean that, where relevant, the drawings have been coordinated with those prepared for the Main Contract Works.

1) Preparation: Include the following information, as applicable:

- Dimensions. (Metric or SI as instructed by Engineer).
- Identification of products.
- Fabrication and installation drawings.
- Roughing-in and setting diagrams.
- Wiring diagrams showing field-installed wiring, including power, signal, and control wiring.
- Shop work manufacturing instructions.

- Templates and patterns.
- Schedules.
- Design calculations
- Compliance with specified standards.
- Notation of coordination requirements.
- Notation of dimensions established by field measurement.
- Identification of any deviations from requirements of the Contract Documents.

2) Wiring Diagrams: Differentiate between manufacturer-installed and field-installed wiring.

3) Sheet Size: Except for templates, patterns, and similar full-size drawings, submit Shop Drawings on sheets at least A4 size, and no larger than Al size, unless otherwise approved.

4) Number of Copies: Submit copies of each submittal, as follows:

- Initial Submittal: Submit one correctable, translucent, reproducible print and one blue- or black-line print. Engineer will return the reproducible print.
- Final Submittal: Submit four black-line prints, unless otherwise indicated. Submit two additional prints where prints are required for operation and maintenance manuals. Engineer will retain two prints; remainder will be returned. Mark up and retain one returned print as a Project Record Drawing.

5) It is deemed that clarifications in respect of the final interface between all of the individual building and services elements are complete and resolved at shop drawing stage. The stamp "COORDINATED" is testimony to this.

d) Coordination Drawings: Comply with requirements in Division I Section "Project Management and Coordination."

e) Samples: Prepare physical units of materials or products, including the following:

1) Comply with requirements in Division I Section "Quality Requirements".

2) Samples for Initial Selection: Submit manufacturer's colour charts consisting of units or sections of units showing the full range of colours, textures, and patterns available.

3) Samples for Verification: Submit full-size units or Samples of size indicated, prepared from the same material to be used for the Works, cured and finished in manner specified, and physically identical with the product proposed for use, and that show full range of colour and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing colour, texture, and pattern; colour range sets; and components used for independent testing and inspection

4) Preparation: Mount, display, or package Samples in manner specified to facilitate review of qualities indicated. Prepare Samples to match Engineer's sample where so indicated. Attach label on unexposed side that includes the following:

- Generic description of Sample.
- Product name.
- Name and address of manufacturer.
- Sample source.

5) Additional Information: On an attached separate sheet, prepared on Contractor's letterhead, provide the following:

- Size limitations.
- Compliance with recognized standards.
- Availability and delivery time.
- Compliance with Contract specifications.

6) Submit Samples for review of kind, colour, pattern, and texture for a final check of these characteristics with other elements and for a comparison of these characteristics between final submittal and actual component as delivered and installed.

- If variation in colour, pattern, texture, or other characteristic is inherent in the product represented by a Sample, submit at least three sets of paired units that show approximate limits of the variations.
- Refer to individual Specification Sections for requirements for Samples that illustrate workmanship, fabrication techniques, details of assembly, connections, operation, and similar construction characteristics.

7) Number of Samples for Initial Selection: Submit one full set of available choices where colour, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Engineer will return submittal with options selected.

8) Number of Samples for Verification: Submit two sets of Samples. Engineer will retain one sample set; the second will be returned, marked with action taken.

- Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.

9) Disposition: Maintain sets of approved Samples at project Site, available for quality-control comparison throughout the course of construction activity.

Sample sets may be used to determine final acceptance of construction associated with each set.

- Samples that may be incorporated into the Works are indicated in individual Specification Sections. Indicate such as special requests on transmittal and obtain approval for disposition in the Works. Such Samples must be in an undamaged condition at time of use.
- Samples not incorporated into the Works, or otherwise designated as Employer's property, are the property of Contractor.

f) Product List: Comply with requirements in Division 1 Section "Product Requirements. "

g) Delegated-Design Submittal: Comply with requirements in Division 1 Section "Quality Requirements."

h) Contractor's Construction Program: Comply with requirements in Division 1 Section "Construction Progress Documentation".

i) Submittals Schedule: Comply with requirements in Division 1 Section "Construction Progress Documentation."

j) Subcontract List: Prepare and submit a list identifying subcontractor individuals or firms proposed for principal portions of the Works, including those who are to fabricate products or equipment to a special design. Include the following information in tabular form:

1) Name, address, and telephone number of entity performing subcontract.

2) Number and title of related Specification Section(s) covered by subcontract.

3) Drawing number and detail references, as appropriate, covered by subcontract.

4) Monetary value, at Contract rates, of work covered by subcontract.

C3.3.4.2.2.2 Cl101.2.2 INFORMATIONAL SUBMITTALS

a) General: Prepare and submit Informational Submittals required by other Specification Sections.

1) Number of Copies: Submit two copies of each submittal, unless otherwise indicated. Engineer will not return copies.

2) Certificates and Certifications: Provide a notarized statement that includes signature of Contractor, testing agency, or design professional responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of the company.

3) Test and Inspection Reports: Comply with requirements in Division I Section "Quality Requirements."

b) Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, names and addresses of architects/engineers and employers, and other information specified.

c) Product Certificates: Prepare written statements on manufacturer's letterhead certifying that product complies with requirements.

d) Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements. Submit record of Welding Procedure Specification (WPS) and Procedure Qualification Record (PQR) on A WS forms. Include names of firms and personnel certified.

e) Installer Certificates: Prepare written statements on manufacturer's letterhead certifying that Installer complies with requirements and, where required, is authorized for this specific Project.

f) Manufacturer Certificates: Prepare written statements on manufacturer's letterhead certifying that manufacturer complies with requirements. Include evidence of manufacturing experience where required.

g) Goods Certificates: Prepare written statements on manufacturer's letterhead certifying that Goods comply with requirements.

h) Goods Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of Goods for compliance with requirements.

i) Preconstruction Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements.

j) Compatibility Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for primers and substrate preparation needed tor adhesion.

k) Field Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements.

l) Product Test Reports: Prepare written reports indicating current product produced by manufacturer complies with requirements. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.

m) Maintenance Data: Prepare written and graphic instructions and procedures for operation and normal maintenance of products and equipment. Comply with all stipulated requirements.

n) Design Data: Prepare written and graphic information, including, but not limited to, performance and design criteria, list of applicable codes and regulations, and calculations. Include list of assumptions and other performance and design criteria and a summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Include page numbers.

o) Manufacturer's Instructions: Prepare written or published information that documents manufacturer's recommendations, guidelines, and procedures for installing or operating a product or equipment. Include name of product and name, address, and telephone number of manufacturer. Include the following, as applicable:

1) Preparation of substrates.

2) Required substrate tolerances.

3) Sequence of installation or erection.

4) Required installation tolerances.

5) Required adjustments.

6) Recommendations for cleaning and protection.

p) Manufacturer's Field Reports: Prepare written information documenting factory- authorized service representative's tests and inspections. Include the following, as applicable:

1) Name, address, and telephone number of factory-authorized service representative making report.

2) Statement on condition of substrates and their acceptability for installation of product.

3) Statement that products at Project Site comply with requirements.

4) Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.

5) Results of operational and other tests and a statement of whether observed performance complies with requirements.

6) Statement whether conditions, products, and installation will affect warranty.

7) Other required items indicated in individual Specification Sections.

q) Insurance Certificates and Bonds: Prepare written information indicating current status of insurance or bonding coverage. Include name of entity covered by insurance or bond, limits of coverage, amounts of deductibles, if any, and term of the coverage.

C3.3.4.2.3 CI101.3 EXECUTION

C3.3.4.2.3.1 CI101.3.1 CONTRACTOR'S REVIEW AND APPROVAL

a) Review each submittal and check for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Engineer.

b) Approval Stamp: Stamp each submittal with a uniform approval stamp. Include Project name and location, submittal number, Specification Section title and number, name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, coordinated, and approved for compliance with the Contract Documents.

C3.3.4.2.3.2 CI101.3.2 ENGINEER'S ACTION

a) General: Engineer will not review submittals that do not bear Contractor's approval stamp and will return them without action.

b) Engineer's Action: Engineer's review is limited only to checking conformance with information given and the design concept expressed in the Contract Documents. It is not conducted for the purpose of determining the accuracy and completeness of details, dimensions or quantities, nor substantiating integrity or compatibility, or confirming instructions for installation or performance.

Engineer's approval does not in any way relieve the Contractor of responsibility for compliance with specified provisions and the Contract Document requirements.

c) Action Submittals: Engineer will review each submittal, mark up to indicate corrections or modifications required, and return it to Contractor. Engineer will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action taken, as follows:

1) Final Unrestricted Release: Where the submittal is marked "APPROVED", the work covered by the submittal may proceed provided it complies with the Contract Documents. Final acceptance of the work will depend on that compliance.

2) Final-but-Restricted Release: Where the submittal is marked "APPROVED AS NOTED", the work covered by the submittal may proceed provided it complies with both Engineer's notations and corrections on the submittal and the Contract Documents. Final acceptance of the work will depend on that compliance.

3) Returned for Resubmittal: Where the submittal is marked "NOT APPROVED, REVISE AND RESUBMIT", do not proceed with the work covered by the submittal, including purchase, fabrication, delivery, or other activity for the product submitted. Revise or prepare a new submittal according to Engineer's notations and corrections.

4) Rejected: Where the submittal is marked "NOT APPROVED, RESUBMIT" or "REJECTED", do not proceed with the work covered by the submittal. Prepare a new submittal for a product that complies with the Contract Documents.

d) Informational Submittals: Engineer will review each submittal and will not return it, or will reject and return it if it does not comply with requirements.

e) Submittals not required by the Contract Documents will not be reviewed and may be discarded.

C3.3.4.3 CI102 OPERATIONS AND MAINTENANCE DATA

C3.3.4.3.1 CI102.1 GENERAL

C3.3.4.3.1.1 CI102.1.1 SECTION INCLUDES

a) Format

b) Maintenance Data

c) Manual for Equipment and System

d) Instruction of Owner Personnel

C3.3.4.3.1.2 CI102.1.2 FORMAT

a) Prepare data in form of instructional manuals.

b) Binders: commercial quality, 2 ring binders with hardback, cleanable, plastic covers; 2-inch maximum ring size. When multiple binders are used, correlate data and in related consistent groups.

c) Cover: identify each binder with typed or printed title OPERATION AND MAINTENANCE INSTRUCTIONS, list title of Project, and identify subject matter of contents. The identifying text should be on the front and on the spine.

d) Arrange content by systems under section numbers and sequence of Table of Contents of Project Manual.

e) Provide tabbed flyleaf for each separate product and system, with typed description of product and major component parts of equipment.

f) Text Manufacturer's printed data or typewritten data on 80gm/sqm paper.

g) Drawings: Provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages and fold such that drawings can be unfolded without removing the drawing from the binder.

C3.3.4.3.1.3 CI102.1.3 MAINTENANCE DATA

a) Table of Contents: Provide title of project; names, addresses, and telephone numbers of the Employer, the Engineer, and the Contractor with names of responsible parties; schedule of products and systems, indexed to content of volume.

b) For each Product or System: List names, addressed, and telephone numbers of subcontractors and suppliers, including local source of supplies and replacement parts.

c) Product Data: mark each sheet to clearly identify specific products and component parts and data applicable to installation, delete inapplicable information.

d) Drawings: Supplement product data to illustrate relations of component parts of equipment and systems and to show control and flow diagrams.

e) Typed text: As required to supplement product data. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions.

f) Warranties, Guarantees and Bonds: Bind in copy of each. Ensure the validity of the documents as per contract data.

C3.3.4.3.1.4 CI102.1.4 MANUAL FOR EQUIPMENT AND SYSTEM

a) Each item of Equipment and Each System: Include description of unit or system and component parts. Give function, normal operating characteristics, and limiting conditions. Include performance curves, with engineering data and tests, and complete nomenclature and commercial number of replaceable parts.

b) Panel board Circuit Directories: Provide electrical service characteristics, controls and communications.

c) Include-installed colour-coded wiring diagrams.

d) Operating Procedures: Includes start-up, break-in, and routine normal operating operations and sequences. Include regulation, control, stopping, shutdown, and emergency instructions. Include summer and any special operating conditions.

e) Maintenance Requirements: Includes routine procedures and guide for troubleshooting; disassembly, repair, and reassembly instructions, and alignment, adjusting, balancing, and instructions.

f) Provide servicing and lubrication schedule and list of lubricants required.

g) Include manufacturer's printed operation and maintenance instructions.

h) Include sequence of operation by controls manufacturer.

i) Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.

j) Provide as-installed control diagrams by controls manufacturer.

k) Provide Contractor's coordination drawings, with as-installed colour-coded piping diagrams.

l) Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.

m) Provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.

n) Additional Requirements: As specified in individual Sections.

C3.3.4.3.1.5 CI102.1.5 INSTRUCTION OF EMPLOYER PERSONNEL

a) Before final inspection, instruct the Employer's designated personnel in operation, adjustment, and maintenance of products, equipment, and systems, at agreed upon times. Provide instruction for durations specified in the individual specifications, or for such duration as necessary level satisfactory to the Engineer

b) For equipment requiring seasonal operation, perform instructions for other seasons within 6 months.

c) Use operation and maintenance manuals as basis of instruction. Review contents of manual with personnel in detail to explain all aspects of operation and maintenance.

Prepare and insert additional data in Operation and Maintenance Manual when needed as such data becomes apparent during construction.

C3.3.4.3.2 CI102.2 PRODUCTS

C3.3.4.3.2.1 CI102.2.1 OPERATION AND MAINTENANCE MANUALS

a) Operation and Maintenance Manuals (O&M Manuals) are to be prepared for all Sections as per the Specifications for the various trades and deliverables, in accordance with the requirements of the Conditions of Contract.

b) The standard content of all O&M Manuals as required shall always be as follows:

1) SECTIONS shall be listed numerological (e.g. …Section XX XX XX, Section 23 81 19, Section 34 77 13 etcetera) and the number of Volumes shall be determined by the contractor based on the preparation and timely gathering of data.

2) SECTION XX XX XX is subdivided in chapters Book A = A1 to A7 and Book B = B8 to B13. Where chapters are not applicable to a Section, the chapter may not be left out from the related Book but should be marked N/A.

3) Book A:

- A1 Description of Work and Function
- A2 Product Data
- A3 Diagrams
- A4 Authorities Approvals and Certificates
- A5 List of Compliance from Manufacturer
- A6 Declaration of Installation in accordance with Specified Requirements
- A7 Training Protocols

4) Book B:

- B8 Commissioning, Testing Protocols
- B9 Operation Manuals
- B10 Maintenance Schedule
- B11 Maintenance Manuals
- B12 List of Spare Parts
- B13 List of Manufacturers and Suppliers

C3.3.4.3.3 CI102.3 EXECUTION

C3.3.4.3.3.1 CI102.3.1 SUBMISSION TIMING

a) Operation and Maintenance Manuals (O&M Manuals) must be prepared timely for review and approval on contents, completeness, scope definition etc.

b) The O&M Manuals must be made available in the quantities as mentioned in the relevant Specifications before the training sessions shall commence.

c) The O&M Manuals should be present during the Training and supply is the responsibility of the Contractor.

C3.3.4.4 CI103 DEMONSTRATION AND TRAINING

C3.3.4.4.1 CI103.1 GENERAL

C3.3.4.4.1.1 CI103.1.1 GENERAL REQUIREMENTS

a) The statements in this document are valid for all following sections.

b) Where requirements for individual systems differ from these general requirements this will be explicitly stated in the relevant Specification Section.

C3.3.4.4.1.2 CI103.1.2 RELATED DOCUMENTS

a) Drawings, Bill of Quantity (BOQ), Service Level Agreements (SLA) and general provisions of the contract, including general and supplementary conditions and Specification Sections, apply to this section.

C3.3.4.4.1.3 CI103.1.3 SUMMARY

a) This Section includes administrative and procedural requirements for instructing Employer's personnel, including the following:

1) Demonstration of operation of systems, subsystems, and equipment.

2) Training in operation and maintenance of systems, subsystems, and equipment.

b) Related Sections include the following:

1) Division 01 Section "Project Management and Coordination" for requirements for pre-instruction conference.

2) Division 01 Section "Photographic Documentation" for preparing and submitting demonstration and training videotapes.

C3.3.4.4.1.4 CI103.1.4 SUBMITTALS

a) Instruction Program: Submit for Engineer's approval, two copies of outline of instructional program for demonstration and training, including a schedule of proposed dates, times, length of instruction time, and instructors' names for each training module. Include learning objective and outline for each training module.

1) At completion of training, submit two complete training manuals for Employer's use.

b) Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of engineers and employers, and other information specified.

c) Attendance Record: For each training module, submit list of participants and length of instruction time.

d) Evaluations: For each participant and for each training module, submit results and documentation of performance-based test.

e) Demonstration and Training Videotape/DVD: Submit two copies at end of each training module.

f) For equipment that requires seasonal operation, provide training and/or instruction during appropriate season.

C3.3.4.4.1.5 CI103.1.5 QUALITY ASSURANCE

a) Facilitator Qualifications: A firm or individual experienced in training or educating maintenance personnel in a training program similar in content and extent to that indicated for this Project, and whose work has resulted in training or education with a record of successful learning performance.

b) Instructor Qualifications: A factory-authorized service representative, complying with requirements in Division 1 Section "Quality Requirements," experienced in operation and maintenance procedures and training.

c) Pre-instruction Conference: Conduct conference at Project Site to comply with requirements in Division 1 Section "Project Management and Coordination." Review methods and procedures related to demonstration and training including, but not limited to, the following:

1) Inspect and discuss locations and other facilities required for instruction.

2) Review and finalize instruction schedule and verify availability of educational materials, instructors' personnel, audio-visual equipment, and facilities needed to avoid delays.

3) Review required content of instruction.

4) For instruction that must occur outside, review weather and forecasted weather conditions and procedures to follow if conditions are unfavourable.

C3.3.4.4.1.6 CI103.1.6 COORDINATION

a) Coordinate instruction schedule with Employer's operations. Adjust schedule as required to minimize disrupting Employer's operations.

b) Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.

c) Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data has been reviewed and approved by Engineer.

C3.3.4.4.2 CI103.2 PRODUCTS

C3.3.4.4.2.1 CI103.2.1 GENERAL

a) Training for equipment operation and the maintenance of the equipment and systems shall be provided.

b) All training shall be conducted in the English language.

c) All training documents should be in the English language.

d) Training manuals shall be new and specifically related to the equipment and services supplied.

e) All training documents shall be provided as HTML-Files to store them on a web-based training server.

f) The Employer's personnel should where possible be involved in installation, configuration and commissioning of the systems. This involvement is an integral part of the training requirement.

g) The Contractor is to provide a structured plan within one month of signing the Contract detailing how he intends to involve Employer personnel in the execution of the Contract.

C3.3.4.4.2.2 Cl103.2.1 TRAINING

a) The Contractor shall prepare training materials and conduct all training for system users, administrators and maintenance staff. The Employer will provide a training classroom to conduct project training.

b) The training shall include operational procedures and recovery techniques in case of a total system failure applicable both for the system running in its intended integrated environment as in a stand-alone environment.

c) The Contractor shall provide the training for designated Employer personnel. The training shall provide personnel with a working knowledge of the system design and layout and shall provide troubleshooting methods and techniques. In addition, the training shall cover testing, maintenance, and repair procedures for all equipment and applications, which are provided under this Specification.

d) The Contractor shall supply a detailed plan of user training, system administrator training and maintenance staff training. The Contractor shall provide a course outline, course materials and syllabus to the Employer for approval 30-days prior to the scheduled training date. Each course shall require Employer's approval prior to presentation.

e) Training facilities: The Contractor will provide any facilities other than a classroom required for the training of the maintenance staff, trainers, and end-users; including equipment software and documentation.

f) Course materials shall be delivered to the employer for future presentation. Final delivery of the course materials shall include a master Hard copy of all materials and an electronic copy in a format approved by the Employer. The Contractor shall supply a videotape of each training course.

g) The following general training guidelines shall be followed:

1) By means of training classes augmented by individual instruction as necessary, the Contractor shall fully instruct the Employer's designated staff in the operation, adjustment and maintenance of all products, equipment and subsystems. The Contractor shall be required to provide all training aids (e.g., notebooks, manuals, etc.).

2) All training shall be completed a minimum of two weeks prior to the system becoming operational and utilized by the Employer or its tenants. The training schedule is subject to the Employer's approval.

3) Training shall be conducted by experienced personnel and supported by training aids. An adequate amount of training material shall be provided by the Contractor. The following is considered a minimum:

- Operations and flow charts, overall block diagrams, and descriptive material for all software
- Schematic drawings for each of the hardware components
- All procedure manuals, specification manuals, and operating manuals
- As-built drawings

4) Participants shall receive individual copies of technical manuals and pertinent documentation 7 days in advance of the training course. The courses shall be scheduled such that Employer personnel can participate in all courses (no overlap).

5) A final course schedule and syllabus shall be prepared by the Contractor for each course to be conducted for Employer personnel and submitted for review at least four (4) weeks prior to the scheduled date of the course commencement.

6) Each course outline shall include, in addition to the subject matter, a short review of the prerequisite subjects (where appropriate); how this course fits into the overall training program; the objective; the standards of evaluation; and any other topics that will enhance the training environment.

7) All training requirements identified are minimum requirements.

8) The training participants have to acknowledge that scope and content of the training had been sufficient to operate the system. This acknowledgement is part of the acceptance procedure.

h) The training courses shall be divided into three components:

1) Training for maintenance staff

2) Training for operational staff

3) Training for end-users

i) Maintenance Staff and System Administrator Training: Training shall include both classroom work and on-the-job training.

1) Classroom Training: A minimum of eighty (80) hours of software and hardware training shall be provided. The Contractor shall structure the course to describe all systems, software and applications and support programs. This course shall include a functional overview of the complete system. The course material shall be presented in depth with the instructor covering detailed design, structure, and algorithms

2) Classroom Training Operators and Call Centre Agents/Supervisors: A minimum eighty (80) hours of hardware and software training shall be provided. The contractor shall structure the course to describe all systems, software and applications and support programs. This course shall include a functional overview of the complete system. The course material shall be provided in depth with the instructor covering detailed design, structure, and algorithms

3) On-the-Job Training: An additional four (4) weeks of on-the-job training shall be provided. This training shall be conducted on site at the Airport. The Contractor shall provide the Employer specified trainees with daily job supervision and direction by a Contractor Engineer. The Contractor shall answer any and all questions regarding the operation, repair, and maintenance of the system, software and equipment.

j) End-user, Operator and Call Centre Agent Training: Training shall include both classroom work and on-the-job training.

1) Classroom Training end-users: The end-user training should be organised in groups up to 12 participants. The Contractor shall structure the course to describe all systems, software and applications and support programs. This course shall include a brief functional overview of the complete system. The course material shall be presented in depth with the instructor covering detailed design, structure, and algorithms.

2) Classroom Training Operators and Call Centre Agents / Supervisors: A minimum of eighty (80) hours of hardware and software training shall be provided. The Contractor shall structure the course to describe all systems, software and applications and support programs. This course shall include a functional overview of the complete system. The course material shall be presented in depth with the instructor covering detailed design, structure, and algorithms.

3) On-the-Job Training Operators and Call Centre Agents / Supervisors: An additional four (4) weeks of on-the-job training shall be provided. This training shall be conducted on site at the Airport. The Contractor shall provide the Employer specified trainees with daily job supervision and direction by a Contractor Engineer. The Contractor shall answer any and all questions regarding the operation, repair, and maintenance of the system, software, and equipment.

k) Additional Training

1) Where significant changes or modifications to equipment are made under the terms of the guarantee, additional instructions shall be provided as may be necessary to acquaint the operating and maintenance staff with the changes or modifications.

2) All additional instruction periods shall be at such times as scheduled by the employer and performed during regular working hours.

C3.3.4.4.3 CI103.3 EXECUTION

C3.3.4.4.3.1 CI103.3.1 PREPARATION

a) Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a combined training manual.

b) Set up instructional equipment at instruction location.

C3.3.4.4.3.2 CI103.3.2 INSTRUCTION

a) Facilitator: Engage a qualified facilitator to prepare instruction program and training modules, to coordinate instructors, and to coordinate between Contractor and Employer for number of participants, instruction times, and location.

b) Engage qualified instructors to instruct Employer's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.

- Employer will furnish Contractor with names and positions of participants.

c) Scheduling: Provide instruction at mutually agreed on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.

- Schedule training with Employer, through Engineer, with at least seven days' advance notice.

d) Evaluation: At conclusion of each training module, assess and document each participant's mastery of module by use of an oral and performance-based test.

e) Demonstration and Training Videotape: Record each training module separately. Include classroom instructions and demonstrations, board diagrams, and other visual aids, but not student practice.

1) Comply with requirements in Division 1 Section "Photographic Documentation."

2) At beginning of each training module, record each chart containing learning objective and lesson outline.

f) Clean-up: Collect used and leftover educational materials and remove from Project Site. Remove instructional equipment. Restore systems and equipment to condition existing before initial training use.

C3.3.4.5 Cl104 GENERAL COMMISSIONING REQUIREMENTS

C3.3.4.5.1 Cl104.1 GENERAL

C3.3.4.5.1.1 Cl104.1.1 RELATED DOCUMENTS

a) The Contractor's attention is specifically directed, but not limited to, the General Conditions of Contracts (GCC) as well as the Particular Conditions (PC) for other requirements.

b) Specifications throughout all Divisions of the Project Specifications, which pertain to operable equipment and/or building systems, are directly applicable to this Section, and this Section is directly applicable to them.

C3.3.4.5.1.2 Cl104.1.2 SUMMARY

a) This Section includes equipment and system commissioning, including the following:

1) Completion of commissioning procedures on specific equipment and systems as indicated under "Related Sections" below.

2) Verification of operational and functional performance of specific equipment and systems for compliance with the “Design Intent” as described in the "Related Sections" indicated below.

b) Related Sections: The following Sections contain requirements that relate to this Section:

1) Section 01 31 00 Project Management and Coordination - specifies procedures for coordinating the Commissioning Process.

2) Division 01 Section 01 33 00 "Submittal Procedures - specifies procedures for submittal of Product Data and Quality Assurance Submittals.

3) Division 01 Section 01 77 00 "Closeout Procedures- specifies general closeout requirements.

4) Division 21 Section 21 08 00 "Commissioning of Fire Suppression" specifies closeout and/or commissioning related requirements for specific pieces of equipment or building operating systems.

5) Division 22 Section 22 08 00 "Commissioning of Plumbing" specifies closeout and/or commissioning related requirements for specific pieces of equipment or building operating systems.

6) Division 23 Section 23 08 00 "Commissioning of HVAC" specifies closeout and/or commissioning related requirements for specific pieces of equipment or building operating systems.

7) Division 23 Section 23 08 00 "Commissioning of HVAC" specifies closeout and/or commissioning related requirements for specific pieces of equipment or building operating systems.

8) Division 25 Section 25 08 00 "Commissioning of Integrated Automation” specifies closeout and/or commissioning related requirements for specific pieces of equipment or building operating systems.

9) Division 26 Section 26 08 00 "Commissioning of Electrical Systems" specifies closeout and/or commissioning related requirements for specific pieces of equipment or building operating systems.

10) Division 27 Section 27 08 00 "Commissioning of Communications" specifies closeout and/or commissioning related requirements for specific pieces of equipment or building operating systems.

C3.3.4.5.1.3 Cl104.1.3 DEFINITIONS

a) Basis of Design (BOD): A document that records the concepts, calculations, decisions, and product selections used to meet the Owner's Project Requirements and to satisfy applicable regulatory requirements, standards, and guidelines. The document includes both narrative descriptions and lists of individual items that support the design process.

b) Commissioning Agent (CxA): An entity identified by the Owner who leads, plans, schedules, and coordinates the commissioning team to implement the Commissioning Process.

c) Commissioning (Cx) Plan: A plan that includes a list of all equipment to be commissioned, delineation of roles for each of the primary commissioning participants, and details on the scope, timeline, and deliverables throughout the commissioning process."

d) Deficiencies and Resolutions List: List of noted deficiencies discovered as result of commissioning process.

e) Final Commissioning Report: Overall final commissioning document (see 1.6, I(2) below), prepared by the Commissioning Agent, which details the actual commissioning procedures performed, inspection and testing results, and the final version of the deficiencies and resolutions list indicating that all issues discovered through the commissioning process have been verified as resolved.

f) Functional Completion: Functional Completion is when all remaining TAB (Testing, Adjusting, Balancing) and commissioning responsibilities of the CMR and their subcontractor's (except for seasonal or approved deferred testing and controls training), have been functionally certified as complete by the Owner's Commissioning Authority (CxA) and the Certificate of Functional Completion has been issued.

g) Functional Performance Testing Process: Documented testing of system parameters, under actual or simulated operating conditions. Functional testing is the dynamic testing of systems (rather than just components).

h) Pre-Commissioning Checklists: Installation and start-up items to be completed by the appropriate party prior to operational verification through Functional Testing.

i) Physical Inspection Process: On-site inspection and review of related system components for conformance to the specifications.

j) Seasonal Commissioning Tests: Functional Tests that are deferred until the system(s) will experience conditions closer to their intended design conditions.

k) Trending: Monitoring using the building control system.

C3.3.4.5.1.4 Cl104.1.4 COORDINATION

a) Commissioning Team: The members of the commissioning team consist of the Commissioning Agent (CxA), the Project Manager (PM), the Owner's Representative (OR), Construction Manager at Risk (CMR), the Architect and Design engineers (particularly the mechanical

engineer), the Mechanical Subcontractor, the Electrical Subcontractor, the TAB representative, the Controls Subcontractor, any other installing subcontractors or suppliers of equipment. If known, the Agency's building or plant operator/engineer is also a member of the Commissioning team.

b) Management: The CxA is hired by the Owner. The CxA directs and coordinates the commissioning activities and the reports to the OR. All members of the Commissioning Team work together to fulfil their contracted responsibilities and meet the objectives of the Contract Documents.

c) Scheduling. The CxA will work with the OR and CMR according to established protocols to schedule the commissioning activities.

1) The CxA will provide sufficient notice to the OR and CMR for scheduling commissioning activities. The CMR will integrate all commissioning activities into their master CPM schedule. All parties will address scheduling problems and make necessary notifications in a timely manner in order to expedite the commissioning process. The CxA will provide the initial schedule of primary commissioning events at the commissioning scoping meeting. The Commissioning Plan—Construction Phase provides a format for this schedule. As construction progresses more detailed schedules are developed by the CxA. The Commissioning Plan also provides a format for detailed schedules.

C3.3.4.5.1.5 Cl104.1.5 DESCRIPTION OF CONSTRUCTION PHASE COMMISSIONING PROCESS

a) As soon as practicable after the "Contract Start Date" the Commissioning Agent (CxA) will conduct a pre-installation commissioning "kick-off" meeting with the Construction Manager's subcontractors. Parties directly affected by the commissioning work will be required to attend. The CxA will explain the commissioning process in detail and identify specific commissioning related responsibilities of the various parties.

b) Commissioning status meetings will be scheduled to occur during construction to monitor progress and to help facilitate the commissioning process. Construction Manager's subcontractor's representatives will be required to attend these meetings.

c) Once Construction Manager's subcontractors have provided the CxA with written verification indicating completion of installation and startup procedures, the CxA will conduct an on-site physical inspection of the specific systems and equipment.

d) Upon confirmation of system readiness, the CxA will schedule with the Construction Manager's subcontractors to perform functional compliance with the project specifications and drawings. The CxA will oversee the process and will provide the format and documentation for these tests.

e) Deficiencies noted during these tests will be documented on the Deficiencies and Resolutions list. When corrected, issues will be resolved at the time of discovery. The responsible Construction Manager's subcontractor will resolve all other issues at a later date. All deficiencies will be noted by the CxA as either resolved or pending resolution.

f) The construction commissioning process will be complete when all noted deficiencies have been corrected, proved to be compliance with the project specifications or otherwise resolved to the satisfaction of the Owner and when the CxA has issued the Certificate of Functional Completion.

C3.3.4.5.1.6 Cl104.1.6 COMMISSIONING AGENT'S DUTIES AND RESPONSIBILITIES

a) Meet and communicate with the Owner's representatives, [Construction Manager] [Owner's Representative], subcontractors, equipment manufacturers' representatives, Architect, Engineer [and others] as needed, to facilitate the commissioning process.

b) Review commissioning related specifications, submittals, and construction documents. Communicate noted deficiencies and concerns to the Owner, Architect and Engineer.

c) Develop detailed and specific Functional Testing procedures for equipment and systems to be commissioned.

d) Develop testing, adjusting and balancing (TAB) specifications. Oversee the TAB process.

e) Perform site inspections and verify Construction Manager's subcontractor readiness for the Functional Testing process. Document deficiencies for future resolution.

f) Witness Construction Manager's subcontractor performed Functional Testing process as appropriate to verify Construction Manager's subcontractor compliance with the functional testing procedures. Document deficiencies for future resolution.

g) Provide the Owner, [Construction Manager] [Owner's Representative], Architect, and Engineer with a Final Commissioning Report to document the commissioning process and to verify that the commissioning process is complete.

h) Verify that CMR O&M documentation is complete.

i) Commissioning Record in O&M Manuals.

1) The CxA is responsible to compile, organize and index the following commissioning data by equipment into labelled, indexed and tabbed, three-ring binders and deliver it to the CMR, to be included with the O&M manuals. Three copies of the manuals will be provided. The format of the manuals shall be:

- Tab I-1: Commissioning Plan;
- Tab I-2: Final Commissioning Report (see (2) below)
- Tab 01: System Type 1 (chiller system, packaged unit, boiler system, etc.);
  - Sub-Tab A: Design narrative and criteria, sequences, approvals for equipment in System Type 1;
  - Sub-Tab B: Startup plan and report, approvals, corrections, blank Pre-commissioning Checklists;
    - Coloured Separator Sheets—for each equipment type (fans, pumps, chiller, etc.);
  - Sub-Tab C: Functional tests (completed), trending and analysis, approvals and corrections, training plan, record and approvals, blank functional test forms and a recommended re-commissioning schedule.
- Tab 02: System Type 2.....repeat as per above requirements for System 1.

2) Final Report Commissioning Report Details. The final commissioning report shall include an executive summary, list of participants and roles, brief building description, overview of commissioning and testing scope and a general description of testing and verification methods. For each piece of commissioned equipment, the report should contain the disposition of the commissioning authority regarding the adequacy of the equipment, documentation and training meeting the contract documents in the following areas:

- Equipment meeting the equipment specifications;
- Equipment installation,

- Functional performance and efficiency;
- Equipment documentation and design intent; and
- Operator training. All outstanding non-compliance items shall be specifically listed. Recommendations for improvement to equipment or operations, future actions, commissioning process changes, etc. shall also be listed. Each non-compliance issue shall be referenced to the specific functional test, inspection, trend log, etc. where the deficiency is documented. The functional performance and efficiency section for each piece of equipment shall include a brief description of the verification method used (manual testing, BAS trend logs, data loggers, etc.) and include observations and conclusions from the testing.
- Pre-Occupancy Commissioning (Cx) Report:
- A Pre-occupancy Commissioning (Cx) Report shall be prepared by the Commissioning Agent (CxA) that demonstrates that the project has met all of the requirements spelled out in the following Table:

Twelve (12) Mandatory Requirements [16a-38k-3] Summary Table			
1	16a-38k-3(a)	Summary Description	
2	16a-38 -3(b)	Building Commissioning	
3	16a-38k-3(d)	Integrated Design Process	
4	16a-38k-3(c)	ENERGY STAR Products	
5	16a-38k-3(e)	Energy Performance	
6	16a-38k-3(f)	Indoor Air Quality Management Plan	
7	16a-38k-3(g)	Water Usage	
8	16a-38k-3(h)	Recycling of Materials	
9	16a-38k-3(i)	Erosion and Sedimentation Control	
10	16a-38k-3(j)	No Smoking Policy	
11	16a-38k-3(k)	Integrated Pest Management Plan	
12	16a-38k-3(l)	Chlorofluorocarbon (CFC)-Based Refrigerants	
Employer:		Service Provider:	
Witness:		Witness:	

- Post-Occupancy Commissioning (Cx) Report:

  A Post-Occupancy Commissioning (Cx) Report shall be prepared by the Commissioning Agent (CxA) and submitted to the CT DCS PM for review and approval. The approved Report shall be submitted by the State Agency that is responsible for the ongoing care, operation, and maintenance of the building to the CT OPM Secretary and the CT DCS Commissioner within one hundred eighty (180) days after one year of occupancy Date of CT DCS Acceptance of the Work. The Report shall include results of any post-occupancy survey of building occupants, a description of any adjustments made to equipment or building operation and the reasons for which the changes were made, and one year of all energy usage by source and water usage.

3) Other documentation will be retained by the CxA.

C3.3.4.5.1.7 Cl104.1.7 DUTIES AND RESPONSIBILITIES OF OTHERS FOR COMMISSIONING

a) The commissioning process will require the active participation of persons qualified to represent the Owner, Mechanical Engineer, Electrical Engineer, Construction Manager, Equipment Manufacturers' Representatives, Mechanical Subcontractor, HVAC Subcontractor, Controls Subcontractor, TAB Subcontractor, Electrical Subcontractor, and other specific subcontractors, as deemed appropriate. The CxA will witness the final functional performance commissioning process. Participants shall include in their contracts all costs necessary to participate in and complete the commissioning process.

b) The Construction Manager will assure the participation and co-operation of the subcontractors, as required to complete the commissioning process.

c) The Owner will assure the participation of their chosen representatives as required to complete the commissioning process.

d) The Architect will assure the participation of necessary representatives from the Design Team as required to complete the commissioning process. Design team members will provide prompt replies to requests for information issued during the commissioning process.

e) It is the Construction Manager's specific responsibility to complete their respective start-up and checkout procedures, and to insure the complete readiness of equipment and systems, prior to the start of the functional performance testing phase. The CxA shall request written confirmation of system readiness for performance testing, from the appropriate Construction Manager's subcontractor. Once the CxA is provided with confirmation of all related systems completion, the actual date and times for the functional performance testing process will be confirmed. Construction Manager's subcontractor shall provide sufficient time, and qualified representatives, to complete this process at no additional cost to the State.

f) After a second failure of a system to successfully meet the criteria as set forth in the functional performance testing process, the Construction Manager shall reimburse the Owner for all costs associated with any additional re-testing efforts made necessary due to remaining Construction Manager related system deficiencies previously reported by the Construction Manager as corrected. These costs shall also include the costs (where applicable) for the CxA.

g) Training on related systems and equipment operation and maintenance shall only be scheduled to commence after final performance commissioning is satisfactorily completed, and systems are verified to be 100 percent complete and functional.

C3.3.4.5.1.8 Cl104.1.8 SUBMITTALS

a) Refer to Section 01 33 00 Submittal Procedures - CMR.

b) Pre-Commissioning Checklist Forms: Submit [two (2)] signed copies of the checklist forms to the CxA upon completion of all listed items.

c) Equipment Manufacturer's Startup Forms: Submit [two (2)] completed copies of the installation and startup checklists provided by the equipment manufacturers to the CxA.

d) Test Reports: Submit [two (2)] copies of test reports for equipment and systems to the CxA.

e) Control Schematics: Submit [two (2)] copies of the control schematics for equipment, systems, and subsystems to the CxA.

f) Inspection Records: Submit [two (2)] copies of the records of inspections for code compliance, and approved permits and licenses to operate the equipment and systems to the CxA.

g) Operating Data: Submit [two (2)] copies of equipment and system operating data including all necessary instructions to facilitate operation to specified performance standards to the Owner.

h) Maintenance Data: Submit [two (2)] copies of equipment and system maintenance data including all necessary information required to maintain the equipment and systems in continuous operation, such as the testing, balancing and adjusting report and the as-built drawings.

C3.3.4.5.1.9 Cl104.1.9 TRAINING OF OWNER PERSONNEL

a) The CMR shall be responsible for training coordination and scheduling and ultimately for ensuring that training is completed.

b) The CxA shall be responsible for overseeing and approving the content and adequacy of the training of Agency's personnel for commissioned equipment.

1) The CxA shall interview the Agency's facility manager and lead engineer to determine the special needs and areas where training will be most valuable. The Owner's Representative, Agency's facility manager, and CxA shall decide how rigorous the training should be for each piece of commissioned equipment. The CxA shall communicate the results to the CMR of Subs and vendors who have training responsibilities.

2) In addition to these general requirements, the specific training requirements of Owner personnel by Subcontractor and vendors are specified in Divisions 21, 22, 23, 25, 26, and 27.

3) The CMR shall require each Subcontractor and vendor responsible for training to submit a written training plan to the CxA for review and approval prior to training. The plan will cover the following elements:

- Equipment (included in training);
- Intended audience;
- Location of training;
- Objectives;
- Subjects covered (description, duration of discussion, special methods, etc.);
- Duration of training on each subject;
- Instructor for each subject;
- Methods (classroom lecture, video, site walk-through, actual operational demonstrations, written handouts, etc.);
- Instructor and qualifications.

4) For the primary HVAC equipment, the Controls Contractor shall provide a short discussion of the control of the equipment during the mechanical or electrical training conducted by others.

5) The CxA shall develop an overall training plan and coordinate and schedule, with the OR, Agency Representative, and CMR, the overall training for the commissioned systems.

The CxA shall develop criteria for determining that the training was satisfactorily completed, including attending some of the training, etc. The CxA shall recommend approval of the training to the OR using a standard form for submittal to the CMR. The OR shall also sign the approval form.

6) At one of the training sessions, the CxA shall present a one (1) hour presentation discussing the use of the blank functional test forms for re-commissioning equipment.

7) Video recording of the training sessions shall be provided by CMR. The CMR shall provide the OR, with video disks catalogued by CMR, and added to the O&M manuals.

8) The HVAC design engineer shall at the first training session present the overall system design concept and the design concept of each equipment section. This presentation shall be two (2) hours in length and include a review of all systems using the simplified system schematics (one-line drawings) including chilled water systems, condenser water or heat rejection systems, heating systems, fuel oil and gas supply systems, supply air systems, exhaust system and outside air strategies.

C3.3.4.5.1.10 CI104.1.10 DEFERRED TESTING

a) Unforeseen Deferred Tests. If the CMR determines that any check or test cannot be completed due to the building structure, required occupancy condition or other deficiency, execution of checklists and Functional Testing may be delayed upon approval of the CT DCS PM. These tests will be conducted in the same manner as the seasonal tests as soon as possible. Services of necessary parties will be negotiated.

b) Seasonal Testing. During the warranty period, seasonal testing (tests delayed until weather conditions are closer to the system's design intent) as specified in Division 23 shall be completed as part of this contract. The CxA shall coordinate this activity. Tests will be executed, documented and deficiencies corrected by the appropriate CMR's Subcontractors, with the Agency facilities staff and the CxA witnessing. Any final adjustments to the O&M manuals and as-built drawings due to the testing will be made.

C3.3.4.5.2 CI104.2 PRODUCTS (NOT APPLICABLE)

C3.3.4.5.3 CI104.3 EXECUTION (NOT APPLICABLE)

C3.3.4.6 CI200 GENERAL SPECIFICATION FOR AN ELECTRONICS INSTALLATION

C3.3.4.6.1 CI200.1 GENERAL

C3.3.4.6.1.1 CI200.1.1 RELATED DOCUMENTS

a) Drawings and General Provisions of the Contract, including General Conditions, Conditions of Particular Application, and Specification Sections, apply to work of this Section.

C3.3.4.6.1.2 CI200.1.2 DESCRIPTION

a) In this document the term "Contractor" shall mean the contractor appointed in terms of this document, irrespective of whether the contract is a direct contract with the client or a sub-contract with a Principal Contractor.

b) If, at any stage, the Contractor wishes to deviate from these specifications, he may do so only if permission has been obtained from the Engineer in writing.

c) Prices tendered for equipment specified by trade names or catalogue references must be for the type and manufacture specified. If it is desired to use substitutes, the onus will be on the Contractor to prove that such substitutes are similar and equivalent to the article specified and meet with the approval of the Engineer in writing. The decision whether the tendered articles are acceptable shall rest solely with the Engineer. The cost implications of such substitutes shall be allowed for in the tendered amount.

d) Tenderers are required to enter at the time of tendering in the Schedules of Equipment and Materials Offered, the manufacturers of the materials on which their tender is based, and the catalogue numbers and other information by which the materials may be identified. Technical brochures of the equipment offered shall be submitted with the tender to enable the unit concerned to be identified without ambiguity.

e) Tenderers shall only offer equipment for which proven backup is available in South Africa.

f) The Project Specification shall take preference over this General specification where any conflict exists.

g) Should the Tenderer become aware of any discrepancies or apparent discrepancies in these documents, he shall notify the Engineer thereof.

h) Only technicians and artisans with adequate and applicable training and experience shall be used to carry out the work on this contract.

i) All materials and equipment used shall be of new or recent manufacture.

j) If requested by the Engineer, the contractor shall submit samples of cables, terminals, labels, trunks and other construction materials which he proposes to use on the installation for the engineer's approval.

k) All materials and equipment used shall be suitable for the environment and service for which it is to be used. This pertains, inter alia, to corrosion protection, UV stability etc.

l) If installation commences with any type of material or equipment, then the same type shall be used throughout the contract.

m) Equipment offered shall be small enough to be moved through the available doorways, passages, etc, to their final locations.

n) Dimensions scaled from drawings shall not be used to obtain lengths of trays, trunks, cables etc. The runs shall be measured on site.

o) The Contractor shall make due allowance for other Contractors' operations in progress concurrent with his own activities.

p) Any damage to protective coatings, equipment, services, or structures caused by the Contractor shall be made good.

q) The Contractor shall prevent pollution caused by spillages of fuels and lubricants, etc.

C3.3.4.6.1.3 CI200.1.3 APPLICABLE CODES AND STANDARDS

a) The entire installation shall be carried out in accordance with the latest revision of the following:

1) SANS 10142. "The Standard Regulations for the Wiring of Premises".

2) SANS 10313 "Lightning Protection of Equipment".

3) The Occupational Health and Safety Act 85/93.

4) The Municipal Bylaws and any special conditions of the Supply Authority in the relevant area.

5) The local Fire Safety Regulations.

6) The Regulations of ICASA.

C3.3.4.6.1.4 CI200.1.4 RELATED SECTIONS

a) The following sections include requirements which relate to this section.

1) Other division 25 sections.

2) Division 26 Electrical sections.

C3.3.4.6.2 CI200.2 PRODUCTS

C3.3.4.6.2.1 CI200.2.1 CABLES AND WIRES

a) All general wiring shall be multi-stranded of minimum thickness of 0,5 mm² with colour-fast PVC insulation.

b) All cables supplies shall be supplied in quantities which allow for a reasonable amount of wastage.

c) No multicore cable shall be fully utilised. A minimum of 2 cores or 10% of the cores, whichever is the greater shall be left for spare.

d) All cabling shall be arranged for maximum accessibility and shall allow for equipment removal without disturbing other operating equipment or disfiguring wiring.

e) Installed cabling shall not obstruct vision or access to any other equipment.

f) No cabling shall be installed directly in concrete or brickwork.

g) Only SWA cables may be buried directly in the ground.

h) Cables within buildings are to be carried on overhead cable trays attached to the building frame or other supports.

i) When laying cables great care shall be taken to avoid twisting, kinking, excessive tension, mechanical pressure and sharp bending.

j) Cables shall run parallel.

k) Only the use of approved lubricants to assist in the drawing in of cable into conduit shall be permitted.

l) At all cable ends compression gland fittings shall be used.

m) Every cable shall have a label attached at each end as identification.

n) Slotted cable trunking shall be used inside cabinets wherever possible.

o) Wire bundle runs in consoles, etc shall be bound with nylon cable ties at intervals not exceeding five bundle diameters.

p) Bundles shall have uniform appearance, circular cross sections, and shall be securely fastened to the panel framework.

C3.3.4.6.2.2 CI200.2.2 CABLE AND WIRE TERMINATING AND MOUNTING HARDWARE

a) Every terminal strip shall be numbered or named.

b) Every terminal shall be numbered.

c) Cable glands shall be of the compression ferrule type with "O" ring seals.

d) No joints will be allowed in cables or wires between terminations.

e) All cable cores and wires shall be numbered at all termination points with "slip-on" interlocking type cable markers. Split-ferrule types are unacceptable. In the case of multicore cables each core shall be numbered.

f) Wherever possible, terminations of cable cores and wires shall be made using spade, pin or bootlace ferrule type crimp-on lugs.

g) Lugs may only be crimped with controlled pressure crimping tools of the correct size for the lug used.

h) Thin, collapsing pipe type ferrules shall not be used.

i) High quality wire strippers shall always be used, and care taken not to nick or otherwise damage the strands.

j) Terminals shall be located so that all connections can be made easily.

k) When wiring of different potentials and types of supply use the same terminal rail then a clear space, or a barrier shall be provided between terminal blocks.

l) Metal wire ways shall be electrically continuous.

m) Cable and wire ways supports shall be spaced adequately to avoid sagging between supports. Cable trays and wire ways shall be firmly fastened to such supports.

n) Any bending, jagged edges or any other forms of damage or deformation of cable trays or wire ways shall be made good, before cables are installed.

o) Conduit shall be thoroughly cleaned and have all burrs removed before the drawing in of any cable.

p) Where outlet boxes, draw boxes, etc., are to be mounted in highly visible areas special attention shall be given to their aesthetic appearance.

q) Cable routes shall be chosen to avoid high temperatures and other hazards.

r) All main cable routes must be vermin-proofed.

s) Where trays are joined together, galvanised or cadmium plated bolts and nuts are to be used. Welding is not permitted.

t) The tray shall be supported at every change in direction of the cable tray route. The minimum radius of any bend of the tray is to suit the minimum bending radius of the largest cable on the tray.

u) Cable trays shall be firmly secured in position in such a manner to cause as little obstruction to walkways etc., as possible.

v) Hangers, supports and anchors for wireways and equipment, shall be designed and installed with regard to appearance and convenience as well as for adequate strength and rigidity. Only professional quality fixing material and methods shall be used. Nails and glue are not acceptable.

C3.3.4.6.2.3 CI200.2.3 SURGE PROTECTION

a) The lightning and switching transients and the regulation of the available 231VAC supplies will be as for a normal industrial supply.

b) The Tenderer has to allow for additional surge suppression and voltage stabilisation equipment if this is required to protect his equipment or to guarantee its correct operation.

c) Equipment which is connected to signal lines of any type which run for any distance outside a building, shall, if technically possible, be surge protected to survive twenty 8/20 microsecond current impulses with maximum amplitude of 10 kA when applied in common mode between the signal lines connected together and earth. Ten of the test pulses shall be applied as positive pulses with respect to earth and the other ten as negative pulses.

d) In addition, the protected equipment shall be able to survive 20 8/20 microsecond current impulses with maximum amplitude of 2 kA when applied in differential mode. Ten of the test pulses shall be applied with any particular polarity and the other ten with the polarity reversed.

e) The test pulses shall be applied at intervals of not less than one minute.

f) The surge protection equipment may be built into the equipment being protected. If the provided internal protection is inadequate to meet this specification, then additional external protection has to be provided.

g) Equipment which is connected to signal lines of any type of which the entire length of the run is within the same building and for which the signal cable is longer than 30 m, shall be protected as in 24.2, except that the maximum amplitude for the common mode test shall be 2 kA and the maximum amplitude for the differential mode test shall be 500 A.

h) Surge protection devices shall be chosen in such a way that the protected circuit shall still function to specification in spite of the introduction of series and/or shunt impedances by the protecting devices.

C3.3.4.6.2.4 CI200.2.4 EQUIPMENT AND JUNCTION BOXES

a) Equipment and junction boxes shall be of steel or GRP construction.

b) All steel shall be primed, undercoated and gloss finished with epoxy or polyurethane paint.

c) All boxes shall have a box name or number on the cover.

d) Boxes for indoor use shall be at least IP 52 rated.

e) Boxes for outdoor use shall be at least IP 65 rated.

f) All junction boxes shall provide the facility to terminate fully the entire multicore cable entering the box.

g) Boxes which are exposed to the sun, shall face South.

h) Boxes shall be mounted with their sides true vertical and horizontal.

C3.3.4.6.2.5 CI200.2.5 CABINETS, CONSOLES AND CONTROL PANELS (METAL WORK)

a) Cabinets, consoles and control panels shall be of mild steel, aluminium or solid wood construction

b) The frames and panels shall be rigid and not flex unduly under forces which may be applied during normal usage.

c) Cabinets, consoles and panels shall be of fully enclosed construction, the base to have plates for incoming connections.

d) Sectional panels, etc shall have open end(s) to permit bolting to adjacent sections. Where later addition of an adjacent section is envisaged, temporary side plates shall be fastened to sectional panels, etc.

e) Cabinets, consoles and panels for equipment which generate heat, shall have suitably sized louvers in the top and bottom of the doors plus ventilation fans if required.

f) Louvers shall be covered internally with close-weave non-ferrous mesh.

g) Cabinets, consoles and panels shall have flush full height and full width doors with lift-off hinges on the back.

h) Doors shall be of the lever handle latch type with integral locks and common keys.

i) Access panels shall be provided on all cabinets, consoles and panels for access to any part of the cabinet etc.

j) All adjoining edges shall have formed radii of 5 to 10mm.

k) All faces shall be flat to within 2 mm over any 750 x 750mm area.

l) Gaps between adjacent units shall be not more than 2 mm.

m) Individual tolerance in height and length shall be not more than 3mm.

n) Each panel, console or cabinet shall be capable of free standing and shall be mounted onto a separately constructed plinth.

o) Adjoining units shall, where required, have openings for passing cables, etc through their mating ends.

p) Plinths shall have provision made for bolting to floor and for bolting down of consoles, etc.

q) All finishes shall provide scratch free surfaces able to withstand high impact loads without chipping.

r) The finishes shall be colour fast and due consideration shall be taken of the area of operation of the cabinet, console, panel or rack when selecting the finish. Textured polyurethane or epoxy paint is an acceptable finish under most circumstances. On wood surfaces, Melamine and Formica are acceptable surfaces.

s) Sufficient space must be allowed around the installation to allow free access for maintenance purposes and to allow adequate ventilation, if required.

t) The installation shall be correctly positioned and fastened.

C3.3.4.6.3 CI200.3 EXECUTION

C3.3.4.6.3.1 CI200.3.1 LAYOUT OF INSTALLATION

a) Field cables, which must be connected to equipment which is mounted in an enclosure of any kind (box, console, panel etc.), shall terminate on terminal strips and shall not be wired directly to the equipment.

b) All wiring must be contained within conduit or trunking or within metal enclosed equipment.

c) When two or more parallel rows of terminal blocks are used, the clear space between the blocks shall be at least 120 mm.

d) Where two or more pieces of electrical equipment in close proximity have similar signal or supply conditions, use shall be made of a junction box to group the tail cables in order that a common multi-core cable may be run to the control room.

e) Cable entries into outdoor junction boxes shall be bottom-entry only.

f) Cables carrying 231 VAC (power or ON/OFF signals) may only be run on the same cable tray as analogue signal cables if the spacing between the cables is at least 100 mm, or if individually and overall screened cables are used. Low voltage signals and power/audio output signals may not be run in the same cable without the permission of the Engineer.

g) LV cables shall be laid 600mm and HV cables 1 000mm below final ground level. All cables in soil trenches shall be bedded in river sand or sifted ground (no clay) 75 mm below and 75 mm over the cables before backfilling of excavations. PVC warning tape shall be laid 300mm above the cables for the full width of the trench.

C3.3.4.6.3.2 CI200.3.2 CONSTRUCTIONAL ASPECTS

a) All holes, wire ways, trenches, etc required for this installation and made by the contractor shall be reinstated to the original condition.

b) In all cases where the Contractor uses facilities provided by others, it is the responsibility of the Contractor to ensure that these are provided correctly to match his requirements. If discrepancies are found, these shall be brought to the attention of the Engineer immediately and prior to the installation of equipment.

c) No face-brick or other finished surfaces may be chased without the permission of the Engineer.

d) No cutting of structural concrete will be permitted without the permission of the Engineer.

e) The Contractor shall provide and erect all necessary scaffolding for this contract. Scaffolding erected by another Contractor may be utilised by the Contractor provided suitable arrangements are made with the other Contractor.

C3.3.4.6.3.3 Cl200.3.3 EARTHING

a) The screen of analogue or high-speed digital signal cables shall be continuous from field device through to control room panel and shall be connected to equipment earth onto special equipment earth busbars in the control room or control panel.

b) Instruments requiring the screen to be earthed locally at the sensing element, shall remain continuous to the control room and shall not be connected to the instrument earth or make contact with other screens at the junction box.

c) The screens of all tail cables entering junction boxes shall be kept clear of system earth and shall be connected to the screen of the interconnecting multicore cable.

d) The case of each device shall be earthed to the system earth by mounting directly on a steel frame or by means of a third wire.

e) Steel framework of panels shall be strapped together, and provision must be made for bolting to an incoming earthing cable separate from system earth.

f) All power supply cables from the local cubicles, boxes, panels or MCC's are to have the armouring and earth core, if any, adequately bonded to the earth terminal or strip in the distribution board.

g) If an armoured signal cable is screened as well, then the armouring shall be connected to system earth at both ends. If the cable is armoured but not screened, then the armouring must be used as if it was the screen.

h) The contractor shall establish the suitability of the provided earth for electronic systems. The onus regarding the effectiveness of the systems remains on the electronic contractor.

C3.3.4.6.3.4 Cl200.3.4 ELECTRICAL POWER SUPPLIES

a) If an AC circuit runs from any one cabinet etc to another cabinet etc, or field equipment, then each circuit shall be individually protected by means of a fuse or circuit breaker.

b) AC loads within a cabinet etc, shall be supplied from circuits which are individually protected by fuses or circuit breakers.

c) All power distribution terminal blocks shall be covered by a shield marked "Isolate Feeder Before Removing Shield".

d) Boards shall be wired such that when the main switch for a panel is switched off at the distribution board, no live incoming wiring shall be accessible in the panel.

C3.3.4.6.3.5 CI200.3.5 INSTALLATION OF EQUIPMENT

a) Equipment shall be mounted for maximum accessibility and visibility.

b) Workmanship shall be of good quality and all cutting, drilling, welding, etc, shall be neatly done. Each completed installation, including supports, brackets and wiring shall present a clean, compact appearance.

c) All fixing hardware for field mounted equipment shall be finished off free from burrs or jagged edges.

C3.3.4.6.3.6 CI200.3.6 DOCUMENTATION AND TRAINING

a) The Engineers drawings covering the various sections of the installation are listed in the schedule of drawings. The working drawings of the Contract shall, however, consist of:

1) The Engineer's drawings;

2) The Architect's drawings;

3) The Structural Engineer's drawings;

4) The Engineer's drawings of the other disciplines, as applicable.

5) The drawings of other services installations that are relevant for co-ordination and installation.

6) The installation drawings of other contractors and subcontractors where applicable.

b) Unless otherwise specified, three sets of the Engineer's drawings will be issued to the Services Contractor for installation purposes. Any further copies may be purchased from the Engineer.

c) The contractor shall submit four copies of shop drawings to the Engineer for examination and to demonstrate compliance with the Contract. Shop drawings shall include drawings, diagrams, illustrations, schedules, performance charts, brochures and other data which are prepared by the Services Contractor, Manufacturer, Supplier or Distributor and which illustrate some portion of the work.

d) The Engineer's examination of shop drawings or samples shall not relieve the Services Contractor of responsibility for any deviation from the requirements of this Contract unless the Services Contractor has informed the Engineer in writing of such deviations at the time of submission of shop drawings or samples and the Engineer has given written approval for the specific deviation, nor shall the Engineer's examination relieve the Services Contractor of responsibility for errors or omissions in the shop drawings or samples or for responsibility for erection or installation fit.

e) The contractor shall submit to the Engineer four copies of marked-up structural drawings, or other drawings, showing changes and/or additional requirements to be made in the structure in order to accommodate equipment installed under this Contract.

f) The installation Contractor will not be allowed to rely on the Engineer for as-installed information which he may have compiled, to produce record drawings.

g) Drawings to be entitled RECORD shall bear the signature of the Installation Contractor, or his authorised representative, and the date.

h) The contractor shall obtain from the Engineer, if available, the Engineers' drawings in electronic format, which have been drawn on a PC based CAD system for the preparation of record drawings to be provided by the contractor. One set of paper prints of the record drawings shall be provided for verification by the Engineer. The record drawings shall be provided in electronic format upon completion of the contract. In the case that drawings are not available in electronic format, the Engineer will issue a set of Engineer's drawings to the Services Contractor near completion of the installation upon request of the Contractor. The Services Contractor shall mark these drawing to indicate the record of the installation.

i) A set of final layout and schematic record drawings shall be mounted towards the end of the contract in a purpose made frame inside a door, or where no doors are fitted, to the front plate of the cabinet. The frame shall be adequately sized to receive the equivalent of one A0 size drawing folded to a nominal size of A4.

j) The contractor shall submit to the Engineer two CD/DVD containing all the record drawings in pdf and dxf format.

k) The contractor shall Submit to the Engineer three manuals bound between hard covers including the following:

1) Dimensioned drawings of the layout of the equipment and systems.

2) Wiring diagrams cross referred to the drawings described above, and to the Engineer's layout and schematic drawings.

3) All Test Certificates for tests done at the factories and on the site.

4) Detailed system and equipment descriptions.

5) Operating instructions.

6) Maintenance, adjustment and calibration instructions with preventive maintenance schedule and fault-finding procedures.

7) Spare parts list with names and address of component suppliers and a list of recommended spare components to be kept in stock.

l) Submit two preliminary hard copies of the manual to the Engineer for scrutiny. Once approved a soft copy in pdf format shall be produced.

m) The contractor shall provide thorough tuition of the Employer's staff in the operating and maintenance of the contract works.

n) The contractor shall allow in his price for the provision of 2 sets of digital photographs to be taken on monthly basis, for the duration of the contract, of all the areas and equipment where the contractor is involved. The photographs shall be properly dated with comments e.g. access to substation not possible etc. One set of the photographs shall be handed each month to the Engineers' Representative at the site meetings. These photographs may be used for the evaluation of claims.

o) The installation shall not be accepted until the manuals have been approved by the Engineer and handed over to the Client.

C3.3.4.6.3.7 CI200.3.7 INSPECTION, TESTING AND COMMISSIONING

a) The Engineer shall be allowed reasonable access for inspection to any equipment which is being manufactured for this contract.

b) All equipment, cabinets, consoles etc, upon completion, must be inspected by the Engineer at the manufacturer's premises prior to delivery to site. Seven days' notice must be given to the Engineer before the date when such inspection is required.

c) The Engineer may inspect the work at any stage of erection, and the Contractor shall provide such facilities (including tools and instruments) as reasonably may be required to perform such inspection. Such inspection by the Engineer shall not relieve the Contractor of ensuring that the works are completed in all aspects in accordance with specifications.

d) The General Conditions of Contract for use with Electrical and Mechanical Services as issued by the CESA shall apply.

C3.3.4.6.3.8 CI200.3.8 MAINTENANCE UNDER THE CONTRACT

a) During the free maintenance period the Contractor shall visit the site (over and above such visits as may become necessary due to system breakdowns), at six-monthly intervals to ascertain that the system is working well.

b) Within 14 days of each such visit the Contractor shall submit a short report to the Engineer which shall include details of all faults that were found as well as a statement that such faults were rectified. At the end of the free maintenance period, the Contractor shall analyse these findings in a "Close-out report" to the Engineer, in which he shall include any recommendations with regard to the augmenting of the system, procuring of additional facilities/equipment, suggested modifications, etc.

C3.3.4.6.3.9 CI200.3.9 POST CONTRACT MAINTENANCE AGREEMENT

a) If the Client requires it, contractors shall be able and willing to maintain their installed equipment for a period of at least five years after completion of the contract. This will be arranged through a maintenance contract, which will be negotiated during the free maintenance period. Such maintenance contract may be either of the following general types.

1) Extended guarantee maintenance contract. Under this type of maintenance agreement, the Contractor undertakes to maintain the installation in a good working condition for a fixed price which is independent of the number of maintenance visits which he has to make. Preventative maintenance visits at agreed intervals are included in the price. (The cost of replacement parts may or may not be included in the fixed price.)

2) Preventative plus breakdown service maintenance. Under this type of maintenance agreement, the contractor undertakes to do preventative maintenance visits at agreed intervals for a fixed fee. Further call-outs will be on breakdown only and are charged at hourly and km rates. The cost of replacement parts is extra.

C3.3.4.7 CI201 COMMISSIONING OFCONTROL SYSTEM

C3.3.4.7.1 CI201.1 GENERAL

C3.3.4.7.1.1 CI201.1.1 DESCRIPTION

a) Commission all systems and equipment of this instrumentation and control system.

C3.3.4.7.1.2 CI201.1.2 RELATED WORK AND DOCUMENTS

a) Division 25 Integrated Automation

C3.3.4.7.1.3 CI201.1.3 SUBMITTALS

a) Submit commissioning documents for all equipment and systems including checklists and test procedures that will be used.

C3.3.4.7.2 CI201.2 PRODUCTS

C3.3.4.7.2.1 CI201.2.1 INSTRUMENTATION

a) Provide all Commissioning. Instrumentation required to verify readings and test system and equipment performance.

b) All equipment used for testing and calibration shall be SABS traceable and calibrated within the preceding 6-month period.

c) Certificates of calibration shall be submitted for all instrumentation utilized during any testing or commissioning process.

C3.3.4.7.3 CI201.3 EXECUTION

C3.3.4.7.3.1 CI201.3.1 INSTALLATION / START-UP VERIFICATION

a) Perform all checks and tests included in the manufacturer's operation and maintenance manual. The Contractor shall provide all pre-commissioning testing, adjusting and calibration services as part of the initial installation and checkout prior to a point demonstration with the Engineer. After all checks have been completed and approved, and all field devices are installed and programmed into the PLC and HMI, the Contractor shall perform start-up tests on each plant area and test each of the devices associated with them.

b) The Engineer shall have the option to witness, with the Contractor present, the performance of the points validated in the checklists. At this time, the Contractor must be able to demonstrate completion of the calibration and function ability of the components of the system.

C3.3.4.7.3.2 CI201.3.2 PRE-COMMISSIONING TESTING, ADJUSTING, CALIBRATION

a) Work and systems installed under this section shall be fully functioning prior to functional performance testing, and contract close-out. Contractor shall start, test, adjust, calibrate all work and systems under this Contract, and record this information and generate a Pre-Commissioning Report as described below:

1) Verify proper pneumatic supply pressures and conditions.

2) Verify proper electrical voltages and amperages, and verify all circuits are free from grounds or faults.

3) Verify integrity/safety of all electrical and pneumatic connections.

4) Pump VFD minimum and maximum speed settings (where applicable);

5) All other necessary system parameters/control settings not specifically listed above but required to provide system operation, stability, and efficiency.

6) Test, calibrate, and set all digital and analogue sensing, and actuating devices including existing instrumentation and control devices that are indicated to be reused. Calibrate each instrumentation device by making a comparison between the interface display and the reading at the device, using a standard traceable to the SABS, which shall be at least twice as accurate as the device to be calibrated (e.g., if field device is plus or minus 0.5 percent accurate, test equipment shall be plus or minus 0.25 percent accurate over same range). Record the measured value and displayed value for each device in the Pre-Commissioning Report.

7) For factory calibrated devices provide factory certified calibration certificate.

8) Check and set zero and span adjustments for all instruments. Record settings for each device in the Pre-Commissioning Report.

9) Check each digital control point by making a comparison between the control command at the PLC and the status of the controlled device. Check each digital input point by making a comparison of the state of the sensing device and the HMI terminal display. Record the results for each device in the Pre-Commissioning Report.

b) Pre-Commissioning testing, adjusting, and calibration shall be completed, and the Pre-Commissioning Report submitted for acceptance prior to commissioning testing/final acceptance.

C3.3.4.7.3.3 CI201.3.3 TRENDS

a) Prepare HMI software to display graphical format trend logs during the Pre-Commissioning period. Trend logs shall demonstrate compliance with Contract Documents. Trend logs shall be set up to meet the following requirements:

1) Trend logs shall include all analogue and digital input values, analogue and digital output values, and set points which are on a reset schedule.

2) Lines shall be labelled and shall be distinguishable from each other by using either different line types, or different line colours.

3) Indicate engineering units of the y-axis values; e.g. degrees Centigrade, KPa, l/s, percent speed, etc.

4) The y-axis scale shall be chosen so that all trended values are in a readable range. Do not mix trended values on one graph if their unit ranges are incompatible.

5) Each graph shall be clearly labelled with subsystem title, date, and times.

b) A complete set of trend logs shall consist of all required points, trended for the time period listed for each point category. Point values shall be recorded based on the change-of-value (COV)

C3.3.4.7.3.4 CI201.3.4 FUNCTIONAL PERFORMANCE TESTS

Performance testing shall demonstrate that the system functions according to the specifications.

C3.3.4.8 CI202 FLOW MEASUREMENT

C3.3.4.8.1 CI202.1 GENERAL

C3.3.4.8.1.1 CI202.1.1 RELATED DOCUMENTS

a) Drawings and General Provisions of the Contract, including General Conditions, Conditions of Particular Application, and Specification Sections, apply to work of this Section.

C3.3.4.8.1.2 CI202.1.2 DESCRIPTION

a) This part of the standard gives detailed technical specifications which apply to the installation of flow instruments.

C3.3.4.8.1.3 CI202.1.3 APPLICABLE CODES AND STANDARDS

a) The following referenced documents are indispensable for the application of this section of the standard and contain provisions which, through reference in this text, constitute provisions of this standard. All standards are subject to revision and, since any reference to a standard is deemed to be a reference to the latest edition of that standard, parties to agreements based on this standard shall take the necessary steps to ensure the use of the most recent editions of the standards indicated below:

1) SANS 10142. "The Standard Regulations for the Wiring of Premises".

2) SANS 10313 "Lightning Protection of Equipment".

3) The Occupational Health and Safety Act 85/93.

4) EN 60204 Electrical

5) IEC 60529 /BS EN 60529 Enclosure non- Hazardous

6) ATEX II 2GD Enclosure Hazardous

7) ATEX II 1G Enclosure Intrinsic Safety

C3.3.4.8.1.4 CI202.1.4 RELATED SECTIONS

a) The following sections include requirements which relate to this section.

1) Other division 25 sections.

2) Division 26 Electrical sections.

C3.3.4.8.1.5 CI202.1.5 COORDINATION

a) The System Supplier shall be responsible to coordinate and exchange information with Suppliers of other systems and equipment which shall interface with, in order to achieve the required specified functions.

b) The coordination includes, but is not limited to mounting positions, cable runs etc.

C3.3.4.8.1.6 CI202.1.6 SUBMITTALS

a) General: Submit each item in this section according to the conditions of the Contract and Division 01 Specification Sections.

b) Product data for each type of product specified. Include manufacturer's technical Product Data for each control device furnished, indicating dimensions, capacities, performance characteristics, electrical characteristics, and finishes of materials, installation instructions and start-up instructions.

c) Provide shop drawings from manufacturer detailing equipment assemblies and indicating dimensions, weight loadings, required clearances, components, location and size of control panel.

d) Shop drawings containing the following information for each control system:

1) Each control device labelled with setting or adjustable range of control.

2) Details of control panels, including controls, instruments, and labelling.

3) Loop drawings showing terminal, core, and cable designations.

e) Wiring diagrams detailing wiring for power and control wiring. Differentiate clearly between manufacturer-installed wiring and field-installed wiring.

f) As-Built drawings

C3.3.4.8.1.7 CI202.1.7 QUALITY ASSURANCE

a) Compliance with Standards: Comply with applicable requirements of standards pertaining to actuators and operator's systems.

b) Manufacture Qualifications: Manufacturing firms shall be regularly engaged in manufacture of flow instruments of type, size and electrical characteristics and whose products have been in satisfactory used in similar services for not less than five (5) years.

1) Manufacturing firms shall be regularly engaged in the manufacture flow instruments of the latest technologies.

2) The Supplier shall submit an official certificate from original Manufacturers that the proposed system belongs to their latest production and identifying the date of the beginning of production.

c) Installer Qualifications: Engage an experienced Installer who is a factory-authorized sales and service representative to perform the work of this section.

Installer shall have at least five (5) years of successful installation experience in projects with flow metering equipment similar to those required for this project.

Installer shall have factory training experience.

d) Training: Equipment's Manufacturer and his authorized local Representative shall provide, in depth, equipment service and programming training to selected Employer's personnel.

C3.3.4.8.1.8 CI202.1.8 DELIVERY STORAGE AND HANDLING

a) Handle flow equipment carefully to prevent damage, breaking and scoring. Do not install damaged equipment or components, replace with new ones.

b) Store flow instruments in clean, dry place. Protect from weather, dirt, fumes, water, construction debris, and physical damage.

C3.3.4.8.2 CI202.2 PRODUCTS

C3.3.4.8.2.1 CI202.2.1 FLOW ELEMENTS

a) Specification for Orifice Plates (DP Element)

1) General

Flange tappings shall be used.

2) Design

- The design shall comply with BS 1042 Part 1 1984, or ISO 5167.
- Material shall be 316 stainless steel unless process conditions dictate otherwise.
- The direction of flow, the orifice size and the tag number shall be stamped into the lug (handle) of the orifice plate. This information shall be clearly visible when the O/P is in service.

3) Performance

The accuracy of each individual installation shall be determined and corrections for the thermal expansion of the plate, the adiabatic expansion of the fluid (if applicable) and the drain hole (if applicable), shall be applied. Determination of head loss shall be calculated.

4) Preferred:

- Proflow
- Engineer approved equivalent

b) Specification for Venturies (DP Element)

1) General

- The Venturi may be used to measure the flow of liquids and slurries that are not too abrasive. They may be used in applications where the requirement for greater accuracy or lower pressure loss is justified by the higher expense, compared to an orifice plate.
- The differential pressure is measured using a standard DP cell (2.2).

2) Design

- The design shall comply with ES1042 Part 1 1984 or ISO 5167.
- Material shall be stainless steel, unless the process conditions dictate otherwise.

3) Performance

- Data sheets provide the information required to perform the calculations and the tolerances permitted.

4) Accuracy:

- ±0.75% of full scale

5) Preferred:

- Proflow
- Kent
- Engineer approved equivalent

c) Specifications for flow nozzles (DP Element)

1) General

- A nozzle may be considered for applications requiring higher flow rates or greater accuracy than an orifice plate. Applications are more suited to gases and clean liquids, especially those that discharge from the pipe to atmosphere.
- The differential pressure is measured using a standard DP ceil (2.1).

2) Design

- The design shall comply with BS1042 Part 1 1984, or ISO 5167.
- Material shall be stainless steel, unless the process conditions dictate otherwise.

3) Performance

- Data sheets provide the information required to perform the calculations and the tolerances permitted.

4) Accuracy:

- ±1% of full scale

5) Preferred:

- Proflow
- Kent
- Engineer approved equivalent

d) Specification for Dall Tubes

1) General

- The Dall tube may be considered where lower pressure loss and lower cost at the expense of accuracy, is required, compared to the Venturi.
- The differential pressure is measured using a standard DP cell (2.1).

2) Design

- The design shall comply with ES1042 Part 1 1984, or ISO 5167.
- Material shall be stainless steel, unless the process conditions dictate otherwise.

3) Performance

- Data sheets provide the information required to perform the calculations and the tolerances permitted.

4) Accuracy:

- ± 1% of full scale

5) Preferred:

- Proflow
- Kent
- Engineer approved equivalent

C3.3.4.8.2.2 CI202.2.2 FLOW TRANSMITTERS

a) Specification for Differential Pressure Transmitters

1) General

- Transmitter shall be indicating, electronic type based on capacitance principle.
- Preference shall be given to a unit that is "smart" in that calibration and diagnostic checking shall be by handheld calibrator.

2) Design

Element Type:	Diaphragm
Wetted Parts:	316 Stainless Steel
Body Material:	316
Stainless Steel Process Connection:	½" NPT
Electrical connection:	20mm ISO conduit
Electronics Housing Protection:	IP65
Overpressure Limit:	200% of maximum process static pressure
Mounting:	Pipe stand or direct process connection as appropriate to application
Output:	4-20mA into 250Ω load
Supply:	24 V DC nominal Loop powered

Calibration Adjustments:	Independent Zero span
Element Temperature Limitation:	100ºC
Electronics:	70ºC
Humidity Limits:	0-100% relative humidity

3) Performance

Accuracy:	0.5% of span or better
Repeatability:	0.1% of span
Dead Band not to exceed:	0,1% of span
Ambient Temperature:	Effect not to exceed 0,5% of maximum span / 10ºC change

4) Preferred Type:

- Honeywell Smart
- Endress + Hauser
- Engineer approved equivalent

C3.3.4.8.2.3 CI202.2.3 FLOW METERS

a) Specification for Magnetic Flowmeters

1) General

- Transmitters shall operate on the law of induction principle. They shall be compact and suitable for mounting in the field without additional protection.
- The flowmeter shall be suitable for use in pipelines that are cathodically protected.
- Supply shall include gaskets and earthing rings.
- A primary head simulator shall be offered as an option.
- Empty pipe detection shall be included.

2) Design

The primary head shall meet the following requirements:

Connection flange rating:	BS4504 NP 10 min (match riser pipework)
Connection flange material:	Carbon Steel or Ni Steel - depending on application
Tube Material:	depending on application
Liner Material:	EPDM or PTFE depending on application

Electrode Material:	Hastelloy Tantalum depending application
Meter Casing:	Die Cast Aluminium
Power Supply:	24V DC, loop powered or 220 V AC
Enclosure Class	IP65 (indoor) or IP 68 (in meter or valve chamber) depending on application
Ambient Temperature Range:	-10 to +50ºC
Electrical Connections:	20mm ISO conduit
Field excitation:	pulsed D.C

The signal converter shall meet the following requirements:

- Transmitter electronics shall be either head mounted or remote mounted depending on application.
- The ingress protection rating of the converter shall be the same as for the primary element, typically IP65 or IP 68.
- Transmitter shall have microprocessor-based electronics with local flow indication and ability to display and change, on-line range, and units.
- The low-flow cut-out shall be user configurable.
- Parameter and data storage shall be kept in non-volatile memory.
- Output shall be 4 to 20mA, isolated. Where transmitters have dual ranges, each range shall have a separate isolated output.
- Totalizer pulsed output shall be maximum 10 pps with a minimum pulse width of 50ms.

3) Performance

Accuracy:	0.5% of span over a velocity range of 0,05 - 10m/s
Repeatability:	0.2% of span
Ambient temperature:	effect not to exceed 0.5% of maximum span per 10ºC change
Minimum sensitivity:	5 µS/cm

4) Preferred:

- Krohne
- Endress+Hauser
- SAFMAG
- Engineer approved equivalent

b) Specification for Vortex Flow Meters

1) General

- Vortex shedding meters shall operate by detecting eddies shed by a bluff body inserted into the stream to be measured, where the number of vortices shed by the bluff body are proportional to the flow rate.
- Vortex precession (Swirl meters), when used, are used primarily on clean gas services. A fixed impeller sets up the swirl, which is detected by a sensor. The number of "swirls" is proportional to flow rate. Since it has lower tolerances than the Vortex Shedding meter, and is expensive, it is not used.

2) Design

The meter tube shall meet the following requirements, subject to the application:

Connecting flange rating:	To piping specification
Connecting flange material:	Carbon steel
Meter body material:	304 Stainless steel
Trim:	316 stainless steel

The signal converter shall meet the following requirements, subject to the application:

- Transmitter electronics shall be either head mounted or remote mounted depending on application.
- Transmitter shall have microprocessor-based electronics with local flow indication and ability to display and change on/line, range, and units.
- Electrical connection 20mm ISO
- Output from amplifier 4 to 20mA, linear

3) Performance

- Accuracy: 0,5% FS over the normal flow range
- Repeatability: 0,15%

4) Preferred:

- Krohne
- Endress + Hauser
- Engineer approved equivalent

c) Specification for Turbine Flow Meters

1) General

- Turbine meters shall consist of a meter housing with a rotor in the stream flow. The angular velocity of the rotor shall be detected by a magnetic follower, which in turn drives a mechanical counter.
- All meters shall be delivered complete with a facility to pick up the flow rate pulses for conversion into an electrical signal for transmission to a remote destination. The electrical signal shall be 4 to 20mA for flow rate plus an impulse with minimum pulse width of 50ms and maximum rate of 10pps for remote totalizing. The converters shall be suitable for either local mounting or at a remote location such as control room.
- Compound meters may be used where higher accuracy is required over the full range of flow.
- Re-ranging of the output shall be possible without major disassembly.

2) Design

The meter tube shall meet the following requirements, subject to the application:

Accuracy:	2% over normal flow range 5% over the low portion of the range
Connecting flange rating:	To piping specification
Connecting flange material:	Carbon steel
Meter body material:	Cast iron with corrosion resistant lining

Cognisance should be taken of the minimum up- and down-stream runs. 3 - 5 diameters are required if the flow is laminar. Straightening vanes shall be used if necessary.

3) Performance

Accuracy:	0,5% over the normal flow range
Linearity:	0,5% over the normal flow range
Repeatability:	0,5% at any point on the normal flow range

4) Preferred:

- Meineke
- Engineer approved equivalent

d) Specification for Positive Displacement Flow Meters

1) General

The Positive Displacement meter shall consist of a volumetric metering mechanism in the flow stream, with a local totalizing indicator coupled to the mechanism. Remote

indication / totalization shall be done, if required, by a transmitter. The output of the transmitter shall accurately reflect the input pulses representing volumetric units of flow.

For accounting applications, accurate compensation for temperature shall be included.

There are several different types of PD meters, for example:

- rotary vane
- oval wheel
- oscillating piston
- fluted rotor
- notating disk

A suitable strainer / filter shall be installed upstream to protect the meter.

2) Design

Each type will have its own relevant design requirements.

The signal converter shall meet the following requirements, subject to the application:

- Transmitter electronics shall be either head mounted or remote mounted depending on application.
- Transmitter shall have microprocessor-based electronics with local flow indication and ability to display and change on/line, range, and units.
- Output shall be 4 to 20mA.

3) Performance

Typical accuracy shall be 0,25% FS.

Typical repeatability shall be 0,05%

4) Preferred:

- Fioco
- Engineer approved equivalent

e) Specification for Open Channel Flow Meters

1) General

The flow of liquids in open channels shall be measured by means of either weirs or flumes.

The variable head at the weir / flume shall be detected by either capacitance level or an ultrasonic sensor located upstream, just clear of the effects of drawdown. Other level-measuring devices, such as the bubbler type, may be considered.

2) Design of Open Channel Flow Meters

The design, location and materials for the weir or flume shall be determined by the application, and in accordance with BS 3680, Part 4.

Pre-constructed weirs and / or flumes shall be manufactured to the specific standard for the application, and correctly installed at the site.

3) Weirs

Ensure that the nappe has sufficient clearance under maximum flow conditions.

Where floating debris exist, broad crested weirs shall be used, unless a suitable debris trap is installed upstream of the weir. Flumes shall be considered.

The geometry of the weir shall be selected to suit the application and the expected flow rate.

Long-base weirs may be used for river flow measurement where construction of flumes may be impractical.

4) Flumes

Flumes may be selected where there is insufficient fall to permit unobstructed downstream flow from a weir.

Flumes may be used where silting at a weir may be a problem, or where floating debris is a problem.

The geometry of the flume shall be selected to suit the application. The surfaces shall be smooth, especially near the throat.

The structure shall be rigid and watertight, and capable of withstanding flood conditions.

Uniform approach of flow is required. The approach channel shall be in the order of 5 times the width of the channel in full flow.

5) Performance Flow ranges

Rectangular weir:	0 - 15 to 0 - 650 l/s
Triangular weir:	0-10 to 0-130 l/s
Trapezoidal weir:	0-15 to 0-650 l/s
Flumes:	Wide
Accuracies:	
Rectangular thin-plate weirs:	1% to 4%
Broad-crested weirs:	3% to 5% "V" notch weir
(θ=20º to 100º):	1% to 2%
Triangular profile weirs:	2% to 5%

Standing-wave flumes: 2% to 5%.

6) Preferred:

- Endress + Hauser
- Engineer approved equivalent

f) Ultrasonic flow Meters

1) Transducers

This section covers ultrasonic transducers located above the surface of the water, at the measuring point.

Suitable support brackets shall be supplied for the ultrasonic transducers.

2) Design:

Enclosure: IP65

Membrane: Stainless Steel

Electrical Connection: 20mm ISO conduit Max

Operating Temperature: 60ºC

3) Transmitter

Preference shall be given to a unit that is "smart" in that calibration and diagnostic checking shall be by hand-held calibrator.

The ability of the system to be configured to ignore unwanted signals from obstructions is essential.

4) Design

Enclosure: To suit application

Output: 4-20mA into 250Ω load

Power Supply: 24V DC

Calibration Adjustments: Independent for Zero & span

5) Performance

Accuracy 1% of span or better

Repeatability 0,2% of span

Dead Band <0,2% of span

Ambient Temperature Effect <0,5% of maximum span per 10ºC change

6) Preferred:

- Endress + Hauser
- Milltronics
- Engineer approved equivalent

g) Capacitance "Flow" Meter

1) General

This section covers capacitance rods in the open channel located in a gauge well or settling chamber.

A counter-electrode shall be supplied and installed into the gauge well.

Rods shall be of a material that is compatible with the process media. Coatings, such as Teflon, shall be used to protect the rods in most applications.

2) Design

- Probe

Material: Stainless steel

Sheath: PTFE

Insertion Length: To suit application

- Transmitter

Preference shall be given to a unit that is "smart" in that calibration and diagnostic checking shall be by hand-held calibration.

Enclosure: To suit (IP65) Output 4-20 mA into a 250Ω load

Power Supply: 24 V DC

Calibration adjustment Independent for Zero & span

3) Performance

Accuracy: 1% of span or better

Repeatability: 0.2% of span

Dead Band: <0.2 % of span

Ambient temperature effect: < 0.5% if maximum span per 10ºC change

4) Preferred

- Endress & Hauser
- Engineer approved equivalent

h) Portable, Clamp-on, Ultrasonic Flow Meters

1) General

Clamp on flow meters shall operate on the time of flight principle. The unit shall be self-obtained and shall be battery and mains powered.

2) Design

The primary head shall meet the following requirements: Sensors - 2 ultrasonic sensors

Clamping arrangement:	The sensors shall be equipped with clamps to enable the sensors to be mounted onto pipes with DN 50 – 3000mm
Pipe material:	Metal, Plastic, Ceramic, Fibre Cement and internally and externally coated pipes
Power Supply:	Internal batteries, 231VAC, 12VDC
Carrying Case:	Aluminium IP54 rated
Ambient Temperature:	-10 to +50ºC
Totalizer Pulses:	Maximum 10pps with minimum pulse width of 50ms
Flow Cut-off:	User configurable

The meter shall be equipped with a local LCD display and shall also have an output of 4 - 20mA. The meter shall have onboard logging facilities and printer. The logged data shall be available to a PC via an RS232 link. The software required for the PC interface shall be supplied with the meter.

3) Performance

Accuracy:	1% of measured value
Repeatability:	1% of measured value
Temperature stability:	< 0.5% of span per 10ºC change

4) Preferred

- Krohne
- Engineer approved equivalent

C3.3.4.8.2.4 Cl202.2.4 FLOW INDICATORS

a) "Rotameters: (Variable Area Meters)

1) General

Rotameters shall be provided for low flow rates if local indication is required. Rotameters shall also be provided if the rangeability, nonlinearity, viscosity, or hazardous nature of the fluid makes a differential-pressure type instrument unreliable. Rotameters shall have line class block valves upstream and downstream for maintenance.

2) Design

A safety-glass indicating tube shall be provided for pressure below 1000kPa and temperatures below 100kPa other applications. Armoured meter tubes shall have internal guides.

All wetted parts of rotameters on high pressures shall be stainless steel. Teflon or other liner materials shall be considered for corrosive fluids.

The manufacturer's standard tube and float shall be supplied to provide a normal flow rate between 40 and 80 percent of the meter capacity. The anticipated minimum and maximum flow rate shall be between 10 and 90 percent of the meter capacity.

Rotameters shall be accurate within 2%indicating scales or percentage scales with stainless steel factor tags. Indicating scales shall have full length safety glasses with shields and gaskets on both sides. If percentage scales are used, the scale factor shall be tagged on the rotameter.

Rotameters shall have beaded, ribbed or flat tube indicators. Plain tempered tubes are not acceptable.

Variable area rotameters shall be completely assembled prior to shipment.

3) Preferred

- Krohne
- Fischer & Porter
- Engineer approved equivalent

C3.3.4.8.2.5 CI202.2.5 MASS FLOW

a) General

1) A systems approach to mass flow of liquids is to correct volumetric flow by density. A "flow computer" receives signals from volumetric flow meters and density meters, and mathematically generates the mass flow. Other physical characteristics like temperature, viscosity and pressure may be taken into consideration, depending on the accuracy required.

2) Dedicated mass flow meters, using the Coriolis principle, can determine the mass flow directly.

b) Design

1) Wetted parts shall be Titanium, unless the application demands another material.

2) The transmitter shall be an intelligent microprocessor device, with multiple 4 to 20mA outputs. Customer defined constants shall be configurable, such as display units, pulse outputs, low flow cut-outs and time constants.

3) Optical (Infra-red) vibration sensors are preferred.

c) Performance

Accuracy: 0.01 % fsd, or ± 0.2% of reading

Repeatability: 0.005% fsd, 0.1% of reading

d) Preferred

- Endress + Hauser
- Krohne
- Engineer approved equivalent

C3.3.4.8.3 CI202.3 EXECUTION

C3.3.4.8.3.1 CI202.3.1 INSTALLATION

a) All flow instruments and sensors shall be installed as recommended by the manufacturer.

b) Wiring shall be neatly labelled, trained, fanned and secured with each cable permanently tagged to identify the area or function served.

c) All cables inside the building shall run in cable trenches or cable trays.

C3.3.4.9 CI203 LEVEL MEASUREMENT

C3.3.4.9.1 CI203.1 GENERAL

C3.3.4.9.1.1 CI203.1.1 RELATED DOCUMENTS

a) Drawings and General Provisions of the Contract, including General Conditions, Conditions of Particular Application, and Specification Sections, apply to work of this Section.

C3.3.4.9.1.2 CI203.1.2 DESCRIPTION

a) This part of the standard gives detailed technical specifications which apply to the installation of level instruments.

C3.3.4.9.1.3 CI203.1.3 APPLICABLE CODES AND STANDARDS

a) The following referenced documents are indispensable for the application of this section of the standard and contain provisions which, through reference in this text, constitute provisions of this standard. All standards are subject to revision and, since any reference to a standard is deemed to be a reference to the latest edition of that standard, parties to agreements based on this standard shall take the necessary steps to ensure the use of the most recent editions of the standards indicated below:

1) SANS 10142. "The Standard Regulations for the Wiring of Premises".

2) SANS 10313 "Lightning Protection of Equipment".

3) The Occupational Health and Safety Act 85/93.

4) EN 60204 Electrical

5) IEC 60529 /BS EN 60529 Enclosure Non-Hazardous

6) ATEX II 2GD Enclosure Hazardous

7) ATEX II 1G Enclosure Intrinsic Safety

C3.3.4.9.1.4 CI203.1.4 RELATED SECTIONS

a) The following sections include requirements which relate to this section.

1) Other division 25 sections.

2) Division 26 Electrical sections.

C3.3.4.9.1.5 CI203.1.5 COORDINATION

The System Supplier shall be responsible to coordinate and exchange information with Suppliers of other systems and equipment which shall interface with, in order to achieve the required specified functions.

The coordination includes, but is not limited to mounting positions, cable runs etc.

C3.3.4.9.1.6 CI203.1.6 SUBMITTALS

a) General: Submit each item in this section according to the conditions of the Contract and Division 01 Specification Sections.

b) Product data for each type of product specified. Include manufacturer's technical Product Data for each control device furnished, indicating dimensions, capacities, performance characteristics, electrical characteristics, and finishes of materials, installation instructions and start-up instructions.

c) Provide shop drawings from manufacturer detailing equipment assemblies and indicating dimensions, weight loadings, required clearances, components, location and size of control panel.

d) Shop drawings containing the following information for each control system:

1) Each control device labelled with setting or adjustable range of control.

2) Details of control panels, including controls, instruments and labelling.

3) Loop drawings showing terminal, core and cable designations.

e) Wiring diagrams detailing wiring for power and control wiring. Differentiate clearly between manufacturer-installed wiring and field-installed wiring.

f) As-Built drawings

C3.3.4.9.1.7 CI203.1.7 QUALITY ASSURANCE

a) Compliance with Standards: Comply with applicable requirements of standards pertaining to level instruments.

b) Manufacture Qualifications: Manufacturing firms shall be regularly engaged in manufacture of level instrumentation of type, size and electrical characteristics and whose products have been in satisfactory use in similar services for not less than five (5) years.

1) Manufacturing firms shall be regularly engaged in the manufacture level instrumentation of the latest technologies.

2) The Supplier shall submit an official certificate from original Manufacturers that the proposed system belongs to their latest production and identifying the date of the beginning of production.

c) Installer Qualifications: Engage an experienced Installer who is a factory-authorized sales and service representative to perform the work of this section.

Installer shall have at least five (5) years of successful installation experience in projects with level instrumentation similar to those required for this project.

Installer shall have factory training experience.

d) Training: Equipment's Manufacturer and his authorized local Representative shall provide, in depth, equipment service and programming training to selected Employer's personnel.

C3.3.4.9.1.8 CI203.1.8 DELIVERY STORAGE AND HANDLING

a) Handle level equipment carefully to prevent damage, breaking and scoring. Do not install damaged equipment or components, replace with new ones.

b) Store level instruments in clean, dry place. Protect from weather, dirt, fumes, water, construction debris, and physical damage.

C3.3.4.9.2 CI203.2 PRODUCTS

C3.3.4.9.2.1 CI203.2.1 SPECIFICATION FOR LEVEL ELEMENTS

a) Bubblers

1) General

Bubblers shall operate on the principle that the back-pressure required to maintain a flow of bubbles in a liquid is representative of the level of liquid in an open vessel.

Back-pressure shall be measured by a DP-Cell transmitter.

Care shall be taken that the dip-tube is adequately supported and clear of any obstructions.

2) Design

The immersed end of the dip-tube shall be cut at an angle of 45mm -150mm base clearance.

3) Dip-tube material

3/8" OD 316 stainless steel tube. (depending on media compatibility)

b) Diaphragms

1) General

Diaphragm type level transmitters shall be used in difficult or hazardous applications, where the level is inferred from the differential pressure.

2) Design

The diaphragms shall be chemical seal devices, connected to the differential pressure transmitter by filled capillary tubes.

C3.3.4.9.2.2 CI203.2.2 SPECIFICATION FOR LEVEL TRANSMITTERS

a) Specification for Ultrasonic Level Transmitter

1) Transducers

- General

Suitable support brackets shall be supplied for all types of ultrasonic transducers.

Coatings shall be applied to exposed surfaces that may be subject to damage from the process.

Alternative mounting methods (e.g.: suspension) may be required in some applications.

- Design

Process Connection: Flange mounting, or to suit Enclosure IP55

Membrane:	Stainless Steel
Electrical Connection:	20mm ISO conduit
Max Operating Temp:	60ºC

2) Transmitter

- General

Transmitter shall comprise of a remote electronics unit and a single field mounted ultrasonic emitter/sensor.

Preference shall be given to a unit that is "smart" in that calibration and diagnostic checking shall be by hand-held calibrator.

The transmitter shall have the ability to linearize the O/P depending on the geometry of the vessel, and thus relate O/P to either level or volume.

The ability of the system to be configured to ignore unwanted signals from obstructions or agitators is essential.

- Design

Enclosure	To suit application
Output	4-20 mA into250Ω load
Power Supply	24V DC
Calibration Adjustments	Independent for Zero & span

- Performance

Accuracy	1% of span or better
Repeatability	0.2% of span
Dead Band	<0.2% of span
Ambient Temperature Effect	<0.5% of maximum span per 10ºC

- Preferred

Milltronics

Endress & Hauser

Engineer approved equivalent

b) Specification for Capacitance Level Transmitter

1) General

This section covers capacitance sensors on rods and suspended on ropes and cables.

Where non-conductive vessels are used, a counter-electrode shall be supplied and installed into the tank.

Rods shall be of a material that is compatible with the process media. Coatings, such as Teflon, shall be used to protect the rods in most applications.

2) Design

- Probe

Material:	Stainless steel
Sheath:	PTFE
Insertion Length:	To suit application
Process Connection:	1½" B.S. P/N.P.T
Temperature:	Maximum process temperature 150ºC
Pressure:	Maximum process pressure 1000 kPa

- Transmitter

Transmitter shall be of electronic type for rod or rope probe connection. Preference shall be given to a unit that is "smart" in that calibration and diagnostic checking shall be by hand-held calibration.

Enclosure:	To suit (IP55)
Output:	4-20 Ma into a 250Ω load
Power Supply:	24V DC
Calibration adjustments:	Independent for Zero & span

3) Performance

Accuracy:	1% of span or better
Repeatability:	0.2% of span
Dead Band:	<0.2% of span
Ambient temperature effect:	<0.5% of maximum span per 10ºC change

4) Preferred:

- Endress + Hauser
- Engineer approved equivalent

c) Specification for Nuclear Devices

1) General

No work shall proceed until the Contractor and the End User (Owner) have satisfied all the regulations governing the handling and transport of nuclear sources. All installations shall be clearly marked with the approved Radiation Warning signs.

Temperature compensation for processes that vary in temperature shall be provided as a standard feature.

Heaters shall be provided for detectors subject to wide temperature variations.

Transmitter electronics shall be either local or suitable for mounting in a cabinet or panel, depending on the application.

2) Design

The source holder shall be fitted with a lockable shutter to permit safe maintenance when required.

Mounting brackets shall be secure and corrosion resistant.

The detector shall be suitable for mounting on vessels that are cathodically protected.

3) Performance

Power supply:	220vAC or 24vDC
Output signal:	4 to 20mA into a 250Ω load
Accuracy:	1% full scale or better

4) Preferred

- Krohne
- Engineer approved equivalent

d) Specification for Differential Pressure Transmitters

1) General

Transmitter shall be indicating, electronic type based on capacitance principle.

Preference shall be given to a unit that is "smart" in that calibration and diagnostic checking shall be by handheld calibrator.

2) Design

Element Type:	Diaphragm
Wetted Parts:	316 Stainless Steel
Body Material:	316 Stainless Steel
Process Connection:	½" NPT
Electrical Connection:	20mm ISO conduit
Electronics Housing Protection:	IP65

Overpressure limit	200% of maximum process static pressure
Mounting	Pipe stand or direct process connection as appropriate to application
Output	4-20mA into 250Ω load
Supply	24 V DC nominal
Calibration Adjustments	Independent Zero Span
Element Temperature Limitation	100ºC
Electronics	70ºC
Humidity Limits	1-100% relative humidity

3) Performance

Accuracy :	0.5% of span or better
Repeatability	0.1% of span
Dead Band	<0.1% of span
Ambient temperature effect	<0.5% of maximum span/ 10ºC change

4) Preferred

- Honeywell Smart
- Endress + Hauser
- Engineer approved equivalent

e) Specification for Level Gauges

1) General

Gauge Glasses shall be installed when a local indication of liquid level is required in an elevated vessel.

Where transparent liquids are to be measured, level gauges with magnetic followers may be used.

Where the level of liquids with non-varying SG needs to be indicated, in open vessels, pressure gauges, calibrated in level units (e.g.: % or meters), may be used.

Local indicators may be pneumatic or digital, depending on the type of level transmitter used. Refer to section 25 35 16.04 for pressure gauges, and section OP11 for local indicators.

2) Design

The mechanical construction of the gauge shall be capable of withstanding the temperatures, pressures, and media types as indicated on the relevant datasheets.

The gauges shall be supplied complete with isolation ball valves and drain / vent valves top and bottom.

Illumination shall be provided for gauge glasses to enable readings to be made in difficult lighting conditions.

C3.3.4.9.2.3 CI203.2.3 SPECIFICATION FOR HYDROSTATIC LEVEL TRANSMITTERS

a) General

Transmitter shall be non-indicating, electronic type based on piezo-restive or capacitive principle. The transmitter shall be a two wire, loop powered unit.

b) Design

1) Submersed

Element Type	Diaphragm
Wetted Parts	316 Stainless Steel
Body Material	316 Stainless Steel
Process Connection	½" NPT Electrical Connection
Electrical Connection	20mm ISO conduit
Electronics Housing Protection	IP68
Overpressure limit	200% of maximum process static pressure
Mounting	Suspended on cable of suitable length as appropriate to application
Output	4-20mA into 250Ω load
Supply	24 V DC nominal
Calibration Adjustments	Fixed range
Element Temperature Limitation	1 - 100ºC Electronics -10 - 70ºC
Humidity Limits	100% relative humidity

2) Dry Process Connection

Element Type	Capacitor Cell
Wetted Parts	316 Stainless Steel
Body Material	Powder Coated Cast Aluminium
Process Connection	½" NPT
Electrical Connection	20mm ISO conduit
Electronics Housing Protection	IP68

Overpressure limit	200% of maximum process static pressure
Mounting	Direct on process pipe via ½" NPT shut off valve
Output	4-20mA into 250 Ω load
Supply	24 V DC nominal
Calibration Adjustments	Zero and span
Element Temperature Limitation	1 - 100ºC Electronics -10 - 70ºC
Humidity Limits	100% relative humidity

c) Performance

Accuracy	0.5% of range or better
Repeatability	0.1% of range
Dead Band	0.1% of range
Ambient temperature effect	0.5% of maximum range/10ºC change

d) Preferred

1) Vega

2) Endress & Hauser

3) Engineer approved equivalent

C3.3.4.9.3 CI203.3 EXECUTION

C3.3.4.9.3.1 CI203.3 .1 INSTALLATION

a) All flow instruments and sensors shall be installed as recommended by the manufacturer.

b) Wiring shall be neatly labelled, trained, fanned and secured with each cable permanently tagged to identify the area or function served.

c) All cables inside the building shall run in cable trenches or cable trays.

C3.3.4.10 CI204 PRESSURE MEASUREMENT

C3.3.4.10.1 CI204.1 GENERAL

C3.3.4.10.1.1 CI204.1.1 RELATED DOCUMENTS

a) Drawings and General Provisions of the Contract, including General Conditions, Conditions of Particular Application, and Specification Sections, apply to work of this Section.

C3.3.4.10.1.2 CI204.1.2 DESCRIPTION

a) This part of the standard gives detailed technical specifications which apply to the installation of pressure instruments.

C3.3.4.10.1.3 CI204.1.3 APPLICABLE CODES AND STANDARDS

a) The following referenced documents are indispensable for the application of this section of the standard and contain provisions which, through reference in this text, constitute provisions of this standard. All standards are subject to revision and, since any reference to a standard is deemed to be a reference to the latest edition of that standard, parties to agreements based on this standard shall take the necessary steps to ensure the use of the most recent editions of the standards indicated below:

1) SANS 10142. "The Standard Regulations for the Wiring of Premises".

2) SANS 10313 "Lightning Protection of Equipment".

3) The Occupational Health and Safety Act 85/93.

4) EN 60204 Electrical

5) IEC 60529 /BS EN 60529 Enclosure Non-Hazardous

6) ATEX II 2GD Enclosure Hazardous

7) ATEX II 1G Enclosure Intrinsic Safety

C3.3.4.10.1.4 CI204.1.4 RELATED SECTIONS

a) The following sections include requirements which relate to this section.

1) Other division 25 sections.

2) Division 26 Electrical sections.

C3.3.4.10.1.5 CI204.1.5 COORDINATION

The System Supplier shall be responsible to coordinate and exchange information with Suppliers of other systems and equipment which shall interface with, in order to achieve the required specified functions.

The coordination includes, but is not limited to mounting positions, cable runs etc.

C3.3.4.10.1.6 CI204.1.6 SUBMITTALS

a) General: Submit each item in this section according to the conditions of the Contract and Division 01 Specification Sections.

b) Product data for each type of product specified. Include manufacturer's technical Product Data for each control device furnished, indicating dimensions, capacities, performance characteristics, electrical characteristics, and finishes of materials, installation instructions and start-up instructions.

c) Provide shop drawings from manufacturer detailing equipment assemblies and indicating dimensions, weight loadings, required clearances, components, location and size of control panel.

d) Shop drawings containing the following information for each control system:

1) Each control device labelled with setting or adjustable range of control.

2) Details of control panels, including controls, instruments and labelling.

e) Wiring diagrams detailing wiring for power and control wiring. Differentiate clearly between manufacturer-installed wiring and field-installed wiring.

f) As-Built drawings

C3.3.4.10.1.7 CI204.1.7 QUALITY ASSURANCE

a) Compliance with Standards: Comply with applicable requirements of standards pertaining to actuators and operator's systems.

b) Manufacture Qualifications: Manufacturing firms shall be regularly engaged in manufacture of pressure instrumentation of type, size and electrical characteristics and whose products have been in satisfactory use in similar services for not less than five (5) years.

1) Manufacturing firms shall be regularly engaged in the manufacture pressure instrumentation of the latest technologies.

2) The Supplier shall submit an official certificate from original Manufacturers that the proposed system belongs to their latest production and identifying the date of the beginning of production.

c) Installer Qualifications: Engage an experienced Installer who is a factory-authorized sales and service representative to perform the work of this section.

Installer shall have at least five (5) years of successful installation experience in projects with pressure instrumentation similar to those required for this project.

Installer shall have factory training experience.

d) Training: Equipment's Manufacturer and his authorized local Representative shall provide, in depth, equipment service and programming training to selected Employer's personnel.

C3.3.4.10.1.8 CI204.1.8 DELIVERY STORAGE AND HANDLING

a) Handle pressure equipment carefully to prevent damage, breaking and scoring. Do not install damaged equipment or components, replace with new ones.

b) Store pressure instruments in clean, dry place. Protect from weather, dirt, fumes, water, construction debris, and physical damage.

C3.3.4.10.2 Cl204.2 PRODUCTS

C3.3.4.10.2.1 Cl204.2.1 SPECIFICATION FOR PRESSURE GAUGES

a) General

Gauges shall operate on the Bourdon tube principle.

b) Design

1) Gauges shall be 100mm nominal diameter unless stated otherwise. Gauges used on pressure regulators and I-to-P's, etc. shall be 50mm nominal diameter.

2) Case and movement shall be of stainless-steel construction.

3) Dial shall be white with black lettering.

4) Gauge shall be suitable for glycerine filling if application requires.

5) A pressure vent shall be incorporated into the case design.

Environment protection shall be at least IP55.

6) Process connection shall be ½" NPT male bottom or rear entry to suit application. Gauges used on regulators, etc. shall be ½" NPT-M connections.

7) Gauges for use on "dirty" of viscous liquids shall be fitted with a diaphragm type chemical seal.

8) Gauges for use on "pulsing" process lines shall be fitted with a snubber.

c) Performance

Over pressure range	1,3 x full scale Upper limit of range for static pressure 75% fsd
Upper limit of range for fluctuating pressure	66% fsd

d) Preferred type

1) Control Instruments

2) Wika.

C3.3.4.10.2.2 Cl204.2.2 SPECIFICATION FOR DIAPHRAGM TYPE CHEMICAL SEALS

a) General

A chemical seal shall be used on a pressure gauge, pressure of flow transmitter when the flowing media is viscous, corrosive or contains suspended solids.

b) Design

1) The unit shall have a stainless-steel body, bolting and diaphragm.

2) Unit pressure rating shall be NP10 or higher as application dictates.

3) Seals and filling liquid shall be suitable for temperatures from 0 to 150°C.

4) Process and instrument connections shall be ½"BSP or NPT.

5) Seal diaphragm must be able to withstand twice the maximum pressure range of the system to which it is connected and be corrosive resistant to the process medium.

6) Where diaphragm seals require capillary extensions, the capillary shall be 316 stainless steel and be shielded by flexible stainless-steel tubing with a neoprene or PVC cover.

7) Length of the capillary shall suit the application, but should be at least 1,0m. For differential pressure applications the capillary tubing shall be the same length.

c) Preferred type:

1) Control Instruments.

C3.3.4.10.2.3 CI204.2.3 SPECIFICATION FOR PRESSURE TRANSMITTERS

a) General

1) Transmitter shall be indicating, two wire and loop powered electronic type based on capacitance principle.

2) Preference shall be given to a unit that is "smart" in that calibration and diagnostic checking shall be by handheld calibrator.

b) Design

Element Type:	Ceramic capacitor cell
Wetted parts:	316 Stainless Steel
Body material:	316 Stainless Steel
Process Connection:	½" NPT
Wetted Parts:	316 Stainless Steel
Body material:	316 Stainless Steel
Process Connection:	½" NPT
Electrical Connection:	20mm ISO conduit
Electronics Housing Protection:	IP65
Overpressure Limit:	200% of maximum process static pressure
Mounting:	Pipestand or direct process connection as appropriate to application
Output:	4-20 mA into 250Ω load
Supply:	24 V DC nominal
Calibration Adjustments:	Independent Zero and span

Element Temperature Limitation:	100ºC
Electronics:	70ºC
Humidity Limits:	0 - 100% relative humidity

c) Performance

Accuracy:	0.5% of span or better
Repeatability:	0.1% of span
Dead Band:	not to exceed 0.1% of span
Ambient Temperature Effect:	not to exceed 0.5% of maximum span / 10ºC change

d) Preferred type:

1) Endress + Hauser

2) Honeywell Smart

C3.3.4.10.2.4 CI204.2.4 SPECIFICATION FOR DIFFERENTIAL PRESSURE TRANSMITTERS

a) General

1) Transmitter shall be indicating, two wire and loop powered electronic type based on capacitance principle.

2) Preference shall be given to a unit that is "smart" in that calibration and diagnostic checking shall be by handheld calibrator.

b) Design

Element Type:	Ceramic capacitor cell
Wetted parts:	316 Stainless Steel
Body material:	316 Stainless Steel
Process Connection:	½" NPT
Electrical Connection:	20mm ISO conduit
Electronics Housing Protection:	IP55
Overpressure Limit pressure:	200% of maximum process static
Mounting:	Pipestand or direct process connection as appropriate to application
Output:	4-20 mA into 250Ω load
Supply:	24 V DC nominal
Calibration Adjustment:	Independent Zero and span

Element Temperature Limitation:	100ºC
Electronics:	70ºC
Humidity Limits	0 - 100% relative humidity

c) Performance

Accuracy	0.5% of span or better
Repeatability	0.1 % of span
Dead Band	not to exceed 0.1% of span
Ambient Temperature Effect	not to exceed 0.5% of maximum span/10ºC change

d) Preferred type

1) Endress + Hauser

2) Honeywell Smart

C3.3.4.10.3 Cl204.3 EXECUTION

C3.3.4.10.3.1 Cl204.3.1 INSTALLATION

a) All flow instruments and sensors shall be installed as recommended by the manufacturer.

b) Wiring shall be neatly labelled, trained, fanned and secured with each cable permanently tagged to identify the area or function served.

c) All cables inside the building shall run in cable trenches or cable trays.

C3.3.4.11 CI205 PROCESS SWITCHES

C3.3.4.11.1 CI205.1 GENERAL

C3.3.4.11.1.1 CI205.1.1 RELATED DOCUMENTS

a) Drawings and General Provisions of the Contract, including General Conditions, Conditions of Particular Application, and Specification Sections, apply to work of this Section.

C3.3.4.11.1.2 CI205.1.2 DESCRIPTION

a) This part of the standard gives detailed technical specifications which apply to the installation of process switches.

C3.3.4.11.1.3 CI205.1.3 APPLICABLE CODES AND STANDARDS

a) The following referenced documents are indispensable for the application of this section of the standard and contain provisions which, through reference in this text, constitute provisions of this standard. All standards are subject to revision and, since any reference to a standard is deemed to be a reference to the latest edition of that standard, parties to agreements based on this standard shall take the necessary steps to ensure the use of the most recent editions of the standards indicated below:

1) SANS 10142. "The Standard Regulations for the Wiring of Premises".

2) SANS 10313 "Lightning Protection of Equipment".

3) The Occupational Health and Safety Act 85/93.

4) EN 60204 Electrical

5) IEC 60529 /BS EN 60529 Enclosure Non-Hazardous

6) ATEX II 2GD Enclosure Hazardous

7) ATEX II 1G Enclosure Intrinsic Safety

C3.3.4.11.1.4 CI205.1.4 RELATED SECTIONS

a) The following sections include requirements which relate to this section.

1) Other division 25 sections.

2) Division 26 Electrical sections.

C3.3.4.11.1.5 CI205.1.5 COORDINATION

The System Supplier shall be responsible to coordinate and exchange information with Suppliers of other systems and equipment which shall interface with, in order to achieve the required specified functions.

The coordination includes, but is not limited to mounting positions, cable runs etc.

C3.3.4.11.1.6 CI205.1.6 SUBMITTALS

a) General: Submit each item in this section according to the conditions of the Contract and Division 01 Specification Sections.

b) Product data for each type of product specified. Include manufacturer's technical Product Data for each control device furnished, indicating dimensions, capacities, performance characteristics, electrical characteristics, and finishes of materials, installation instructions and start-up instructions.

c) Provide shop drawings from manufacturer detailing equipment assemblies and indicating dimensions, weight loadings, required clearances, components, location and size of control panel.

d) Shop drawings containing the following information for each control system:

1) Each control device labelled with setting or adjustable range of control.

2) Details of control panels, including controls, instruments and labelling.

3) Loop drawings showing terminal, core and cable designations.

e) Wiring diagrams detailing wiring for power and control wiring. Differentiate clearly between manufacturer-installed wiring and field-installed wiring.

f) As-Built drawings

C3.3.4.11.1.7 CI205.1.7 QUALITY ASSURANCE

a) Compliance with Standards: Comply with applicable requirements of standards pertaining to actuators and operators' systems.

b) Manufacture Qualifications: Manufacturing firms shall be regularly engaged in manufacture of process switches of type, size and electrical characteristics and whose products have been in satisfactory use in similar services for not less than five (5) years.

1) Manufacturing firms shall be regularly engaged in the manufacture of process switches of the latest technologies.

2) The Supplier shall submit an official certificate from original Manufacturers that the proposed system belongs to their latest production and identifying the date of the beginning of production.

c) Installer Qualifications: Engage an experienced Installer who is a factory-authorized sales and service representative to perform the work of this section.

Installer shall have at least five (5) years of successful installation experience in projects with process switches similar to those required for this project.

C3.3.4.11.1.8 CI205.1.8 DELIVERY STORAGE AND HANDLING

a) Handle pressure equipment carefully to prevent damage, breaking and scoring. Do not install damaged equipment or components, replace with new ones.

b) Store pressure instruments in clean, dry place. Protect from weather, dirt, fumes, water, construction debris, and physical damage.

C3.3.4.11.2 CI205.2 PRODUCTS

C3.3.4.11.2.1 CI205.2.1 GENERAL

a) Switches shall be provided with an enclosure of a type suitable for the individual environmental conditions (Minimum IP65).

b) Actuating switches shall be snap action micro-switches. Contracts shall have a minimum rating of 3Amps inductive breaking at 220VAC.

c) All switches shall have two parallel contacts normally open/closed and the on-off differential of switches shall be adjustable. The set-point shall be adjustable over the full instrument range.

d) Specific applications may demand that methods other than those listed below shall be used.

C3.3.4.11.2.2 CI205.2.2 PRESSURE SWITCHES

a) Pressure switches shall generally be of the Diaphragm type.

Element Material:	Bronze or Stainless Steel to suit the application
Process Connection:	½" N.P.T. or to suit
Electrical Connection:	20 mm ISO conduit
Max Process Pressure:	5000 kPa
Max Process Temperature:	100ºC

b) Preferred:

- Asco

C3.3.4.11.2.3 CI205.2.3 TEMPERATURE

a) Temperature switches shall be filled systems or bimetallic.

b) Filled systems may be direct mount or capillary mount.

c) Capillary mount shall be used where applications make access to the head difficult.

Element Material:	Bronze or Stainless Steel to suit the application
Process Connection:	½" N.P.T. or to suit
Electrical Connection:	20 mm ISO conduit
Max process Temperature:	100ºC

d) Preferred:

- Asco,
- Fenwal

C3.3.4.11.2.4 Cl205.2.4 FLOW SWITCHES

a) Paddle Type

1) Flow switches shall be of the paddle type and shall have a paddle which is changeable to suit the flow rate.

Wetted pants:	Stainless Steel
Process Connection:	1" N.P.T. or to suit
Electrical Connection:	20 mm ISO conduit
Max Process Pressure:	1000 kPa Max process
Temperature:	100ºC

2) Preferred:

- Asco

b) Thermal Type

1) Flow switches shall be of the thermal type and shall have a switch point which is changeable to suit the flow rate.

Wetted pants:	Stainless Steel
Process Connection:	1" N.P.T. or to suit
Electrical Connection:	20 mm ISO conduit
Max Process Pressure:	1000 kPa Max process
Temperature:	100ºC

2) Preferred:

- Effector;
- FCI

C3.3.4.11.2.5 Cl205.2.5 LEVEL

a) Ultrasonic

1) Point source/detector types shall be used, especially for level in a vessel.

2) Installation shall be done with due care, to avoid interference from obstructions.

3) Temperature variations shall be compensated for.

4) Preferred

- Endress + Hauser

b) Capacitance

1) Capacitance probes may be used as level switches.

2) The probe is one plate of a capacitor, so capacitance probes shall be used in media of varying moisture content.

3) Where non-conductive vessels are used, a counter-electrode shall be supplied and installed into the tank.

4) Probes shall be of a material that is compatible with the process media. Coatings, such as Teflon, shall be used to protect the rods in most applications.

5) Preferred:

- Endress + Hauser

c) Conductivity

1) Conductivity probes may be used as level switches.

2) The conductivity of the medium with respect to a reference probe, or the wall of a conducting vessel is used to determine the switch point.

3) Preferred:

- Endress + Hauser

d) Nucleonic

1) No work shall proceed until the Contractor and the End User (Owner) have satisfied all the regulations governing the handling and transport of nuclear sources. All installations shall be clearly marked with the approved Radiation Warning signs.

2) Transmitter electronics shall be either local or suitable for mounting in a cabinet or panel, depending on the application.

3) The source holder shall be fitted with a lockable shutter to permit sage maintenance when required.

4) Mounting brackets shall be secure and corrosion resistant.

5) The detector shall be suitable for mounting on vessels that are cathodically protected.

6) Preferred:

- Endress + Hauser

e) Displacer/Float

1)	Wetted parts	Stainless Steel or to suit application
2)	Process Connection	To suit application
3)	Electrical Connection	20 mm ISO conduit
4)	Max Process Temperature	100ºC

5) Max Process Pressure 1000 kPa

6) Typical applications:

- Level, especially useful for pump protection.

7) Preferred:

- Flyght
- Kübler

f) Frequency

1) A frequency on a probe is attenuated by the medium and is used for liquid level applications.

Supply voltage:	24 VDC
Process connection:	1" N.P.T. or to suit
Electrical Connection:	20 mm ISO conduit Max.
Process Temperature:	100ºC
Max. Ambient Temperature:	65ºC Max.
Process Pressure:	1000 kPa
Wetted parts:	Stainless Steel

2) Preferred:

- Endress + Hauser

C3.3.4.11.2.6 Cl205.2.6 VIBRATION

a) Vibration switches shall be used, when required, for monitoring of electrical motor and pump vibration.

b) Single-channel or Multi-channel configurations are acceptable, to suit the application. The control unit shall be microprocessor based.

c) Two configurable outputs per channel for pre-alarm and alarm points shall be available.

d) Vibrations in the range of 0 to 20mm/s shall be detected.

e) Preferred:

- Bentley Nevada

C3.3.4.11.2.7 Cl205.2.7 PROXIMITY

a) Proximity switches shall be encapsulated and shall operate on a magnetic field principle. The switch shall have a LED indicator and have a detection range of 10 - 20mm. Proximity switches shall have a mechanical adjustment on the mounting bracket of at least 35mm.

b) Preferred:

- Turck

C3.3.4.11.3 Cl205.3 EXECUTION

C3.3.4.11.3.1 Cl205.3.1 INSTALLATION

All flow instruments and sensors shall be installed as recommended by the manufacturer.

Wiring shall be neatly labelled, trained, fanned, and secured with each cable permanently tagged to identify the area or function served.

All cables inside the building shall run in cable trenches or cable trays.

C3.3.4.12 CI206 TEMPERATURE MEASUREMENT

C3.3.4.12.1 CI206.1 GENERAL

C3.3.4.12.1.1 CI206.1.1 RELATED DOCUMENTS

a) Drawings and General Provisions of the Contract, including General Conditions, Conditions of Particular Application, and Specification Sections, apply to work of this Section.

C3.3.4.12.1.2 CI206.1.2 DESCRIPTION

a) This part of the standard gives detailed technical specifications which apply to the installation of temperature measurement equipment.

C3.3.4.12.1.3 CI206.1.3 APPLICABLE CODES AND STANDARDS

a) The following referenced documents are indispensable for the application of this section of the standard and contain provisions which, through reference in this text, constitute provisions of this standard. All standards are subject to revision and, since any reference to a standard is deemed to be a reference to the latest edition of that standard, parties to agreements based on this standard shall take the necessary steps to ensure the use of the most recent editions of the standards indicated below:

1) SANS 10142. "The Standard Regulations for the Wiring of Premises".

2) SANS 10313 "Lightning Protection of Equipment".

3) The Occupational Health and Safety Act 85/93.

4) EN 60204 Electrical

5) IEC 60529 /BS EN 60529 Enclosure Non-Hazardous

6) ATEX II 2GD Enclosure Hazardous

7) ATEX II 1G Enclosure Intrinsic Safety

C3.3.4.12.1.4 CI206.1.4 RELATED SECTIONS

a) The following sections include requirements which relate to this section.

1) Other division 25 sections.

2) Division 26 Electrical sections.

C3.3.4.12.1.5 CI206.1.5 COORDINATION

The System Supplier shall be responsible to coordinate and exchange information with Suppliers of other systems and equipment which shall interface with, in order to achieve the required specified functions.

The coordination includes, but is not limited to mounting positions, provision of thermo-wells, cable runs etc.

C3.3.4.12.1.6 Cl206.1.6 SUBMITTALS

a) General: Submit each item in this section according to the conditions of the Contract and Division 01 Specification Sections.

b) Product data for each type of product specified. Include manufacturer's technical Product Data for each control device furnished, indicating dimensions, capacities, performance characteristics, electrical characteristics, and finishes of materials, installation instructions and start-up instructions.

c) Provide shop drawings from manufacturer detailing equipment assemblies and indicating dimensions, weight loadings, required clearances, components, location and size of control panel.

d) Shop drawings containing the following information for each control system:

1) Each control device labelled with setting or adjustable range of control.

2) Details of control panels, including controls, instruments, and labelling.

e) Wiring diagrams detailing wiring for power and control wiring. Differentiate clearly between manufacturer-installed wiring and field-installed wiring.

f) As-Built drawings

C3.3.4.12.1.7 Cl206.1.7 QUALITY ASSURANCE

a) Compliance with Standards: Comply with applicable requirements of standards pertaining to temperature measurement.

b) Manufacture Qualifications: Manufacturing firms shall be regularly engaged in manufacture of temperature measurement of type, size and electrical characteristics and whose products have been in satisfactory use in similar services for not less than five (5) years.

1) Manufacturing firms shall be regularly engaged in the manufacture of temperature measurement of the latest technologies.

2) The Supplier shall submit an official certificate from original Manufacturers that the proposed system belongs to their latest production and identifying the date of the beginning of production.

c) Installer Qualifications: Engage an experienced Installer who is a factory-authorized sales and service representative to perform the work of this section.

Installer shall have at least five (5) years of successful installation experience in projects with temperature instruments similar to those required for this project.

C3.3.4.12.1.8 Cl206.1.8 DELIVERY STORAGE AND HANDLING

a) Handle temperature equipment carefully to prevent damage, breaking and scoring. Do not install damaged equipment or components, replace with new ones.

b) Store temperature instruments in clean, dry place. Protect from weather, dirt, fumes, water, construction debris, and physical damage.

C3.3.4.12.2 Cl206.2 PRODUCTS

C3.3.4.12.2.1 Cl206.2.1 TEMPERATURE ELEMENTS

a) Thermo Wells

1) Thermo wells shall be provided for all temperature measuring elements that are inserted into process vessels and process pipes.

2) The tips of thermowells in pipes shall be situated in the third of the pipe. Care shall be taken to ensure that the wake frequency is less than the natural frequency of the well.

Type:	Fabricated
Material:	316 Stainless Steel or process compatible
Internal Diameter:	8mm nominal
External Diameter:	10mm nominal Process Connection ½"NPT male
Bulb Connection:	½"NPT female

3) Preferred:

- Temperature Controls

b) Thermocouples

1) Thermocouples shall be used for general temperature measurement where the temperature needs to be read at a remote location, e.g.: a control panel.

2) Ensure that the length is selected to permit good thermal contact at the tip of the couple with the end of the well.

Type:	Type "J" (Iron Constantan), mineral insulated
Diameter:	6mm nominal OD
Performance:	±2°C up to 300°C ±¾%from 300°C to 1300°C
Emf Output to Temperature Relationship:	According to tables in BS1829

3) Preferred:

- Temperature Controls

c) Resistance Temperature Detector (RTD)

1) RTD's shall be used where greater accuracy than thermocouples are required.

2) Ensure that the length is selected to permit good thermal contact at the tip of the couple with the end of the well.

Type:	PT 100 3 wire simplex mineral insulated

Diameter: 6mm nominal OD

Resistance/Temperature Relationship: As per BS1904 Table 1 Rev 1979

3) Performance:

Accuracy: ±0.5% of span, or better

Repeatability: ±0.1% of span

Dead Band: Not to exceed 0.1% of span

Ambient Temperature effect: Not to exceed 0.5% of span per 10°Cchange

4) Preferred:

- Endress + Hauser
- Temperature Controls

d) Filled Systems

1) The filled systems shall be all welded, including the bulb and capillary tube.

2) Maximum temperature shall not exceed 300°C, over-range shall be minimum 50%.

3) Filled systems shall not be used on shutdown services.

4) Maximum length shall be 3m.

5) Accuracy shall be 1% of span or better.

6) Preferred:

- Temperature Controls

C3.3.4.12.2.2 CI206.2.2 SPECIFICATION FOR TEMPERATURE GAUGES

a) General

The gauge shall be either a bimetal coil type or a gas filled system as appropriate for the application.

b) Design

The gauges shall be 150mm nominal diameter unless stated otherwise. Viewing angle shall be adjustable.

1) Case material shall be stainless steel.

2) Dial shall be white with black lettering and marked in degrees centigrade.

3) The bulb shall be 8mm nominal diameter with a length to suit the application.

4) Capillary tube where application demands.

c) Gauge shall be furnished with a pre-fabricated stainless steel thermowell that shall have a process connection of ½"NPT male and a bulk connection of ½ NPT female.

d) Performance

Accuracy:	± 1% of span
Response time:	20 seconds
Overrange limits:	1,2 X maximum span

e) Preferred:

1) Temperature Controls

C3.3.4.12.2.3 CI206.2.3 SPECIFICATION FOR TEMPERATURE TRANSMITTERS

a) General

1) Transmitter shall be electronic two-wire type for RTD connection.

2) Unit shall comprise of a head-mounted transmitter, RTD and a thermowell.

b) Design

1) Transmitter

Mounting Head mounted, encapsulated unit

Ambient Temperature limitations:	70°C
Humidity Limits:	0-100% relative humidity
Power Supply:	24V DC nominal
Output:	4-20 mA into 250Ωload
Burnout Facility:	Upscale or downscale option
Calibration Adjustments:	Independent Zero and span
Input	To suit sensor

2) Head

Material	Aluminium
Protection Class	IP65
Electrical Connection	20mm ISO conduit

3) Preferred

- Honeywell Smart
- Temperature Controls

- Endress + Hauser

C3.3.4.12.3 Cl206.3 EXECUTION

C3.3.4.12.3.1 Cl206.3.1 INSTALLATION

a) All flow instruments and sensors shall be installed as recommended by the manufacturer.

b) Wiring shall be neatly labelled, trained, fanned and secured with each cable permanently tagged to identify the area or function served.

c) All cables inside the building shall run in cable trenches or cable trays.

C3.3.4.13 CI207 VIBRATION MEASUREMENT

C3.3.4.13.1 CI207.1 GENERAL

C3.3.4.13.1.1 CI207.1.1 RELATED DOCUMENTS

a) Drawings and General Provisions of the Contract, including General Conditions, Conditions of Particular Application, and Specification Sections, apply to work of this Section.

C3.3.4.13.1.2 CI207.1.2 DESCRIPTION

a) This part of the standard gives detailed technical specifications which apply to the installation of vibration measurement equipment.

C3.3.4.13.1.3 CI207.1.3 APPLICABLE CODES AND STANDARDS

a) The following referenced documents are indispensable for the application of this section of the standard and contain provisions which, through reference in this text, constitute provisions of this standard. All standards are subject to revision and, since any reference to a standard is deemed to be a reference to the latest edition of that standard, parties to agreements based on this standard shall take the necessary steps to ensure the use of the most recent editions of the standards indicated below:

1) SANS 10142. "The Standard Regulations for the Wiring of Premises".

2) SANS 10313 "Lightning Protection of Equipment".

3) The Occupational Health and Safety Act 85/93.

4) EN 60204 Electrical

5) IEC 60529 /BS EN 60529 Enclosure non- Hazardous

6) ATEX II 2GD Enclosure Hazardous

7) ATEX II 1G Enclosure Intrinsic Safety

C3.3.4.13.1.4 CI207.1.4 RELATED SECTIONS

a) The following sections include requirements which relate to this section.

1) Other division 25 sections.

2) Division 26 Electrical sections.

C3.3.4.13.1.5 CI207.1.5 COORDINATION

The System Supplier shall be responsible to coordinate and exchange information with Suppliers of other systems and equipment which shall interface with, in order to achieve the required specified functions.

The coordination includes, but is not limited to mounting positions, provision of thermo-wells, cable runs etc.

C3.3.4.13.1.6 CI207.1.6 SUBMITTALS

a) General: Submit each item in this section according to the conditions of the Contract and Division 01 Specification Sections.

b) Product data for each type of product specified. Include manufacturer's technical Product Data for each control device furnished, indicating dimensions, capacities, performance characteristics, electrical characteristics, and finishes of materials, installation instructions and start-up instructions.

c) Provide shop drawings from manufacturer detailing equipment assemblies and indicating dimensions, weight loadings, required clearances, components, location and size of control panel.

d) Shop drawings containing the following information for each control system:

1) Each control device labelled with setting or adjustable range of control.

2) Details of control panels, including controls, instruments and labelling.

e) Wiring diagrams detailing wiring for power and control wiring. Differentiate clearly between manufacturer-installed wiring and field-installed wiring.

f) As-Built drawings

C3.3.4.13.1.7 CI207.1.7 QUALITY ASSURANCE

a) Compliance with Standards: Comply with applicable requirements of standards pertaining to vibration measurement systems.

b) Manufacture Qualifications: Manufacturing firms shall be regularly engaged in manufacture of process switches of type, size and electrical characteristics and whose products have been in satisfactory use in similar services for not less than five (5) years.

1) Manufacturing firms shall be regularly engaged in the manufacture of vibration systems of the latest technologies.

2) The Supplier shall submit an official certificate from original Manufacturers that the proposed system belongs to their latest production and identifying the date of the beginning of production.

c) Installer Qualifications: Engage an experienced Installer who is a factory-authorized sales and service representative to perform the work of this section.

Installer shall have at least five (5) years of successful installation experience in projects with vibration instruments similar to those required for this project.

C3.3.4.13.1.8 CI207.1.8 DELIVERY STORAGE AND HANDLING

a) Handle vibration equipment carefully to prevent damage, breaking and scoring. Do not install damaged equipment or components, replace with new ones.

b) Store vibration instruments in clean, dry place. Protect from weather, dirt, fumes, water, construction debris, and physical damage.

C3.3.4.13.2 CI207.2 PRODUCTS

C3.3.4.13.2.1 CI207.2.1SEISMIC ACCELEROMETERS (VIBRATION SENSORS)

a) General

Seismic accelerometers shall make use of the piezoelectric principle for sensing. Sensors shall be equipped with a built-in pre-amplifier.

b) Design

Element Type:	Quartz
Body material:	316 Stainless Steel
Mounting Stud:	M5
Electrical Connection:	Screw on connection
Environmental Protection:	IP65
Sensing Direction:	In line with symmetry axis
Sensing structure:	Shear
Element Temperature Limitation:	-10 to100ºC
Humidity Limits:	0 - 100% relative humidity
Shock Limits:	1000 g

c) Performance

Accuracy:	0,5% of span or better
Repeatability:	0,1% of span
Cross Axis Sensitivity	not to exceed 5% of signal
Frequency Range	2 Hz to 6 kHz
Resonant Frequency	> 2X Highest measured frequency
Sensitivity	100mV/g or better
Measurement Range	±50 g
Resolution	0,002 g or better

d) Preferred Types

1) Bentley Nevada

2) Metrix

C3.3.4.13.2.2 CI207.2.2 SEISMIC ACCELEROMETER TRANSMITTER (VIBRATION TRANSMITTER)

a) General

Transmitter shall be electronic 230VAC 50 Hz for seismic accelerometer sensors. A local indicator shall be integrated into the transmitter. The unit can be stand alone or multi-channel panel rack mount.

b) Design

Mounting:	Wall or panel mounted unit
Ambient Temperature limitations:	0 -50°C
Humidity Limits:	0-95% relative humidity (non-condensing)
Power Supply:	230VAC 50Hz nominal
Output:	4-20 mA into 250 Ohm load
Burnout Facility:	Upscale or downscale option
Calibration Adjustments:	Independent Zero and span
Input:	To suit sensor
Protection Class:	IP65
Electrical Connection:	20mm ISO conduit

c) Preferred Types

1) Bentley Nevada

2) Metrix

C3.3.4.13.2.3 CI207.2.3 VIBRATION TRANSMITTER

a) General

The unit shall be a sensor/transmitter and shall be loop powered. Range 0-25mm/s

b) Design

Mounting:	Stud mount M6
Ambient Temperature limitations:	0 -50°C
Humidity Limits:	0-95% relative humidity (non-condensing)
Power Supply:	Loop powered 24VDC
Output:	4-20 mA into 250 Ohm load
Burnout Facility:	Upscale or downscale option
Protection Class:	IP65

Electrical Connection:	MIL style screw connection

c) Performance

Accuracy:	0,5% of span or better
Repeatability:	0,1% of span
Cross Axis Sensitivity:	not to exceed 5% of signal
Frequency Range:	10 Hz to 1 kHz
Resonant Frequency:	> 2X Highest measured frequency
Measurement Range:	±50 g
Resolution:	0,02 g or better

d) Preferred Types

1) Metrix ST 6917-121

C3.3.4.13.3 CI207.3 EXECUTION

C3.3.4.13.3.1 CI207.3.1 INSTALLATION

a) All flow instruments and sensors shall be installed as recommended by the manufacturer.

b) Wiring shall be neatly labelled, trained, fanned and secured with each cable permanently tagged to identify the area or function served.

c) All cables inside the building shall run in cable trenches or cable trays.

APPENDIX A: INSTRUMENT INDEX

Particular Specifications

P&ID/SCADA TAG	INSTRUMENT TAG	SERVICE DECRIPTION	PRINCIPLE OF OPERATION	P&ID No.	REV	DATA SHEET No.	SPECIFICATION			SIGNAL		INDICATION		ADDITIONAL COMMENTS
							PROCESS CONNECTION	RANGE	UNIT	ANALOG	DIGITAL	LOCAL	REMOTE	
000-FIT-001	000-FE-001	BRIXTON RESERVOIR# INLET-A FLOW RATE MONITORING	ULTRASONIC		0		FLANGED	0-300	L/s	4-20mA		DIGITAL	SCADA	
000-FIT-002	000-FE-002	BRIXTON RESERVOIR# INLET-B FLOW RATE MONITORING	ULTRASONIC		0		FLANGED	0-300	L/s	4-20mA		DIGITAL	SCADA	
000-FIT-003	000-FE-003	RETICULATION RESERVOIR ZONE FLOW RATE MONITORING	ULTRASONIC		0		FLANGED	0-300	L/s	4-20mA		DIGITAL	SCADA	
000-LALL-004	000-LSLL-004	BRIXTON RESERVOIR# LOW LOW LEVEL SWITCH	FLOAT		0		WALL MOUNTED				24V	NOT REQUIRED	SCADA	
000-LAL-005	000-LSL-005	BRIXTON RESERVOIR# CONTROL LOW LEVEL SWITCH	FLOAT		0		WALL MOUNTED				24V	NOT REQUIRED	SCADA	
000-LAH-006	000-LSH-006	BRIXTON RESERVOIR# HIGH LEVEL SWITCH	FLOAT		0		WALL MOUNTED				24V	NOT REQUIRED	SCADA	
000-LI-007	000-LIT-007	BRIXTON RESERVOIR# LEVEL INDICATING TRANSMITTER	ULTRASONIC		0		FLANGED	0-10	m	4-20mA		DIGITAL	SCADA	
000-LALL-008	000-LSLL-008	BRIXTON TOWER# LOW LOW LEVEL SWITCH	FLOAT		0		WALL MOUNTED				24V	NOT REQUIRED	SCADA	

000-LAL-009	000-LSL-009	BRIXTON TOWER# CONTROL LOW LEVEL SWITCH	FLOAT		0		WALL MOUNTED				24V	NOT REQUIRED	SCADA	
000-LAH-010	000-LSH-010	BRIXTON TOWER# HIGH LEVEL SWITCH	FLOAT		0		WALL MOUNTED				24V	NOT REQUIRED	SCADA	
000-LI-011	000-LIT-011	BRIXTON TOWER# LEVEL INDICATING TRANSMITTER	ULTRASONIC		0		FLANGED	0-10	m	4-20mA		DIGITAL	SCADA	
000-FIT-012	000-FE-012	COMBINED PUMP DISCHARGE FLOW RATE MONITORING	ULTRASONIC		0		FLANGED	0-300	L/s	4-20mA		DIGITAL	SCADA	
000-FIT-013	000-FE-013	RETICULATION TOWER ZONE FLOW RATE MONITORING	ULTRASONIC		0		FLANGED	0-300	L/s	4-20mA		DIGITAL	SCADA	
000-FIT-100	000-FE-100	PUMP 1 SUCTION FLOW RATE MONITORING	ULTRASONIC		0		FLANGED	0-300	L/s	4-20mA		DIGITAL	SCADA	

Particular Specifications

P&ID/SCADA TAG	INSTRUMENT TAG	SERVICE DECRIPTION	PRINCIPLE OF OPERATION	P&ID No.	REV	DATA SHEET No.	SPECIFICATION			SIGNAL		INDICATION		ADDITIONAL COMMENTS
							PROCESS CONNECTION	RANGE	UNIT	ANALOG	DIGITAL	LOCAL	REMOTE	
000-ZI-101	000-ZSO-101	PUMP 1 SUCTION ISOLATION VALVE OPEN POSITION SWITCH	INDUCTIVE		0		M12				12V	LED	SCADA	
000-ZI-101	000-ZSC-101	PUMP 1 SUCTION ISOLATION VALVE CLOSE POSITION SWITCH	INDUCTIVE		0		M12				12V	LED	SCADA	
000-PI-102	000-PIT-102	PUMP 1 SUCTION PRESSURE MONITORING	CAPACITANCE		0		1/2"MNPT	0-50000	KPa (g)	4-20mA		DIGITAL	SCADA	
000-TIT-103	000-TT-103	PUMP 1 NON-DRIVE END MOTOR BEARING TEMPERATURE	RTD		0		DIN RAIL	0-200	°C	4-20mA		NOT REQUIRED	SCADA	RTD SUPPLIED WITH PUMP – TT MOUNTED IN PANEL
000-TIT-104	000-TT-104	PUMP 1 DRIVE END MOTOR BEARING TEMPERATURE	RTD		0		DIN RAIL	0-200	°C	4-20mA		NOT REQUIRED	SCADA	RTD SUPPLIED WITH PUMP – TT MOUNTED IN PANEL
000-TIT-105	000-TT-105	PUMP 1 MOTOR WINDING RED PHASE TEMPERATURE	RTD		0		DIN RAIL	0-200	°C	4-20mA		NOT REQUIRED	SCADA	RTD SUPPLIED WITH PUMP – TT MOUNTED IN PANEL
000-TIT-106	000-TT-106	PUMP 1 MOTOR WINDING BLUE PHASE TEMPERATURE	RTD		0		DIN RAIL	0-200	°C	4-20mA		NOT REQUIRED	SCADA	RTD SUPPLIED WITH PUMP – TT MOUNTED IN PANEL
000-TIT-107	000-TT-107	PUMP 1 MOTOR WINDING WHITE	RTD		0		DIN RAIL	0-200	°C	4-20mA		NOT REQUIRED	SCADA	RTD SUPPLIED WITH PUMP – TT

		PHASE TEMPERATURE												MOUNTED IN PANEL
000-VIT-108	000-VT-108	PUMP 1 NON-DRIVE END MOTOR BEARING VIBRATION A			0		DIN RAIL			4-20mA		NOT REQUIRED	SCADA	TRANSMITTER IN PANEL
000-VIT-109	000-VT-109	PUMP 1 NON-DRIVE END MOTOR BEARING VIBRATION B			0		DIN RAIL			4-20mA		NOT REQUIRED	SCADA	TRANSMITTER IN PANEL
000-VIT-110	000-VT-110	PUMP 1 DRIVE END MOTOR BEARING VIBRATION A			0		DIN RAIL			4-20mA		NOT REQUIRED	SCADA	TRANSMITTER IN PANEL
000-VIT-111	000-VT-111	PUMP 1 DRIVE END MOTOR BEARING VIBRATION B			0		DIN RAIL			4-20mA		NOT REQUIRED	SCADA	TRANSMITTER IN PANEL
000-TIT-112	000-TT-112	PUMP 1 NON-DRIVE END PUMP BEARING TEMPERATURE	RTD		0		DIN RAIL	0-200	°C	4-20mA		NOT REQUIRED	SCADA	RTD SUPPLIED WITH PUMP – TT MOUNTED IN PANEL

Particular Specifications

P&ID/SCADA TAG	INSTRUMENT TAG	SERVICE DECRIPTION	PRINCIPLE OF OPERATION	P&ID No.	REV	DATA SHEET No.	SPECIFICATION			SIGNAL		INDICATION		ADDITIONAL COMMENTS
							PROCESS CONNECTION	RANGE	UNIT	ANALOG	DIGITAL	LOCAL	REMOTE	
000-TIT-113	000-TT-113	PUMP 1 DRIVE END PUMP BEARING TEMPERATURE	RTD		0		DIN RAIL	0-200	°C	4-20mA		NOT REQUIRED	SCADA	RTD SUPPLIED WITH PUMP – TT MOUNTED IN PANEL
000-VIT-114	000-VT-114	PUMP 1 NON-DRIVE END PUMP BEARING VIBRATION A			0		DIN RAIL			4-20mA		NOT REQUIRED	SCADA	TRANSMITTER IN PANEL
000-VIT-115	000-VT-115	PUMP 1 NON-DRIVE END PUMP BEARING VIBRATION B			0		DIN RAIL			4-20mA		NOT REQUIRED	SCADA	TRANSMITTER IN PANEL
000-VIT-116	000-VT-116	PUMP 1 DRIVE END PUMP BEARING VIBRATION A			0		DIN RAIL			4-20mA		NOT REQUIRED	SCADA	TRANSMITTER IN PANEL
000-VIT-117	000-VT-117	PUMP 1 DRIVE END PUMP BEARING VIBRATION B			0		DIN RAIL			4-20mA		NOT REQUIRED	SCADA	TRANSMITTER IN PANEL
000-PI-118	000-PIT-118	PUMP 1 DISCHARGE PRESSURE MONITORING	CAPACITANCE		0		1/2"MNPT	0-50000	KPa (g)	4-20mA		DIGITAL	SCADA	
000-FAL-119	000-FSL-119	PUMP 1 DISCHARGE FLOW SWITCH LOW	CALORIFIC		0		1/2"MNPT	0-300	L/s		24V	DIGITAL	SCADA	
000-ZI-120a	000-HSO-120	PUMP 1 DISCHARGE ISOLATION VALVE OPEN POSITION SWITCH	INDUCTIVE		0		M12				24V	LED	SCADA	

000-ZI-120b	000-HSC-120	PUMP 1 DISCHARGE ISOLATION VALVE CLOSE POSITION SWITCH	INDUCTIVE		0		M12				24V	LED	SCADA	
000-FIT-200	000-FE-200	PUMP 2 SUCTION FLOW RATE MONITORING	ULTRASONIC		0		FLANGED	0-300	L/s			DIGITAL	SCADA	
000-ZI-201	000-ZSO-201	PUMP 2 SUCTION ISOLATION VALVE OPEN POSITION SWITCH	INDUCTIVE		0		M12				24V	LED	SCADA	
000-ZI-201	000-ZSC-201	PUMP 2 SUCTION ISOLATION VALVE CLOSE POSITION SWITCH	INDUCTIVE		0		M12				24V	LED	SCADA	
000-PI-202	000-PIT-202	PUMP 2 SUCTION PRESSURE MONITORING	CAPACITANCE		0		1/2"MNPT	0-50000	KPa (g)	4-20mA		DIGITAL	SCADA	

Particular Specifications

P&ID/SCADA TAG	INSTRUMENT TAG	SERVICE DECRIPTION	PRINCIPLE OF OPERATION	P&ID No.	REV	DATA SHEET No.	SPECIFICATION			SIGNAL		INDICATION		ADDITIONAL COMMENTS
							PROCESS CONNECTION	RANGE	UNIT	ANALOG	DIGITAL	LOCAL	REMOTE	
000-TIT-203	000-TT-203	PUMP 2 NON-DRIVE END MOTOR BEARING TEMPERATURE	RTD		0		DIN RAIL	0-200	°C	4-20mA		NOT REQUIRED	SCADA	RTD SUPPLIED WITH PUMP – TT MOUNTED IN PANEL
000-TIT-204	000-TT-204	PUMP 2 DRIVE END MOTOR BEARING TEMPERATURE	RTD		0		DIN RAIL	0-200	°C	4-20mA		NOT REQUIRED	SCADA	RTD SUPPLIED WITH PUMP – TT MOUNTED IN PANEL
000-TIT-205	000-TT-205	PUMP 1 MOTOR WINDING RED PHASE TEMPERATURE	RTD		0		DIN RAIL	0-200	°C	4-20mA		NOT REQUIRED	SCADA	RTD SUPPLIED WITH PUMP – TT MOUNTED IN PANEL
000-TIT-206	000-TT-206	PUMP 1 MOTOR WINDING BLUE PHASE TEMPERATURE	RTD		0		DIN RAIL	0-200	°C	4-20mA		NOT REQUIRED	SCADA	RTD SUPPLIED WITH PUMP – TT MOUNTED IN PANEL
000-TIT-207	000-TT-207	PUMP 1 MOTOR WINDING WHITE PHASE TEMPERATURE	RTD		0		DIN RAIL	0-200	°C	4-20mA		NOT REQUIRED	SCADA	RTD SUPPLIED WITH PUMP – TT MOUNTED IN PANEL
000-VIT-208	000-VT-208	PUMP 1 NON-DRIVE END MOTOR BEARING VIBRATION A			0		DIN RAIL			4-20mA		NOT REQUIRED	SCADA	TRANSMITTER IN PANEL
000-VIT-209	000-VT-209	PUMP 1 NON-DRIVE END MOTOR BEARING VIBRATION B			0		DIN RAIL			4-20mA		NOT REQUIRED	SCADA	TRANSMITTER IN PANEL

000-VIT-210	000-VT-210	PUMP 1 DRIVE END MOTOR BEARING VIBRATION A			0		DIN RAIL			4-20mA		NOT REQUIRED	SCADA	TRANSMITTER IN PANEL
000-TIT-211	000-TT-211	PUMP 2 DRIVE END MOTOR BEARING VIBRATION B			0		DIN RAIL			4-20mA		NOT REQUIRED	SCADA	TRANSMITTER IN PANEL
000-TIT-212	000-TT-212	PUMP 2 NON-DRIVE END PUMP BEARING TEMPERATURE	RTD		0		DIN RAIL	0-200	°C	4-20mA		NOT REQUIRED	SCADA	RTD SUPPLIED WITH PUMP – TT MOUNTED IN PANEL
000-TIT-213	000-TT-213	PUMP 2 DRIVE END PUMP BEARING TEMPERATURE	RTD		0		DIN RAIL	0-200	°C	4-20mA		NOT REQUIRED	SCADA	RTD SUPPLIED WITH PUMP – TT MOUNTED IN PANEL
000-VIT-214	000-VT-214	PUMP 2 NON-DRIVE END PUMP BEARING VIBRATION A			0		DIN RAIL			4-20mA		NOT REQUIRED	SCADA	TRANSMITTER IN PANEL
000-VIT-215	000-VT-215	PUMP 2 NON-DRIVE END PUMP BEARING VIBRATION B			0		DIN RAIL			4-20mA		NOT REQUIRED	SCADA	TRANSMITTER IN PANEL
000-VIT-216	000-VT-216	PUMP 2 DRIVE END PUMP BEARING VIBRATION A			0		DIN RAIL			4-20mA		NOT REQUIRED	SCADA	TRANSMITTER IN PANEL

Particular Specifications

P&ID/SCADA TAG	INSTRUMENT TAG	SERVICE DECRIPTION	PRINCIPLE OF OPERATION	P&ID No.	REV	DATA SHEET No.	SPECIFICATION			SIGNAL		INDICATION		ADDITIONAL COMMENTS
							PROCESS CONNECTION	RANGE	UNIT	ANALOG	DIGITAL	LOCAL	REMOTE	
000-VIT-217	000-VT-217	PUMP 2 DRIVE END PUMP BEARING VIBRATION B			0		DIN RAIL			4-20mA		NOT REQUIRED	SCADA	TRANSMITTER IN PANEL
000-PI-218	000-PIT-218	PUMP 2 DISCHARGE PRESSURE MONITORING	CAPACITANCE		0		1/2"MNPT	0-50000	KPa (g)	4-20mA		DIGITAL	SCADA	
000-FAL-219	000-FSL-219	PUMP 2 DISCHARGE FLOW SWITCH LOW	CALORIFIC		0		1/2"MNPT	0-300	L/s		24V	DIGITAL	SCADA	
000-ZI-220	000-ZSO-220	PUMP 2 DISCHARGE ISOLATION VALVE OPEN POSITION SWITCH	INDUCTIVE		0		M12				24V	LED	SCADA	
000-ZI-220	000-ZSC-220	PUMP 2 DISCHARGE ISOLATION VALVE CLOSE POSITION SWITCH	INDUCTIVE		0		M12				24V	LED	SCADA	

APPENDIX B: I/O LIST

BRIXTON PUMP STATION I/O LIST							
P&ID Tag	EQUIPMENT	UNITS	ANALOG INPUT	DIGITAL INPUT	ANALOG OUTPUT	DIGITAL OUTPUT	COMMS
000-FIT-001	BRIXTON RESERVOIR# INLET-A FLOW RATE MONITORING	L/s	1				
000-FIT-002	BRIXTON RESERVOIR# INLET-B FLOW RATE MONITORING	L/s	1				
000-FIT-003	RETICULATION RESERVOIR ZONE FLOW RATE MONITORING	L/s	1				
000-LALL-004	BRIXTON RESERVOIR# LOW LOW LEVEL SWITCH			1			
000-LAL-005	BRIXTON RESERVOIR# CONTROL LOW LEVEL SWITCH			1			
000-LAH-006	BRIXTON RESERVOIR# HIGH LEVEL SWITCH			1			
000-LI-007	BRIXTON RESERVOIR# LEVEL INDICATING TRANSMITTER			1			
000-LALL-008	BRIXTON TOWER# LOW LOW LEVEL SWITCH			1			
000-LAL-009	BRIXTON TOWER# CONTROL LOW LEVEL SWITCH			1			
000-LAH-010	RIXTON TOWER# HIGH LEVEL SWITCH			1			
000-LI-011	BRIXTON TOWER# LEVEL INDICATING TRANSMITTER			1			
000-FIT-012	COMBINED PUMP DISCHARGE FLOW RATE MONITORING	L/s	1				
000-FIT-013	RETICULATION TOWER ZONE FLOW RATE MONITORING	L/s	1				
000-GEN-001	STANDBY DIESEL GENERATOR						Modbus
000-POW-001	PUMP STATION POWER METER						Modbus
		TOTAL	**5**	**8**	**0**	**0**	**2**

PUMP SET 1							
P&ID Tag	EQUIPMENT	UNITS	ANALOG INPUT	DIGITAL INPUT	ANALOG OUTPUT	DIGITAL OUTPUT	COMMS
000-FIT-100	PUMP 1 SUCTION FLOW RATE MONITORING	L/s		1			
000-ZI-101	PUMP 1 SUCTION ISOLATION VALVE OPEN POSITION SWITCH			1			
000-ZI-101	PUMP 1 SUCTION ISOLATION VALVE CLOSE POSITION SWITCH			1			
000-PI-102	PUMP 1 SUCTION PRESSURE MONITORING	kPa (g)	1				
000-TIT-103	PUMP 1 NON-DRIVE END MOTOR BEARING TEMPERATURE	°C	1				
000-TIT-104	PUMP 1 DRIVE END MOTOR BEARING TEMPERATURE	°C	1				
000-TIT-105	PUMP 1 MOTOR WINDING RED PHASE TEMPERATURE	°C	1				
000-TIT-106	PUMP 1 MOTOR WINDING BLUE PHASE TEMPERATURE	°C	1				
000-TIT-107	PUMP 1 MOTOR WINDING WHITE PHASE TEMPERATURE	°C	1				
000-VIT-108	PUMP 1 NON-DRIVE END MOTOR BEARING VIBRATION A		1				
000-VIT-109	PUMP 1 NON-DRIVE END MOTOR BEARING VIBRATION B		1				
000-VIT-110	PUMP 1 DRIVE END MOTOR BEARING VIBRATION A		1				
000-VIT-111	PUMP 1 DRIVE END MOTOR BEARING VIBRATION B		1				
000-TIT-112	PUMP 1 NON-DRIVE END PUMP BEARING TEMPERATURE	°C	1				
000-TIT-113	PUMP 1 DRIVE END PUMP BEARING TEMPERATURE	°C	1				

PUMP SET 1							
P&ID Tag	**EQUIPMENT**	**UNITS**	**ANALOG INPUT**	**DIGITAL INPUT**	**ANALOG OUTPUT**	**DIGITAL OUTPUT**	**COMMS**
000-VIT-114	PUMP 1 NON-DRIVE END PUMP BEARING VIBRATION A		1				
000-VIT-115	PUMP 1 NON-DRIVE END PUMP BEARING VIBRATION B		1				
000-VIT-116	PUMP 1 DRIVE END PUMP BEARING VIBRATION A		1				
000-VIT-117	PUMP 1 DRIVE END PUMP BEARING VIBRATION B		1				
000-PI-118	PUMP 1 DISCHARGE PRESSURE MONITORING	kPa (g)	1				
000-FAL-119	PUMP 1 DISCHARGE FLOW SWITCH LOW	L/s		1			
000-ZI-120	PUMP 1 DISCHARGE ISOLATION VALVE OPEN POSITION SWITCH			1			
000-ZI-120	PUMP 1 DISCHARGE ISOLATION VALVE CLOSE POSITION SWITCH			1			
000-PP-001	PUMP1 MOTOR CONTROL						Modbus
		TOTAL	**17**	**6**	**0**	**0**	**1**

PUMP SET 2							
P&ID Tag	EQUIPMENT	UNITS	ANALOG INPUT	DIGITAL INPUT	ANALOG OUTPUT	DIGITAL OUTPUT	COMMS
000-FIT-200	PUMP 2 SUCTION FLOW RATE MONITORING	L/s		1			
000-ZI-201	PUMP 2 SUCTION ISOLATION VALVE OPEN POSITION SWITCH			1			
000-ZI-201	PUMP 2 SUCTION ISOLATION VALVE CLOSE POSITION SWITCH			1			
000-PI-202	PUMP 2 SUCTION PRESSURE MONITORING	kPa (g)	1				
000-TIT-203	PUMP 2 NON-DRIVE END MOTOR BEARING TEMPERATURE	°C	1				
000-TIT-204	PUMP 2 DRIVE END MOTOR BEARING TEMPERATURE	°C	1				
000-TIT-205	PUMP 1 MOTOR WINDING RED PHASE TEMPERATURE	°C	1				
000-TIT-206	PUMP 1 MOTOR WINDING BLUE PHASE TEMPERATURE	°C	1				
000-TIT-207	PUMP 1 MOTOR WINDING WHITE PHASE TEMPERATURE	°C	1				
000-VIT-208	PUMP 1 NON-DRIVE END MOTOR BEARING VIBRATION A		1				
000-VIT-209	PUMP 1 NON-DRIVE END MOTOR BEARING VIBRATION B		1				
000-VIT-210	PUMP 1 DRIVE END MOTOR BEARING VIBRATION A		1				
000-TIT-211	PUMP 2 DRIVE END MOTOR BEARING VIBRATION B		1				
000-TIT-212	PUMP 2 NON-DRIVE END PUMP BEARING TEMPERATURE	°C	1				
000-TIT-213	PUMP 2 DRIVE END PUMP BEARING TEMPERATURE	°C	1				
000-VIT-214	PUMP 2 NON-DRIVE END PUMP BEARING VIBRATION A		1				
000-VIT-215	PUMP 2 NON-DRIVE END PUMP BEARING VIBRATION B		1				
000-VIT-216	PUMP 2 DRIVE END PUMP BEARING VIBRATION A		1				

PUMP SET 2							
P&ID Tag	**EQUIPMENT**	**UNITS**	**ANALOG INPUT**	**DIGITAL INPUT**	**ANALOG OUTPUT**	**DIGITAL OUTPUT**	**COMMS**
000-VIT-217	PUMP 2 DRIVE END PUMP BEARING VIBRATION B		1				
000-PI-218	PUMP 2 DISCHARGE PRESSURE MONITORING	kPa (g)	1				
000-FAL-219	PUMP 2 DISCHARGE FLOW SWITCH LOW	L/s		1			
000-ZI-220	PUMP 2 DISCHARGE ISOLATION VALVE OPEN POSITION SWITCH			1			
000-ZI-220	PUMP 2 DISCHARGE ISOLATION VALVE CLOSE POSITION SWITCH			1			
000-PP-001	PUMP1 MOTOR CONTROL						Modbus
		TOTAL	**17**	**6**	**0**	**0**	**1**

APPENDIX C: CONTROL INSTRUMENTATION CABLE SCHEDULE

CONTROL INSTRUMENTATION CABLE SCHEDULE						
CABLE TAG	CABLE SOURCE	CABLE DESTINATION	# CORES/PARES	CORE SIZE	MECHANICAL PROTECTION	CABLE LENGTH
FE001/FIT001	000-FE-001	000-FIT-001	2 PAIR	1mm²	SWA	10m
FE002/FIT002	000-FE-002	000-FIT-002	2 PAIR	1mm²	SWA	10m
FE003/FIT003	000-FE-003	000-FIT-003	2 PAIR	1mm²	SWA	10m
LSLL004/LS001	000-LSLL-004	000-LS-001	2 PAIR	1mm²	SWA	10m
LSL005/LS001	000-LSL-005	000-LS-001	2 PAIR	1mm²	SWA	10m
LSH006/LS001	000-LSH-006	000-LS-001	2 PAIR	1mm²	SWA	10m
LIT007/LT001	000-LIT-007	000-LT-001	2 PAIR	1mm²	SWA	40m
LSLL008/LS002	000-LSLL-008	000-LS-002	2 PAIR	1mm²	SWA	10m
LSL009/LS002	000-LSL-009	000-LS-002	2 PAIR	1mm²	SWA	10m
LSH010/LS002	000-LSH-010	000-LS-002	2 PAIR	1mm²	SWA	10m
LIT011/LT011	000-LIT-011	000-LT-011	2 PAIR	1mm²	SWA	40m
FE012/FIT012	000-FE-012	000-FIT-012	2 PAIR	1mm²	SWA	10m
FE013/FIT013	000-FE-013	000-FIT-013	2 PAIR	1mm²	SWA	10m
FE100/FIT100	000-FE-100	000-FIT-100	2 PAIR	1mm²	APL	10m
ZSO101/ZS101	000-ZSO-101	000-ZS-101	2 PAIR	1mm²	APL	10m
ZSC101/ZS101	000-ZSC-101	000-ZS-101	2 PAIR	1mm²	APL	10m
PIT102/JB001	000-PIT-102	001-JB-001	2 PAIR	1mm²	APL	20m
TT103/JB-001	000-TT-103	001-JB-001	1 TRIAD	0.5mm²	APL	20m
TT104/JB001	000-TT-104	001-JB-001	1 TRIAD	0.5mm²	APL	20m
TT105/JB001	000-TT-105	001-JB-001	1 TRIAD	0.5mm²	APL	20m
TT106/JB001	000-TT-106	001-JB-001	1 TRIAD	0.5mm²	APL	20m
TT107/JB001	000-TT-107	001-JB-001	1 TRIAD	0.5mm²	APL	20m
VT108/JB001	000-VT-108	001-JB-001	2 PAIR	1mm²	APL	20m
VT109/JB001	000-VT-109	001-JB-001	2 PAIR	1mm²	APL	20m
VT110/JB001	000-VT-110	001-JB-001	2 PAIR	1mm²	APL	20m
VT111/JB001	000-VT-111	001-JB-001	2 PAIR	1mm²	APL	20m
TT112/JB001	000-TT-112	001-JB-001	1 TRIAD	0.5mm²	APL	20m
TT113/JB001	000-TT-113	001-JB-001	1 TRIAD	0.5mm²	APL	20m
VT114/JB001	000-VT-114	001-JB-001	2 PAIR	1mm²	APL	20m
VT115/JB001	000-VT-115	001-JB-001	2 PAIR	1mm²	APL	20m
VT116/JB001	000-VT-116	001-JB-001	2 PAIR	1mm²	APL	20m
VT117/JB001	000-VT-117	001-JB-001	2 PAIR	1mm²	APL	20m
PIT118/JB001	000-PIT-118	001-JB-001	2 PAIR	1mm²	APL	20m
FSL119/JB001	000-FSL-119	001-JB-001	1 PAIR	1mm²	APL	20m
ZSO120/ZS120	000-ZSO-120	000-ZS-120	2 PAIR	1mm²	APL	10m
ZSC120/ZS120	000-ZSC-120	000-ZS-120	2 PAIR	1mm²	APL	10m

CONTROL INSTRUMENTATION CABLE SCHEDULE						
CABLE TAG	CABLE SOURCE	CABLE DESTINATION	# CORES/PARES	CORE SIZE	MECHANICAL PROTECTION	CABLE LENGTH
FE200/FIT200	000-FE-200	000-FIT-200	2 PAIR	1mm²	APL	10m
ZSO201/ZS201	000-ZSO-201	000-ZS-201	2 PAIR	1mm²	APL	10m
ZSC201/ZS201	000-ZSC-201	000-ZS-201	2 PAIR	1mm²	APL	10m
PIT202/JB002	000-PIT-202	001-JB-002	2 PAIR	1mm²	APL	20m
TT203/JB002	000-TT-203	001-JB-002	1 TRIAD	0.5mm²	APL	20m
TT204/JB002	000-TT-204	001-JB-002	1 TRIAD	0.5mm²	APL	20m
TT205/JB002	000-TT-205	001-JB-002	1 TRIAD	0.5mm²	APL	20m
TT206/JB002	000-TT-206	001-JB-002	1 TRIAD	0.5mm²	APL	20m
TT207/JB002	000-TT-207	001-JB-002	1 TRIAD	0.5mm²	APL	20m
VT208/JB002	000-VT-208	001-JB-002	2 PAIR	1mm²	APL	20m
VT209/JB002	000-VT-209	001-JB-002	2 PAIR	1mm²	APL	20m
VT210/JB002	000-VT-210	001-JB-002	2 PAIR	1mm²	APL	20m
TT211/JB002	000-TT-211	001-JB-002	2 PAIR	1mm²	APL	20m
TT212/JB002	000-TT-212	001-JB-002	1 TRIAD	0.5mm²	APL	20m
TT213/JB002	000-TT-213	001-JB-002	1 TRIAD	0.5mm²	APL	20m
VT214/JB002	000-VT-214	001-JB-002	2 PAIR	1mm²	APL	20m
VT215/JB002	000-VT-215	001-JB-002	2 PAIR	1mm²	APL	20m
VT216/JB002	000-VT-216	001-JB-002	2 PAIR	1mm²	APL	20m
VT217/VT217	000-VT-217	001-JB-002	2 PAIR	1mm²	APL	20m
PIT218/JB002	000-PIT-218	001-JB-002	2 PAIR	1mm²	APL	20m
FSL219/JB002	000-FSL-219	001-JB-002	1 PAIR	1mm²	APL	20m
ZSO220/ZS120	000-ZSO-220	000-ZS-120	2 PAIR	1mm²	APL	10m
ZSC220/ZS120	000-ZSC-220	000-ZS-120	2 PAIR	1mm²	APL	10m
FIT001/PLC001	000-FIT-001	001-PLC-001	2 PAIR	1mm²	SWA	30m
FIT002/PLC001	000-FIT-002	001-PLC-001	2 PAIR	1mm²	SWA	30m
FIT003/PLC001	000-FIT-003	001-PLC-001	2 PAIR	1mm²	SWA	30m
LS001/PLC001	000-LS-001	001-PLC-001	4 PAIR	1mm²	SWA	30m
LT007/PLC001	000-LT-007	001-PLC-001	4 PAIR	1mm²	SWA	30m
LS002/PLC001	000-LS-002	001-PLC-001	4 PAIR	1mm²	SWA	30m
LT011/PLC001	000-LT-011	001-PLC-001	4 PAIR	1mm²	SWA	30m
FIT012/PLC001	000-FIT-012	001-PLC-001	2 PAIR	1mm²	SWA	30m
FIT013/PLC001	000-FIT-013	001-PLC-001	2 PAIR	1mm²	SWA	30m
FIT100/JB001	000-FIT-100	001-JB-001	2 PAIR	1mm²	APL	20m
ZS101/JB001	000-ZS-101	001-JB-001	6 PAIR	1mm²	APL	20m
ZS120/JB001	000-ZS-120	001-JB-001	6 PAIR	1mm²	APL	20m
FIT200/JB002	000-FIT-200	001-JB-002	2 PAIR	1mm²	APL	20m

CONTROL INSTRUMENTATION CABLE SCHEDULE						
CABLE TAG	CABLE SOURCE	CABLE DESTINATION	# CORES/PARES	CORE SIZE	MECHANICAL PROTECTION	CABLE LENGTH
ZS201/JB002	000-ZS-201	001-JB-002	6 PAIR	1mm²	APL	20m
ZS220/JB002	000-ZS-220	001-JB-002	6 PAIR	1mm²	APL	20m
JB001/PLC001	001-JB-001	001-PLC-001	24 PAIR	1mm²	APL	30m
JB001/PP001	001-JB-001	001-PP-001	2 PAIR	1mm²	APL	30m
JB002/PLC001	001-JB-002	001-PLC-001	24 PAIR	1mm²	APL	30m
JB002/PP002	001-JB-002	001-PP-002	2 PAIR	1mm²	APL	30m
PP001/TEL001	001-PP-001	001-TEL-001	8 PAIR	1mm²	APL	20m
PP002/TEL001	001-PP-002	001-TEL-001	8 PAIR	1mm²	APL	20m

C3.3.5 CONCRETE WORKS (STRUCTURAL) (SANS 2001 – CC1)

The following variations and additions to the SANS 2100 Standardized Specifications referred to above apply to this Contract. The prefix SD indicates an amendment to SANS 2100. The letters and numbers following these prefixes respectively indicate the relevant Standardized Specification and clause numbers in SANS 2100 to which the variation or addition thereto applies.

C3.3.5.1 SD1 SCOPE

This Specification Data deals with the structural use of plain, reinforced, pre-stressed and precast concrete to be used in the Works and gives amendments and additions to the South African National Standard SANS 2001, Part CC1: Concrete Works (Structural) which shall form part of the Contract.

Generally, the Specification Data clauses and sub-clauses follow the same numbering system as the clauses and sub-clauses to which they refer in the Standard and to which they either amend or supplement. Where a Specification Data clause or sub-clause refers to some other clause or sub-clause in the Standard this is indicated in brackets following the heading. Where a Specification Data sub-clause is an addition and there is no appropriate clause in the Standard to which it can be linked, no clause reference is given following the heading.

Should any requirement of this Specification Data conflict with any requirement of the Standard, the requirement of this Specification Data shall prevail.

C3.3.5.2 SD2 NORMATIVE REFERENCES

All the applicable national and international standards as listed in Clause 2, Normative References of SANS 2001 CC1, shall apply to this Contract where appropriate.

In particular, SANS 10100-2 (SABS 0100-2) “The structural use of concrete, Part 2: Materials and execution of work,” provides useful recommendations and information.

C3.3.5.3 SD3 DEFINITIONS

C3.3.5.3.1 SD3.1 GENERAL

C3.3.5.3.1.1 SD3.1.1 Expansion Joint (Sub-clause 4.7.12.2)

“Expansion Joint” shall be a “filled joint” designed to allow for thermal or other expansive movements of the adjacent concrete.

C3.3.5.3.1.2 SD3.1.2 Contraction Joint (Sub-clause 4.7.12.2)

“Contraction Joint” shall be an “unfilled Joint” designed to allow for thermal or other contraction movements of the adjacent concrete.

C3.3.5.3.1.3 SD3.1.3 Construction Joint (Sub-clause 4.7.12.1)

“Construction Joint” shall be a joint required on account of constraints or convenience in the method of construction and that is not an expansion, contraction or other movement joint.

C3.3.5.3.1.4 SD3.1.4 Designated Joints (Sub-clause 4.7.12)

Expansion joints, contraction joints, formed construction joints and unformed construction joints which are sealed, will be considered to be “designated joints” provided that the joints are shown on the drawings or approved as such by the Engineer prior to concreting.

Other unformed construction joints that are required by the Contractor as a result of his construction constraints or for any other reason, whether or not shown on the drawings, shall not be considered to be “designated joints”.

C3.3.5.3.1.5 SD3.1.5 Strength Concrete (Clause 3.4.3)

The Contractor shall be responsible for the design of strength concrete and determining the proportions of all the constituent materials in order to produce concrete that complies with the strength requirements specified on the drawings as well as the specified requirements for durability, appropriate workability, a good surface finish and all other specified requirements.

The Engineer will specify the following on the drawings and Bill of Quantities for each section of the Works:

- The required grade and strength of the concrete
- The maximum nominal size of the coarse aggregate in mm.

C3.3.5.3.1.6 SD3.1.6 Notation for Grades of Strength Concrete Containing Extenders (Clauses 3.4.3 and 4.2.6)

Where a cement extender is specified, the grade of strength concrete containing the extender will be specified on the Drawings and Bill of Quantities by a compound number as follows:

A/B C (e.g. 30MPa/19mm F30)
Where

A = the 28-day characteristic strength (MPa)

B = the nominal maximum aggregate size e.g. 19 mm

C = the cement extender as a % of total cementitious material e.g.:

F30 = 30% of Fly Ash (FA)

C15 = 15% of Condensed Silica Fume (CSF)

G50 = 50% of Ground Granulated Blast-furnace Slag (GGBS)

C3.3.5.4 SD4 REQUIREMENTS

C3.3.5.4.1 SD4.1 GENERAL

C3.3.5.4.1.1 SD4.1.1 Brand Name Products

In addition to the requirements of this Specification Data, the conditions and the methods specified by manufacturers of specified or approved brand name products shall be strictly adhered to. This includes such aspects as substrate preparation, the application of primers, storage and shelf life.

The Contractor shall confirm and submit to the Engineer at least 28 days prior to the commencement of any specific section of the Works, samples, specifications and performance data, as applicable to all the products he intends to use.

C3.3.5.4.1.2 SD4.1.2 Plant for Concrete

Sound, modern, efficient, accurate plant shall be provided and maintained in good working order in accordance with SANS 10100-2 (SABS 0100-2) Sections 5.2 Batching plant and 5.3 Mixing plant.

C3.3.5.4.1.3 SD4.1.3 Cube Moulds and Water Bath (Sub-clause 5.1.1.3)

At least nine 150 mm cube moulds and an adequately sized and covered temperature-controlled water bath with a capacity of at least 300 cubes as approved for curing concrete cubes shall be available on site at all times. The water bath shall be located under cover. Thermostatically controlled heaters/coolers shall be provided to keep the temperature of the water in the bath between 220C and 250C. The Contractor shall be responsible for providing a sufficient number of cube moulds and an adequately sized water bath to suit the size of the project and the number of cubes that will be made and cured for 7 and 28 days.

C3.3.5.4.1.4 SD4.1.4 Slump Test Apparatus

Slump test apparatus as specified in SABS method 862 shall be provided in good condition.

C3.3.5.4.2 SD4.2 MATERIALS

C3.3.5.4.2.1 SD4.2.1 Cementitious Binders

C3.3.5.4.2.1.1 SD4.2.1.1 Cement

Unless otherwise specified, only CEM I 42.5 (Portland cement) or CEM II A-V 42.5 (Portland fly ash cement) in accordance with SANS 50197-1 may be used. CEM II A-V 42.5 may not contain more than 20% of siliceous fly ash.

C3.3.5.4.2.1.2 SD4.2.1.2 Cement Extenders

Cement extenders shall only be used where specified on the drawings and scheduled in the Bill of Quantities. An approved cement extender shall only be blended with CEM I 42.5 (Portland Cement) and this shall be done in the batch plant unless otherwise approved.

Any cement extender used shall comply with SANS 1491 Parts 1, 2 or 3 as appropriate for Ground Granulated Blast-Furnace Slag (GGBS), Fly Ash (FA) or Condensed Silica Fume (CSF) respectively, and shall carry the SANS mark, or similar approved.

C3.3.5.4.2.1.3 SD4.2.1.3 Proportions of Cement Extenders in Concrete

Where a cement extender is specified, the proportion by mass of the extender as proportion of the total mass of cementitious material shall be as follows for different extenders unless otherwise specified:

GGBS 50%

FA 30%

CSF 15%

C3.3.5.4.2.1.4 SD4.2.1.4 Conformity of Cement

The test results conducted to evaluate the conformity of cement in terms of SANS 50197-1, Clause 9, shall be made available to the Engineer at least 28 days before the materials are used for concrete.

C3.3.5.4.2.2 SD4.2.2 Water

Mixing water for concrete shall comply with the requirements of EN 1008 and shall be tested for conformation.

C3.3.5.4.2.3 SD4.2.3 Aggregates

C3.3.5.4.2.3.1 SD4.2.3.1 Source of Aggregates

Fine aggregate (sand) shall be obtained from an approved commercial source. Coarse aggregate (stone) shall be obtained by crushing rock from hard excavations on Site or from an approved commercial source.

C3.3.5.4.2.3.2 SD4.2.3.2 Fineness of Fine Aggregate

The fineness modulus of sand delivered to the mixer shall lie between 1.7 and 2.8 and the standard deviation of fineness moduli of samples of sand that is delivered to the mixer during one shift shall be not more than 0.1.

C3.3.5.4.2.3.3 SD4.2.3.3 Aggregate Samples

At least 28 days before commencement of concrete work the Contractor shall supply, at his own cost, full details and representative samples to the Engineer of the aggregates he intends using, together with certificates from an approved laboratory indicating that the aggregates comply with the requirements of this Standard and Specification Data. Approximately 50 kg of each sample of aggregate shall be supplied.

After approval, these samples shall be taken as the standard for the agreed aggregates to be used in the Works. If at any time during the course of the Contract there is a deviation from the approved standard or the Engineer considers that there has been a deviation, the Contractor shall submit further tested samples of the new material to the Engineer for approval.

No concrete shall be placed in the Works until the Engineer has approved the materials the Contractor intends using.

C3.3.5.4.2.3.4 SD4.2.3.4 Tests on Aggregates (Sub-clause 4.2.3.5)

The following tests are required on aggregates to be used in the Contract:

a) Drying shrinkage on fine and coarse aggregates;

b) Flakiness index of the stone;

c) Tests for alkali-aggregate reaction, in accordance with SANS 6245, shall be carried out where in the opinion of the Engineer potentially reactive aggregates to be used and where none of the cement extenders listed in SD4.2.1.3 will be used in at least the proportions given.

C3.3.5.4.2.3.5 SD4.2.3.5 Prevention of Deleterious Alkali-Aggregate Reaction

The requirements of this clause shall not apply to concrete containing a cement extender in at least the proportions given in SD4.2.1.3.

Reference is made to “Fulton’s Concrete Technology, Chapter 10, Alkali-silica reaction.”

In accordance with this reference, the Contractor shall provide the Engineer with sufficient data to enable him to assess the degree of alkali-aggregate reactivity of the aggregates and cement to be used for concrete. For the aggregates, the type of rock and source will be required. For the cement, the percentage alkali content shall be given.

In accordance with the above reference, where potentially reactive aggregates are used for concrete, the Contractor shall ensure that the concrete is not subject to deleterious alkali-aggregate reaction by limiting the total equivalent sodium oxide content of the concrete to a maximum of 0.86 x the value

given in kg/m³ in Table 10.1. (e.g. for Malmesbury Group, 0.86 x 2.1 = 1.8 kg/m³) This may be achieved by careful mix design and the use of cement with a low equivalent sodium oxide content or if necessary, blending with a cement extender.

For each delivery of cement the Contractor shall provide an acceptable test certificate indicating the actual equivalent sodium oxide content of the consignment.

Note 1: Potentially reactive aggregates have been identified in the following areas of South Africa: South Western Cape, Eastern Cape, KwaZulu-Natal, Gauteng and Free State.

Note 2: The equivalent sodium oxide content is measured as Na20 + 0,658 K20. For cement it is expressed as a percentage by mass, for concrete it is expressed in kg/m³.

C3.3.5.4.2.3.6 SD4.2.3.6 Storage of Aggregates

When aggregates of different chloride content are stored on site, their use in the various grades of concrete shall be strictly controlled.

C3.3.5.4.2.3.7 SD4.2.3.7 Use of Plums (Sub-clause 4.2.3.4 and 4.7.10.11)

The use of plums will not be permitted.

C3.3.5.4.2.4 SD4.2.4 Admixtures, Air-entrainment Agents and Curing Agents

Admixtures are permitted, provided that the results of trial tests which demonstrate their suitability and the following are made available to the Engineer for Approval:

i) The trade name of the admixture, its source and the manufacturer's recommended method of use;

ii) The chemical names of the main active ingredients in the admixture;

iii) Typical dosages and possible detrimental effects of under or over dosages;

iv) Whether compounds that are likely to cause corrosion of the reinforcement or deterioration of the concrete (such as those containing chloride, in any form, as an active ingredient) are present and, if so, the chloride content of the admixtures, expressed as a mass fraction of chloride ions or expressed as an equivalent mass fraction of anhydrous calcium chloride; and

v) The average expected air content of the freshly mixed concrete containing an admixture that causes air to be entrained when the admixture is used at the manufacturer's recommended dosage.

The amounts of admixture used shall be measured to an accuracy of 2 % or better. Daily calibration and cleaning of the measuring device is imperative. Persons responsible for batching shall be fully conversant with the effects of the admixture and the consequences of over or under-dosage.

Control of admixtures shall be in accordance with SANS 10100-2 (SABS 0100-2) Section 7.2.1.2.

C3.3.5.4.2.5 SD4.2.5 Reinforcement – No Specification Data applicable

C3.3.5.4.2.6 SD4.2.6 Grade of Concrete – No Specification Data applicable

C3.3.5.4.2.7 SD4.2.7 Grout – No Specification Data applicable

C3.3.5.4.2.8 SD4.2.8 Tendons (Clause 4.2.8)

C3.3.5.4.2.8.1 SD4.2.8.1 Characteristic Strength of the Steel (Sub-clause 4.2.8.2)

The required characteristic strength of the steel will be specified on the construction drawings.

C3.3.5.4.2.9 SD4.2.9 Anchorages and couplers – No Specification Data applicable

C3.3.5.4.2.10 SD4.2.10 Sheaths – No Specification Data applicable

C3.3.5.4.2.11 SD4.2.11 Joint Fillers, Sealants, Waterstops, Bearings and Accessories

The following prescribed products or brand name products, or equivalent materials subject to the written approval of the Engineer, shall be used:

C3.3.5.4.2.11.1 SD4.2.11.1 Joint Fillers

Joint filler material shall be "Sondor" closed cell expanded polyethylene of minimum density 35kg/m3 "Jointex". The required thickness and density of the filler will be specified on the drawings. Densities of up to 110kg/m3 may be required.

Fillers shall be pre-cut to suit the application with a tear-out strip forming the specified recess for the sealant. If so required, the filler shall be glued into position with approved glue.

C3.3.5.4.2.11.2 SD4.2.11.2 Bond Breakers

The bond breaker between the blinding layer, no-fines concrete layer or soil and the underside of ground floor slabs or surface beds shall be minimum 250-micron polyethylene sheeting that complies with SANS 952, i.e. USB Green co ex 250 ®.

The bond breaker to the face of contraction joints shall be two coats of good quality lime wash.

The bond breaker at the bottom of a joint sealing recess, where the sealant is not backed by a joint filler or bond breaking cord, shall be self-adhesive PVC tape with the same width as the joint recess.

C3.3.5.4.2.11.3 SD4.2.11.3 Sealants (Sub-clause 4.2.11.1)

SikaFlex® Pro-3WF 1–part, moisture cured, high mechanical resistant polyurethane sealant, shall be used for all water retaining and water excluding structures including pump stations, valve chambers, and inlet and outlet structures.

SikaFlex® PRO-2HP 1-part, moisture cured, soft elastic polyurethane sealant, shall be used for building structures above ground floor level.

An approved primer fully compatible with and/or manufactured for the specified jointing and sealing material shall be applied to the prepared joint surfaces.

C3.3.5.4.2.11.4 SD4.2.11.4 Waterstops (Sub-clauses 4.2.11.1)

Waterstops shall be "Durajoint PVC or Durajoint Rubber" as manufactured by "ABE Construction Chemicals" and to the pattern and the material and widths shown on the drawings. They shall conform to Specifications CKS 388 or 389, for natural rubber or PVC respectively.

C3.3.5.4.2.11.5 SD4.2.11.5 Bandage Sealing Systems

a) "Sikadur-Combiflex" Bandage System

The "Sikadur-Combiflex" bandage System is manufactured by "Sika" and consists of a flexible Hypalon sealing tape/strip and "Sikadur -31 CF" epoxy adhesive. The width and thickness of the tape/strip will be specified on the drawings.

b) Cemflex Bandage System

The "Cemflex" bandage System is manufactured by "Sika" and consists of a strip of Cemflex fabric which must be saturated with a Cemflex slurry. The width of the strip will be specified on the drawings.

c) Laminated Butyl Rubber or Polymer Bandage System

3 mm thick laminated butyl rubber or 2 mm thick polymer strips shall be permanently fixed to the concrete with an approved epoxy adhesive where shown on the drawings. Aluminium backing strips shall be provided where specified.

C3.3.5.4.2.11.6 SD4.2.11.6 Swellable Joint Sealing Strips

Swellable joint sealing strips shall be "SikaSwell-P Profiles manufactured by "Sika". The width, thickness and type of profile will be shown on the drawings.

C3.3.5.4.2.11.7 SD4.2.11.7 Bearings (Sub-clause 4.2.11.1)

Where indicated on the Drawings, bearings shall consist of "Kilcher Bearings" of one of the following three types: "Resilient", "Limitgliss" or "Teflon Sliding bearings". All of these shall be supplied in a strip of expanded polyethylene of width equal to the seating or wall width. The required capacity of the bearing strip in t/m will be shown on the drawings

Where laminated elastometric bearings or bridge type bearings are required, full details will be given on the drawings.

C3.3.5.4.2.12 SD4.2.12 Epoxy-based bonding agent for screeds

Where indicated on the drawings, epoxy bonding agent for screeds shall be ABE Construction Chemicals, "epidermix 116".

C3.3.5.4.2.13 SD4.2.13 Surface hardener for concrete floors

Where indicated on the drawings, surface hardener for concrete floors shall be "Sikafloor-3 QuartzTop ZA" natural (not coloured). This may be applied to steel floated or power floated surfaces or granolithic screeds.

C3.3.5.4.2.14 SD4.2.14 Colour Mitigation

The Contractor shall supply and apply concrete colouring at the locations as specified on the Drawings or indicated by the Engineer.

The colouring material shall be landscape varnish which shall be aqueous containing salts and iron and manganese and other trace elements including copper and zinc. The material shall be manufactured as a concentrate that can be diluted with water to achieve the desired colour intensity. The material shall contain no caustic or alkaline chemicals.

The colouring material shall be "PERMEON" or equivalent approved.

C3.3.5.4.3 SD4.3 FORMWORK

C3.3.5.4.3.1 SD4.3.1 GENERAL

C3.3.5.4.3.1.1 SD4.3.1.1 Earth or Rock Cuts (Sub-clause 4.3.1.5)

Earth or rock cuts may be used as forms for vertical or sloping surfaces only if dictated by the Design and indicated on the Drawings or approved by the Engineer on Site.

Concrete used in pipe trenches for encasement may be cast against the side of the excavation.

Concrete for thrust / anchor blocks shall be cast directly against the side of the excavation as shown on the Drawings.

C3.3.5.4.3.1.2 SD4.3.1.2 Approval by Authority (Sub-clause 4.3.1.6)

Liaison with the authority controlling the service is required before commencing with the design of formwork over an existing service i.e. pipelines, roads, streets, railways, etc. The design shall be approved by the authority.

C3.3.5.4.3.1.3 SD4.3.1.3 Surface Finish of Formed Surfaces (Sub-clause 4.3.1.8)

Various formed surface finishes are described in detail in Table 1.

Unless otherwise specified on the drawings, the formed surfaces of sections of the work shall be as follows:

a) “rough” to all surfaces more than 150mm below finished ground level or concealed from view.

b) “smooth” to all other surfaces except where otherwise specified.

Special-smooth finish, special off-form finishes / exposed aggregate finishes shall be shown on the Drawings and, where they are required, scheduled in the Bill of Quantities.

C3.3.5.4.3.1.4 SD4.3.1.4 Special-smooth finish

This finish is obtained by first giving the surface a smooth finish with the joints between formwork panels forming an approved regular pattern suitable for the appearance of the structure. All projections shall then be removed, irregularities repaired, and the surface rubbed or otherwise treated until it is smooth with an even texture, appearance and colour.

If the finish of exposed surfaces does not comply with the requirements for uniformity of the texture and appearance, the Contractor shall, when instructed to do so by the Engineer, rub down the exposed surfaces of the entire structure or any part thereof as specified below, entirely at his own cost. All repairs must be completed before the rubbing commences.

Rubbing down shall be carried out strictly in accordance with Subclause 4.7.20.

C3.3.5.4.3.1.5 SD4.3.1.5 Chamfers and Fillets

All exposed external angles in concrete work shall have 20mm x 20mm chamfers unless otherwise specified on the Drawings or ordered by the Engineer, but the top edge of a slab that is to receive an applied finish shall not be chamfered.

Internal corners in concrete work need not have fillets unless such fillets have been specified on the Drawings or ordered by the Engineer.

C3.3.5.4.3.2 SD4.3.2 DESIGN AND CONSTRUCTION OF FORMWORK AND FALSEWORK

C3.3.5.4.3.2.1 SD4.3.2.1 Responsibility for Formwork and Falsework

The Contractor shall be entirely responsible for the design, construction, accuracy and safety of all formwork and falsework.

C3.3.5.4.3.2.2 SD4.3.2.2 Review of Formwork Design (Sub-clause 4.3.2.1.4)

Where approval is required in terms of Sub-clause 4.3.1.6, by a controlling authority, the design and drawings for formwork and falsework shall be submitted to the Engineer for review before being submitted to the authority for approval.

C3.3.5.4.3.3 SD4.3.3 FORMWORK ACCESSORIES

C3.3.5.4.3.3.1 SD4.3.3.1 Formwork Ties

a) Formwork ties for water retaining and water excluding structures

The use of sleeves for formwork ties through the walls of these structures will not be permitted. Cast in ties shall have some form of positive anchorage to prevent any rotation when loosening formwork. Tie cone recesses shall be effectively plugged as described in SD4.7.19.2.

b) Formwork ties for other structures

Formwork ties for other structures shall run through a sleeve in order for the ties to be completely removed after the formwork has been struck. The outer cover width of the sleeves shall be removed by drilling or any other appropriate method leaving a clean inner surface which shall be effectively caulked with mortar by approved means in accordance with Sub-Clause 4.5.3.

c) Formwork shall not be secured to reinforcing bars

C3.3.5.4.3.4 SD4.3.4 TEMPORARY OPENINGS - NO SPECIFICATION DATA APPLICABLE

C3.3.5.4.3.5 SD4.3.5 VOID FORMERS - NO SPECIFICATION DATA APPLICABLE

C3.3.5.4.3.6 SD4.3.6 PREPARATION OF FORMWORK - NO SPECIFICATION DATA APPLICABLE

C3.3.5.4.3.7 SD4.3.7 REUSE OF FORMWORK- NO SPECIFICATION DATA APPLICABLE

C3.3.5.4.3.8 SD4.3.8 REMOVAL OF FORMWORK

C3.3.5.4.3.8.1 SD4.3.8.1 Removal of Falsework and Supporting Formwork on Reinforced Concrete Structures (Sub-clause 4.3.8.3)

Where a continuously reinforced concrete structure will be constructed in stages, the Contractor shall submit to the Engineer for his review and approval, at least 28 days prior to the commencement of the work, full details of the manner in which the falsework and supporting framework will be removed.

The Contractor shall make provision for continued support of beams and slabs while the formwork is being removed and/or for back propping of beams and slabs. Reference shall also be made to SANS 10100-2 (SABS 0100-2) Section 9.5.3 “Reshoring”.

C3.3.5.4.3.8.2 SD4.3.8.2 Removal of Falsework and Supporting Formwork for Pre-stressed Concrete Structures (Sub-clause 4.3.8.4)

Where the falsework and supporting formwork in pre-stressed structures will be removed, prior to the full pre-stressing force relating to the particular stage of construction being applied, the Contractor shall submit to the Engineer for his review and approval, at least 28 days prior to the commencement of the work, full details of the manner in which the falsework and supporting framework will be removed.

C3.3.5.4.4 SD4.4 REINFORCEMENT

C3.3.5.4.4.1 SD4.4.1 Bending

C3.3.5.4.4.1.1 SD4.4.1.1 Hot Bending (Sub-clause 4.4.1.3)

Bars shall not be bent hot.

C3.3.5.4.4.2 SD4.4.2 Fixing

C3.3.5.4.4.2.1 SD4.4.2.1 Safety of the reinforcement (Sub-clause 4.4.2.2)

The Contractor shall be responsible for the safety of the reinforcement. In addition to the chairs and spacers specified, diagonal bars, robust temporary props or whatever else is necessary shall be provided to ensure the safety of the reinforcement under all loads and particularly those due to construction activities.

C3.3.5.4.4.2.2 SD4.4.2.2 Inspection by the Engineer

The Engineer will inspect the reinforcement after it has been fixed in place, the formwork has been cleaned, cover blocks have been positioned, and at least 24 hours before concreting is due to commence.

C3.3.5.4.4.2.3 SD4.4.2.3 Welding of Bars (Sub-clause 4.4.2.2 b)

Welding of bars will not be permitted.

C3.3.5.4.4.2.4 SD4.4.2.4 Spacers

Where concrete spacer blocks manufactured on Site are used, they shall be made and cured strictly in accordance with Sub-Clause 4.4.2.3 and the following NOTE. The wire ties in the blocks shall be galvanized. Concrete spacer blocks which have not been manufactured and cured strictly in accordance with these requirements or which are in any other way considered unsatisfactory by the Engineer, will be rejected and shall be removed from the Site.

C3.3.5.4.4.3 SD4.4.3 Cover

C3.3.5.4.4.3.1 SD4.4.3.1 Minimum cover

With due cognisance of Table 3, the minimum required cover of concrete over reinforcement will be specified on the reinforcement drawings for different structures and allowing for different exposure conditions in accordance with the design.

C3.3.5.4.4.3.2 SD4.4.3.2 Minimum cover to Pipes and Ducts

The minimum distance between pipes or ducts in the concrete and reinforcement shall nowhere be less than 40 mm or 5 mm plus the maximum size of the coarse aggregate, whichever is the largest.

C3.3.5.4.4.3.3 SD4.4.3.3 Exposure conditions (Table 3)

The various structures will not be classified in terms of exposure conditions. Instead the Engineer will specify the cover to reinforcement as per SD4.4.3.1 and durability requirements as per SD4.7.5.1.

C3.3.5.4.5 SD4.5 HOLES, CHASES AND FIXING BLOCKS

C3.3.5.4.5.1 SD4.5.1 Fixtures

Fixtures to be embedded in the concrete shall be embedded into the concrete as shown on the Drawings.

C3.3.5.4.5.2 SD4.5.2 Ferrules (Clause 4.5.3)

Refer also to SD4.3.3.1.

C3.3.5.4.6 SD4.6 EMBEDDED ITEMS

C3.3.5.4.6.1 SD4.6.1 General

Material used for forming temporary voids (box-outs) shall be completely removed. The faces of temporary voids shall be thoroughly cleaned and prepared as for a construction joint surface. Refer to SD4.7.12.1(b)

C3.3.5.4.6.2 SD4.6.2 Waterstops

C3.3.5.4.6.2.1 SD4.6.2.1 General

Only straight lengths of waterstop may be site butt welded/vulcanised using appropriate jigs and equipment. All other intersection pieces shall be factory made by the manufacturer.

Factory-made junction pieces shall be properly corner-mitred and jointed at intersections, shall be formed in accordance with the manufacturer's instructions to approval and shall have a tensile strength across the joint of not less than 75% of that of the original material. Junction pieces shall be made so that all ribs in the original cross-section are maintained continuously and the joints are dense, homogeneous, free of all porosity and each leg of the junction having a minimum length of 300 mm. Intersections of waterstops with dissimilar pattern (i.e. "rearguard centre bulb" type, with "internal dumbbell" type) shall be made using specially-made junction pieces which accommodate the transition between patterns. On Site joints shall also comply with these requirements.

The Contractor shall test, in the presence of the Engineer, joints made in waterstops of each type of material used.

C3.3.5.4.6.3 SD4.6.3 Pipes, conduits, and ducts

C3.3.5.4.6.3.1 SD4.6.3.1 Casting in of Pipes and Pipe Specials in Concrete

The Contractor shall be responsible for the installation, positioning, alignment, support and concreting in of all pipes and pipe specials regardless of whether or not these have been supplied by him and whether or not they have puddle flanges. He shall also be responsible for the watertightness of the completed structure around the pipe or special, where this is a requirement.

The Contractor shall submit to the Engineer for his review and approval, at least 28 days prior to the commencement of any specific section of the Works, a schedule indicating all the pipes and pipe specials he intends to cast in directly and the items for which he intends to provide box-outs. He shall also submit a detailed method statement describing precisely how the work will be done.

Where it is a requirement that a pipe or pipe special be anchored to resist longitudinal forces and it is provided with anchor flanges, details of the box-out and special reinforcement around the anchor flange(s) will be as shown on the Drawings and Bending Schedules. Reinforcement shown at box-outs shall not be cut and will generally have been detailed to run through the formwork, but not through the opening itself. Reinforcement shall be added around the anchor flanges to tie in with protruding reinforcement before the pipe or pipe special is concreted in.

Where it is not a requirement that a pipe or pipe special be anchored to resist longitudinal forces, the reinforcement shall not initially be cut and will generally have been detailed to run through the formwork and through the opening itself. Reinforcement shall only be cut and/or bent out of the way at a later stage to suit the item to be cast in. After installation of the item, the remaining reinforcement shall be bent back in position as directed by the Engineer.

During the installation, positioning and concreting in of any item in an opening the Contractor shall:

i) Remove all formwork remaining in the box-out;

ii) Make any alterations required to the position and shape of the opening;

iii) Thoroughly prepare the faces of the opening as for a construction joint surface in accordance with Sub-clause 4.7.12.1.3 and SD4.7.12.1(b) so as to obtain a satisfactory bond for the new concrete;

iv) Install, position, align and support the item to be cast in;

v) Bend back and/or fix reinforcement around the item as directed by the Engineer or as shown on the Drawings;

vi) Install formwork as required for the concreting in operation; and

vii) Carry out final surface preparation in accordance with Sub-clause 4.7.12.1.3 before concreting.

In order to achieve the necessary watertightness and structural soundness, the following shall be considered and provided by the Contractor and shall be described in his method statement:

i) Cast in waterstops, a bandage sealing system and/or a swellable sealing strip around the box-out;

ii) Wet-to-dry epoxy on the box-out faces;

iii) Grouting at the top of the box-out to fill any voids left;

iv) A specially designed shrinkage compensated concrete mix to fill the box-out.

C3.3.5.4.7 SD4.7 QUALITY OF CONCRETE

C3.3.5.4.7.1 SD4.7.1 General

C3.3.5.4.7.1.1 SD4.7.1.1 Design of Strength Concrete Mixes

The concrete mix designs for strength concrete shall be prepared in an approved laboratory such that the concrete meets the strength and all other specified criteria as well as ensuring good workability and surface finish without excessive bleeding. Special attention is drawn to the fact that the concrete for water retaining/excluding structures must be very dense and impervious.

The Contractor shall submit full details of all the mixes he proposes to use to the Engineer not less than 30 days prior to the intended use of the concrete in the Works.

No concrete shall be cast until the mix designs have been approved by the Engineer. The Engineer may call for revised mix designs at any stage during the Contract.

Once approval by the Engineer has been given for the use of a particular mix, the proportions of cement, extender, aggregate, water and admixtures shall not be changed without prior approval of the Engineer.

C3.3.5.4.7.1.2 SD4.7.1.2 Trial Mixes

Trial mixes for each of the concrete grades/ mix designs to be used in the Works shall be prepared under conditions acceptable to the Engineer. Six cubes shall be made from each mix and three of each tested for compressive strength at 7 and 28 days respectively.

The results of the compressive tests on these cubes shall be submitted to the Engineer for approval not less than 30 days prior to the intended use of the concrete in the Works.

C3.3.5.4.7.1.3 SD4.7.1.3 Maximum Cementitious Binder Content (Sub-clause 4.7.1.2)

The maximum content of CEM I 42.5 (Portland cement) shall be 400 kg/m3 of concrete.

The maximum cementitious content of a binder for concrete containing a cement extender shall be 450 kg/m3 of concrete.

C3.3.5.4.7.2 SD4.7.2 Consistency

C3.3.5.4.7.2.1 SD4.7.2.1 Slump

The slump of the concrete shall be as given in Table 4.

C3.3.5.4.7.3 SD4.7.3 Workability

C3.3.5.4.7.3.1 SD4.7.3.1 Pumping of Concrete (Sub-clause 4.7.3.2 and 4.7.10.15)

Pumping of concrete will be permitted.

C3.3.5.4.7.4 SD4.7.4 Chloride and Sulphate Content

C3.3.5.4.7.4.1 SD4.7.4.1 Chloride Content

The maximum chloride ion content shall be as given in Table 5; and

Efflorescence will not be acceptable on any exposed concrete surface.

C3.3.5.4.7.4.2 SD4.7.4.2 Sulphate Content

The total water-soluble sulphate content of a concrete mix shall not exceed a mass fraction of 4% of the cementitious binder content of the mix.

C3.3.5.4.7.5 SD4.7.5 Durability

C3.3.5.4.7.5.1 SD4.7.5.1 Requirements for Durability in Water-retaining/excluding structures

Any mix to be used in water-retaining or excluding structures shall have a water / cementitious ratio not exceeding 0.5 and a cement content of not less than 325kg/m3 of concrete. The proportions of the various aggregates shall be such as to produce a density of at least 2,400kg/m3.

C3.3.5.4.7.5.2 SD4.7.5.2 Concrete containing entrained air

Where concrete is required to contain entrained air as indicated on the drawings, the requirements of Sub-Clauses 4.7.5.1 and 4.7.5.2 shall apply.

C3.3.5.4.7.6 SD4.7.6 Prescribed-mix concrete- No Specification Data applicable

C3.3.5.4.7.7 SD4.7.7 Batching - No Specification Data applicable

C3.3.5.4.7.8 SD4.7.8 Mixing

C3.3.5.4.7.8.1 SD4.7.8.1 Mixing Period for Concrete Containing an Extender (Sub-Clause 4.7.8.1.1 e)

For concrete containing an extender in the proportions given in SD4.2.1.3 the minimum periods of mixing given in Sub-Clause 4.7.8.1.1 (e) shall be increased by 2 minutes.

C3.3.5.4.7.8.2 SD4.7.8.2 Ready-mixed Concrete

Ready-mixed concrete will be permitted and shall be mixed in accordance with the requirements of SANS 878.

C3.3.5.4.7.8.3 SD4.7.8.3 Mortar Skim on No-fines Concrete (Sub-clause 4.7.8.4)

Where a mortar skim is specified or shown on the drawings it shall be constructed as follows: Between 24h and 48h after the no-fines layer has been laid it shall be covered with a 1:4 cement: sand mortar layer 10mm thick. The mix shall be comparatively dry to ensure that it does not penetrate and block the cavities in the no-fines concrete. The surface shall be steel, or power floated to form a plane surface.

Curing shall be accordance with Sub-Clause 4.7.8.4.6.

C3.3.5.4.7.9 SD4.7.9 Transportation of concrete- *No Specification Data applicable*

C3.3.5.4.7.10 SD4.7.10 Placing

C3.3.5.4.7.10.1 SD4.7.10.1 General

The Engineer shall be given adequate notice of the intention to place concrete.

Concrete shall be placed continuously, or in layers of such thickness that no concrete will be placed on concrete that has so hardened as to cause planes of weakness.

C3.3.5.4.7.10.2 SD4.7.10.2 Under Water (Sub-clause 4.7.10.13)

Concrete may only be placed under water if dictated by the design and indicated on the Drawings, or as and approved by the Engineer on Site.

C3.3.5.4.7.11 SD4.7.11 Compaction

C3.3.5.4.7.11.1 SD4.7.11.1 Method (Sub-clause 4.7.11.3)

Compaction shall only be achieved by means of mechanical vibration.

C3.3.5.4.7.12 SD4.7.12 Joints

C3.3.5.4.7.12.1 SD4.7.12.1 Construction Joints

a) Location (Sub-clause 4.7.12.1.1)

Construction joints will be required and will be shown on the drawings.

The location of planned construction joints, not indicated on the Drawings, shall be submitted to the Engineer for review and approval.

Walls shall be cast in lifts of a height that permits each lift to be poured without interruption in one continuous operation during normal working hours.

b) Preparation of Construction Joint Surfaces (Sub-clause 4.7.12.1.3 and Table 7)

Special care shall be taken in the preparation of construction joints in accordance with the requirements of Table 7 and as follows:

As soon as practical but not before 15 hours after placing, the entire area of each construction joint shall be cleaned using whatever mechanical devices are required and/or compressed air and water (green cutting). All laitance and similar deposits shall be removed and the coarse aggregate in the hardened concrete shall be exposed over the entire area of the joint. Each joint shall be inspected by the Engineer before it is rendered inaccessible by the erection of further formwork.

Where construction joint preparation is not carried out as described above, for instance on formed joint surfaces, the surface shall be wet sand blasted or scabbled after the concrete has hardened sufficiently to prevent the displacement or loosening of the coarse aggregate, followed by wire brushing and washing with high pressure air and water jets. The roughness of a scabbled or wet sand blasted surface shall be similar to that achieved by green cutting. A bush hammered surface or a surface in which the large aggregate pieces have been removed by chipping will not be considered an acceptable alternative to scabbling.

When concreting is interrupted, concrete surfaces shall be protected from the sun as specified in Sub-clause 4.7.13.2(d) or by means of hessian kept damp until concreting is resumed.

For horizontal joints in water retaining/excluding structures the mortar layer specified in method 2 in Table 7 shall be 25 mm thick. The mortar shall be protected from drying out before the fresh concrete is placed against it.

C3.3.5.4.7.12.2 SD4.7.12.2 Expansion (Filled) and Contraction (Unfilled) Joints

Expansion and contraction joints shall be formed true to line in smooth formwork.

Joints in the joint filler material in expansion joints shall be neatly butted so as to exclude mortar from the joint. Edges of the filler strip against waterstops, concrete, formwork, projections, etc., shall also be closely fitted to exclude mortar, so that there is no resistance (other than the compression of the filler material) to the expansion movement for which the joint is designed.

Two coats of bondbreaker shall be applied to contraction joint surfaces.

C3.3.5.4.7.12.3 SD4.7.12.3 Installation of Waterstops in Joints

Waterstops shall be so held in formwork to eliminate air pockets forming underneath. Special precautions shall be taken to the approval of the Engineer, to ensure that all flexible waterstops are in perfect contact with well compacted void free concrete. The Contractor shall provide satisfactory supervision of such vital operations.

C3.3.5.4.7.12.4 SD4.7.12.4 Application of Joint Sealants

Rebates for sealants shall be formed to required dimensions and lines or cut true to line and size by skilled workmen with special tools, after floating the surface and before the final set of the cement has taken place. All rebates shall be adequately protected against damage until the completion of the work. Rebates for sealants shall be grit blasted or wire brushed on all faces to remove surface laitance and thoroughly cleaned with soft brushes and/or compressed air jets, and, if necessary, dried by blow-lamp or other approved means before priming. The rebates shall be inspected by the Engineer before filling.

Sealants and primers shall be applied strictly in accordance with the manufacturer's instructions. Flow, and non-slumping grades shall be used for horizontal and vertical joints respectively.

Immediately after the sealant is applied, the joint shall be protected against damage until completion of construction.

C3.3.5.4.7.12.5 SD4.7.12.5 Proprietary Bonding Compounds (Sub-clause 4.7.12.1.4)

Proprietary bonding compounds, including wet-to-dry epoxy, may be used between old and new concrete if approved by the Engineer. (See also SD4.2.11.8)

C3.3.5.4.7.12.6 SD4.7.12.6 Sealing of Joints (Sub-clause 4.7.12.4)

The sealing of joints shall be undertaken in accordance with the requirements of the details as shown on the Drawings. In addition to the requirements of this Section all the conditions and methods specified by the manufacturers of the specified or approved brand name products shall be strictly adhered to.

C3.3.5.4.7.13 SD4.7.13 Curing and Protection

C3.3.5.4.7.13.1 SD4.7.13.1 Additional Curing method (Sub-clause 4.7.13.2)

Retaining the formwork in place is a very effective curing method for applicable surfaces.

C3.3.5.4.7.13.2 SD4.7.13.2 Curing Compound (Sub-clause 4.7.13.2.e)

The use of membrane curing compounds will only be considered on vertical surfaces or steeply inclined surfaces (i.e. steeper than 45˚ to the horizontal) of cast in situ members of a structure.

Approval of their use and the compound to be used shall be to the approval of the Engineer. Wax based curing compounds will not be permitted.

The curing compound shall be applied immediately as formwork is progressively stripped or, in the case of unformed surfaces, when the concrete has taken its initial set. The compound shall preferably be applied by spraying and the rate of application shall be strictly in accordance with manufacturer's recommendations. A method of monitoring the area to which the curing compound has been applied, and the application rate, shall be approved by the Engineer and rigidly adhered to by the Contractor.

Surfaces of joint rebates, where elastomeric sealant is to be applied, shall be protected from contamination by curing compound by the use of masking tape.

The use of membrane curing compounds on surfaces that are to be coloured will not be permitted. In this instance, effective alternative means of curing shall be used.

C3.3.5.4.7.14 SD4.7.14 Adverse Weather Conditions

C3.3.5.4.7.14.1 SD4.7.14.1 Concreting in hot weather

High temperatures and loss of moisture due to hot drying winds may cause thermal and plastic shrinkage, cracking and a reduction of strength and durability. Appropriate action is specified in Sub-clause 4.7.14.1.

C3.3.5.4.7.14.2 SD4.7.14.2 Temperature Control for Sections thicker than 900mm

Such sections may be considered to be “Massive concrete” in terms of SANS 10100-2 (SABS 0100-2) Section 11.

Irrespective of the ambient temperature or wind conditions, the Contractor shall take all measures necessary to ensure that the temperature of concrete at the time of placing in the Works does not exceed 260C and that the loss of moisture during transporting and placing is reduced to the minimum possible.

During hot weather, such measures may include but are not necessarily limited to the following:

a) Shielding aggregates from direct sunshine.

b) Sun shields on mixing plants and transporting equipment. This could also include lagging to moving parts kept damp to cause cooling by evaporation.

c) Cooling the mixing water. If ice is used for this purpose it shall be in flake or hollow cylinder form. Lump ice shall not be allowed to enter the tank supplying the mixer drum.

d) Injecting liquid nitrogen into the mixer trucks.

e) Cooling of steel formwork and reinforcing steel by sprinkling with water.

f) Painting all equipment and sunshields white.

g) Blasting of chilled air through aggregate storage bays and hoppers.

h) Spraying the coarse aggregate with water.

i) Re-scheduling concreting to take place at night.

Areas in which concrete is to be placed shall be shielded from direct sunshine and rock or concrete surfaces shall be thoroughly wetted if instructed by the Engineer to reduce absorption of water from the concrete placed on or against them.

After concrete in any part of an area has been placed, the specified curing process shall be commenced as soon as possible. If any interval occurs between completion of placing and start of curing, the concrete shall be closely covered during the interval with polythene sheet to prevent loss of moisture.

To limit the risk of thermal cracking, the Contractor shall ensure that the temperature differential between the surface concrete and the interior concrete at any position does not exceed 200C at any time and that the maximum temperature of the concrete at any position does not exceed 600C at any time. To ensure compliance, the Contractor shall provide the necessary temperature measurement

devices and take precautions appropriate to the circumstances as accepted by the Engineer which shall include the following:

a) Limiting the size of concrete pours.

b) Reducing the heat of hydration of the cement by use of an increased proportion of cement extender, if permitted by the Engineer.

c) Reducing the placing temperature of the concrete to less than the 260C specified above

d) Insulation of exposed concrete surfaces by insulating blankets.

e) Increasing the period before stripping of formwork. Steel forms shall be suitably insulated on the outside.

f) Increasing the period between placing successive lifts.

g) Preventing rapid dissipation of heat from surfaces by shielding from wind.

h) Avoiding the use of water sprays when such use would cause rapid cooling of the surface.

i) Shielding concrete surfaces from cold air temperatures, together with the use of heaters where appropriate.

j) Internal cooling using cast in ducts through which cooled water is passed.

The Contractor shall obtain the Engineer's agreement of all procedures which will be applied to control concrete temperatures.

C3.3.5.4.7.14.3 SD4.7.14.3 Prevention and Repair of Plastic Shrinkage Cracks

The Contractor shall take whatever measures are necessary to prevent plastic shrinkage cracking in the concrete. Particularly on dry windy days or hot sunny days the Contractor shall make provision for fine spraying of the concrete surface within one hour of casting, or immediately covering the concrete with black plastic sheeting. If shrinkage cracking occurs, it may be necessary to change the aggregates or the concrete mix proportions. In order to combat shrinkage cracking it may also be necessary to chance the time at which, or the manner in which, power floating in terms of SD4.7.15.6 is carried out.

If plastic shrinkage cracks occur, after screeding of the concrete, the cracks shall be closed up by re-vibrating the concrete with a poker vibrator, within about three hours of casting. Once the cracks have been closed, and after the completion of the specified or scheduled surface finish, the concrete shall be kept thoroughly wet, or covered with plastic sheeting for at least a further three hours.

C3.3.5.4.7.15 SD4.7.15 Finishing of Unformed Concrete Surfaces

C3.3.5.4.7.15.1 SD4.7.15.1 Exposed Surfaces

Exposed surfaces of concrete not cast against formwork shall be finished in accordance with Sub-clause 4.7.15.1.

C3.3.5.4.7.15.2 SD4.7.15.2 Non-skid Surfaces

Exposed surfaces requiring a non-skid finish will be indicated on the Drawings and/or in the Bill of Quantities.

C3.3.5.4.7.15.3 SD4.7.15.3 Screeded Finish (Sub-clause 4.7.15.1 a)

In addition to Sub-clause 4.7.15.1 (a) no mortar shall be added during the screeding operation, and noticeable surface irregularities caused by the displacement of coarse aggregate shall be made good by re-screeding after displaced aggregate has been removed or tamped.

C3.3.5.4.7.15.4 SD4.7.15.4 Wood-floated Finish (Sub-clause 4.7.15.1 b)

Where wood-floating is specified, the surface shall first be given a finish as specified in Sub-clause 4.7.15.1 (a) and, after the concrete has hardened sufficiently, the surface shall be wood-floated, either by hand or machine, only sufficiently to produce a uniform surface free from screeding marks.

C3.3.5.4.7.15.5 SD4.7.15.5 Steel-floated Finish (Sub-clause 4.7.15.1 c)

Where steel-floating is specified, the surface shall first be given a finish as specified in Sub-clause 4.7.15.1 (b). When the moisture film has disappeared and the concrete has hardened sufficiently to prevent laitance from being worked to the surface, the screeded surface shall be finished through a combination of wood-floating, followed by steel floating under firm pressure to produce a dense, smooth, uniform surface free from trowel marks.

C3.3.5.4.7.15.6 SD4.7.15.6 Power Float Finish

Where power floating is specified, the surface shall be treated as specified in Sub-clause 4.7.15.1 (a). When the moisture film has disappeared and the concrete has hardened sufficiently to prevent laitance from being worked to the surface, the screeded surface shall be power floated to produce a dense, smooth and uniform surface free of trowel marks. In corners and areas of restricted access the concrete surface shall be finished by steel floating in accordance with SD4.7.15.5.

The timing of power-floating is critical to its success. Power-floating shall not commence until the concrete can support the weight of a man with minimum indentation or when a footprint is barely perceptible and until the moisture sheen has disappeared. Thus several hours will have to elapse after concreting has been completed before this operation can commence. Night work may therefore be required.

C3.3.5.4.7.15.7 SD4.7.15.7 Broom-swept Finish (Sub-clause 4.7.15.2)

Where a broom-swept finish is specified, the surface shall be wood floated as specified in Sub-clause 4.7.15.1 (b) and thereafter swept with a stiff bristle broom to produce an approved non-skid surface.

C3.3.5.4.7.15.8 SD4.7.15.8 Preparation for and Laying of Granolithic Screeds

Before placing any granolithic screed, the base concrete shall be given a construction joint finish in accordance with SD4.7.12.1(b) and then soaked with water for at least 24 hours.

Before laying the screed, the concrete shall be thoroughly cleaned by scrubbing, and all standing water removed after soaking. A 1:2 cement / sand grout shall then be brushed on to the prepared surface, and the granolithic screed laid before the grout sets. The granolithic screed shall be of the driest feasible consistency with a slump not exceeding 50mm and shall be formed true to profile and shape as required and shown on the Drawings. Before fresh granolithic screed is placed against existing, adjacent granolithic screed the edge of the latter shall be prepared by chipping back to firm material, wire brushing the exposed surface and brushing it with grout as for the base concrete.

Granolithic screed shall be compacted to remove all air and shall be screeded and steel trowel finished to a degree of accuracy I unless otherwise specified.

The trowelling shall be carried out in the following stages:

1st – as soon as the granolithic screed has been compacted and screeded.
2nd – after 2 hours to close the surface and remove laitance.
3rd – after a further 4 hours.

These time intervals are appropriate to normal temperature conditions and shall be varied by the Contractor according to the temperature to ensure a smooth dense finish.

Granolithic screeds shall be diamond saw cut into panels not exceeding 2m in any direction. The saw cutting shall be carried out after an appropriate time interval to avoid cracking of the screed. Saw cut joints shall later be filled with an approved sealant.

Granolithic screed shall be cured as specified in Clause 4.7.13 but shall additionally be protected from direct sunlight and drying winds as it is being placed.

All screeding necessary to accommodate mechanical equipment shall be done under the equipment supplier's supervision and strictly in accordance with his instructions. Screeding shall commence as soon as the equipment supplier gives notice on completion of erection and shall be finished expeditiously.

The Contractor shall make good any damage to the mechanical equipment resulting from his personnel not following the supplier's instructions. Any spillage on the equipment shall be cleaned off immediately.

C3.3.5.4.7.15.9 SD4.7.15.9 Preparation for Laying of Screeds

The interface between concrete floors and screeds shall be regarded as construction joints and the surface of the floor shall be so prepared in accordance with SD4.7.12.1(b).

C3.3.5.4.7.15.10 SD4.7.15.10 Colour Mitigation – Application

Surfaces to be coloured shall be free of curing compounds, surface hardening or other material that may prevent direct contact with the colouring.

The colouring shall be applied directly to clean concrete surfaces at locations as specified or directed by the Engineer. Dark patches that may develop shall be controlled or avoided by custom blending of the basic technique, amending the dilution rate of the colour concentrate with water or a combination of these.

If required, the Contractor shall apply the colouring to a test section to be reviewed by the Engineer. Upon approval of both the test section and application procedures by the Engineer, the Contractor may proceed using the approved application procedures.

Rock colouring material shall be applied only by licensed applicators approved by the manufacturer. Variegated patinas that develop shall be controlled by custom blending of the rock colouring material and/or varying the application techniques.

C3.3.5.4.7.16 SD4.7.16 Watertight Concrete

Water retaining structures and water excluding structures will be so designated on the drawings. These will all be considered to be watertight concrete in terms of Sub-Clause 4.7.16. Special care shall be taken with all aspects of construction of these structures in order to ensure watertightness.

The tests in Sub-clauses 5.1.6.1 and 5.1.6.2 will be required for water retaining structures but not for water excluding structures.

However, should any section of the concrete Works show any sign of water leakage or penetration, irrespective of the source, that section shall be deemed to be defective and the necessary remedial work shall be carried out in accordance with Sub-clause 5.1.6.3.

C3.3.5.4.7.17 SD4.7.17 Concrete in Wet Ground

Provisions for concrete in wet ground shall be as shown on the drawings and not necessarily as indicated in Clause 4.7.17.

C3.3.5.4.7.18 SD4.7.18 Grouting

C3.3.5.4.7.18.1 SD4.7.18.1 Holding-down Bolts, Column Bases and Mechanical Equipment Bedplates

The mortar grout for holding-down bolts, column bases and mechanical equipment bedplates shall be a proprietary grout ready mixed in sealed packets as supplied by the manufacturer, and mixed and placed in accordance with the manufacturer's instructions.

The following prescribed products or brand name products, or equivalent materials subject to the written approval of the Engineer, shall be used:

SikaGrout® 212, high performance cementitious grout.

C3.3.5.4.7.19 SD4.7.19 Defects

C3.3.5.4.7.19.1 SD4.7.19.1 General

Defects shall be repaired as soon as possible after formwork has been removed and the Engineer has inspected the concrete. A statement of the method and materials to be used for each repair shall be submitted to the Engineer for his approval before any work is carried out. The Engineer may prohibit the further placing of concrete in the particular structure concerned until he is satisfied that the repair has been satisfactorily executed.

An example of the methodology and materials required for an effective repair is given in ABE Construction Chemicals' data sheets "Preparation of Surfaces" and "Dura Spalling Repair". These give detailed descriptions for cleaning and surface preparation, cleaning of reinforcement, corrosion protection of reinforcement, wet-to-dry epoxy bonding agents, curing etc. Similar products are available from Sika. In making any repairs, a high level of workmanship will be required and only the very best materials shall be used.

C3.3.5.4.7.19.2 SD4.7.19.2 Repair (plugging) of Formwork Tie Cone Recesses

Where practical, tie cone recesses shall be plugged with well rammed, dry 3:1 mortar within 48 hours of casting the concrete. The surfaces of the recesses shall first be roughened by chipping and wire brushing.

Tie cone recesses which cannot be plugged within 48 hours of casting shall be roughened by scabbling and an approved wet-to-dry epoxy shall be applied before plugging the recesses with mortar.

The mortar plugs shall be effectively cured.

C3.3.5.4.7.20 SD4.7.20 Rubbing Down of Concrete Surfaces- No Specification Data applicable

C3.3.5.4.7.21 SD4.7.21 The Use of Sliding Formwork- No Specification Data applicable

C3.3.5.4.7.22 SD4.7.22 Records- No Specification Data applicable

C3.3.5.4.7.23 SD4.7.23 Demolition and Removal of Existing Structural Concrete- No Specification Data applicable

C3.3.5.4.7.24 SD4.7.24 Granolithic Screed

Granolithic screed shall consist of:

Cement	1 part by mass
Sand	1.25 parts by mass
Coarse aggregate	2 parts by mass

The coarse aggregate shall consist of granite or other approved chips which shall pass a 10 mm sieve and be retained on a 5mm sieve.

The consistency of the mix shall be as dry as practicable and the water /cement ratio shall be approximately 0.4.

C3.3.5.4.8 SD4.8 PRECAST CONCRETE

In addition to these clauses, useful recommendations and information is given in SANS 10100-2 (SABS 0100-2) Section 13.

C3.3.5.4.8.1 SD4.8.1 Casting Beds, Moulds and Formwork- *No Specification Data applicable*

C3.3.5.4.8.2 SD4.8.2 Concrete mixers- *No Specification Data applicable*

C3.3.5.4.8.3 SD4.8.3 Vibrating Equipment- *No Specification Data applicable*

C3.3.5.4.8.4 SD4.8.4 Handling, Lifting and Stacking- *No Specification Data applicable*

C3.3.5.4.8.5 SD4.8.5 Placing and Vibrating of Concrete- *No Specification Data applicable*

C3.3.5.4.8.6 SD4.8.6 Units that have Architectural Finishes

C3.3.5.4.8.6.1 SD4.8.6.1 Samples of Concrete

Samples of precast concrete units that have architectural finishes shall be prepared.

Samples of concrete units, not having architectural finishes shall also be prepared to establish quality before full-scale production is commenced.

C3.3.5.4.8.7 SD4.8.7 Reinforcement in Precast Concrete- No Specification Data applicable

C3.3.5.4.8.8 SD4.8.8 Curing of Precast Concrete Works- No Specification Data applicable

C3.3.5.4.9 SD4.9 PRE-STRESSED CONCRETE

A tendon, when tensioned, contains a considerable amount of stored energy, which, in the event of failure of the tendon, anchorage or jack, may be released violently. All possible precautions shall be taken (both during and after tensioning) to safeguard persons from injury caused by the sudden release of this energy.

C3.3.5.4.9.1 SD4.9.1 Apparatus- No Specification Data applicable

C3.3.5.4.9.2 SD4.9.2 Tendons

C3.3.5.4.9.2.1 SD4.9.2.1 Surface Condition

a) Solvents (Sub-clause 4.9.2.1.1)

Solvents may be used for cleaning.

C3.3.5.4.9.2.2 SD4.9.2.2 Straightness- No Specification Data applicable

C3.3.5.4.9.2.3 SD4.9.2.3 Cutting- No Specification Data applicable

C3.3.5.4.9.2.4 SD4.9.2.4 Positioning of Tendons and Sheaths- No Specification Data applicable

C3.3.5.4.9.2.5 SD4.9.2.5 Tensioning Procedure

a) Pre-stressing Force Diagram (Sub-clause 4.9.2.5.1)

Pre-stressing force diagrams will be shown on the Drawings.

b) Order of Loading and Magnitude (Sub-clause 4.9.2.5.8)

The order of loading and magnitude of the load for each component of the tendon shall be as indicated on the Drawings.

C3.3.5.4.9.3 SD4.9.3 Grouting of Sheaths

C3.3.5.4.9.3.1 SD4.9.3.1 General

Tests (Sub-clause 4.9.3.1.2)

Bleeding tests and grouting trials will be required.

C3.3.5.4.9.3.2 SD4.9.3.2 Sheaths (Sub-clause 4.9.3.2.1)

Sheaths shall be fitted at both ends with pipes with a diameter of at least 10 mm for the injection of grout. The ends of the injection pipe shall be fitted with a clamp valve or device capable of withstanding a pressure of at least 1,5 MPa without loss of grout.

C3.3.5.4.9.4 SD4.9.4 Permanent Protection and Bonding of External Tendons (Clause 4.9.4)

C3.3.5.4.9.4.1 SD4.9.4.1 Tests (Sub-clause 4.9.4.2)

Preliminary tests shall be undertaken on the proposed encasement materials.

C3.3.5.4.9.4.2 SD4.9.4.2 Protection (Sub-clause 4.9.4.3)

The protection and bonding of the tendons shall be affected within 7 days after final tensioning of the tendon(s).

C3.3.5.4.9.5 SD4.9.5 Pre-tensioning- No Specification Data applicable

C3.3.5.4.9.6 SD4.9.6 Circular Pre-stressed Concrete Reservoirs and Tanks

C3.3.5.4.9.6.1 SD4.9.6.1 Contractor's Responsibilities

The Contractor is responsible for submitting his proposals for the pre-stressing work. He shall satisfy the Engineer with regard to all details that may be required, shall provide all plant and equipment required, shall supply all materials and shall execute and complete the pre-stressing and associated work. Accordingly, the Contractor shall comply with the requirements of SD4.9.6.2 to SD4.9.6.5 below.

C3.3.5.4.9.6.2 SD4.9.6.2 Pre-stressing system and tendon layout

The reservoir wall is to be pre-stressed circumferentially as shown on the Engineer's drawings. The drawings show the required minimum pre-stressing force in the wall after all losses, but do not specify details of the pre-stressing system, or the sizes and arrangement of tendons.

Any proven and approved method of pre-stressing may be used, although wrapping type systems are not acceptable.

The Contractor shall determine the arrangement and sizes of tendons to provide the required pre-stressing force in accordance with the following criteria and details given on the drawings:

a) Losses of pre-stress shall be calculated according to SANS 10100-1 (SABS 0100-1).

b) The prestressing force, expressed as a percentage of minimum guaranteed ultimate tensile strength of the steel shall not be allowed to exceed the following values:

at any stage during the jacking process	80%
on completion of transfer	70%.

c) The maximum vertical spacing of tendons shall be: 400 mm at the base of the wall varying uniformly to 1 200 mm at the top of the wall.

d) All tendons shall be stressed from both ends.

C3.3.5.4.9.6.3 SD4.9.6.3 Reinforcement

The Contractor shall design and provide the spiral bursting reinforcement to anchorages to the Engineer's approval.

C3.3.5.4.9.6.4 SD4.9.6.4 Calculations, drawings and records

The Contractor shall, at least two months before he intends commencing with construction of the wall, submit the following to the Engineer for his approval, for the pre-stressing system adopted:

a) A set of detailed calculations in respect of the tendon force along the length of each tendon, the expected extension and the bursting forces, using a numbering system to identify each tendon,

b) Drawings detailing the number, layout and alignment of the tendons, the tendon supports, details of the bursting and other reinforcement, anchorage recesses, tensioning sequence, tensioning loads and extensions,

c) Requirements for controlling the tensioning operations, and,

d) Details of any technical data which are at variance with the information given on the Engineer's drawings.

Pre-stressing work shall not commence before the relevant calculations and drawings prepared by the Contractor have been approved by the Engineer. After this approval, no departure shall be permitted from the forces, stresses and extensions shown thereon without authorization by the Engineer.

In addition to complying with the requirements of Sub-clause 4.9.2.5.11, the Contractor shall, upon completion of the pre-stressing work, furnish a permanent record of each working drawing in the form of an A1 size drawing in electronic AutoCAD format.

C3.3.5.4.9.6.5 SD4.9.6.5 Friction Tests

For purposes of verifying the assumed losses of pre-stressing resulting from friction between the pre-stressing tendons and the sheathing which occurs during the jacking operation, the Contractor shall carry out friction tests on the first tendon and thereafter on every fifth tendon stressed or as may be directed by the Engineer. To this end the Contractor shall provide all necessary jacking and measuring devices and all labour required for carrying out and recording the friction tests.

C3.3.5.4.10 SD4.10 HANDLING AND ERECTION OF PRECAST CONCRETE UNITS

In addition to these clauses, useful recommendations and information is given in SANS 10100-2 (SABS 0100-2) Section 13.4.

Special care shall be taken to ensure the safety of personnel during this delicate phase.

C3.3.5.4.10.1 SD4.10.1 Handling and Transportation

C3.3.5.4.10.1.1 SD4.10.1.1 Lifting (Sub-clause 4.10.1.3)

The position of lifting and supporting points, the method of lifting, the type of equipment and the type of transport to be used shall be determined by the Contractor in liaison with the Engineer. The agreed system layout shall be submitted to the Engineer (for review, detailed design and reinforcement detailing) 28 days before the construction Drawings and Reinforcement Schedules are required by the Contractor.

C3.3.5.4.10.2 SD4.10.2 Assembly and Erection

At least 28 days before commencement of the work, the Contractor shall submit to the Engineer a Method Statement including proposed methods of assembly and erection for review and approval by the Engineer.

C3.3.5.4.10.3 SD4.10.3 Temporary Supports during Construction- No Specification Data applicable

C3.3.5.4.10.4 SD4.10.4 Forming Structural Connections

C3.3.5.4.10.4.1 SD4.10.4.1 Design

The design requirements for the structural connections will be indicated on the Drawings.

C3.3.5.5 SD5 COMPLIANCE WITH THE REQUIREMENTS

C3.3.5.5.1 SD5.1 TESTING

C3.3.5.5.1.1 SD5.1.1 General

a) Cube testing (Sub-clause 5.1.1.4)

Cubes shall be tested by an approved laboratory.

b) Ready-mix Production (Sub-clause 5.1.1.7)

The tests result from a ready-mix production facility, as part of its quality control system, will not be accepted. Only concrete cubes taken and stored on site will be accepted.

c) Alkali-aggregate Reaction (Sub-clause 5.1.1.8 and SD4.2.3.5)

The tests for potential reactivity of the aggregates shall be Petrography ASTM C 295 and Mortar-bar test SANS 6245 or ASTM C 1260 (AASHTO T 303).

C3.3.5.5.1.2 SD5.1.2 Acceptance of Strength Concrete (Clause 5.1.2)

C3.3.5.5.1.2.1 SD5.1.2.1 Assessment (Sub-clause 5.1.2.3)

The test results will be assessed statistically.

C3.3.5.5.1.3 SD5.1.3 Frequency of Sampling- No Specification Data applicable

C3.3.5.5.1.4 SD5.1.4 Individual Load Tests on Precast Units and Pre-stressed Units

The following load test values will be as indicated on the Drawings:

C3.3.5.5.1.4.1 SD5.1.4.1 Deflection (Sub-clause 5.1.4.2.1)

The maximum deflection.

C3.3.5.5.1.4.2 SD5.1.4.2 Load (Sub-clause 5.1.4.3)

The ultimate design load.

C3.3.5.5.1.4.3 SD5.1.4.3 Special Tests (Sub-clause 5.1.4.4)

Any special tests required.

C3.3.5.5.1.5 SD5.1.5 Tests on Pre-stressed Structures

C3.3.5.5.1.5.1 SD5.1.5.1 Tests Requirements (Sub-clause 5.1.5.1.1)

Particular requirements for pre-stressed structures will be indicated on the Drawings.

C3.3.5.5.1.5.2 SD5.1.5.2 Acceptance Criteria (Sub-clause 5.1.5.4 and Table 10)

The acceptance criteria for pre-stressed structures in extreme exposure conditions will be indicated on the Drawings.

C3.3.5.5.1.5.3 SD5.1.5.3 Class (Sub-clause 5.1.5.4 a)

The class of pre-stressed structures will be indicated on the Drawings.

C3.3.5.5.1.5.4 SD5.1.5.4 Deflection (Sub-clause 5.1.5.4 c)

The deflection measured immediately after application of the test load for deflection shall not exceed the values indicated on the Drawings.

C3.3.5.5.1.6 SD5.1.6 Tests for Watertightness

C3.3.5.5.1.6.1 SD5.1.6.1 Requirements

The following requirements amplify those in Clause 5.1.6.

Water for testing shall be provided by the Contractor and he 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 2.0m in 24 hours until the top water level has been reached. The water level will then be carefully noted and recorded by the Engineer in relation to a fixed benchmark and shall be maintained by the addition of further water for a stabilizing period to permit complete absorption of water by the concrete.

The stabilizing period shall be 7 days for a maximum design-crack width of 0.1mm or 21 days for 0.2mm or greater. After the stabilizing period, the level of the liquid surface shall be recorded at 24-hour intervals for a test period of 7 days. During this 7-day test period the total permissible drop in level, after allowing for evaporation, shall not exceed 1/500th of the average water depth of the full tank, or 10mm.

The evaporation shall be measured by the mean drop in level caused by the evaporation of the water in three flat containers floating in the water being recorded.

In the event of any leakage or dampness being evident at any stage of the filling or testing or in the event of the Engineer considering the final degree of watertightness to be unsatisfactory, the Contractor when ordered by the Engineer 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 Engineer that a sufficient degree of watertightness has been obtained.

The costs 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 Engineer and shall be such that the Employer can utilise the water if he so desires.

The water shall not be used as a medium for additives to effect remedial work or to stop leaks.

The costs of retesting the structure for watertightness shall be borne by the Contractor."

Water shall be used as the liquid for test purposes.

C3.3.5.5.1.7 SD5.1.7 Cleaning and Sterilising

C3.3.5.5.1.7.1 SD5.1.7.1 Requirements

The reservoir shall be sterilized as specified below, before testing, and, should repairs have been necessary, before retesting.

The walls, floor and underside of the reservoir roof shall first be thoroughly hosed down with water and swept with brushes until properly cleaned of all dirt and other foreign matter. All water shall be drained away.

The reservoir shall be filled with water to a depth of 150mm, chloride of lime solution being added as the water enters at a dosing rate of 150 grams of chloride of lime for every cubic metre of water entering the structure. The chloride of lime solution shall be mixed thoroughly with water. The walls shall then be thoroughly brushed down with the solution. On completion and when all personnel have vacated the structure, the internal access ladder shall be washed down with additional chlorinated water.

No personnel shall enter the reservoir during and after sterilizing unless wearing sterilized gumboots.

C3.3.5.5.2 SD5.2 TOLERANCES

C3.3.5.5.2.1 SD5.2.1 GENERAL

C3.3.5.5.2.1.1 SD5.2.1.1 Degree of Accuracy

Unless otherwise specified on the drawings or directed by the Engineer, the degree of accuracy for all work, including floated finishes, shall be II.

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.

C3.3.5.5.2.1.2 SD5.2.1.2 Tolerances for Verticality

Replace in the permissible deviations for verticality in Table 11 as follows:

Table 11: Accuracy in concrete work

1	2	3	4
Item	**Permissible deviation (pd) mm**		
	Degree of accuracy		
	III	**II**	**I**
Elements or component above foundations 5) Verticality, per metre of height, Subject to a maximum of	 5 50	 3 30	 2 10

Tolerances not stated (Table 11)

The tolerances for bow, camber and twist in slipform / precast concrete shall be as indicated on the Drawings.

C3.3.5.6 SD6 ADDITIONAL SD CLAUSES FOR WASTEWATER TREATMENT WORKS

C3.3.5.6.1 SD6.1 Aggregates of Dolomitic Origin

Where specified on the drawings and scheduled in the Bill of Quantities, aggregates for structural concrete shall be of dolomitic origin. The quantity of insoluble matter in respect of concrete made with these aggregates, determined according to the method described in SANS 677, Appendix C, shall not be more than 15%.

C3.3.5.6.2 SD6.2 Screeds for Settling Tanks

a) Surface of floor slab below screed

As stated in SD4.7.15.9, the top surface of the floor slab shall be regarded as a construction joint and prepared as such in accordance with SD4.7.12.1(b).

All joints shall be sealed in the manner shown on the drawings. All dust, debris, etc. must be removed immediately prior to the application of the bonding agent and screed.

b) Materials

Only CEM I 42.5 (Portland cement) shall be used.

Coarse aggregate maximum size: 10mm
28-day cube strength: 30MPa.

A plasticizer approved by the Engineer shall be used to reduce the water content of the mix to an absolute workable minimum. The mix design shall be submitted to the Engineer for approval.

c) Placing of screed

All surface water shall be removed after which Fosroc Nitobond EP slowset bonding agent or similar approved shall be applied strictly according to the manufacturer's specifications. The screed shall be placed according to the recommendations and/or specifications of the manufacturer of the bonding agent.

The screed shall be placed, spread and compacted in one layer and care shall be taken to obtain maximum compaction. After the screed has been compacted and before the surface is power floated, angle irons fixed to the mechanical equipment shall be used to finish off the screed to the correct levels.

Power floating shall not commence until such time as the screed surface has lost its sheen and barely shows footprints. All laitance on the surface of the screed resulting from compaction shall be struck off prior to power floating. Too much floating causing excessive cement-water paste to surface, shall be avoided.

Curing shall commence as soon as finishing operations have been completed and shall be continued for at least 7 days. The method of curing shall be by means of a peripheral pipe directly next to the inside face of the wall with water running down the slope of the floor to the centre cone. This shall be discussed with the Engineer. Any alternative curing method must be submitted to the Engineer for approval.

d) Joints

The joints in screeds shall be constructed according to the details shown on the drawings and must in all cases be aligned with the joints in the floor slab below.

e) Surface finish of screeds

The finishing-off of the screed shall be done in conjunction with the mechanical contractor to ensure that the surface fits the mechanical equipment. The maximum allowable deviation of the floor from the design level is ± 3 mm.

C3.3.5.6.3 SD6.3 COATINGS

Where indicated on the drawings, the following coatings shall be provided to structures:

C3.3.5.6.3.1 SD6.3.1 Algae-resistant coating on concrete surfaces

a) General

Concrete launder channels are attacked over a period of time by the acids generated in the purification processes. This leads to loss of cement with consequent increase in roughness by exposure of the aggregate. Phosphates in the water and the action of sunlight encourage the growth of algae. Removal of algae is a costly and continuous process; hence it is preferable to provide a smooth surface to minimise build-up of algae growth.

b) Surface preparation

For immersion or other heavy-duty applications, laitance shall be totally removed by water blast cleaning, with abrasive injection, or by mechanical scabbling of the surface, or by acid pickling, followed by very thorough washing with potable water.

For coatings of low water permeability, such as solvent borne epoxies, vinyls and chlorinated rubber, the moisture content of the concrete or plaster shall be not more than an indicated 5% when tested with an approved electrical conductivity meter, designed for use on concrete or plaster (such as the Delmhorst meter). The pins of the meter shall penetrate the concrete or plaster to a depth not less than 5 mm.

The first coat of the coating system may require thinning with the manufacturer's recommended solvent to assist penetration of the substrate.

The surface shall be dry before coatings are applied.

c) Application

Apply epoxy tar primer such as Ivory 310P, thinned when necessary in accordance with the manufacturer's instructions to obtain adequate penetration.

Apply a suitable scraper coat such as Ivory 319TAQ to obtain a smooth finish followed by a suitable solvent-free epoxy tar coating such as Ivory 310 to give a coating thickness of 250 micrometres and finally a vinyl anti-fouling paint at the coverage recommended by the manufacturer.

NOTE: Since an anti-fouling paint functions by leaking toxic materials into the water, it has a limited effective life, dependent on flow rate. The topcoat must therefore be renewed when its efficacy starts to diminish.

C3.3.5.6.3.2 SD6.3.2 Abrasion-resistant coating on concrete surfaces

a) General

Concrete structures subject to heavy abrasion and scouring action shall be coated with an abrasion-resistant coating based on solvent-free, two-component polyurethane hybrid.

For immersion or other heavy-duty applications, laitance shall be totally removed by water blast cleaning, with abrasive injection, by mechanical scabbling of the surface or by acid pickling followed by very thorough washing with potable water.

For coatings of low water permeability, such as solvent-borne epoxies, vinyls and chlorinated rubber, the moisture content of the concrete or plaster shall be not more than an indicated 5% when tested with an approved electrical conductivity meter, designed for use on concrete or plaster (such as the Delmhorst meter). The pins of the meter shall penetrate the concrete or plaster to a depth not less than 5mm.

The first coat of the coating system may require thinning with the manufacturer's recommended solvent to assist penetration of the substrate.

The surface shall be dry to a depth of not less than 5mm.

Alternatively, when agreed by the supplier of the material, the surface may be treated with a chemical water scavenger, supplied by the manufacturer of the coating material.

The clean, dry surface shall be primed with the manufacturer's recommended primer for concrete, applied in accordance with the manufacturer's recommendations.

Blowholes in the concrete shall be filled by application of the manufacturer's scraper coat.

b) Materials

i) Primer

The primer shall be a suitable primer for concrete plus scraper coat supplied by the manufacturer of the coating material and shall be applied at the manufacturer's specified thickness and shall be overcoated within the specified overcoating time.

ii) Coating material

The coating material shall be a solvent-free, two-component polyurethane hybrid based on polyether type polyol and aromatic isocyanate. The cured coating shall comply with the following requirements:

The coating or lining thickness shall not be less than 3mm.

Tensile strength at 3mm thickness (ASTM D 638), not less than 15MPa

Adhesion to correctly primed steel at 1mm thickness (SABS Method 776), not less than 10MPa

Impact resistance direct at 1 mm thickness (ASTM G 14), not less than 8 joules

Dielectric strength not less than 10kV/mm

Elongation at break at 3mm thickness, not less than 25%

Compressibility, not less than 25MPa

Surface hardness of 5mm thick sample, not less than 60 nor greater than 80 Shore 'D'.

Water vapour permeability at 1mm thickness, not greater than 0,5g/24h/m²/mm

Cathodic disbonding when tested in accordance with ASTM G8 Method A, for 60 days, the disbonded area shall not exceed 500mm².

Where it is not practical to apply the coating using a two-component spray gun, the manufacturer's brushing grade may be used, provided that the completed coating meets all the requirements of the specification.

c) Requirements for the finished coating

The coating shall be smooth, glossy, free from bubbling, excessive orange peel or brushmarking and from excessive runs and sags.

The dry film thickness shall be not less than 3mm.

The edge of the coated area shall be neatly finished. No overspraying or splashes shall be permitted on surfaces adjacent to the coated surface.

The coated surface shall be free from electrical insulation defects when tested with a high voltage holiday detector, earthed to the concrete substrate by wet sponge contact and operated at 15kV potential.

d) Application

i) Prepare surface as specified above.

ii) Prime the surface with the coating manufacturer's primer for concrete.

iii) Within the minimum and maximum overcoating time interval specified for the primer by the manufacturer apply one coat or two coats by means of an airless spray machine fitted with metering pumps that dispenses the correct mix ratio at the spray head. The machine shall be maintained in a clean condition and in good working order. The Contractor may be required to demonstrate to the Engineer that the machine is delivering components in the correct mixing ratio.

C3.3.5.6.4 SD6.4 FLUMES

C3.3.5.6.4.1 SD6.4.1 Flume structure

The structure shall be rigid and watertight and capable of withstanding flood-flow conditions without damage from outflanking or from downstream erosion. The axis shall be in line with the direction of flow in the upstream channel, and the geometry shall conform with the dimensions given on the drawings.

The surfaces of the flume, particularly those of the entrance section and throat, shall be smooth. The flume shall be constructed of concrete with a smooth cement finish and shall be surfaced with a smooth non-corrosive material. The surface finish is of particular importance within the prismatic part of the throat, but the requirements may be relaxed beyond a distance along the profile 0.5 hmax upstream and downstream of the throat proper.

To minimize uncertainty in the discharge measurements, the tolerances specified under Sub-clause SD6.5.3 shall be satisfied in construction.

C3.3.5.6.4.2 SD6.4.2 Mechanical devices for flumes

C3.3.5.6.4.2.1 SD6.4.2.1 Linear scale plates and pointers

i) Linear scale plates to be installed at all Parshall flumes for measuring flow shall be manufactured from 2mm thick 304L stainless steel.

ii) All linear scale plates shall be calibrated in litres per second and shall have a width of 50mm and a length of 1,000mm. All numbers shall be punched onto the stainless-steel plate and shall be filled with a suitable yellow paint to the satisfaction of the Engineer. The units of calibration shall be in litre/s in increments of 50 litre/s. The linear scale plates shall be fixed into position with the aid of stainless-steel chemical anchor bolts in a position as indicated on the drawings and flush with the concrete.

iii) Mechanical pointers for elevated linear scale plates shall be manufactured from grade 304 stainless steel. They shall be robust devices which facilitate the easy and accurate reading of linear scale plates."

C3.3.5.6.5 SD6.5 TOLERANCES

C3.3.5.6.5.1 SD6.5.1 Floors

The maximum permissible deviation from a 3m long straight line connecting two points on the surface of the finished settling tank floor is ± 3mm.

C3.3.5.6.5.2 SD6.5.2 Top of settling tank walls

The bridge-wheel tread path surface shall have a smooth finish constructed within a vertical tolerance of ± 2mm. This tolerance shall be measured by means of laser equipment. The top edges of the outer ring walls of the WAS thickeners shall be chamfered with fillet strips to form 25mm x 25mm chamfers:

C3.3.5.6.5.3 SD6.5.3 Flume structure

i) On the bottom width b of the throat, 0.2% of b with an absolute maximum of 0.01m;

ii) on point deviations from a plane surface in the throat, 0.1% of litre;

iii) on the width between vertical surfaces in the throat, 0.2% of this width with a maximum of 0.01m;

iv) on the average longitudinal and transverse slopes of the base of the throat, 0.1%;

v) on the slope of inclined surfaces in the throat, 0.1%;

vi) on the length of the throat, 1% of litre;

vii) on point deviations from a plane surface in the entrance transition to the throat, 0.1% of litre;

viii) on point deviations from a plane surface in the exit transition from the throat, 0.3% of litre;

ix) on deviations from a plane or curve on other vertical or inclined surfaces, 1%;

x) on deviation from a plane of the bed of the lined approach channel, 0.1% of litre.

The structure shall be measured on completion of construction, and average values of relevant dimensions and their standard deviations at 95% confidence limits shall be computed. The average values of dimensions shall be used for computation of the discharge of their standard deviations to obtain the overall uncertainty in the determination of discharge.

Construction tolerances of the concrete flume must allow for the final application of a 3mm thick abrasive resistant coating to be applied to the concrete surfaces, where this is specified.

A method statement for construction of the flume shall be submitted to the Engineer for approval at least 14 days prior to construction.

C3.3.5.6.6 SD6.6 ADDITIONAL MEASUREMENT AND PAYMENT CLAUSES FOR WASTEWATER TREATMENT WORKS

C3.3.5.6.6.1 SD6.6.1 Algae resistant and abrasion resistant coatings

a) Vinyl anti-fouling paint and undercoats to form an algae-resistant coating on (Description of structural element stated):……Unit: m^2

b) Solvent-free abrasion-resistant coating and primer to a minimum thickness of 3mm on (Description of structural element stated):……...Unit: m^2

The unit of measurement shall be the square metre of surface protected against corrosion.

The tendered rates shall include full compensation for surface preparation for supplying and applying the materials as specified, for all labour, equipment and appurtenant materials necessary to carry out the work and for all waste and cleaning up after the work has been completed.

C3.3.5.6.6.2 SD6.6.2 Supply and delivery of Linear Scale plates to Parshall Flumes (excluding pointers)……..Unit: No

The rate shall include full compensation for the manufacture, corrosion protection, supply, handling, transport and delivery of the complete units.

C3.3.5.6.6.3 SD6.6.3 Installation, calibration, testing, commissioning, and maintenance of linear scale plates for Parshall Flumes (excluding pointers)……..Unit: No

The rate shall include full compensation for the installation, testing, calibration, commissioning, maintenance, the making good of damaged corrosion-protection areas, etc, and all other actions required for establishing an efficient working system."

C3.3.5.7 SD7 NOT USED

C3.3.5.8 SD8 MEASUREMENT AND PAYMENT

The rates tendered under this Section shall not include for the general obligations, Contractor's Plant and Equipment and work deemed to be covered by the items provided in Section A – General.

C3.3.5.8.1 SD8.1 Measurement and Rates

C3.3.5.8.1.1 SD8.1.1 Formwork

C3.3.5.8.1.1.1 SD8.1.1.1 General Formwork

Formwork, other than formwork covered below, will be measured as the net area of the face of the concrete to be supported during the placing of concrete. No deduction will be made for fillets and chamfers of size up to 50mm x 50mm or for openings of diameter up to 0.7m or of area up to 0.5m2.

C3.3.5.8.1.1.2 SD8.1.1.2 Narrow Widths

Formwork in continuous lengths of narrow widths and of fillets or chamfers over 50mm x 50mm will be measured by length, the width or range of widths being stated in the Bill of Quantities.

Boxing-out, the forming of holes, and other such operations will be measured by number, basic dimensions, perimeters, or drawing references, as stated in the Bill of Quantities.

C3.3.5.8.1.1.3 SD8.1.1.3 Separate items will be scheduled:

a) For each class of finish required on the formed concrete.

b) For the different angles of inclination of formwork given below:

DESCRIPTION OF FORMWORK	ANGLE OF INCLINATION FROM THE VERTICAL
Horizontal	Exceeding 85° and not exceeding 95°
Sloping	Exceeding 10° and not exceeding 85°
Battered	Not exceeding 10°
Vertical	0°

c) For each inclination of each type of structural element, such as walls and beams, and for different prop heights for beams and slabs, and for formwork to curved (singly and double curvature), curved in plan only, arched, domical, specially moulded, and other types of work.

d) For depths of openings required in the formed concrete, as follows:

Not exceeding 0.5 m;

Exceeding 0.5 m but not exceeding 1.0 m;

Exceeding 1.0 m but not exceeding 1.5 m;

Exceeding 1.5 m but not exceeding 2.0 m;

Exceeding 2.0 m;

Measured perpendicular to the surface; and

For large and small voids classified as follows:

DESCRIPTION	MAXIMUM CROSS-SECTION	
	CIRCULAR VOIDS, DIAMETER, m	OTHER VOIDS, AREA, m2
Large	Exceeding 0.35 and not exceeding 0.7	Exceeding 0.1 and not exceeding 0.5
Small	Not exceeding 0.35	Not exceeding 0.1

C3.3.5.8.1.1.4 SD8.1.1.4 Special Smooth Finish

Where a “special-smooth” or “smooth-special” finish is specified (See SD4.3.1.4 and Table 1) and scheduled which requires more extensive operations to be carried out after striking than are specified for a smooth finish, payment for formwork will become due when the finish has been achieved as specified.

C3.3.5.8.1.1.5 SD8.1.1.5 Special Finish

Where a special off-form finish (See Table 1) is specified and scheduled, payment for formwork will become due when the finish has been achieved as specified.

C3.3.5.8.1.1.6 SD8.1.1.6 The Unit Rate

The unit rate shall cover the cost of all parts of formwork in contact with the concrete (including forming fillets or splays up to 50mm x 50mm) and the necessary ties, bearers, struts, and other supports (falsework) plus the labour and equipment necessary to erect the formwork to the required accuracy and with the specified surface finish and to strike such formwork. The unit rate shall also cover all costs associated with the design of the formwork and falsework and ensuring their safety, and for effectively plugging tie sleeves and tie cone recesses.

C3.3.5.8.1.1.7 SD8.1.1.7 Formwork to kickers

For formwork to kickers, all additional costs for formwork to edges up to 300mm high will be deemed to be included in the rates tendered for vertical formwork to sides of walls or columns and will not be measured separately in narrow widths.

C3.3.5.8.1.1.8 SD8.1.1.8 Edges of Blinding/ No-fines layer

No separate payment will be made for formwork to the edge of the blinding layer, no-fines layer or divider strip. The rates tendered for concrete to the blinding layer, no-fines layer shall cover the cost of such formwork.

C3.3.5.8.1.1.9 SD8.1.1.9 Formwork to top of sloping surfaces

Formwork to the top of sloping or conical surfaces will only be measured to surfaces of over 30° and up to 85° to the horizontal.

C3.3.5.8.1.1.10 SD8.1.1.10 Removal of soffit formwork

Soffit formwork to top slabs of reservoirs, pump stations, valve chambers, manholes sumps etc can either be removed through the manhole cover opening or the Contractor may use permanent formwork at his own cost.

C3.3.5.8.1.2 SD8.1.2 Reinforcement

C3.3.5.8.1.2.1 SD8.1.2.1 Steel for Normal Reinforced Concrete

Steel for normal reinforced concrete will be measured net by mass of all bars, including supporting steel detailed on the reinforcement bending schedules. The mass will be computed from the nominal bar size and the nominal mass per unit length. No allowance will be made for cutting, waste, spacer devices (materials other than steel bars), or binding wire.

Separate items will be scheduled for:

a) Mild steel bars of different sizes, which may be grouped.

b) High tensile steel bars of different sizes, which may be grouped.

c) Each steel section where rails or other steel sections are used; and

d) Steel to be fixed in different parts of the Works if this could materially influence the pricing of the work.

Steel reinforcement for precast concrete units will not be measured unless so scheduled. (See SD 8.6).

Welded mesh will be measured by area shown on the Drawings, no allowance being made for cutting, waste, laps, or deduction for end cover. The areas measured will be those of the concrete floor or slab reinforced by means of mesh. In the case of continuous units partly reinforced by mesh, the area will be computed from the outside dimensions of the area covered by mesh regardless of whether additional reinforcing steel is present in the same area.

Steel off-cuts resulting from the cutting and bending of reinforcement in accordance with the bending schedule shall be deemed to be the property of the Contractor.

C3.3.5.8.1.2.2 SD8.1.2.2 The Total Mass

The total mass of all mild and high tensile steel bars of different sizes will be scheduled.

Welded mesh will be scheduled separately for each type and mass per square metre of mesh.

C3.3.5.8.1.2.3 SD8.1.2.3 The Unit Rates

a) The unit rates for steel bars shall cover the cost of supply, cutting, bending, placing in position, and fixing of the reinforcing and supporting steel scheduled, and the provision of all spacer devices and binding wire, as well as the cost of tests in terms of SANS 920.

b) The unit rate for welded mesh shall cover the supply, cutting, and placing of mesh, and the cost of all waste due to laps.

C3.3.5.8.1.3 SD8.1.3 Concrete

C3.3.5.8.1.3.1 SD8.1.3.1 Measurement

a) Concrete will be measured net to the dimensions shown on the Drawings or to the dimensions cast, whichever are the smaller. However, structural elements that are undersized will be measured for payment only if they are accepted by the Engineer.

b) No allowance will be made for concrete required to make up overbreak in soft excavation, but payment will be made for additional concrete or formwork, ordered in writing by the Engineer to replace unsuitable material or overbreak in hard rock or in intermediate excavation (see (d) below).

c) Sub-foundation carpets and blinding layers will be measured to the plan size of the concrete structure resting on the carpet. Where the concrete is scheduled by volume it will be measured on the mean thickness as cast, provided that the Engineer is satisfied that the excavation has not at any point been taken deeper or wider than necessary (see (b) above).

d) Where concrete is placed directly against the sides or bottoms of excavations in hard rock or in intermediate excavation, an item may be included in the schedule of quantities for any additional concrete placed in overbreak. Such additional concrete will be measured on the basis of the superficial area of the sides or bottom, or both, as applicable, of the theoretical net excavation in rock that is overbroken and in contact with the concrete.

C3.3.5.8.1.3.2 SD8.1.3.2 Separate Items

Separate items will be scheduled, as applicable, for each type and each grade of concrete, for each type of cement and each type of aggregate, and for each unit of the Works or each element of a structure, where these could materially influence the pricing of the work and where the cost of placing concrete is affected by its position in the Works or by the conditions of placing, such as:

a) Slabs that are sloping, conical, or horizontal, and those of different thicknesses;

b) Concrete placed under water or between tides, the levels of demarcation being stated;

c) Small quantities each less than 0.5 m3 of formed concrete; and

d) Different surface finishes (other than striking-off and levelling) such as wood- floated or steel-floated finishes and granolithic or mortar screeds.

C3.3.5.8.1.3.3 SD8.1.3.3 The Unit Rates

a) The unit rates shall cover the cost of the design of the mix in the case of strength concrete, the provision of concrete, mixing, placing, compacting, unforeseen construction joints, striking-off or levelling as applicable, and curing and repairing of defects where necessary.

The unit rates shall also cover the cost of the following:

i) The design of concrete mixes by an approved laboratory, preparation of trial mixes and submission to the Engineer for approval. (see SD4.7.1.1 and SD 4.7.1.2).

ii) All costs associated with the use of a cement extender if specified, including:

- Supply, storage, handling on site and mixing in of the extender.
- Increased concrete mixing time as per SD4.7.8.1.

- Increased times before formwork may be removed as per Table 2.
- Increased curing times as per Table 8.

iii) All costs associated with the use of special aggregates (e.g. Dolomitic)

iv) Temperature control for sections thicker than 900 mm as per SD4.7.14.1.

v) Non-designated joints (see SD3.1.4).

vi) Screeded finish to unformed surfaces as specified in SD4.7.15.3 and Sub-clause 4.7.15.1 (a).

vii) All required tests (except the watertightness test).

viii) All other requirements of SANS 2001, Part CC1 and these Specification Data clauses were no payment items are provided in the Bill of Quantities.

b) Floor slabs, where placed on sub-foundation carpets or directly on the prepared ground surface, will be measured to the net thickness dimensioned on the Drawings.

c) Concrete in a column supporting a reinforced concrete beam or slab structure will be measured between the top surface of the foundation, beam, or slab on which the foot of the column is standing, and the underside of the beam or slab supported by the column.

d) No deduction or addition will be made for nosings, bolt holes, chamfers or splays of size up to 50mm x 50mm, grooves or chases not exceeding 0.015m3 each in volume, or holding-down bolts, rails, steel sections, and reinforcement cast in the concrete.

C3.3.5.8.2 SD8.2 SCHEDULED FORMWORK ITEMS

C3.3.5.8.2.1 SD8.2.1 Rough……Unit: square metre (m²)

The surfaces to be so formed will be identified in the Bill of Quantities.

C3.3.5.8.2.2 SD8.2.2 Smooth……..Unit: square metre (m²)

The surfaces to be so formed will be identified in the Bill of Quantities.

C3.3.5.8.2.3 SD8.2.3 Special smooth, repaired and rubbed……Unit: square metre (m²)

The surfaces to be so formed will be identified in the Bill of Quantities.

C3.3.5.8.2.4 SD8.2.4 Special off-form……..……Unit: square metre (m²)

The surfaces to be so formed will be identified in the Bill of Quantities.

C3.3.5.8.2.5 SD8.2.5 Narrow widths (up to mm wide)……..Unit: square metre (m²)

The constant width, if in excess of 300 mm, or the range of widths if up to 300 mm, or width and depth in the case of grooves or chases, or the width in the case of fillets or chamfers over 50 mm wide, will be stated in the Bill of Quantities.

C3.3.5.8.2.6 SD8.2.6 Box-out holes/ Form voids……Unit: square metre (m²)

Items will be scheduled as set out below:

a) Small, circular, of diameter up to and including 0.35 m

Over	and	Up to and including	
0.0 m deep		0.5 m deep	Unit: No.
0.5 m		1.0 m deep	Unit: No.
1.0 m		1.5 m deep	Unit: No.
1.5 m		2.0 m deep	Unit: No.
2.0 m		- deep	Unit: No.

b) Small, other than circular, areas up to and including 0.1m² Unit: No.

Depths as in a) above

c) Large, circular, of diameter over 0.35 m up to and including 0.7m Unit: No.

Depths as in a) above

d) Large, other than circular, areas over 5 m² and up to and including 15m² Unit: No.

Depths as in a) above

C3.3.5.8.3 SD8.3 SCHEDULED REINFORCEMENT ITEMS

C3.3.5.8.3.1 SD8.3.1 Steel bars……..……..Unit: t

The type of steel bar (mild, high-tensile, or other) will be stated and different sizes will be given. These may be grouped.

C3.3.5.8.3.2 SD8.3.2 High-tensile welded mesh……...……Unit: m²

The type reference will be stated.

C3.3.5.8.3.3 SD8.3.3 Rails or other steel sections used as reinforcement……Unit: t

C3.3.5.8.4 SD8.4 SCHEDULED CONCRETE ITEMS

C3.3.5.8.4.1 SD8.4.1 Prescribed mix concrete……..Unit: m³

The proportions and the positions or elements in the Works will be stated.

C3.3.5.8.4.2 SD8.4.2 Blinding layer in concrete……..Unit: m³

Either of the following will be stated:

a) Minimum thickness and proportions or grade ……..……..Unit: m²

b) Proportions or grade ……Unit: m³

C3.3.5.8.4.3 SD8.4.3 Strength concrete, grade……Unit: m³

The characteristic strength followed by the size of stone and positions or elements in the Works will be stated. Where a cement extender is specified, the type and proportion of the extender will be indicated. Where a special aggregate (e.g. Dolomitic) is specified this will be stated.

C3.3.5.8.4.4 SD8.4.4 Unformed surface finishes

C3.3.5.8.4.4.1 SD8.4.4.1 Unformed surface finishes ……Unit: m^2

Where better than a "screeded finish" (SD4.7.15.3) is required, items will be scheduled for each class or type of finish, i.e.:

a) Wood-floated finish

b) Steel-floated finish

c) Power-floated finish, or

d) Other special finish

The rate shall cover the cost of providing the specified surface finish.

C3.3.5.8.4.4.2 SD8.4.4.2 Extra over for finishing to special accuracy……Unit: m^2

This item is extra over sub-item (b), (c) or (d) which will be stated.

The quoted rate shall include full compensation for the additional cost of finishing the stated area to closer tolerances than per Table 11 where specified e.g. SD 6.5.2 Settling tank walls and SD6.5.3 Flume structures.

C3.3.5.8.4.5 SD8.4.5 Aggregate (where measured separately)……Unit: m^3

The rate shall cover the cost of supplying at the point of use and using the aggregate in the manner specified.

C3.3.5.8.4.6 SD8.4.6 Cement (where measured separately)……Unit: t

The rate shall cover the cost of supplying at the point of use and using the cement in the manner specified.

C3.3.5.8.4.7 SD8.4.7 No fines concrete layer with mortar skim……Unit: m^2

The thickness of the no-fines layer and mortar skim will be stated.

The rate shall cover all costs to construct the no-fines layer to the required thickness and where specified, providing a mortar skim. The rate shall also cover the cost of power or steel floating the mortar skim to the required accuracy as well as curing

C3.3.5.8.4.8 SD8.4.8 Screeds……Unit: m^2

The type of screed and thickness will be stated. The name of any special bonding agent will also be stated.

This item includes all concrete screeds including grano screeds and screeds to settling tanks as scheduled in the Bill of Quantities.

The rate shall cover all costs to construct the specified screed to the required thickness and accuracy. The rate shall also cover the cost of providing a construction joint surface to the concrete below in accordance with SD4.7.12.1(b), applying a bonding agent and primer where specified, floating the surface of the screed, curing and all other specified requirements.

C3.3.5.8.4.9 SD8.4.9 Bond breaker below floor……Unit: m^2

The bond breaker between the blinding/ no-fines layer and the underside of the floor slab will be measured as the total area of the floor.

The rate shall cover the cost of the supply of all materials and labour for the application of the bond breaker in accordance with SD4.2.11.2.

C3.3.5.8.4.10 SD8.4.10 Casting pipes and specials in concrete……..Unit: m or No

The size (NB) of each pipe or special and the thickness of the concrete wall or floor through which it passes will be stated.

The rate shall cover all costs of fixing the item in position and casting it in in accordance with SD4.6.3.1, regardless of whether the Contractor chooses to fix the item into the formwork and cast it in or to box-out an opening and cast the item in later.

The pipe or special is measured elsewhere.

C3.3.5.8.4.11 SD8.4.11 Miscellaneous work……...Unit: As scheduled

Separate items will be scheduled for each type of miscellaneous work.

The tendered rates shall include full compensation for providing all labour, materials and equipment required to carry out the work, for all preparatory work, for constructing the work scheduled in a workmanlike manner and for finishing off and cleaning up when the work has been completed.

C3.3.5.8.5 SD8.5 DESIGNATED JOINTS ……..Unit: m

Only designated joints (SD3.1.4) as shown on the drawings or approved by the Engineer will be measured for payment. Non-designated joints will not be measured or paid for.

Separate items will be scheduled for different types of designated joints as shown on the drawings. These will include different types, sizes, and qualities of waterstops, bandage seals, sealants, joint fillers etc.

The unit rate shall cover the cost of all materials, labour and plant required to construct each type of joint as specified on the Drawings, including the cost of all formwork, preparation of construction joint surfaces as specified in SD4.7.12.1(b), the provision and installation of waterstops (including all joints), bandage sealing systems (including all joints), swellable sealing strips, bearings, sealants, fillers at expansion joints and sliding joints, bond breakers at contraction joints, recesses for sealants, chamfers or recesses as specified where concrete is exposed, as well as testing and repairing where necessary.

For designated joints in very thick members, it may be decided to measure the joint by area (m3).

In this case, the various components of the joint (waterstops etc) will be measured separately by length (m) as appropriate.

C3.3.5.8.6 SD8.6 MANUFACTURE (OR SUPPLY) AND ERECT PRECAST CONCRETE UNITS

Measurement will be any of the following:……Unit: (No, m, m^2 or m^3)

1) The total number of units

2) The total length of units

3) The total surface area of units

4) The total volume of units

Separate items will be scheduled for:

a) Different qualities of concrete

b) Different types and sizes of units

c) Small units not exceeding 0.5m3 of formed concrete

d) Different positions of units for erection purposes

Except where separate items are scheduled for specific operations or materials, the rates shall cover all the costs of manufacture (or supply) and erection of the precast concrete units complete, in accordance with all the requirements of this Standard and Specification Data, including concrete and reinforcement and all materials, equipment and labour. The rates shall also include the cost of moulds for forming the units, special finishes, curing, transportation, handling, assembly, erecting, aligning, temporary support work, building in or fixing the units in their final position including grouting or other bedding and jointing materials, fixing dowels, and built-in metalwork and components including service ducts where applicable.

C3.3.5.8.7 SD8.7 GROUTING

a) Under bases (or beds)…….Unit: m^3

Grouting under structural steel column bases or members or under pumps, motors, or other machinery will be measured by the volume of grout (before the edges are trimmed at 45º from the bottom edges of bedplates) necessary to fill the voids and pockets between the underside of the metalwork and the top of the concrete. No deduction will be made for bolts, packers, and baseplate shear keys protruding into the grout space.

b) HD bolts, etc. (see SD8.8)……...Unit: m^3

Separate items will be scheduled for HD bolts or pockets, as applicable, of different diameters, lengths, and types, and for bearings and miscellaneous metal work of different types. The quantity will be measured by the volume of grout necessary to fill the voids in the concrete. No deduction will be made for bolts and packers protruding into the grout space.

The rates for a) and b) above shall cover the cost of scabbling, cleaning, and preparing the concrete surfaces, providing an approved proprietary grout, placing and ramming it solidly into all voids and pockets, and mitring the outside edges to a true wood-floated surface and all costs of grouting in accordance with Sub-clause 4.7.18, including the provision of formwork, if required.

C3.3.5.8.8 SD8.8 HD BOLTS AND MISCELLANEOUS METAL WORK…….Unit: t

Whether the item is to be supplied by the Contractor or by others will be stated. Separate items will be scheduled as specified in SD8.7 (b).

The rate shall cover the cost of supplying and delivering or taking delivery (as applicable), fixing or casting into concrete, and all cleaning, preparation, and finishing.

The cost of installing fixings for items such as handrailing, ladders and similar, shall be included in the unit rate or sum tendered for the item to be fixed.

C3.3.5.8.9 SD8.9 COLOUR MITIGATION…….Unit: m^2

Measurement shall be on the plane projection along the exposed planes of the area being coloured.

The rate shall cover full compensation for all labour, materials, operation of equipment, tools, supplies and incidentals necessary to complete the work specified or as directed by the Engineer.

C3.3.5.8.10 SD8.10 TEST FOR WATER TIGHTNESS…….Unit: Sum

Each water retaining structure will be stated.

The unit of measurement shall be the number of each structure successfully passing the specified watertightness tests to the satisfaction of the Engineer.

The sum shall cover all costs of testing each structure as specified, including for all water required for filling and for emptying the structure of water on completion of the test, including where the structure cannot be drained, and for measuring devices and all necessary equipment. The sum shall also include for testing of the roof of each water retaining structures as specified.

C3.3.5.8.11 SD8.11 CLEANING AND STERILISING……...Unit: Sum

Payment for the cleaning and sterilising of the reservoir will be by the sum which shall cover the cost of all labour, equipment and materials, including any water required, in cleaning and sterilising as specified in SD5.1.7.

C3.3.5.8.12 SD8.12 CAST IN OF PIPES WITH OR WITHOUT PUDDLE FLANGES ……Unit: No

All pipes cast into concrete will be with a puddle flange, or as indicated on the drawing. The rate to supply and install all special pipe fittings are as per Section L: Water Mains of the Bill of Quantities which will include all costs associated with the installation of the pipe into the concrete wall as a cast in item, including labour, formwork, grout, bentonite strips etc.

The tendered rates shall include full compensation for installing the pipe where new pipes are used (with or without a puddle flange) in the exact position as shown on the drawings, for splitting or cutting the formwork where required, for ensuring water tightness where required and for all additional costs required to install the pipes specified or shown on the drawings.

New pipes shall be measured under the items of the relevant section of the specifications.

C3.3.5.8.13 SD8.13 CAST IN OF PIPES WITH OR WITHOUT PUDDLE FLANGES……Unit: as scheduled

Separate items will be scheduled for each type of miscellaneous work.

The tendered rates shall include full compensation for providing all labour, materials and equipment required to carry out the work, for all preparatory work, for constructing the work scheduled in a workmanlike manner and for finishing off and cleaning up when the work has been completed.

C3.3.5.9 SD9 MEASUREMENT AND PAYMENT FOR PRE-STRESSED CONCRETE

C3.3.5.9.1 SD9.1 CIRCULAR PRE-STRESSED CONCRETE RESERVOIRS AND TANKS

C3.3.5.9.1.1 SD9.1.1 Scheduled Items

Pre-stressing work to circular pre-stressed concrete reservoirs and tanks will be measured and paid for only under Items SD9.1.2, SD9.1.3 and SD9.1.4.

C3.3.5.9.1.2 SD9.1.2 Supply and install sheathing and tendons (Including grouting the sheaths) ....Unit: MN.m

The unit, meganewton-metre, will be calculated as the product of the characteristic strength of the pre-stressing steel in megapascals, the cross-sectional area of the tendon in square metres and the length of the tendon in metres between the faces of the anchorages. In the case of fan and loop anchorages, the length of tendon will include the length of tendon forming the loop or fan.

The rate shall cover the cost of supplying sheathing, complete with threaded inlets and with vents, supporting the sheathing, supplying and making up tendons (including the cost of spacers and waste) and threading the tendons through the sheaths as well as:

a) Royalties (if any).

b) Site supervision and labour.

c) Plant and materials.

The rate shall also cover the costs of the preparation of calculations, drawings and records and furnishing information, the provision and installation of tendon carriers, the flushing out and grouting of the sheaths and all work and incidentals required for completing the work as specified.

C3.3.5.9.1.3 SD9.1.3 Supply and install anchorages and couplers (including stressing the tendons).....Unit: MN

The unit, meganewton, will be calculated as the product of the characteristic strength of the pre-stressing steel in megapascals and the cross-sectional area of the effectively anchored tendon in square metres.

The rate shall cover the cost of fabricating, supplying, storing, handling, protecting, forming a recess for the anchorage and, where relevant for any couplers, installing and fixing the complete anchorage assembly (including, where relevant any couplers) to formwork, together with the cost of the reinforcement design for the whole anchorage zone and the cost of spiral bursting reinforcement. The rate for loop or fan anchorages shall exclude the cost of the length of tendon forming the loop or fan.

The rate shall also cover the cost of:

a) Pre-stressing the unit by tensioning the tendons in a specified sequence.

b) Anchoring off and coupling where relevant.

c) Trimming of tendon ends.

The rate shall also cover the cost of the provision and installation of reinforcement to anchor head recesses, as well as making good the anchorage recesses and all work and incidentals required for completing the work as specified.

C3.3.5.9.1.4 SD9.1.4 Friction tests.....Unit (No)

Friction tests will be measured by the number of tendons tested. The rate shall cover all costs of the friction tests specified in SD4.9.6.5.

C3.3.6 LANDSCAPE ARCHITECT

C3.3.6.1 PLS9 PARTICULAR LANDSCAPE SOFTSCAPING

C3.3.6.1.1 PLS9.1 SCOPE

This specification deal with work required for the landscape installation of trees, shrubs and ground covers.

The Contractor shall not do any planting until all operations that may require construction equipment has been completed. No construction equipment, trucks or water carts shall be allowed on areas that have been planted. Only equipment required for the preparation of areas, application of fertilizer and spreading of topsoil and compost shall be allowed to operate on these areas.

C3.3.6.1.2 PLS9.2 SOIL TESTING

The contractor shall take representative soil samples of the top 75-100mm topsoil for soil analysis from areas to be landscaped as agreed with the Landscape Architect. The sample shall be in accordance with the requirements of the soil laboratory. Samples shall be taken to determine the soil Ph, Lime, Superphosphate, NPL (Nitrogen, Phosphor and Potassium) levels, the CEC (Cation exchange capacity) and organic carbon content. These samples shall be tested by an approved laboratory to determine the appropriate fertilizer mixture, application rates and timing for the establishment of vegetation as specified.

C3.3.6.1.3 PLS9.3 MATERIALS

C3.3.6.1.3.1 PLS9.3.1 TOPSOIL

From stockpile

Where applicable, topsoil from site shall be available from the site stockpile. Where there is topsoil in cut areas, it shall first be put aside in storage piles for later usage on site. After the area is cleared all suitable topsoil, if any, located in the landscaped area and related services footprint will need to be harvested and stored in a stockpile on site. Stockpile location on site will be allocated by the Landscape Architect and will be in an area with disturbed vegetation.

All topsoil to be separated and protected from degradation, erosion or mixing with fill or waste (Protected topsoil). The contractor must ensure that 100 % of all this protected topsoil (by volume) remains on site. No topsoil may be removed from site without the written consent of the Landscape Architect.

Protected topsoil remaining on site must be kept productive by the following measures:

- Site clearance should occur in a phased manner, a maximum of 4 weeks prior to construction in the specific area, or as approved by the Landscape Architect. Salvaged topsoil must be stockpiled and protected from degradation and erosion by planting and maintaining of an approved vegetative layer in stockpiles that will be stored for more than three months. Stockpiles that will be kept for less than three months must be covered with an approved durable yet permeable material.

- Topsoil stockpiled may not be compacted to a greater density as the density prior to topsoil harvesting. No topsoil stockpile may exceed the height from the bottom of the stockpile of 1,000.00 mm to avoid unnecessary compaction.

- All stockpiled topsoil will only be used for landscaping and not for any other building or filling operations.

- Topsoil shall be placed and spread over prepared garden and lawn areas and then trimmed, all tree holes shall receive topsoil as indicated on the drawings, veld grass areas will receive

as indicated in the bill, or as required by the Landscape Architect. The topsoil thickness shall never be less than specified.

Imported to site

Importation of topsoil form contractors' own source shall only be on instruction of the Engineer or Landscape Architect. Topsoil shall only be approved after a soil analysis test is carried out by an authorised institution.

Acceptable topsoil shall be fertile with humus and fibre content, of a medium texture, composed of a sandy loam to sand clay loam with a ratio of 15 to 20% clay, 10% silt and 65 to 75% sand. The organic material contents should be not less than 2% of the volume. Topsoil shall be free of harmful damaging salts, heavy metals, potentially toxic elements, weeds, roots, other plant matter, stones and alien materials. Topsoil shall be screened at the source to remove any items larger than 15 mm that may be present & ensure that any load of topsoil contains less than 20% stone.

C3.3.6.1.3.2 PLS9.3.2 COMPOST

All compost shall consist of good decomposed organic material, free of harmful damaging salts, heavy metals, potentially toxic elements and with a pH not higher than 7.0. The maximum allowances of foreign matter particles shall be:

- Stones % of dry weight, shall be < 5% of > 5mm size
- Man-made foreign matter glass, plastic, metal, no visible contaminant, with a max 0.5% > 2mm size as % of dry weight.

Particle size shall have a coarseness of < 20mm. A sample shall be submitted to the Landscape Architect for approval. Where compost is delivered on site in bulk the Contractor shall take precautions in order to protect it from excessive dehydration, dispersal as a result of wind or exposure to rain.

C3.3.6.1.3.3 PLS9.3.3 FERTILIZER

The correct type and rate of fertilizer shall be applied based on the soil test results.

C3.3.6.1.3.4 PLS9.3.4 PLANTER MIX

Planter mix shall include 20% river sand, the Contractor shall ensure that soil drains easily, and a sample of the planter mix must be approved by the Landscape Architect.

C3.3.6.1.3.5 PLS9.3.5 LAWN

Lawn shall be the specie indicated in the BoQ. And be of pure species or similar approved.

Lawn sods or turf shall be obtained from an approved grower. The Contractor shall supply a sample of the turf he intends using for approval by the Landscape Architect. All sods used on the site shall be of a similar type to the approved sample.

The grass shall be of close texture, fibrous for sods to hold together when handled. The runners shall be well matted, with a soil layer of at least 25mm thick on the underside of the sod. The sod shall have a good even density, healthy green colour, without any dead spots and be free of infection by pests or diseases. The grass shall have been closely mown to a maximum length of 25mm. Sods shall be transported to the site in a roll form and shall be laid down in its final position on the same day as delivery, with a uniform thickness. Sods shall be kept in shade and moist until laid. The grass shall be pure according to species, unless specified as veld sods, which may contain more than one specie.

C3.3.6.1.3.6 PLS9.3.6 GRASS SEEDS

Seed shall only be the types of seed as specified, if some of the seeds in the seed mixture is not available it shall be replaced with similar species on approval by the Landscape Architect.

All the seed to be used for re-vegetation shall be supplied by Contractor. All the seed procured commercially must be germination tested by an approved laboratory and shall be free of foreign seed and other material. Test certificates to this effect shall be made available on request.

C3.3.6.1.3.7 PLS9.3.7 ANTI-EROSION COMPOUNDS

Anti-erosion compounds shall consist of a soil binding agent in suspension, which is sprayed on the soil as part of the hydro-seeding mix to bind the soil and protect it against erosion, such as “Hydropam” or a similar compound approved by the Landscape Architect. Anti-erosion compound shall be used at the rate stated in BoQ.

C3.3.6.1.3.8 PLS9.3.8 TREES, SHRUBS AND GROUNDCOVERS

All plant material shall be procured from a recognised reputable dealer. Plants shall be according to the size and species as listed in the Bill of Quantities. No species shall be substituted without submission of evidence that said species is not available at time of contract. The Contractor may propose an alternative, nearest equivalent to the original species specified for the written approval of the Landscape Architect.

Each plant shall be handled and packed in the approved manner for that species or variety and all necessary precautions shall be taken to ensure that plants shall arrive at the site in proper condition for successful growth. Trucks used for transporting plants shall be equipped with covers to protect plants from windburn. Containers shall be in a good condition and free from weeds. Plants shall be healthy, shapely and have well established rooting systems. Roots shall show no evidence of having been restricted or deformed at any time. Plants shall be well-grown, vigorous free from insect, pests and diseases.

The Contractor shall accept full responsibility to maintain all the plant material delivered to site in a good condition for the period of construction and the period defined as maintenance. The plants shall be fully maintained during this period, including watering, and any losses of plants due to lack of maintenance, including diseases developed during the contract period and the period of maintenance shall be replaced at the Contractor's expense. Plants shall be in containers for a minimum of 8 weeks and shall be stored under nursery conditions. Where plants are kept on site for an exceptionally long period and roots begin to grow out of the containers, the plants shall be planted into larger containers or root pruned regularly. No broken or bruised plant shall be stored on site. Dead plants shall be immediately removed from site. Plants furnished by the Contractor as replacements shall conform to the original specification.

No pruning wounds shall be present with a diameter of more than 25 mm. All wounds shall show vigorous bark on all edges. Plants shall not be pruned immediately prior to delivery.

Where plants are kept on site for an exceptionally long period and roots begin to grow out of the containers, the plants shall be planted into larger containers or root pruned regularly.

In addition, the Contractor should adhere to the following tree furnishing requirements:

- Trees out of 500 / 1000 Litre crated container

  Trees must be 3.5 - 4m high after planting, with well-established crowns with 150mm diameter trunks, measured 300mm above soil level. Photographs of the trees must be submitted with the tender.

- Trees out of 200 Litre containers

  Trees must be 3.5m high after planting, with well-established crowns with 60 – 90 mm diameter trunks, measured 300mm above soil level. Photographs of the trees must be submitted with the tender.

- Trees out of 100 Litre containers

  Trees must be 3m high after planting, with well-established crowns with 50 – 60mm diameter trunks, measured 300mm above soil level. Photographs of the trees must be submitted with the tender.

- Trees out of 50 Litre containers

  Trees must be 2.5m high after planting, with well-established crowns and root ball with 40 - 50mm diameter trunks, measured 300mm above soil level.

- Transplanting of plants from open ground

  Plants from open ground shall be groundcovers, trees and shrubs, grass runners, perennials that have been carefully lifted and transported to the site under ideal conditions i.e. kept moist protected against sun and wind. Plants must be sourced by a legal vendor and comply with conservation regulations.

  Open-rooted plants shall have an established root system and shall always be kept damp before transplanting. Open-rooted plants will only be acceptable where specifically stated in the Bill of Quantities.

  Plants must be transplanted on the same day that they are taken from the ground. Where plants for transplanting are out of open ground, they must be laid in soil immediately after arriving on site, such plants must be watered directly after they have been brought to the site and kept watered until planting commence. Care must be taken that roots are well spread and not broken or bent when the plants are planted. Root ends must be trimmed at an angle.

- Transplanting of plants from containers

  Remove the plant from the container without loosening the soil. Remove any stones or ash from the roots at the bottom of the container. Loosen the bottom 50mm of roots thoroughly and place plant in the prepared hole. Replace the soil so that the plant is 10mm deeper than what it was in the container. All roots must be thoroughly covered. Grafted plants must be planted such that the graft is above the ground. The soil must be shaped so that a pond is formed around the plant. Tramp the plant roots down to embed them firmly, irrigate to fill pond and hole to capacity and replace a layer of mulch (quantity as specified in the Bill of Quantities) or other approved material above the ground around the plant to fill the pond.

- Ex open ground trees

  Trees must be 4m high after planting, with well-established multi-stemmed crowns with 300mm Diameter trunks and will require viewing and approval by the Landscape Architect prior to purchasing and transporting to site. Photographs of the trees must be submitted with the tender.

C3.3.6.1.3.9 PLS9.3.9 TREE STAKES AND TREE TIES

Trees with a height of less than 3000mm

Trees stakes shall be suitable wooden stakes with a diameter of 40 -70 mm driven 300mm into the ground. Wooden stakes shall be treated with an approved preservative; poles treated with creosote

shall not be acceptable. Alternatively, an approved patent tree tie can be used and be completely adjustable to the girth of the tree.

Trees with a height of more than 3000mm

Trees stakes shall be suitable wooden stakes with a diameter of 40 -70 mm driven 400mm – 600mm into the ground. These shall be anchored by wire anchors in four directions tied to the trunk with plastic piping and anchored in the ground to iron stakes. Iron stakes shall be Y or I type poles and shall be 1,800mm in length. Alternatively, an approved patent tree anchoring system shall be used.

C3.3.6.1.3.10 PLS9.3.10 TOPDRESSING

Top dressing shall consist of equal parts of topsoil and compost, with no lump greater than < 10mm. The topdressing shall be mixed within a dedicated area on-site or be pre-mixed and imported to site.

Precautionary measures to protect the topdressing from excessive dehydration, dispersal as a result of wind or exposure to rain shall be undertaken.

C3.3.6.1.3.11 PLS9.3.11 MULCH (DRIED FIBRES)

Mulch shall consist of natural seed – free, dried fibres of hay, chaff or tall grass clippings of various lengths between 50mm-400mm or as specified.

C3.3.6.1.3.12 PLS9.3.12 MULCH (BARK CHIPS)

Bark chips shall be free of sawdust, twigs, excessive bark or any other debris. Bark chips shall consist of shredded bark and wood.

C3.3.6.1.4 PLS9.4 PREPARATION OF PLANTING AREAS

C3.3.6.1.4.1 PLS9.4.1 CLEARING OF AREA

The Contractor must remove all foreign materials and building rubble resulting from the building operations for the whole area to be landscaped. All materials must be removed and cart away to the Contractor's own dumping site.

C3.3.6.1.4.2 PLS9.4.2 BACKFILL WITH SOIL MIX

Soil mix to consist of a ratio of 70% topsoil: 30% compost.

Filling must be done in 150mm layers to the specified depth as per Bill of Quantities. The soil mix must be spread and lightly compacted to avoid sagging during wet conditions.

C3.3.6.1.4.3 PLS9.4.3 TOPSOILING

Topsoil shall be spread evenly over the prepared surfaces and be trimmed to a uniform thickness as specified in the BoQ by means of hand raking and/or mechanical blading. In all cases the layer of topsoil may be thicker than specified, but never thinner.

Topsoiling shall only be implemented after scarification has been carried out to the satisfaction of the Landscape Architect.

C3.3.6.1.4.4 PLS9.4.4 COMPOSTING

Compost shall be applied in quantities as specified in the BoQ. The compost shall be spread evenly over the area, by means of hand raking. In all cases the layer of compost may be thicker than specified,

but never thinner. This shall then be thoroughly mixed with the topsoil to a depth of 100 mm either mechanically or manually. Composting shall only be implemented after topsoil has been applied.

C3.3.6.1.4.5 PLS9.4.5 PLANTER MIX

Planter mix shall be applied in the quantities as specified in the Bill of Quantities.

C3.3.6.1.4.6 PLS9.4.6 SCARIFYING OF AREAS

The surface shall be scarified to a minimum depth as indicated in the Bill of Quantities ensuring that the entire surface is loosened. Stones less than 50 mm in size loosened or brought to the surface by scarifying may be left on the surface. However, all stones larger than 50 mm as well as foreign materials & building rubble shall be removed to spoil. Scarified surfaces shall be left of even texture, but not compacted to facilitate binding with topsoil.

Scarifying shall only be carried out once the bulk level has been achieved by the bulk earthworks contractor. On completion the surface shall be left smoothly contoured.

C3.3.6.1.4.7 PLS9.4.7 SHAPING AND TRIMMING

All areas to be landscaped shall be shaped in such a manner that the final profile shall appear as a natural extension of the adjacent undisturbed ground profiles. Trimming shall consist of bringing the existing or previously shaped ground to a smoothly flowing surface with the final levels generally following the original surface. Trimming shall normally be done using hand tools. Where machine operations are possible, trimming shall be done by grader. There may be limited cut and fill during the trimming operation and all surplus material shall be removed to spoil.

Trimming of any areas shall be done in such a way that, after scarifying and application of topsoil, if required, the finished surface of the area shall be approximately 75 mm below the top of adjacent kerbing, channelling or pavement. In all instances the areas shall be shaped to ensure that drainage of storm water to the existing storm water facilities shall be possible.

C3.3.6.1.4.8 PLS9.4.8 FINE GRADING

After the soil has been tilled and shaped to the desired soil profile and stipulated in the BoQ, final formation will be achieved by means of garden rakes.

The finished surface of the area shall be approximately 75mm lower than top of kerb or adjacent paving.

C3.3.6.1.4.9 PLS9.4.9 SUBSIDENCE

The Contractor shall address any subsidence of soil levels that may occur relating to the works as set out in this contract.

The cost of reinstating soil levels shall be borne by the Contractor.

C3.3.6.1.4.10 PLS9.4.10 FERTILIZING

The fertilizer shall be evenly applied over all surfaces where planting works shall be done and shall then be thoroughly mixed with the topsoil to a depth of 100 - 200 mm either mechanically or manually. Fertilizer shall be applied over the area once at the time of planting (within 12 hours of application) and thereafter once a year, or as required. Soluble fertilizers such as nitrates and synthetic mixtures shall be applied no more than 8 days before planting. Soluble fertilizer may only be used on growing plants if the leaves are dry and shall then be washed into soil with light watering.

Where topsoil is brought in, quantities of fertilizer as determined by the soil test, shall be broadcast during the dumping process. Manual applications of pre- measured quantities per volume of soil dumped shall be applied.

Agricultural lime shall, where large quantities are required be applied at intervals of four weeks thoroughly mixed with the soil. Where agricultural lime has been applied, superphosphate may only be applied six weeks later.

The application rate for fertilizer shall be as indicated in the BoQ.

All fertilizer shall comply with the Fertilizers, Farm feeds, Agricultural remedies & Stock remedies act, 1947 (ACT NO. 36 OF 1947)

Fertilizing shall only be implemented after topsoiling has been carried out to the satisfaction of the Landscape Architect.

C3.3.6.1.4.11 PLS9.4.11 TOPDRESSING

The Landscape Architect can at any stage request the Contractor to apply a top dressing. Before applying the topdressing, the grass shall be cut, and all cuttings removed.

The topdressing shall be applied in layers with a maximum thickness as stated in the BoQ, but never less than 5 mm. The surface shall be neatly finished by using a drag-mat, rakes and straightedges. Fertilizers prescribed by the Landscape Architect or Client may be added to the topdressing mixture before application if necessary or requested.

C3.3.6.1.4.12 PLS9.4.12 MULCHING (DRIED FIBRES)

Mulch shall be delivered to site and applied by hand to the areas before planting and to cover plant holes. Mulch shall be applied to all landscaped gardening areas by hand at the application rate specified in the BoQ. Mulch shall be mixed with topsoil, such that the mulch fibres are partly imbedded in the topsoil, but with sufficient length above the topsoil to prevent wind erosion of the topsoil. Where machine operations are not practicable, because of confined space or steep slopes, mixing of the mulch shall be done by using hand tools.

C3.3.6.1.4.13 PLS9.4.13 MULCHING (BARK CHIPS)

After trees and shrubs have been planted, soil tramped down, watered and stayed, a layer (thickness as indicated in the BoQ) of bark chip (nuggets), shall be placed around the stems.

C3.3.6.1.4.14 PLS9.4.14 STONES AND RUBBLE

Stones larger than 50 mm diameter and rubble, which are exposed during the finishing processes, must be removed and cart away to Contractor's own dumping site.

C3.3.6.1.5 PLS9.5 PLANTING

C3.3.6.1.5.1 PLS9.5.1 GENERAL

Plant material shall strictly conform to the planting plans. Alternatives shall be submitted for approval to the Landscape Architect. Planting shall be done after preparation has been completed and the irrigation system has been installed.

Extremes in temperature and moisture must be considered before the commencement of planting.

The responsibility rests with the Contractor to maintain and protect his work until completion of the project.

C3.3.6.1.5.2 PLS9.5.2 STORAGE OF PLANTS

Plants that cannot be planted immediately (i.e. plants in containers), shall be stored in nursery conditions in an area as specified by the Client and shall be tended up to and including such time as the plants are replanted.

C3.3.6.1.5.3 PLS9.5.3 PLANTING OF TREES

The positions of trees shall be as shown on the drawings and/or as directed by the Landscape Architect.

Preparation of planting holes shall be as follows:

- All holes shall be square in plan.
- Holes shall be at least twice the size (in all directions) of the plant container.
- The plant holes shall be refilled with topsoil from the stockpile mixed with the specified quantities of fertilizer.
- The holes shall be thoroughly watered before planting.
- All subsoil excavated from plant holes shall be removed to spoil.

For planting, a hole the size of the plant container shall be excavated in the centre of the previously prepared plant hole. Plants shall be carefully removed from the containers without damage to the root ball and planted in the hole such that the container soil level is flush with the surrounding ground level after firmly pressing down the soil in the hole. All surplus soil shall be levelled out over the area after planting. Directly after the planting, each plant shall be watered well, to establish the plant firmly in the soil. To avoid excessive runoff from the holes, watering shall be done three times. After the soil is set, additional topsoil shall be added where necessary to bring the hole backfill to within 50 mm of the ground surface to ensure that sufficient water can be retained.

C3.3.6.1.5.4 PLS9.5.4 STAKING OF TREES

All trees with a trunk diameter of less than 30mm, shall be fastened to (2) two wooden tree stakes.

Tree stakes shall be driven into the ground at the edge of the root zone, not through the root zone. All stakes shall be driven in at minimum of 300mm depth into solid ground.

Adjustable tree ties shall be looped loosely around the stem and fastened/nailed securely to the stake at two per tree, one at 150mm below top of stake and another one meter below first tie, depending on total height of tree.

All trees shall be kept staked and tied according to specification. Broken or unserviceable stakes shall be systematically replaced with the same type of staked as part of the routine maintenance

Wherever necessary, due to the structure and/or the shape of the trees, the tree stake and/or tree ties shall be adjusted to allow uninhabited tree growth and avoid damage to the tree.

C3.3.6.1.5.5 PLS9.5.5 PLANTING OF PLANT MATERIAL FROM A CONTAINER OR BAG

The positions of plant material shall be as indicated on the drawings and/or as directed by Landscape Architect. This shall be either:

- A symbol representing each individual plant

- A rate for the number of plants per square metre.

All areas to be planted shall be prepared by working in compost and fertilizer as specified.

Preparation of planting holes shall be as follows:

- All holes shall be square in plan.
- Holes shall be at least twice the size (in all directions) of the plant container.
- The holes shall be thoroughly watered before planting.
- Plants shall be carefully removed from the containers without damage to the root ball, placed in the centre of the prepared hole.
- The plant holes shall be refilled with imported topsoil mixed with superphosphate, fertilizer, and compost at the specified rate.
- Planting in the hole shall be such that the container soil level is flush with the surrounding ground level after firmly pressing down the soil by hand into the hole.
- All surplus soil shall be levelled out over the area after planting.
- Directly after the planting, each plant shall be watered well to establish the plant firmly in the soil. To avoid excessive runoff from the holes, watering shall be done in three small volumes over a period.
- After the soil is set, additional topsoil shall be added where necessary to bring the hole backfill to within 50 mm of the ground surface to ensure that sufficient water can be retained, thus forming a dish or saucer.

C3.3.6.1.5.6 PLS9.5.6 PLANTING OF PLANT MATERIAL FROM E.O.G, PLUG TRAYS AND ROOTED CUTTINGS

The positions of plant material shall be as indicated on the drawings and/or as directed by Landscape Architect. This shall be a rate for the number of plants per square metre indicated on the plant plan and Bill of Quantities.

All areas to be planted shall be prepared by working in compost and fertilizer as specified.

Preparation of planting holes shall be as follows:

- All holes shall be square in plan.
- Individual holes shall be dug large enough to accommodate the total root system.
- The spacing should be according to specifications, indicated on the plan and Bill of Quantities.
- The spacing of individual plants shall be such as to evenly and equally fill the area indicated on plan and shall be in neat rows.
- All subsoil excavated from plant holes shall be removed to spoil.
- The holes shall be thoroughly watered before planting.

- Plants shall be carefully handled without damage to the root system, placed in the centre of the prepared hole.
- The plant holes shall be refilled with topsoil from the stockpile mixed with superphosphate, fertilizer, and compost at the specified rate.
- Planting in the hole shall be such that the container soil level is flush with the surrounding ground level, after firmly pressing down the soil by hand into the hole.
- All surplus soil shall be levelled out over the area after planting.
- Directly after the planting, each plant shall be watered well to establish the plant firmly in the soil.
- Directly after the planting, each plant shall be watered well to establish the plant firmly in the soil. To avoid excessive runoff from the holes, watering shall be done in three small volumes over a period.
- After the soil is set, additional topsoil shall be added where necessary to bring the hole backfill to within 50 mm of the ground surface.

C3.3.6.1.5.7 PLS9.5.7 PLANTING OF LAWN SODS

Before any lawn or turf sods are laid down, the ground must first be moist to prevent excessive dehydration of the roots. Sods shall be laid against each other to form a continuous grass mat, with a uniform thickness. The surface of the grass shall be level after planting and any irregularities shall be filled in with a topdressing mixture as per specification. The maximum permissible difference in height between sods shall be 5mm or to the satisfaction of the Landscape Architect.

The finished level of the turf should conform to the levels indicated, allowing for final settlement.

Sods shall be kept in shade and moist until laid. Sods shall be lightly rolled with a roller not exceeding 20kg to achieve final levels, but under no circumstances may a heavy roller be used except where authorised by the Landscape Architect. All the sods shall, immediately after being laid, be thoroughly irrigated and kept moist.

C3.3.6.1.5.8 PLS9.5.8 SPRIGGING OF LAWN

On level ground, grass sprigs must be planted in drills 150mm apart and 50mm deep with roots laid continuously in rows.

Top dressing shall be as specified with a maximum thickness of 20 mm.

For the species ‘Cynodon transvaalensis’ the sprig shall be planted in such a way that the leaves are visible above the top-dressing.

Should the species differ from ‘Cynodon transvaalensis’ the below shall apply.

Planting for the species ‘Stenotaphrum secundatum’, ‘Dactyloctenium austral’ and ‘Digitaria swazilandensis’ shall be as for ‘Cynodon transvaalensis’.

For the species ‘Pennisetum clandestinum’ and ‘Cynodon dactylon’ can be completely covered with application if necessary or requested.

C3.3.6.1.5.9 PLS9.5.9 SEEDING

Seeding of areas shall only be carried out once all planting work in areas adjacent to the areas to be seeded have been completed.

Fertilizing for Seeding

The fertilizer shall be evenly applied over all surfaces where seeding work shall be done.

The application rate for fertilizer shall be as indicated in the BoQ (or as indicated by the soil test):

All fertilizer shall comply with the Fertilizers, Farm feeds, Agricultural remedies & Stock remedies act, 1947 (ACT NO. 36 OF 1947)

Hand-Seeding

Prior to hand-seeding the soil shall be prepared by forming furrows 50 mm deep in rows approximately 150 mm apart running parallel to the contour of the finished surface. After mixing, the seed mixture shall be divided in half and applied evenly in two successive applications, one after the other, by means of an approved hand-seeding machine (known colloquially as a “tefsaaier”). The two halves of the seed mixtures shall be applied perpendicularly to each other, across the entire area. During seeding, the seed mixture shall be regularly mixed by hand to prevent the separation of smaller and larger seeds in the mixture.

Where hand-seeding is done, seeds shall be mixed before placement with either chopped straw, sawdust or sand to prevent the separation of seeds of different size, weight and shape. Prior to seeding, trials shall be conducted to determine which of these materials is most effective in preventing the separation of seeds.

On completion of the seeding, the surface shall be lightly raked parallel to the contours to cover the seed with no more than 5 mm of soil. During raking care shall be taken to prevent the redistribution or removal of seed from any area.

Hydroseeding

Prior to hydro-seeding, the surface to be seeded shall be prepared by forming furrows 50 mm deep in rows approximately 150 mm apart running parallel to the contours of the finished surface. Anti-erosion compound shall be mixed with the hydro-seeding mixture before application.

Hydro-seeding shall be carried out using an approved hydro-seeding machine. The hydro-seeding mix shall be applied to the areas to be hydro-seeded at a rate of not less than 20 kilolitres of water per hectare.

The hydro-seeder shall have the capability to pump the specified seed mix, fertilizer and anti-erosion compound (mixed in water) at the specified rates over the areas to be seeded. The slurry distribution lines shall be large enough to prevent stoppage, and the discharge line shall be equipped with a set of hydraulic spray nozzles suitable for the even distribution of the slurry on the areas to be seeded. The mixture shall be kept uniform during the seeding operation by means of a power-driven agitator. No mixing of seed or hydro-seeding mixes shall be done without the approval of the Landscape Architect.

C3.3.6.1.5.10 PLS9.5.10 WATERING, WEEDING AND REPLANTING/ RE SEEDED

All plants shall be adequately watered at frequent and regular intervals to ensure proper growth as per LIA guidelines until the plants have established an acceptable growth and thereafter as required to sustain growth to the end of the Contractor's liability period for maintenance. The amount and frequency of watering shall be agreed upon, by the schedule provided by the Contractor.

Damage to or die back due to neglect of watering shall be the responsibility of the Contractor. Any scorched or wilted plant shall be replaced at the Contractor's own expense.

All areas shall be kept free of weeds for the period up to acceptable growth and for the period of maintenance. Weeds shall be controlled by means of pulling, cutting or any other approved means.

Any bare patches where the plants have not taken, or where it has been damaged, or has dried up shall be re-cultivated and re-planted without any additional payment.

The seeded areas shall be kept free of weeds for the period up to establishing acceptable cover and for the period of maintenance. Weeds shall be controlled by means of pulling, cutting or any other approved means.

Any bare patches where the vegetation has not taken, or where it has been damaged or has dried up, shall be re-cultivated and seeded without any additional payment.

C3.3.6.1.6 PLS9.6 GENERAL

C3.3.6.1.6.1 PLS9.6.1 TRAFFIC ON LANDSCAPE GARDENING AREAS

The Contractor shall not do any planting until all operations that may require construction equipment to be taken over areas has been completed. No construction equipment, trucks or water carts shall be allowed on areas that have been planted. Only equipment required for the preparation of areas, application of fertilizer and spreading of topsoil & compost will be allowed to operate on these areas.

C3.3.6.1.6.2 PLS9.6.2 RESPONSIBILITY FOR ESTABLISHING AN ACCEPTABLE COVER AND GROWTH

Contractor shall be solely responsible for establishing an acceptable cover and growth and for the cost of re-planting or re-seeding where acceptable cover or growth is not obtained. Where, however, in the opinion of the Contractor, it is doubtful from the outset whether it will be possible to establish an acceptable cover or growth, he may inform the Landscape Architect of his reasons for this and the Landscape Architect shall, if he agrees, either adopt another method of planting or agree to accept whatever cover or growth can be obtained, provided that all reasonable efforts are made to establish a good cover or growth using the method specified. Any such agreement shall only be valid if given in writing by the Landscape Architect, Engineer and Client.

C3.3.6.1.7 PLS9.7 MEASUREMENT AND PAYMENT

C3.3.6.1.7.1 PLS9.7.1 SOIL TEST

Unit: ea.

Measurement shall be for the test conducted according to the specifications.

The rate tendered shall include full compensation for tests, this shall include for all works required, including but not limited to taking samples, packaging, delivery to approved laboratory and payment of laboratory fees.

C3.3.6.1.7.2 PLS9.7.2 CLEARING OF AREA FOR PLANTING

Unit: m²

Measurement shall be the net area of surface cleared for planting beds.

The rate tendered shall include full compensation for all work necessary for clearing the area.

C3.3.6.1.7.3 PLS9.7.3 BACKFILL WITH SOIL MIX

Unit: m³

Measurement shall be the volume of backfill and soil mix as per the specifications.

C3.3.6.1.7.4 PLS9.7.4 TOPSOIL FROM STOCKPILE

Unit: m³

Measurement shall be the volume of topsoil applied at the specified thickness over the area. The quantity shall be calculated from the net area of the surface topsoil multiplied by the specified thickness of the topsoil but before the application of grass sods.

Any topsoil placed in excess of the average thickness specified or ordered shall not be measured.

The rate tendered for topsoil obtained from Contractors own source shall include full compensation for loading the topsoil, hauling, roughening the surface to be top soiled, offloading, placing and spreading the topsoil to the required thickness, levelling it off to a smooth surface and removing any stones as specified.

C3.3.6.1.7.5 PLS9.7.5 TOPSOIL IMPORTED TO SITE

Unit: m³

Measurement shall be the volume of topsoil applied at the specified thickness over the area. The quantity shall be calculated from the net area of the surface topsoil multiplied by the specified thickness of the topsoil, before the application of grass sods.

Any topsoil placed in excess of the average thickness specified or ordered shall not be measured.

The rate tendered for topsoil obtained from Contractors own source shall include full compensation for loading the topsoil, hauling, roughening the surface to be top soiled, offloading, placing and spreading the topsoil to the required thickness, levelling it off to a smooth surface and removing any stones as specified.

C3.3.6.1.7.6 PLS9.7.6 COMPOSTING

Unit: m³

Measurement shall be the volume of compost applied at the specified thickness over the area. The quantity shall be calculated from the net area of the surface composted multiplied by the specified thickness of the compost and shall be before the planting of plant material.

Any compost placed in excess of the average thickness specified or ordered shall not be measured.

C3.3.6.1.7.7 PLS9.7.7 PLANTER MIX

Unit: m³

Measurement shall be the volume of growth medium supplied. The quantity shall be calculated from the net area of the surface multiplied by the specified thickness of the planter mix.

C3.3.6.1.7.8 PLS9.7.8 SCARIFYING OF AREAS

Unit: m²

Measurement shall be the net area of surface prepared by means of scarifying.

The rate tendered shall include full compensation for all work necessary to scarify the area including the removal of any foreign materials and building rubble to spoil.

C3.3.6.1.7.9 PLS9.7.9 SHAPING AND TRIMMING

Unit: m²

Measurement shall be the net area of surface prepared by means of shaping and trimming.

The rate tendered shall include full compensation for all work necessary for shaping and trimming the area.

C3.3.6.1.7.10 PLS9.7.10 FINE GRADING

Unit: m²

Measurement shall be the net area of surface prepared by means of fine grading.

The rate tendered shall include full compensation for all work necessary to fine grade the area including the removal of any foreign materials and building rubble to spoil.

C3.3.6.1.7.11 PLS9.7.11 FERTILIZING

Unit: kg

Measurement of fertilizer shall be the net mass of each type of fertilizer ordered, supplied and applied.

The rate tendered shall include full compensation for furnishing the fertilizer, transporting it to the point of use, storage for spreading and mixing it into the scarified soil or topsoil in accordance with the manufacturer's instructions or as agreed to by the Landscape Architect.

C3.3.6.1.7.12 PLS9.7.12 MULCH

Unit: m³

Measurement shall be the volume of mulch applied at the specified thickness over the area.

The rate shall include for the purchase, spreading and working in of the material.

C3.3.6.1.7.13 PLS9.7.13 TOP DRESSING

Unit: m³

Measurement shall be the volume of top dressing applied at the specified thickness over the area. The quantity shall be calculated from the net area of the surface top dressed multiplied by the specified thickness of the top dressing.

The rate tendered for top dressing shall include full compensation for mixing, loading, hauling, off-loading, placing and spreading the top dressing to the required thickness, levelling it off to a smooth surface, watering and removing any surplus material. Any topdressing placed in excess of the average thickness specified or ordered shall not be measured.

C3.3.6.1.7.14 PLS9.7.14 TREES

Unit: ea.

Measurement of trees shall be the number of each type and size of tree approved, supplied, and planted on site according to the drawings.

The rate tendered shall include full compensation for procuring the plants, transporting trees from commercial nurseries to the site, maintaining the tree in a healthy condition on site until it is planted and planting the tree according to the specifications.

C3.3.6.1.7.15 PLS9.7.15 TREE STAKES AND TIES

Unit: ea.

Measurement for tree staking of trees shall be the actual number installed to specification in agreed positions.

The rate tendered shall include full compensation for transporting and installation in accordance with the specification, disposal of any waste, replacement during the maintenance period, re-adjusting where necessary, and for any other work which may be necessary to supply, delivery and install tree stakes and tree ties.

C3.3.6.1.7.16 PLS9.7.16 SHRUBS

Unit: ea.

Measurement of shrubs shall be the number of each type and size of shrub approved, supplied and planted on site according to the drawings.

The rate tendered shall include full compensation for procuring the shrub, transporting plants from commercial nurseries to the site, maintaining the shrub in a healthy condition on site until it is planted and planting the shrub according to the specifications.

C3.3.6.1.7.17 PLS9.7.17 GROUNDCOVERS

Unit: ea.

Measurement of groundcovers shall be the number of each type and size of groundcover approved, supplied and planted on site according to the drawings.

The rate tendered shall include full compensation for procuring the groundcover, transporting groundcovers from commercial nurseries to the site, maintaining the groundcovers in a healthy condition on site until it is planted and planting the groundcover according to the specifications.

C3.3.6.1.7.18 PLS9.7.18 LAWN

Unit: m²

Measurement of supply and planting of lawn shall be the net surface area of sods planted on site. The rate tendered shall include full compensation for procuring, transporting from commercial nurseries to the site.

The rate tendered shall include full compensation for procuring, transporting sods around the nursery to the site and planting it in accordance with the specifications, disposal of any waste material off-site, for initial watering and watering during the maintenance period, weeding, re-planting where necessary, and for any other work which may be necessary to plant and maintain the lawn.

C3.3.6.1.7.19 PLS9.7.19 HYDROSEEDING

Unit: ha

Measurement for hydro-seeding shall be the net area of vegetation established by hydro-seeding.

The rate tendered shall include full compensation for, procuring seed, mixing seed, fertilizer, water and anti-erosion compound (if required), for applying the mixture and for watering, re-hydro-seeding bare patches, and for any other work which may be necessary to establish acceptable cover.

C3.3.6.1.7.20 PLS9.7.20 HANDSEEDING

Unit:m²

Measurement for hand-seeding shall be the net area of vegetation established by hand-seeding.

The rate tendered shall include full compensation for, procuring seed, mixing seed, fertilizer, water and anti-erosion compound (if required), for applying the mixture and for watering, re-seeding bare patches, and for any other work which may be necessary to establish acceptable cover.

C3.3.6.2 PHC11 MULTI PURPOSE HARD COURT

C3.3.6.2.1 PHC11.1 SCOPE

This section deals with the construction and repair of multipurpose hard courts.

C3.3.6.2.2 PHC11.2 GENERAL

The Contractor shall engage and appoint the services of a hardcourt construction and repair specialist to (if applicable) to inspect existing court conditions and make recommendation on a systematic method for the repair of existing courts.

A report shall be provided (for both new and existing courts) to the Landscape Architect for approval, together with a detailed itemized quote for the works to be completed. The report on the conditions and recommendations shall contain, but will not be limited to the following items:

- Subbase and base (concrete or asphalt).
- Re surfacing and levelling level.
- Filler course and coating layer.
- Sealer layer.
- Colouring layer.
- Line markings.

C3.3.6.2.3 PHC11.3 MEASUREMENT AND PAYMENT

C3.3.6.2.3.1 PHC11.3.1 BASE LAYERS

Unit: number

Measurement will be the number of completed hardcourt bases as set out in the specifications

C3.3.6.2.3.2 PHC11.3.2 EXTRA ITEMS PER COURT

Unit: number

Measurement will be the complete number of additional items per court as set out in the specifications.

C3.3.6.3 PLH13 LANDSCAPE HARDSCAPING

C3.3.6.3.1 PLH13.1 SCOPE

This section covers all aspects of hard building works, paving, rock, concrete and street furniture. All construction work will be of the highest standard and be finished off to standards as specified by the Landscape Architect.

C3.3.6.3.2 PLH13.2 MATERIALS

C3.3.6.3.2.1 PLH13.2.1 MASS CONCRETE

Further reference must be made to SANS 1200GA with regards to basic materials, quality, manufacture and curing of concrete, reinforcement, tolerances in workmanship and testing.

Cement

Type, composition and strength must be shown on the bag or the delivery slip of the bulk cement.

Water

Water must be clean and free from injurious amounts of acids, alkalis, organic matter and other substances that could impair the strength and durability of concrete.

Gravel aggregate

Where gravel aggregate is used as surface material the specified size and colour must be cleaned and washed and laid in accordance with the plans.

Concrete mix

Mix cement, sand and stone by volume or by mass to produce the specified compressive strength at 28 days.

Mix proportions may be arrived at by a process of mix design, by the use of recognised tables of trial mixes with South African aggregates, or according to the cement manufacturer's instructions.

Mixing of concrete may be done by hand or by machine.

Add just enough eater to produce a workable consistence. Measure consistence with the standard slump test as described in SANS or as directed by the Landscape Architect.

Ready mix concrete

The Contractor may purchase ready – mix concrete, in which case the following applies:

- It must conform to the relevant SANS standards.
- The supplier is responsible for the quality of the material and the design of the mix.
- Delivery tickets must be kept for inspection.

Testing

Cast concrete test cubes of size and quantity and at intervals or of batches as specified in accordance with SANS test methods. The test cubes should be tested by an approved laboratory and all results to be send through to the Landscape Architect.

Curing

Cure concrete by means of a liquid membrane – forming curing compound at an approved rate, by ponding with water, or by covering with polyethylene or similar vapour proof material in large sheet. Cure for 7 days and longer if the ambient temperature falls below 10°C.

Surface beds

Use 15MPa concrete for surface beds to be covered with a screed. Cast to thickness of 75mm, or as specified on detail drawings. Place, compact, strike off level with the top of foundation walls and leave as is. Do not trowel, so as to provide a
good key for the screed.

Cast concrete surface beds without contraction joints or cast in 200 x 200 x 4 mm welded steel mesh, placed near the top of the surface, or as specified. Use large mats, overlap mats by at least 300mm.

C3.3.6.3.2.2 PLH13.2.2 PRECAST CONCRETE

Further reference must be made to SANS 1200 GE.

Casting

Precast concrete units may be cast on or off site in approved conditions. Submit proposals for casting procedures to be used.

Samples

Submit samples on site of every required architectural finish for approval as specified. Do not start production before samples have been approved.

Storing

Store units separately on their design and bearing surfaces in the position they will adopt when built in. Cure for at least 10 days.

Handling

Handle units so that strain, deformation and damage is kept to a minimum.

Damaged units

Report minor and hair cracks. Repair of these defects may be permitted depending on exposure.

C3.3.6.3.2.3 PLH13.2.3 MASONRY

This item is specifically for masonry work less than 1.8m in height measured from ground level. Materials and workmanship shall comply with the following standards:

- Burnt clay masonry units: SANS 227
- Limes for use in building: SANS 523
- Aggregates from natural sources: SANS 1090
- Burnt clay paving units: SANS 1575
- Metal ties for cavity walls: SANS 28

- Common cement: SANS 50197-1 (Class 32,5N)
- Masonry cement: SANS 50413-1(Class 22,5X)
- The structural use of masonry: SANS 10164-1
- Masonry walling: SANS 10249

Clay bricks

- Face bricks must be class FBS, FBX or FBA as specified or to match existing face bricks, with a minimum compressive strength of 17MPa.
- Common bricks must be class NFP with a minimum compressive strength of 7MPa for general single storey work, class NFX with a minimum compressive strength of 10,5 MPa for double storey structural walls, free standing walls and retaining walls.
- Water absorption limits must be 6-14%.
- Moisture expansion limits must be 0.015%.
- Work size must be as specified.

Concrete bricks and blocks

- Concrete bricks and blocks must comply with applicable SANS regulations.
- Colour, size, profile, and surface texture as specified.
- Compressive strength: 7MPa for freestanding walls and retaining walls.
- Average drying shrinkage:0.06%

Proof of quality

Despatch or consignment notes of bricks and blocks delivered to site must state the specified requirements and must be kept or shown when requested by Landscape Architect.

Samples

Supply a sample of 20 clay face bricks and six of every other type of clay bricks for approval. Supply one sample of every type of concrete block. Sample units must be kept on site for reference.

Storage

Unload bricks and blocks carefully to prevent chipping and breakage. Stack on prepared level areas and protect from staining and marking.

C3.3.6.3.2.4 PLH13.2.4 MORTAR

Cement

Common cement must comply with SANS 197-1, strength class 32,5 or masonry cement to comply with SANS 413-1, type MC 12,5X or 22,5X.

Type, composition and strength of the cement must be shown on the bag or the delivery slip of bulk cement.

Keep bagged cement in a dry store, always use the oldest cement first. Do not use bagged cement with lumps that cannot be crumbled by hand.

Sand

Natural or crusher sand for mortar to comply with SANS 1090. Obtain sand from one source throughout the duration of the works.

Store sand in a way that will avoid contamination by foreign matter.

Mix proportions

Mortar shall comply with the following table:

Table 1: Mortar classification

1	2	3	4
Mortar class	Minimum compressive strength MPa	Cement: sand (common cement)	Cement: sand (masonry cement)
I	10	1:4 or 50kg to 130 litres	1:3 or 50kg to 100 litres
II	5	1:6 or 50kg to 200 litres	1:5 or 50kg to 170 litres
III	1.5	1:9 or 50kg to 300 litres	1:6 or 50kg to 200 litres

Mortar shall be class II, unless otherwise specified.

Mixing

Mortar shall be mixed dry on a clean surface until of uniform colour, water added, and the mixture turned over until the ingredients are thoroughly incorporated. Mortar shall be produced in such quantities as can be used. Mixed mortar to be used within 2 hours.

C3.3.6.3.2.5 PLH13.2.5 BRICK AND BLOCKWORK

Bond

Use full bricks or blocks wherever possible.

Wherever practical brickwork shall be built in stretcher bond. Unless legitimately required to form a bond, no false headers shall be used. English bond shall only be used where specifically so indicated or where stretcher bond is not practical.

Brick reinforcement

Wire ties shall be of galvanized steel of the single wire type for solid walls and either the “butterfly” or modified PWD type for hollow walls. Ties shall be of sufficient length to allow not less than 75mm of each end to be built into brickwork or embedded in concrete.

Brickwork reinforcement shall be manufactured from hard drawn steel wire conforming to BS 785 and shall consist of two 2.8mm diameter main wires with 2.5mm diameter cross wires at 30mm centres welded at intersections. Brickwork reinforcement shall be lapped not less than 300mm at the end joints and for a length equal to the width of the widest reinforcement at intersections.

Walls in thickness of more than one skin shall have at least five wire ties per square metre. Linings to concrete, unless otherwise specified, shall be tied to the concrete with at least five wire ties per square metre.

Laying bricks and blocks

Bricks shall be laid on a solid bed of mortar and all joints shall be grouted up solid. Lay concrete blocks according to the recommendations of the Concrete Manufacturer's Association. Obtain a copy and keep on site for reference.

Lay hollow concrete blocks on shell bedding except first course of foundations, where damp proof course occurs, and in columns where all horizontal joints must be filled solid.

Fill all vertical joints solid.

The brickwork shall be carried up in a uniform manner, no part being raised more than 1.2m above adjoining work.

Rake out joints 10mm deep where a mechanical key is required for plastering.

Where necessary, bricks which are highly porous shall be wetted before being laid and the course of bricks last laid shall be well wetted before laying a fresh course upon it. Do not wet concrete bricks or blocks.

Face-brick work

Sort face bricks to ensure proper mixing within the colour range. Prepare mortar in a consistent manner to ensure face-brickwork with a uniform appearance.

Cut face bricks with a bolster or carborundum wheel.

Prepare a sample panel for approval, as specified. Maintain and protect until bricklaying is complete.

Clean face brick work as the work progresses.

C3.3.6.3.2.6 PLH13.2.6 PRECAST CONCRETE PAVING SLABS

Slabs

Paving slabs must be precast natural colour concrete paving slabs to comply with SANS 541.

Laying

Treat ground underneath concrete paving slabs with an approved weed – killer. Lay slabs on 50mm clean river sand with a 1:100 fall away from the building or as specified. Fill joints with class 1 cement mortar and strike off with a jointer.

C3.3.6.3.2.7 PLH13.2.7 RUBBLE WALLING

Stone

Stone must be approved natural stone varying in size between 150 and 600mm in section.

Mortar

Mortar must be class III mortar.

Bond

Bond must be uncoursed, but with homogenous pattern. Prepare a sample panel for approval, as specified.

Laying

Bed stones solid in mortar.

Build in wire ties at 3 per m2 where rubble walls are to be joined to brick – or blockwork. Level up tops of walls with selected long and flat stones.

Keep wall faces even.

Jointing

Make joints 25 -50mm wide and deep, square recessed.

C3.3.6.3.2.8 PLH13.2.8 STONEWORK

Specialist contractors

This work must be done by specialist contractors. Arrange a meeting between the specialist contractor and the Landscape Architect to discuss every aspect of the work, well in advance of ordering materials.

Stone

Type, colour, finish and size must be as specified.

Sub construction

The sub construction must be corrosion free structural grade aluminium horizontal rails fixed to extrude brackets of the same material and anchored to the building frame.

Stone panels

Attached stone panels with machine grooves in top and bottom edge to the aluminium rail sub – construction.

Joints

Seal joints between panels with silicone compound of approved colour, according to manufacturer's instructions.

C3.3.6.3.2.9 PLH13.2.9 PLASTERING

Materials and workmanship shall comply with the following standards:

- Common cement: SANS 50197-1 (Class 32,5N)
- Masonry cement: SANS 50413-1 (Class 225X)
- Limes for use in building: SANS 523 (slaked hydrated limes)
- Aggregates from natural sources: SANS 1090

Surfaces shall be clean and free of oil and thoroughly wetted directly before any plastering or other in situ finishes are commenced. Concrete surfaces shall be slushed with a mixture of one-part cement and one-part coarse sand or otherwise treated to form a proper key. Preparatory coats shall be thoroughly scored and roughened to form a proper key.

All coats of plastering shall be executed in one operation without any blemishes.

Screeds shall be composed of one-part cement and four parts sand.

All plaster, other than skim plaster, shall not be less than 10mm and not more than 20mm thick.

Cement plaster shall comply with the following table:

Table 2: Plaster classification

1	2	3
Plaster Class	Cement: sand (common cement)	Cement: sand (masonry cement)
I	1:4 or 50kg to 130 litres	1:3 or 50kg to 100 litres
II	1:6 or 50kg to 200 litres	1:5 or 50kg to 170 litres
III	1:9 or 50kg to 300 litres	1:6 or 50kg to 200 litres

C3.3.6.3.2.10 PLH13.2.10 WATERPROOFING

C3.3.6.3.2.10.1 PLH13.2.10.1 Damp proof courses and membranes

Polyolefin damp proof course

0.375 mm black embossed polyolefin damp proof course to comply with SANS 952, type B.

Lay damp proof course in unjointed lengths where possible and with full corner laps over full width of wall and not less than 150mm above finished ground level.

Polyolefin damp proof membrane

0.25mm smooth green polyolefin membrane to comply with SANS 952 type C.

Lay damp proof members in the largest practical sizes with 200mm laps. Seal laps with according to the manufacturer's instructions when so specified.

C3.3.6.3.2.10.2 PLH13.2.10.2 Waterproofing

Materials and Application

Waterproofing materials must be one of the following, as specified:

- Modified bitumen sheeting, consisting of a polyester core impregnated with polymer modified bitumen, of type APP (Atactic polypropylene) wax modified bitumen membrane, or type SBS (Styrene Butadiene Styrene) rubber modified bitumen membrane, as specified and of 4mm thickness. Apply in a single layer for exposed surfaces, and in double layer for applications where the sheeting is covered with stone, paving etc. Seal laps by heat fusion.

- Reinforced liquid waterproofing compounds must be acrylic or styrene/acrylic of approved colour or rubberised bitumen, as specified, reinforced with a non – woven – needle – punched polyester or polypropylene fibre fabric with a mass of 125 – 150 g/m2. Apply in five coats, i.e.

primer, bed coat, saturation code and two topcoats or according to the manufacturer's specifications.

- Polyolefin sheet waterproofing must comply with SANS 952 type C of thickness as specified. Apply sheeting in one layer. Make joints and laps waterproof with compatible solvent welds, strictly according to manufacturer's instructions.

- Synthetic waterproof membranes must be high density polyethylene, polypropylene alloys, chlorosulphinated polyethylene or polyvinyl chlorides, as specified. Apply synthetic waterproofing membranes in a single layer for exposed or covered applications. Seal laps by heat welding.

Preparation

- Surfaces to receive waterproofing must conform to the minimum substrate requirements as set out in SANS 021.

- Screed must be a minimum of 40mm thick and laid to a minimum fall of 1:70, or as specified.

- Fillets, covers and chamfers must be provided where horizontal and vertical surfaces meet.

- Screeds must be clean, smooth, even, and stable. Cracks up to 0.3m are acceptable.

- Moisture content of the screed must be less than 7%.

- Outlets must have a minimum diameter of 75mm, and not be of plastic material.

- The area to be waterproofed must be free of traffic and without protrusions.

Organise a pre – installation meeting with the manufacturer of the waterproofing material, the architect/principal agent, and the waterproofing contractor well in advance of installation to review products, procedures, quality control and guarantees, and so that clarity may be reached on construction details, for example grooves, flashing and outlets. These works procedures must be signed off by the waterproofing contractor and the manufacturer.

General application

Waterproofing to be sandwiched between wet mortar and not laid directly onto brick or concrete surfaces.

Waterproofing must be applied according to SANS 021 and according to the manufacturer's instructions.

Waterproofing must be applied by trained artisans, or, when specified, by Contractor who is a member of the Waterproofing Federation of South Africa

Provide slip layers, blinding layer, metal lathe, ventilators, movement joints etc. as necessary and according to the manufacturer's instructions.

Dress the waterproofing down into patent type stormwater outlets

Take up waterproofing at least 150mm above external soil level, tuck into the grooves where provided, and counter flash, or as specified.

Testing

Where waterproofing is applied to a horizontal surface and before applying the protection layer, one of the following tests must be performed:

- A flood test of 48 hours
- A spark, vacuum, or air pressure test, using approved testing apparatus

Where waterproofing is applied to a vertical surface, a spark or vacuum test must be performed, whichever is easiest.

Provide the Landscape Architect with a certificate that the waterproofing treatment was handed over in a watertight and workmanlike condition.

Protection

Protect the waterproofing surface with one of the following specified:

- Paint the surface of bituminous – based systems with a heavy brush of bituminous based aluminium paint to comply with SANS 802.
- Paint other systems with an approved ultra – violet block. In the case of acrylic or styrene /acrylic this UV block must be an enriched titanium tiocide dispersion applied in two coats in cross directions.
- Lay a specified geocomposite drainage layer having a minimum mass of 210g/m2 on the waterproofing, followed by an 80mm thick layer of light coloured non-absorbent natural stone of 15mm nominal size. Keep stone back from outlets and water shedding edges and bond the stone in these areas with a thinly applied cold dressing compound.

Guarantee

Provide an insurance backed guarantee from the manufacturer for the waterproofed area including flashings, skirtings, outlets, expansion joints, retaining walls, plant boxes and other details for a minimum period of 5 years on general surfaces

If any finish installed over the waterproofing is to be removed due to leaks it shall be replaced by the guarantor at no charge.

Provide full maintenance particulars.

Joints

All joints in damp proof course to walls shall be lapped a minimum of 150mm except at junctions and corners where the lap shall equal the full thickness of the wall.

C3.3.6.3.2.11 PLH13.2.11 PAINT

General requirements

Materials and workmanship shall comply with the following standards:

- Decorative high gloss enamel paints: SANS 630.
- Zinc phosphate primer for steel: SANS 1319.

- Aluminium paint: SANS 682.
- Emulsion paints: SANS 1586.

Materials for paintwork shall be delivered to the site in unopened containers and applied accordance with the manufacturer's instructions. Materials shall be suitable for application to the surface concerned. Undercoats shall be as recommend by the manufacturer of the finishing coats.

C3.3.6.3.2.12 PLH13.2.12 PREPARATION

Plastered surfaces shall be thoroughly inspected and, if necessary, washed down and brushed in order to remove any traces of efflorescence and allowed to dry completely before any paint finish is applied. Before any paint is applied, holes, cracks and irregularities in plaster and other surfaces shall be filled with a suitable filler and finished smooth. Unfinished concrete surfaces shall have all projections rubbed off and shall be thoroughly cleaned with a spirit – of – salts solution (1-part concentrated spirits – of – salts to 4 parts water).

Metal surfaces shall be sanded, where necessary, washed with a suitable cleaning agent and left smooth.

Protective coatings applied by manufacturers to galvanized surfaces shall be removed with a suitable agent and the surfaces washed down.

Rust, grease and defective factory primers on metal surfaces, as well as pitch on cast iron pipes shall be removed.

Protect surfaces not to be painted

Colours

The colours of undercoats must match the finishing coat closely but with enough difference to be able to distinguish between all coats.

Prepare colour samples of all finishing coats for approval before any bulk paint is purchased.

A colour scheme comprising colours and the blending of colours approved by the Landscape Architect shall be used for the paintwork.

C3.3.6.3.2.13 PLH13.2.13 PAINTING IN GENERAL

Before subsequent coats of paint are applied the previous coat shall be properly dry and shall be sanded down where necessary.

Do not paint when conditions are unsuitable, for example dust, insufficient light, direct sunlight and increment weather.

Paint shall not be sprayed on except in the case of cellulose and other special paints where spray painting is the accepted method of application.

Paint on woodwork

In the case of existing woodwork that has to be redecorated, wash down if paint is still firm or remove blistered or broken-down paint with a blow – torch or paint remover. Scrape out cracks, holes and crevices and make good with hard stopping.

Sand down surfaces with suitable grit abrasive paper or cloth, or with steel wool.

Knots in woodwork shall be treated with knotting. Minor blemishes shall be fitted with a suitable filler. Wood surfaces shall be sanded smooth.

Treat knots with wood knotting

Stop nail and screw heads, and cracks, with suitable hard stopping.

Prime or seal joinery before building in. This applies to all frames, all six sides of a door, and to rebates and the backs of beads in glazing apertures.

Prime external structural timber before fixing.

Primers to wood surfaces shall be applied by brush. Primers to other surfaces may be applied by brush or roller.

Paint wood as follows:

- Prime wood, external primers for woods to comply with SANS 678, type 2.
- Paint on universal undercoat to comply with SANS 681(except emulsion paint).
- Finish with 2 coats alkyd enamel paint to comply with SANS 630, type 2 and of specified finish.

Clear finish on woodwork

Sand down surfaces with suitable grit abrasive paper in the direction of the grain. Remove all pencil marks or other surface discolourants. Clean down existing hardwood that has to be redecorated.

Stop nail and screw heads and cracks with tinted stopping to match wood and rub down.

Stain wood if specified with approved stain. Apply stain according to the manufacturer's instructions. Provide a separate sample panel for approval of colour and application.

Finish wood as follows:

Apply approved wood preservative to exposed exterior wood to saturate the surface, allowing each coat to soak in before applying further coats. Apply to end grain until no further soaking in takes place.

Alkyd paint on plaster

Make sure walls are dry

Remove loose paint from previously painted surfaces.

Fill and stop cracks on one coat plaster only with suitable filling or with plaster of the same mix and rub down. Do not fill gypsum plaster.

Paint plaster as follows:

- Apply one coat bonding liquid on gypsum plaster.
- Apply one coat alkali resistant plaster primer to comply with SANS 1416 on one coat plaster.
- Apply one universal undercoat to comply with SANS 681, grade 1.

- Finish with one or two coats alkyd enamel paint to comply with SANS 630, type 2 and of specified finish.

Emulsion paint on plaster

Remove loose paint from previously painted surfaces

Ensure complete drying depth of plater before applying paint

Rake out cracks and prime with emulsion paint to comply with SANS 1586, grade 2

Paint walls as follows:

- Apply one coat emulsion paint to comply with SANS 1586, grade 2 thinned with 10% clean water.
- Apply two coats emulsion paint to comply with SANS 1586, of grade and gloss designation as specified.

Paint plastering ceilings as follows:

- Apply two coats emulsion paint to comply with SANS 1586, of grade and gloss designation as specified.

Emulsion paint on fibre cement, barge boards, cladding

Remove loose paint from previously painted surfaces

Touch up steel screw heads and metal cover strips with zinc phosphate primer to comply with SANS 1319.

Touch up brass screw heads with vinyl wash primer to comply with SANS 723, paint fascia's, barge boards etc. as follows:
Apply one coat emulsion paint to comply with SANS 1586, grade 2 thinned down with 10% clean water

Apply two coats emulsion paint to comply with SANS 1586, of grade and gloss designation as specified.

Alkyd paint on structural steel

In the case of structural steel that could not be factory primed, or where shop primed steel has been damaged on site, or in the case of previously painted surfaces where the paint system has failed, prepare steel surfaces for priming to shiny metal state according to SANS 064.

In the case where painting will not be possible after fixing, paint steel components with the full paint system before fixing in positions.

Paint steel as follows:

- Apply two coats of zinc phosphate primer to comply with SANS 1319.
- Apply one universal undercoat to comply with SANS 681, grade 1.
- Finish with two coats structural steel alkyd-based paint to comply with SANS 684, type B.

Paint on galvanized steel

Remove loose paint from previously painted surfaces

Scrub and wash with galvanized iron cleaner. Rinse thoroughly with clean water.

Sand or abrade to remove any rust stains, wipe clean and treat affected areas with a rust remover

Where galvanized steel was unavoidably welded on site, clean joint and cold galvanise to approval.

Paint galvanized steel with one of the following systems, as specified:

- Apply one coat vinyl wash primer to comply with SANS 723, one coat universal undercoat to comply with SANS 681 grade 1, and finish with two coats alkyd enamel paint to comply SANS 630, type 2, and of specified finish, or
- Apply two coats emulsion roof paint to comply with SANS 940, or
- Apply one coat vinyl wash primer to comply with SANS 723, and two coats emulsion paint to comply with SANS 1586, grade 1.

Paint galvanized fence posts as follows:

Apply one coat vinyl wash primer to comply with SANS 723, and two coats aluminium finishing paint to comply with SANS 682, grade 2.

Alkyd paint on cast iron

Remove bitumen until a clean, sound substrate is achieved

Apply one coat vinyl wash primer to comply with SANS 723

Finish with one coat alkyd paint to comply with SANS 630, type 2, or with two coats emulsion paint to comply with SANS 1586, of grade and gloss designation as specified.

C3.3.6.3.2.14 PLH13.2.14 CONCRETE RETAINING BLOCKS

Blocks

Concrete retaining blocks must be of type, size and colour as specified.

Preparation

Ascertain the position and depth of existing buried services before excavating, to avoid damage.

Prepare level and compacted earth foundation trench of depth as specified.

In the case of walls not higher than 1.2m lay a 300 x 75mm deep layer of compacted granular base material like crushed rock or gravel.

In the case of walls higher than 1.2m, lay a concrete strip foundation of 150mm thick and of width as specified.

Install perforated drain pipe with positive gravity flow to outlets, aggregate blanket drain and geotextile covering behind wall as specified.

Placing

Place blocks as follows:

- Stack units by hand, without mortar, true to line, level and in an agreed pattern.
- Place approved granular backfill and compact to specified density.
- Lay geosynthetic reinforcement according to the manufacturer's instructions, when specified.
- Clean wall, clear debris, and clear pockets, ready to accept planting

C3.3.6.3.2.15 PLH13.2.15 WIRE FENCING

Wire

Straining wire, binding wire and chain link wire must comply with SANS 1373 with light zinc coating to comply with SANS 675, and of grade steel, diameter and mesh size as specified.

Flat wrap razor security wire must comply with SANS -CKS 592. Wire and clips must be aluzink coated.

Straining eye bolts

Straining eye bolts must be 10mm diameter x 300mm threaded mild steel bolt with eye, washer and nut, galvanised to SANS 763, general duty. Approved permanent wire pullers may be sued instead.

Droppers

Droppers must be mild steel H section with holes and a mass of 470g/m or T section with ridged face and a mass of 550g/m. The length of droppers must be 75mm longer than the distance between top and bottom lines. Droppers must be finished as specified.

Standards

Standards must be mild steel H-, bulb T – or bell section, pointed to facilitate insertion in the ground. Standards must be finished as specified.

Posts and stays

Steel posts must be mild steel tubing of minimum 65mm nominal diameter and minimum 3.25 mm wall thickness, with 230 x 230 x 5 mm mild steel base plates welded on.

Steel stays must be mild steel tubing of minimum 40mm nominal diameter and minimum 2.9mm wall thickness, with 150 x 150 x 3mm mild steel base plates welded on. One end of stays must be flattened, bent and holed for fixing to post with 12M bolt.

Posts and stays must be painted with two coats bituminous aluminium paint to parts above ground and parts below ground as specified.

Concrete posts must be prestressed alkali aggregate reactive concrete

Wood posts must be creosote or tanalith treated to comply with SANS 457.

Posts must be provided with holes for hinges, straining bolts or binding wire.

Concrete

Concrete for bases must be 10mpa concrete

Erection

Erect fence as follows:

- Clear the fence route of vegetation or other obstructions. Roughly level to obtain a uniform gradient.
- Excavate holes 400 x 400 x 800mm for posts and 300 x 300 x 600 deep for stays. Excavations are deemed to be in “soil”. Notify the Landscape Architect if harder material is encountered.
- Plant posts and stays in concrete 50mm above ground level with chamfered top surface, at gates, corners and at specified distances or at acute changes in distance or at acute changes in level. Provide stays at all straining posts in direction of the line of fence.
- Drive standards 450mm deep into ground at 3m centres.
- Thread straining wire through holes in standards, bind around posts or straining eye bolts and strain to approval.
- Bind droppers to straining wire with binding wire.
- Cover with wire mesh, tension and bind securely to straining wire at every third mesh. Join roll ends with a spiral to form continuous fence. Tie or clip welded mesh to straining wire at 300mm centres. Trim roll ends by overlapping 100mm.
- Fix flat wrap razor wire in loops of specified diameter and with barbed straining wires, with binding wire as specified.
- Make good any protective coatings.
- Do not cut preservative treated timber where it will be in the ground.
- Check fence on completion. Grease hinges. Cut off projecting bolt threads. Burr over bolt ends to prevent nut removal and coat with bitumen paint.

Gates

Form gates of 50mm diameter x 2.8m wall thickness mild steel pipe frame with all joints welded, with braces as specified, and filled in with wire mesh as described fencing, strained and bound to the frame with binding wire.

Gates must be of sizes as specified

Hang gates on hinges as specified

Provide gates with catches, drop bolts and locking devices

Gates and accessories must be hot dip galvanized to comply with SANS 763 or painted two coats bituminous paint to comply with SANS 682, as specified.

C3.3.6.3.2.16 PLH13.2.16 RIP RAP (DUMP ROCK)

Rock used should be clean, sufficiently durable and should be obtained from a commercial crushing source. Place dump rock on separation layer with large face down and stepped back from rocks below. Rock must be un-weathered and solid without flaking or weathering evident, soft rocks and brick fragments are not suitable. Rocks must be packed at a slope of 2:1 and must have an overall thickness of approximately 330mm as indicated on the detail drawings. Dump rock shall not be flaky and shall not contain deleterious materials. Approximate rip rap dump rock composition:

Table 3: Rip rap composition

Approximate average dimension	Percentage cover
0.09m	15%
0.195m	35%
0.28m	35%
0.33m	15%

C3.3.6.3.2.17 PLH13.2.17 IMPORTED BOULDERS

Boulders must be pre-approved before imported to site and placed in the position as indicted on the plans.

C3.3.6.3.2.18 PLH13.2.18 WET POURED RECYCLED RUBBER FLOORING

Material must be delivered in the manufacturer's original, unopened, undamaged wrapping and/or containers with identification labels intact clearly marking edge type, thickness, percentage of speckle and shade of colour(s).

Inspect all deliveries to ensure undamaged goods and for accurate product type for colour and speckle.

Materials must be handled carefully and protected from exposure to harmful weather and temperature conditions recommended by the manufacturer.

Rubberized surfaces must be laid on a smooth (free of depressions) and cleaned (free of debris) area according to the manufacturer's specifications. Colours and patterns must be according to the detailed plans.

Do not proceed with floor surfacing installation until all applicable site work, including substrate preparation, painting, equipment installation, compounds, sealers, hardeners and other relevant work by trades affecting the installation area, has been completed. Once all applicable site works are complete, a moisture test, according to manufacturer's specifications must be performed.

All substrate testing shall be documented and submitted to the Landscape Architect/Engineer before commencement of the flooring installation.

Close spaces to traffic during rubber flooring installation and for a period after installation as recommended by the manufacturer.

Comply with manufacturer's instructions for proper cleaning and maintenance of the products.

C3.3.6.3.2.19 PLH13.2.19 TIMBER PERGOLA

The details (including foundations) of the timber pergola must be conducted by an industry specialist, based on the dimensions and height as indicated in the layout drawings. The drawings must be approved by the Landscape Architect before installation commence.

All design and construction of the timber pergola must comply to SANS 10400 and SANS 10082 Code and Practice for Timber Buildings.

C3.3.6.3.2.20 PLH13.2.20 PLAYGROUND EQUIPMENT

All products must be delivered to site undamaged, safely stored on site and installed according to the manufacturer's specifications.

C3.3.6.3.2.21 PLH13.2.21 OUTDOOR GYM EQUIPMENT

All outdoor gym equipment must be delivered to site undamaged, safely stored on site and installed according to manufacturer's detailed specifications. All outdoor gym equipment must be of the same design as specified and placed in the positions as indicated on the detail drawings.

C3.3.6.3.2.22 PLH13.2.22 CUSTOMIZED STREET FURNITURE

All construction work shall be done with the materials specified and in accordance with the detailed drawings and bill of quantities.

All construction work shall be protected from exposure to the elements until it has been treated according to specifications. Any construction work which is exposed to moisture, other hazards or potential damage before treatment, will not be accepted.

C3.3.6.3.2.23 PLH13.2.23 PRE-FABRICATED STREET FURNITURE AND OTHER ELEMENTS

All pre-fabricated street furniture shall be delivered to site undamaged and must be stored safely. A level area must be provided around benches and seats where it is installed on slopes.

C3.3.6.3.2.23.1 PLH13.2.23.1 Litter bins

Litter bins must be of the same size, type, colour, material and design as indicated in the BoQ and/or detail drawings, placed and fastened in the positions as indicated on the layout plans and detail drawings.

C3.3.6.3.2.23.2 PLH13.2.23.2 Benches

Benches must be of the same size, type colour, material and design as indicated in the BoQ and/or detail drawings, placed and fastened in the positions as indicated on the layout plans and detail drawings.

C3.3.6.3.2.23.3 PLH13.2.23.3 Tree rings

Tree rings must be of the same size, type, colour, material, and design as indicated in the BoQ and/or detail drawings, placed and fastened in the positions as indicated on the layout plans and detail drawings.

C3.3.6.3.2.23.4 PLH13.2.23.4 Picnic sets

Picnic sets must be of the same size, type, colour, material, and design as indicated in the BoQ and/or detail drawings, placed and fastened in the positions as indicated on the layout plans and detail drawings.

C3.3.6.3.2.23.5 PLH13.2.23.5 Tables

Tables must be of the same size, type, colour, material, and design as indicated in the BoQ and/or detail drawings, placed and fastened in the positions as indicated on the layout plans and detail drawings.

C3.3.6.3.2.23.6 PLH13.2.23.6 Braais

Braais must be of the same size, type, colour, material and design as indicated in the BoQ and/or detail drawings, placed and fastened in the positions as indicated on the layout plans and detail drawings.

C3.3.6.3.3 PLH13.3 MEASUREMENT AND PAYMENT

C3.3.6.3.3.1 PLH13.3.1 GRAVEL AGGREGATE

Unit: m³

The rate for gravel aggregate shall be cubic meters.

All gravel aggregate shall include full settlement per measured cubic meter; the rate shall include compensation for all work necessary to undertake the laying of the gravel as per specification, including but not limited to all materials, plant equipment, labour, supervision, cleaning, mark up, profit, wastage and removal of waste from site.

C3.3.6.3.3.2 PLH13.3.2 SEPARATION LAYER (BIDIM OR SIMILAR APPROVED)

Unit: m²

Measurement of separation layer shall be the number of square meters.

The rate for the approved liner shall include work necessary to undertake the laying of the liner as per detailed specification, including but not limited to all materials equipment, labour and supervision, cleaning, mark up, wastage and removal of waste from site.

C3.3.6.3.3.3 PLH13.3.3 RIP RAP (DUMP ROCK)

Unit: m³

The rate for rip rap will be cubic meters.

All dump rock shall include full settlement per measured cubic meter; the rate shall include compensation for all work necessary to undertake the laying of the rip rap as per specification, including but not limited to all materials, plant equipment, labour, supervision, cleaning, mark up, wastage and removal of waste from site.

C3.3.6.3.3.4 PLH13.3.4 IMPORTED BOULDERS

Unit: Each

Measurement of imported boulders shall be the number of each size of boulder approved, supplied and placed on site according to the drawings.

The rate tendered shall include full compensation for procuring, transporting and placing.

C3.3.6.3.3.5 PLH13.3.5 WET POURED RECYCLED RUBBER FLOORING

Unit: m²

Measurement of wet poured recycled surfaces shall be the number of square meters.

The rate for the wet poured recycled rubber flooring shall include all work necessary to undertake the laying of the rubber flooring as per detailed drawings, the rate shall include (but not be limited) to all

materials equipment, labour and supervision, cleaning, mark up, wastage and removal of waste from site.

C3.3.6.3.3.6 PLH13.3.6 PLAYGROUND EQUIPMENT

Unit: Each

Measurement of playground equipment shall be the number of each specified playground equipment, supplied and fixed on site according to the drawings.

The rate tendered shall include full compensation for procuring, transporting and fastening.

C3.3.6.3.3.7 PLH13.3.7 OUTDOOR GYM EQUIPMENT

Unit: Each

Measurement of outdoor gym equipment shall be the number of each specified gym equipment, supplied and fixed on site according to the drawings.

The rate tendered shall include full compensation for procuring, transporting and fastening.

C3.3.6.3.3.8 PLH13.3.8 CUSTOMIZED STREET FURNITURE

Unit: Each

Measurement of customized street furniture shall be the number of each specified customized street furniture, built and fixed on site according to the drawings.

The rate tendered shall include full compensation for procuring and transporting of materials and fastening of the final product according to the detail drawings.

C3.3.6.3.3.9 PLH13.3.9 PRE-FABRICATED STREET FURNITURE

Unit: Each

Measurement of outdoor gym equipment shall be the number of each specified street furniture, supplied and fixed on site according to the drawings.

The rate tendered shall include full compensation for procuring, transporting and fastening.

C3.3.6.3.3.10 PLH13.3.10 MASONRY PODIUMS

Unit: Each

Measurement of masonry podiums shall be the number of each masonry podium with unique specified height, width and length built on site according to the detail drawings.

The rate tendered shall include full compensation for labour and procuring and transporting of all materials.

C3.3.6.3.3.11 PLH13.3.11 MASONRY FEATURE WALLS

Unit: Each

Measurement of masonry feature walls shall be the number of each feature wall with unique specified height, width and length built on site according to the detail drawings.

The rate tendered shall include full compensation for labour and procuring and transporting of all materials.

C3.3.6.3.3.12 PLH13.3.12 IN SITU CONCRETE SURFACES

Unit: m²

Measurement of in situ concrete surfaces shall be the number of square meters.

The rate for in situ concrete surfaces shall include all work necessary to undertake the laying of the concrete according to the specified thickness and strength as per detailed drawings, the rate shall include (but not be limited) to all materials equipment, labour and supervision, cleaning, mark up, wastage and removal of waste from site.

C3.3.6.3.3.13 PLH13.3.13 PERCENTAGE MARK UP

Unit: %

The percentage mark-up is a percentage related to the fixed sum of the specific item as stated in the BoQ. The percentage shall include all supervision and stated requirements related to the specific product.

C3.3.6.3.3.14 PLH13.3.14 WOODEN VEGETABLE PLANTER BOXES

Unit: Each

Measurement of wooden vegetable planter boxes shall be the number of each specified planter box, supplied, assembled and fixed on site according to the drawings.

The rate tendered shall include full compensation for contractor's mark up, required soil, plants, procuring, transporting, assembling and fastening on site.

C3.3.6.3.3.15 PLH13.3.15 SHADE NET CANOPY STRUCTURE

Unit: Each

Measurement of shade net canopy structures shall be the number of each shade net canopy, supplied, assembled and fixed on site according to the drawings.

The rate tendered shall include full compensation for contractor's mark up, procuring, transporting, assembling and fastening on site.

C3.3.6.3.3.16 PLH13.3.16 STEEL MESH FENCE

Unit: m

Measurement for steel mesh fencing shall be linear meters.

The rate for steel mesh fence shall include all work necessary to undertake the erection of the fence according to the drawings and manufacturer's specifications. The rate shall include (but not be limited) to all materials, equipment, labour and supervision, cleaning, mark up, wastage and removal of waste from site.

C3.3.6.4 PIR14 AUTOMATIC IRRIGATION

C3.3.6.4.1 PIR14.1 SCOPE

The works shall comprise of the supply, installation and commissioning of an automatic irrigation system as shown on the irrigation plan and irrigation BoQ. Included in the works are the installation of sprinklers, pipelines, control valves, control wires, an irrigation control system, the supply of as-built drawings and a working manual of the system.

C3.3.6.4.2 PIR14.2 GENERAL CONDITIONS

C3.3.6.4.2.1 PIR14.2.1 EXAMINATION AND VERIFICATION OF THE DRAWING AND SITE

Sprinkler lines shown on the drawing are essentially diagrammatic.

It shall be the Contractor's responsibility to report to the Landscape Architect any deviations between drawings, specifications and the site. Failure to do so prior to the installing of equipment and resulting in replacing, and/or relocating equipment shall be done at the Contractor's expense.

C3.3.6.4.2.2 PIR14.2.2 MATERIALS AND WORKMANSHIP

Whenever a name and/or number thereof specify any material, such specifications shall be deemed to be used for the purpose of facilitating a description of the materials and establishing quality.

No material shall be substituted without submission of specifications for the written approval of the Landscape Architect.

All materials shall be new and without flaws or defects.

C3.3.6.4.2.3 PIR14.2.3 ELECTRICAL SUPPLY AND CONTROLLER LOCATION

The Client and the Contractor shall mutually agree on the locations of the irrigation controller. The Client is responsible for providing a 220 - volt power supply within 3m of the controller location.

All communication and decoder cable to be laid in the same trench as mainline piping and is not to be sleeved. If joints are necessary, they must be housed in a valve box.

The supply point should be provided with lightning surge protection according to SANS standards. All electrical work to be carried out by qualified electrician.

C3.3.6.4.2.4 PIR14.2.4 WATER SOURCE

Water must be provided as per specified requirement. If this is not possible redesign will be necessary.

If fertigation is used anti-backflow devices must be fitted.

If pressure of source is higher than the pipe rating adequate pressure reducing valves need to be installed.

C3.3.6.4.2.5 PIR14.2.5 GUARANTEE

It shall be the Contractor's responsibility to ensure and guarantee complete coverage of the areas shown on the drawings to be irrigated, without excessive overthrow onto streets, driveways and buildings.

The Contractor shall guarantee the satisfactory operation of the entire system and the workmanship and restoration of the area for 1 year.

The Contractor hereby agrees to repair or replace any defects occurring within that year, free of expense to the Client.

C3.3.6.4.2.6 PIR14.2.6 AS-BUILT DRAWINGS

Upon completion of his work, the Contractor shall prepare an as-built drawing of the system indicating:

- sprinkler model and location
- pipe size and location
- automatic valves model and location
- wire or control tube location
- controller location
- main shut-off valve and any isolation valve locations
- location of buried sleeves
- irrigation zones

The as-built drawings need not be drawn to scale but must be proportionally and diagrammatically correct. The Contractor shall retain the original drawing in his files and summit two copies to the Client.

C3.3.6.4.2.7 PIR14.2.7 MATERIAL

C3.3.6.4.2.7.1 PIR14.2.7.1 Pipe

All pipes shall be continuously free from visible cracks, dents, hole or foreign materials.

Pipes must be permanently marked with the following information: manufacturer's name or trademark, size, schedule and type of pipe, working pressure. All pipes to be SANS approved unless otherwise arranged.

C3.3.6.4.2.7.2 PIR14.2.7.2 Wiring

All 220-volt wiring shall conform to the local electrical codes.

All 24-volt control wire between the solenoid valves and the controllers shall be of sufficient size to limit volt drop. These sizes are listed as in the BoQ calculated by the irrigation specialist.

C3.3.6.4.2.7.3 PIR14.2.7.3 Manual control and isolation valves

All mainline isolating valves shall be of the SANS approved resilient seat type and shall be right hand closing cap top types. All other valves shall be of brass with cast hand wheels. All valves shall be housed in valve boxes.

C3.3.6.4.2.7.4 PIR14.2.7.4 Valve boxes

All manual and automatic valves shall be enclosed in proper irrigation thermo plastic valve boxes, of size as required to permit "ease of access" for service purpose. The boxes shall feature locking or hinged covers, with an impregnated green colour. The term "ease of access" means that every solenoid and manual valve should have adequate access for all types of maintenance.

C3.3.6.4.2.7.5 PIR14.2.7.5 Sleeves

Contractor may not use sleeves provided for electricity.

C3.3.6.4.2.8 PIR14.2.8 INSTALLATION

Mainlines and laterals

All plastic pipe and fittings shall be installed as outlined and instructed by the pipe manufacturers and it shall be the Contractor's responsibility to make arrangements with the pipe manufacturer for any field assistance that may be necessary. The Contractor shall assume full responsibility for the correct installation.

Control valves

All control valves shall be installed in proper irrigation valves boxes, in such a manner as to readily permit servicing and operation. The location of the valve boxes shall be coordinated with the Landscape Architect, so as not to interfere with the aesthetics of the project, or in the case of manual controls, expose the operator to sprinkler overthrow. Gravel is to be placed under the valve box to aid drainage and keep dirt away from the valves.

Mounting of an automatic controller

The location of the controller is to be negotiated between the Contractor and the Client. The unit shall be installed as per manufacture's specifications.

Wiring

All 220-volt wiring to the controllers shall be enclosed in PVC electrical conduit.

All visible low voltage wire shall be enclosed in PVC electrical conduit. Direct burial wire may be trenched or placed in a common trench beneath irrigation pipes.

Wire must be cable tied or bound with insulation tape at 3m intervals to keep the wire in place.

Control tubing

All visible control tubing shall be enclosed in conduit. Control tubing may be trenched or placed in a common trench beneath irrigation piping. When more than one control tube is in a common trench, it shall be bundled and taped together every 3m.

The control tubing must be sealed close at each connection to an automatic valve, and provision must be made for expansion and contraction of all buried tubing, including protection from foreign objects.

Flushing and set up

Upon completion of each section or of the entire installation, and prior to assembly of nozzles and pop-up components, the control valves shall be opened, and a full head of water used to flush out the system. Sprinklers assembly can then be completed, including all necessary adjustments and setup procedures.

C3.3.6.4.2.9 PIR14.2.9 TESTING AND OPERATION OF THE IRRIGATION NETWORK

Testing

Flush all lines and ensure that all air is expelled from the system.

Inspect all visible piping and walk all buried lines for any leakage.

If a pump is included, verify direction of rotation (if applicable), operating pressure and any leakage. Any repairs necessary to render the system in good working order shall be completed at this time, at the Contractor's expense, before final payment by the Client.

Operation

Verify all sprinklers settings, overlap, nozzle sizes, and operating pressures. Adjust the flow control on automatic valves where necessary. Program the controller into a logical sequence and endeavour to accomplish heavy infrequent water cycles as opposed to light frequent settings.

C3.3.6.4.3 PIR14.3 MEASUREMENT AND PAYMENT

C3.3.6.4.3.1 PIR14.3.1 AUTOMATED IRRIGATION SYSTEM

Unit: sum

The rate shall include for full compensation for all work necessary to undertake the installation of the fully automatic irrigation system, including but not limited to all plant equipment, materials, labour, supervision, cleaning, up mark, profit wastage and removal of waste from site.

C3.3.6.4.3.2 PIR14.3.2 SLEEVES

Unit: sum

The rate shall include for full compensation for all work necessary to undertake the construction of the sleeves, including but not limited to all plant equipment, materials, labour, supervision, cleaning, up mark, profit wastage and removal of waste from site.

C3.3.6.5 PLM15 LANDSCAPE MAINTENANCE

C3.3.6.5.1 PLM15.1 SCOPE

This specification deals with work required for the landscape maintenance of paving, trees, shrubs, ground covers, lawn and veld-grass areas as applicable to the design.

Landscape maintenance shall include but not be limited to the supply of all management, expertise, labour, maintenance equipment, tools, fuel, required materials, as may be deemed necessary for the mowing of lawns, pruning of trees and shrubs, replacement of dead plants, working in of compost controlling of the environment, removal of litter and rubble, weeding, inspections, fertilizing, irrigating and in general everything that is deemed necessary to produce vigorous growth to maintain the site to the highest standards in a neat and acceptable condition to the satisfaction of the Landscape Architect and Client.

The maintenance includes but is not restricted to:

- Provide and apply expertise in field of horticulture.
- Provide and apply expertise in field of landscape maintenance management.
- Drawing of soil and water samples and conducting other tests (if applicable).
- Maintenance and establishment of landscape installation.
- Maintenance and adjustment of the irrigation system.
- Observation and preparation of reports of activities on site (as well as adjoining sites which affect the landscape installation).
- It is a specific requirement of this contract that the design philosophy of the landscape be brought to maturity.

C3.3.6.5.2 PLM15.2 GENERAL

C3.3.6.5.2.1 PLM15.2.1 MAINTENANCE PRIOR TO PRACTICAL COMPLETION

The contractor must maintain all planting. All planted areas shall be maintained in a weed-free condition by hand. No chemical weed killers shall be used without prior approval of the Landscape Architect/Client. The beds shall be kept in a tidy condition. The Contractor shall allow for checking the stakes and pruning as required. Any pruning shall only be carried out with the prior agreement of the Landscape Architect.

All planted and seeded areas shall be adequately watered in frequent and regular intervals in order to ensure proper germination and growth until an acceptable cover has been established and thereafter until the commencement of the maintenance period. The amount and frequency of watering shall be subject to the Landscape Architect's approval.

The Contractor shall ensure that during this period the irrigation system is working adequately and shall immediately report any malfunction to the Landscape Architect. Should the system malfunction, the Contractor shall during this period of malfunctioning allow for hand watering of all landscaped areas such that each area receives water every two days during initial establishment, or as instructed.

C3.3.6.5.2.2 PLM15.2.2 COMMENCEMENT OF MAINTENANCE PERIOD

The maintenance period shall commence when all work, including all additional work has been completed and practical completion is reached mutually agreed between the Client, Project Manager and Landscape Architect. Where the terrain has been divided into areas or phases, such phases of the work must be agreed by the Client and may on approval be considered complete. The acceptance of completed work shall not relieve the contractor of any of his obligations and responsibilities in connection with this document.

C3.3.6.5.2.3 PLM15.2.3 DURATION OF MAINTENANCE PERIOD

When the completed work has been accepted, the terrain or portions thereof, as agreed, shall be maintained as specified.

C3.3.6.5.2.4 PLM15.2.4 FINAL HANDOVER

The terrain or part thereof shall, after complying with all maintenance requirements, be taken over by the Client. This is only after a final inspection of the work has been done and it is found that the work or the repair work has been done satisfactorily.

C3.3.6.5.3 PLM15.3 MATERIALS

C3.3.6.5.3.1 PLM15.3.1 LANDSCAPE MAINTENANCE EQUIPMENT

It is an express condition of this specification that only specialized equipment and machinery in good condition be used for their intended purpose. Under no circumstances may damage equipment be used, the contractor shall at all times ensure that all equipment be in working order as per the manufacture's specifications. All equipment shall be used or operated by skilled persons and operators, as per the manufacturer's directions and the equipment's intended use.

C3.3.6.5.3.2 PLM15.3.2 CHIPPER AND SHREDDER

The contractor will be permitted as part of his routine maintenance to chip or shredded all pruned tree and shrub branches which after a composting period may then be used for mulch in the plant beds.

C3.3.6.5.3.3 PLM15.3.3 COMPOST

All compost shall consist of good decomposed organic material, free of harmful damaging salts, heavy metals, potentially toxic elements and with a pH not higher than 7.0. The maximum allowances of foreign matter particles shall be:

- Stones % of dry weight, shall be < 5% of > 5mm size.
- Man-Made foreign matter glass, plastic, metal, no visible contaminant, with a max 0.5% > 2mm size as % of dry weight.

Particle size shall have a coarseness of < 20mm.

A sample shall be submitted to the Landscape Architect for approval.

Where compost is delivered on site in bulk the Contractor shall take precautions in order to protect it from excessive dehydration, dispersal as a result of wind or exposure to rain.

C3.3.6.5.3.4 PLM15.3.4 FERTILIZER

The type of fertilizer to be used shall be the following:

- Agricultural lime
- Super phosphate
- 2:3:2 (22)
- 5:1:5

All fertilizer shall comply with the Fertilizers, Farm feeds, Agricultural remedies & Stock remedies act, 1947 (ACT NO. 36 OF 1947) and shall be stored in plastic bags.

C3.3.6.5.3.5 PLM15.3.5 TOP DRESSING

Top dressing shall consist of equal parts of topsoil and compost, with no lump greater than < 10mm. The topdressing shall be mixed within a dedicated area on-site or be pre-mixed and imported to site.

Grass shall first be mowed, and all cuttings removed before top dressing is applied. Top dressing shall be applied in layers not more than 20mm thick and shall be made neat with a drag mat and rakes and finally tested for levelness with a straightedge. If necessary, fertilizers shall be added to the top dressing and mixed in before application.

Precautions in order to protect the topdressing from excessive dehydration, dispersal as a result of wind or exposure to rain shall be undertaken.

C3.3.6.5.4 PLM15.4 MAINTENANCE PROCESSES AND PROCEDURES

C3.3.6.5.4.1 PLM15.4.1 WEEDING

No alien, invasive or exotic vegetation shall be introduced to the area of the Site. Existing alien, invasive species shall be dealt with accordingly to comply with the relevant legislation.

Weeds are defined as any plant that the Landscape Architect or Client does not wish to have on the site, as well as any plant generally considered to be a weed.

Declared alien and invasive species are defined within the Conservation of Agricultural Resources Act, 1983 (Act No 43 of 1983) (CARA) and in terms of the National Environmental Management: Biodiversity Act (Act No 10 of 2004) (NEMBA).

All weeds occurring in the landscape shall be removed on a regularly bases.

Weeds within lawns which are not removed by the normal cutting process shall be removed by hand. All impurities in the lawns must also be removed and runners of the same species replaced.

Weeds and invader plants of any kind occurring in beds and all other areas must be hoed or pulled out. Weeds occurring in roadways, kerbs or on paving have also to be pulled out and removed from site.

Aquatic weeds must be removed by hand and under no circumstances are herbicides to be used.

Herbicides may only be used in specific areas with the written consent of the Client and have to be applied under the supervision of skilled and trained personnel. The contractor has to take the necessary precautions to prevent organic material brought to the site from spreading foreign grass types or weeds on the site. Pre-emergent, as approved, may be used by the Contractor to control weeds.

Weeding by hand shall be by the use of small hand-held garden forks, tilling or forking of soil during weeding and maintenance shall not be accepted.

All weeds that have been removed shall be removed from the site.

C3.3.6.5.4.2 PLM15.4.2 INSPECTION OF SITE AND PLANTS

A detailed site inspection is to be undertaken once a week by a competent person as to the status of landscape weeds, invader plants, insects, pests, ants, termites, pollution and in general any other aspects which may have an effect on the successful establishment of all plant growth. All of the above are to be controlled where necessary as routine maintenance and subject to the conditions as set out elsewhere in this document. A monthly written report shall submit to the Landscape Architect and Client, this shall inform and be the bases of monthly certification for payment. Special attention must be given to the control of all pests.

C3.3.6.5.4.3 PLM15.4.3 MOWING OF LAWN

AII lawn areas must be manicured once a week during the summer months and once every 3-4 weeks during the winter months.

Mowing shall be with an acceptable modern lawn mower (petrol, diesel or electric) to the height dependant on species, see table below:

Table 4: Lawn height

Species (Common Name)	Mowing Frequency	Mowing Height
Cynodon dactylon – Bermuda grass	7-day cycle, once a week	10 – 15 mm
Cynodon transvaalensis – Couch grass	7-day cycle, once a week	10 – 15 mm
Pennisetum clandestinum – Kikuyu grass	7-day cycle, once a week winter 5-day cycle, twice a week summer	15 – 20 mm
Dactylocenium australe – LM or Berea grass	7-day cycle, once a week	25 mm – Full sun 25 – 30 mm, Semi shade
Stenotaphrum secundatum - Buffalo grass	7-day cycle, once a week	20 – 25 mm

Mowing height maybe adjusted to specific client requirements, this shall be done in writing by the Landscape Architect. All lawn clippings are to be collected using the clipping catcher, any remaining shall be collected and removed.

Grass shall only be cut when the grass blades are dry unless continuous wet weather persist. Grass shall be cut the first time when runners are 100mm long, unless otherwise decided.

Inspection of area to be mowed shall be undertaken before each cut, all stones and foreign objects shall be removed. Lawns may only be cut when leave blades are dry. Lawnmowers are to be set so as to cut the leaves and not the root mat. A scarified appearance of the lawns will not be acceptable.

Should the Client or Landscape Architect be of the opinion that the contractor is using the incorrect or ineffective mowing equipment, he may direct that the correct mowers be used without additional remuneration and without relieving the contractor of any of his duties.

Lawns may only be cut during normal and acceptable working hours unless prior approval is given by the Client to cut lawns outside of normal working hours. Mowing of all lawns is part of the routine maintenance.

C3.3.6.5.4.4 PLM15.4.4 CUTTING OF BORDERS AND EDGES

All lawn areas bordering on paving, structures, kerb stones, roads, poles, fencing and planted areas, are to be cut neatly to form on a regular basis as part of the routine maintenance. Lawn roots growing into these areas are also to be contained and where necessary, removed. All clippings and roots are to be collected and removed from the site. The works shall be carried out by hand, using sheep shears. Should the site size warrant the above process can be undertaken by mechanical means, with the uses of an edger.

Similarly, all groundcovers/shrubs overhanging kerbs are to be selectively pruned. Bedding edges shall be as above, and care taken that the bedding area doesn't grow and encroach into the lawn.

C3.3.6.5.4.5 PLM15.4.5 CUTTING OF VELDGRASS

The contractor is to cut the Veldgrass areas once a year as part of the routine maintenance or as and when directed to do so by the Client.

C3.3.6.5.4.6 PLM15.4.6 AERATION

The Contractor shall make provision as part of his normal maintenance routine for the aeration of all plant beds on a bi-weekly basis by means of light forking. Care must be taken not to damage or disturb any plant roots.

C3.3.6.5.4.7 PLM15.4.7 PRUNING OF TREES AND SHRUBS

All trees and shrubs are to be regularly pruned by a skilled and trained person as part of the routine maintenance. All branches and leaves shall be removed from site.

Trees and shrubs are to be pruned according to species and to the desired shape. All prune wounds are to be suitably sealed off. All damaged branches and stems are to be treated and tied up as is common horticultural practice. The indiscriminate pruning of trees and shrubs will not be tolerated. Plants, where necessary, must be pruned so as not to impair visibility of motorists as well as create security risk areas.

The contractor may only, with the prior written approval of the employer take cuttings from plants on the site for use elsewhere.

C3.3.6.5.4.8 PLM15.4.8 RETOUCHING OR SOWING OF GRASS

Any open patches in the lawn areas must be rectified by either sowing applicable seed or planting additional sprigs of the specific species as part of the routine maintenance. Such areas must be loosened and fertilised thoroughly before planting or sowing, in accordance with the specification.

C3.3.6.5.4.9 PLM15.4.9 TREE STAKES

All trees are to be kept staked and tied according to specification. Broken or unserviceable stakes are to be systematically replaced with the same type of stake as part of the routine maintenance.

C3.3.6.5.4.10 PLM15.4.10 PAVING

Maintenance of a well designed and constructed segmented pavement normally involves the treatment of weeds, sweeping and cleaning, with the possible replacement of jointing sand should this be required.

The removal of weeds shall preferable be by hand, should the extent of the area require, an approved herbicide can be used.

Maintenance of paving shall also include the control of pests, with special reference to ants. These shall be controlled by treatment with approved pesticide. Paved areas shall be swept by hand held broom or blower, whenever required.

Paved areas with any defects of any kind, shall be reported to the Client.

C3.3.6.5.4.11 PLM15.4.11 CLEANLINESS OF ROADWAYS, PARKING AREAS AND PAVED AREAS

All roadways, parking areas and paved areas are to be kept clean and all silt wash aways swept up and removed on a weekly basis as part of the routine maintenance.

C3.3.6.5.4.12 PLM15.4.12 CLEANING OF AREAS

All the areas where landscaping work is carried out shall be cleared of: (including but not limited to) foreign materials and building rubble during routine maintenance. Areas shall be kept as neat and clean as possible and all soil, mud, plant material, fertilizer and litter shall be swept and cleaned.

Should any remedial works be carried out in the landscape, by the contractor, spillage of soil, mud, plant material or fertilizer shall be cleaned.

C3.3.6.5.4.13 PLM15.4.13 WASH AWAY & SAGGING

The contractor will as part of his routine maintenance regularly repair all normal wash-away and sagging of any nature in the landscaped areas. If applicable groundcovers which are available on site may be harvested and planted in areas to combat wash-away as part of the routine maintenance. Abnormal damage is to be referred to the Landscape Architect for a decision and instruction.

C3.3.6.5.4.14 PLM15.4.14 DRAINAGE

The contractor will as part of his routine maintenance ensure that all storm water and irrigation water drain away, so as to avoid swamping. All storm water catchpits are to be kept clean and free of plant matter, litter etc. The cleaning of storm water pipes and systems does not form part of the routine maintenance. Water which cannot drain away as normal must be referred to the relevant party for a decision and instruction.

C3.3.6.5.4.15 PLM15.4.15 PEBBLES, GRAVEL, PACK ROCK AND OR DUMP ROCK AREAS

The Contractor will as part of his routine maintenance keep clean all pebbles, gravel, pack rock and or dump rock areas.

This shall entail but not be limited to, removal of all weeds, leaves, rubble, litter and foreign objects. The area shall be washed down on a regular basis to keep them free of dust and sediment.

All materials shall be kept true to form and should the lifting and repacking be required; this shall be undertaken to reinstate the original intended design state or condition.

C3.3.6.5.4.16 PLM15.4.16 STRUCTURES & SCULPTURES IN THE LANDSCAPE

All structures and sculptures shall be maintained as recommended by the manufacturer and specifications. These shall be washed down on a regular basis to keep them free of dust and sediment.

C3.3.6.5.4.17 PLM15.4.17 ACCESS TO SERVICES

All manholes are to at all times be kept totally exposed for easy identification and access.

C3.3.6.5.4.18 PLM15.4.18 APPLICATION OF FERTILIZERS AND NUTRIENTS

All fertilizers and nutrients will be applied evenly using calibrated and suitable equipment to the manufacturer's specification at the rates as specified. Areas which are to be fertilized are to be well irrigated after each application to ensure that there is no fertilizer left on the leaves of any plants to avoid burning of foliage.

The application rate for fertilizer shall be as follows:

- Superphosphate 0.015kg/m² - All planted areas.
- 2:3:2 (22) at 150 gram/m² - All planted areas.
- 5:1:5 at 25 100 gram/m² - All planted areas.

All fertilizer shall comply with the Fertilizers, Farm feeds, Agricultural remedies & Stock remedies act, 1947 (ACT NO. 36 OF 1947)

Fertilizing shall be implemented twice a year as part of routine maintenance.

The Landscape Architect can at any stage request the contractor to apply fertilizers to indicated areas.

C3.3.6.5.4.19 PLM15.4.19 APPLICATION OF COMPOSTING

Composting to all landscape areas shall be to a depth of 50mm thick unless otherwise instructed.

The compost shall be spread evenly over the area. In all cases the layer of compost may be thicker than specified, but never thinner. This shall then be thoroughly mixed with the topsoil to a depth of 100 mm manually.

Composting shall be implemented once a year as part of routine maintenance, additional applications shall only be under the instruction of the Landscape Architect.

C3.3.6.5.4.20 PLM15.4.20 TOP DRESSING

The top dressing shall be applied in layers with a maximum thickness of 20 mm, but never less than 5 mm. The surface shall be neatly finished by using a drag-mat, rakes and straightedges. Fertilizers prescribed by the Landscape Architect or Client maybe be added to the top-dressing mixture before application if necessary or requested. Before applying the top dressing, the grass shall be cut, and all cuttings removed. Top dressing shall be implemented once a year as part of routine maintenance.

C3.3.6.5.4.21 PLM15.4.21 IRRIGATION AND WATERING

All plants shall be adequately watered at frequent and regular intervals to ensure proper growth as per LIA guidelines until the plants have established and thereafter as required to sustain growth. The amount and frequency of watering shall be agreed upon, by the schedule provided by contractor for approval by Landscape Architect.

The contractor must take care that all planted areas are continuously kept moist and above the point of withering. All areas which have been planted must be moist up to a depth of 300 mm. Only planted trees are to be irrigated by filling each tree pond with water (20 litres per tree) once every two weeks in the summer months and once every two weeks in the winter months.

The irrigation of the entire site as required will form part of the routine maintenance.

C3.3.6.5.4.22 PLM15.4.22 PESTICIDE AND HERBICIDE APPLICATION

Where the application of pesticides and herbicides is required, expert advice on the choice of herbicides shall be sought. The Department of Agriculture and reputable manufacturers can be contracted of advice.

Care shall be exercised since the injudicious use of poisonous substances may result in extensive damage to fauna and flora. Pesticides and herbicides having no residual effect are available; they will not contaminate water supplies distributed by surface run-off during rainstorms.

C3.3.6.5.4.23 PLM15.4.23 REMOVAL OF LANDSCAPE WASTE FROM SITE

Throughout the course of routine landscape maintenance, the generation of waste materials shall be removed. All areas are to be kept clear and precautions undertaken to avoid damage to existing structures, trees, shrubs, plants and grass.

C3.3.6.5.4.24 PLM15.4.24 RUBBLE AND LITTER

All rubble and site litter must be collected and removed from the site as part of the routine maintenance. Under no circumstances may site litter, or rubble be placed in site litter bins.

C3.3.6.5.5 PLM15.5 GUARANTEE

Plants shall be guaranteed by the Contractor and shall be alive and in a satisfactory growing condition at the end of the maintenance period. Plants, which die or become unhealthy from any cause or appear to be in a badly impaired condition, shall be removed promptly and replaced. Any plants that settle below or rise above the described finished grades shall be reset at proper grades. All replacement plants shall be plants of the same kind as the plant to be replaced and of good quality. The replaced plant shall be planted, guyed and maintained as specified herein.

C3.3.6.5.6 PLM15.6 MONTHLY MAINTENANCE PROGRAM

The contractor must provide a scheduled maintenance program for the routine landscape maintenance works, following accepted horticultural practices. It shall contain, but not be limited to method statements and seasonal schedules for:

- Watering and or seasonal irrigation program.
- Mowing, pruning, weeding, and sweeping.
- Fertilizing, composting, topdressing, and specialised lawn care.
- Pest & weed control.

C3.3.6.5.7 PLM15.7 MEASUREMENT AND PAYMENT

Unit: Month

Measurement for monthly maintenance shall be calculated from the date of issuing the practical completion certificate. It shall be for the duration as specified in the BoQ.

The rate shall include for the supervision and management of the irrigation system, the trimming and pruning of trees, the application of fertilizer and compost, the cutting of lawn and veldgrass, the application of herbicides and pesticides, weeding, sweeping of hard surfaces and collecting litter and removing it from site to an approved dump site.

Johannesburg Water SOC Ltd

Johannesburg Water

CONTRACT JW14322

CONSTRUCTION OF A 26ML CONCRETE RESERVOIR AND 2ML CONCRETE WATER TOWER IN BRIXTON WITH ASSOCIATED PIPE AND PUMP WORKS

VOLUME 2A

PART 3: SCOPE OF WORK

C3.1 SCOPE OF WORK

Employer:		Contractor:	
Witness:		Witness:	

C3 PREAMBLE TO SCOPE OF WORK

GENERAL

The Standard Specification for all associated civil work shall be the SANS 1200 and the SANS 2001 – Standardized Specification for Civil Engineering Construction.

The Standardized Specifications applicable to this Contract are listed in the Project Specification.

These Specifications are not issued with this volume but are available at the Contractor's expense from: SA Bureau of Standards, Private Bag X191, Pretoria, 0001.

SCOPE

This Project Specification is set out in three portions:

Portion 1: SCOPE OF WORK covers a general description of the project, the facilities available and the requirements to be met.

Portion 2: GENERIC SPECIFICATIONS covers variations to the standardized specifications which are applicable to the contract.

Portion 3: PARTICULAR SPECIFICATIONS covers 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.

Should any requirement of the Particular Project Specification conflict with any requirement of the Project Specification or Variations and Additions to the Standardised Specifications, the requirements of the Particular Project Specifications shall prevail.

C3.1 SCOPE OF WORK

In the event of any discrepancy between the Scope of Works and a part or parts of the SANS 1200 Standardized Specifications, the Bill of Quantities or the Drawings, the Project Specifications shall take precedence and prevail in the Contract.

C3.1.1 DESCRIPTION OF THE WORKS

C3.1.1.1 EMPLOYER'S OBJECTIVES

The employer's objective is to augment the current water supply in the Brixton area, and increase storage capacity within the Brixton Water District. This will result in the improvement of availability of water for the current and future demands. This project entails the construction of a 26Ml buried, ground reservoir, 2Ml elevated water tower, pumpstation, bulk water pipelines, and the upgrading of existing water pipelines.

C3.1.1.2 OVERVIEW OF THE WORKS

This Contract comprises inter alia of the construction of the Brixton 26Ml Reservoir, 2Ml Water Tower, and pumpstation with associated pipelines, among which include the 600 mm diameter supply pipeline from the existing reservoir approximately 1km away.

The work is broadly described, but not limited to deliver:

New Brixton Reservoir

- The construction of a 26ML reinforced concrete underground Reservoir. TWL = 1,782.2m, BWL = 1,777.4m.
- Associated inlet, outlet, and scour pipework.
- Sub-surface drainage beneath reservoir.
- Conduits and wireways for security, access control and telemetry.

New Brixton Tower

- The construction of a 2ML reinforced concrete tower. TWL = 1,807.0m, BWL = 1,801.4m.
- Associated inlet, outlet and scour pipework.
- Conduits and wireways for security, access control and telemetry.

New Brixton Pumpstation

- The construction of a pump station building.
- Electrical supply with back-up supply via diesel generators.
- Motor control centres and distribution boards.
- Pumps and pipe fittings.
- Metering.
- Telemetry room extension to building for pump operations.
- Conduits and wireways for security, access control and telemetry

- Foundations for mini-substation

New Bulk Water Pipelines

- Location of existing services not identified by other Utilities and Agencies.
- New 600 mm diameter supply pipe, approximately 885 m in length, from the existing Reservoir to the New Reservoir.
- New 500 mm diameter feeder pipe, approximately 450 m in length reducing to 400 mm diameter feeder pipe, approximately 400 m in length, from new Brixton tower to the Tower water supply zone.
- New 600 mm diameter feeder pipe, approximately 1,410 m in length, from the new Reservoir to the Reservoir water supply zone.
- Cathodic protection of steel pipelines.
- All shutdown arrangements for tie-ins of the supply and delivery pipes to existing infrastructure.
- Valve and meter chambers.
- Conduits and wireways for security, access control and telemetry.
- Horizontal drilling at JRA Road crossings.
- Reinstatement along pipeline route of the same or higher condition as the original.

Water Pipeline Upgrades

- Within Reservoir Water Supply Zone:
    - New 450 mm diameter pipe, approximately 740 m in length, along Bunting road, Canary Street and Artillery Road.
    - New 315 mm diameter pipe, approximately 555 m in length, along Henley Road.
    - New 250 mm diameter pipe, approximately 276 m in length, along Finsbury Road.
    - New 250 mm diameter pipe, approximately 8 m in length, along Henley Road.
    - New 200 mm diameter pipe, approximately 126 m in length, along Henley Road.
    - New 200 mm diameter pipe, approximately 3.5 m in length, along Henley and Finsbury Road.
    - New 200 mm diameter pipe, approximately 1.5 m in length, at the corner of Canary Street and Artillery Road.
    - New 160 mm diameter pipe, approximately 440 m in length, along Bunting Road.
    - All shutdown arrangements for tie-ins of the supply and delivery pipes to existing infrastructure.
- Within Tower Water Supply Zone:
    - New 400 mm diameter pipe, approximately 325 m in length, along Esher Street and Barnes Road.

- New 315 mm diameter pipe, approximately 193 m in length, along Caroline Street.
- New 250 mm diameter pipe, approximately 790 m in length, along Caroline Street, Russ Road and First Street.
- New 250 mm diameter pipe, approximately 450 m in length, along Caroline Street.
- New 160 mm diameter pipe, approximately 72 m in length, along Vygie Street.
- New 160 mm diameter pipe, approximately 555 m in length, along Henley Road.
- All shutdown arrangements for tie-ins of the supply and delivery pipes to existing infrastructure.

Site Clearance & Bulk Earthworks

- Site clearing at reservoir and tower site.
- Bulk earthworks at reservoir and tower site.

Roads and Parking

- Paved access and parking areas at reservoir and tower site.
- Stormwater drainage.

External Works

- Guardhouse.
- Sewer line to service guard house.
- Perimeter fence at reservoir and tower site.
- Small power and lighting at reservoir and tower site.
- Relocation of sewer line.

Site Rehabilitation

- Rehabilitation of site area once construction of services has been completed.

This description of the Works is not necessarily complete and shall not limit the work to be carried out by the Contractor under this Contract. Approximate quantities of each type of work are given in the Bill of Quantities.

C3.1.1.3 LOCATION OF THE WORKS

Proposed Reservoir and Tower Location

The proposed reservoir and tower site area will be located on an open area adjacent to and forming part of the Brixton Primary School plot boundary in Brixton on the corner of Symons Road and Caroline Street. The approximate coordinates of this new reservoir and tower site area are as follows:

Latitude = 26°11’37.95”S; Longitude = 28°0’23.70”E

The site is fairly level but has slopes of up to approximately 1:25 (4%) at the entrance to the site, and is sparsely covered by veld grass. The site area will have to be fenced and the Contractor must provide a security guard 24 hours a day. An entrance and access is already available for use by the Contractor.

Existing Reservoir and Tower Location

The existing reservoir and tower site is located on the corner of Isleworth and Fulham Roads, as shown on the locality plan below. The approximate coordinates of this existing reservoir and tower site area are as follows:

Latitude = 26°11'30.43"S; Longitude = 27°59'57.92"E

New bulk pipelines

The main bulk pipeline routes have been differentiated as follows:

- Supply pipeline from the existing Brixton Reservoir to the new Brixton Reservoir.
- Feeder pipeline from the new Brixton Tower to the Tower water supply zone.
- Feeder pipeline from the new Brixton Reservoir to the Reservoir water supply zone.

The bulk supply pipeline from the existing Brixton Reservoir to the new Brixton Reservoir will start at a connection to an existing 675 mm diameter bulk pipeline supplying the existing Brixton Reservoir located along Fulham Road. This bulk pipeline will continue to run along Fulham road, will cross Esher Street, Wimbledon Road, Chiswick Street and Symons Street and will then enter Brixton Primary School to connect to the feed to the new Brixton Reservoir. This pipeline will be 600 mm in diameter and approximately 885m in length.

The bulk feeder pipeline from the new Brixton Tower to the existing Brixton Tower water supply zone will be split into four sections. The first section will comprise of a 500 mm diameter pipeline, approximately 450 m in length, starting at the new Brixton Tower, running along Caroline Street, crossing Symons Road and Chiswick Street until a point located at the intersection of Caroline Street and Wimbledon Road. The second section will comprise of a 250 mm diameter pipeline, approximately 450 m in length, starting at the point located at the intersection of Caroline Street and Wimbledon Road. This pipeline will then continue along Caroline Street, will cross Esher Street and will connect to an existing 225 mm diameter pipeline along Caroline Street. The third section will comprise of a 400 mm diameter pipeline, approximately 400 m in length, starting at the point located at the intersection of Caroline Street and Wimbledon Road, continuing up along Wimbledon Road then running along Fulham Road, to connect to the existing Brixton Tower 350 mm diameter pipe outlet. The fourth section will comprise of a 400 mm diameter pipeline, which will run from a point located at the intersection of Fulham Road and Esher Street, up along Esher Street, and along Barnes Road to connect to an existing 450mm diameter pipeline.

The bulk feeder pipeline from the new Brixton Reservoir to the Reservoir water supply zone will be 600 mm in diameter and approximately 1.41km in length. It starts at the new Brixton Reservoir, runs along Caroline Street, up Gousblom Street, along First Street, up Sonneblom Street, and along Katjiepiering Street to tie into existing 150 mm diameter pipeline along Bunting Road, which is to be upgraded to a tee with a 160 mm diameter pipe running in one direction, and a 450 mm diameter pipe running in the opposite direction along Bunting Road.

Bulk pipeline upgrades

The pipeline upgrades will also affect a few of the roads within the Brixton area. The table below summarises the roads where the pipeline upgrades will be located.

Table 1: Bulk Pipeline Upgrades

Pipe diameter (mm)	Approximate pipe length (m)	Pipeline Location
450 mm Ø	740 m	Pipeline along Bunting Road, Canary Street and Artillery Road
315 mm Ø	555 m	Pipeline along Henley Road
250 mm Ø	276 m	Pipeline along Finsbury Road
250 mm Ø	8 m	Pipeline along Henley Road
200 mm Ø	126 m	Pipeline along Henley Road
200 mm Ø	3.5 m	Pipeline along Henley and Finsbury Roads
200 mm Ø	1.5 m	At the corner of Canary Street and Artillery Road
160 mm Ø	440 m	Pipeline along Bunting Road
400 mm Ø	325 m	Pipeline along Esher street and Barnes Road
315 mm Ø	193 m	Pipeline along Caroline Street
250 mm Ø	790 m	Pipeline along Caroline Street, Russ Road and First Street
250 mm Ø	450 m	Pipeline along Caroline Street
160 mm Ø	72 m	Pipeline along Vygie Street
160 mm Ø	26 m	Pipeline along Caroline Street

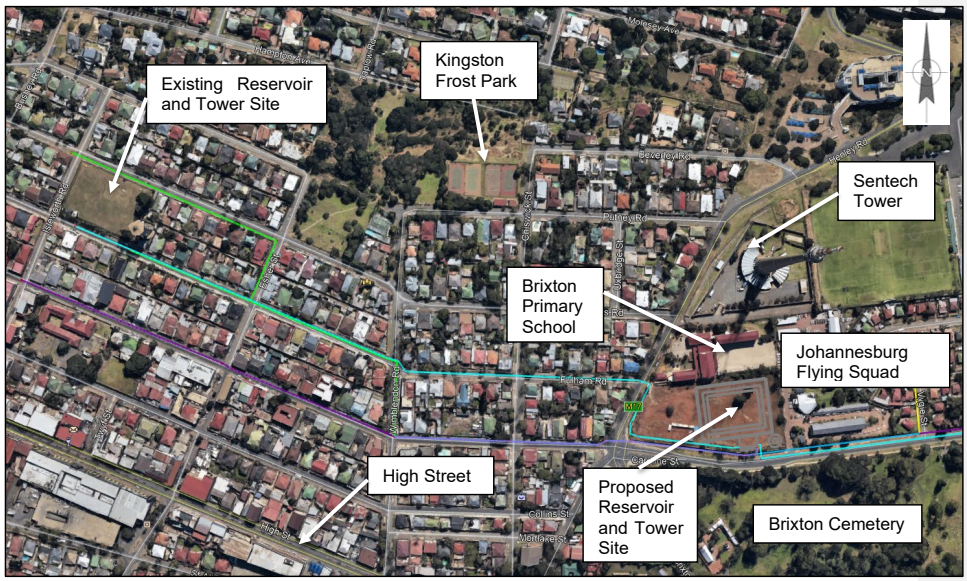

Figure1: Locality Plan

C3.1.1.4 TEMPORARY WORKS

The Contractor shall construct all temporary works as required by the Contractors Construction method. The tendered rates shall include full compensation for all temporary works.

C3.1.2 ENGINEERING

C3.1.2.1 DESIGN

(a) The Employer is responsible for the design of the permanent Works as reflected in the Contract Documents unless otherwise stated.

(b) The Contractor is responsible for the design of the temporary Works and their compatibility with the permanent Works.

(c) The Contractor shall supply all details necessary to assist the Engineer in the compilation of the as-built drawings.

C3.1.2.2 EMPLOYER'S DESIGN

The employer's design is as detailed in the documentation and on the drawings.

C3.1.2.3 CONTRACTOR'S DESIGN

Where the Contractor is to supply the design of designated parts of the permanent Works or temporary Works he shall supply full working drawings supported by a professional engineer's design certificate. Approval from the Engineer is required prior to the commencement of any works.

C3.1.2.4 DRAWINGS

The Contractor shall use only the dimensions stated in figures on the Drawings in setting out the Works, and dimensions shall not be scaled from the Drawings, unless required by the Engineer. A list of the tender drawings is provided in Volume 4 of the tender document. Construction drawings will be issued to the successful tenderer, prior to commencement of construction. The Engineer will, on the request of the Contractor in accordance with the provisions of the Conditions of Contract, provide such dimensions as may have been omitted from the Drawings.

The Contractor shall ensure that accurate as-built records are kept of all infrastructure installed or relocated during the contract. The position of pipe bends, junction boxes, duct ends, and all other underground infrastructure shall be given by either co-ordinates, or stake value and offset. Where necessary, levels shall also be given. A marked-up set of drawings shall also be kept and updated by the Contractor. This information shall be supplied to the Engineer's Representative on a regular basis.

All information in possession of the Contractor, required by the Engineer and/or the Engineer's Representative to complete the as-built/record drawings, must be submitted to the Engineer's Representative before a Certificate of Completion will be issued.

The Drawings prepared by the Employed for the permanent Works are listed and bound at the back of this volume. The Employer reserves the right to issue amended and/or additional drawings during the Contract.

C3.1.2.5 DESIGN PROCEDURES

All design and modifications thereto shall be communicated in writing and the Contractor and engineer shall maintain lists to record and track all transactions.

C3.1.3 PROCUREMENT

C3.1.3.1 PREFERENTIAL PROCUREMENT

The Employer's promotes preferential procurement. The philosophy of the process and mechanics of the points scoring system are described in section JW10, which is included in the returnable documents section T2.2.

C3.1.3.2 SUBCONTRACTING

Some specialized work could be subcontracted, including CP and AC Mitigation installations and horizontal drilling. The Contractor must take note of the following clause in the Standard Conditions of Contract.

The minimum requirements of the sub-contractors are as follows:

1. Valid CK registration

2. SA ID copies of owners

3. Active CIDB membership

4. Valid Tax clearance certificate

5. Valid BBBEE certificate

6. COID certificate

7. Company Profile including similar experience and skilled personnel CVs

8. Health and Safety Plan

The main contractor is:

a) to enter into contract with the above sub-contractor(s) including any other subcontractors (for specialised work, if any) in accordance with the requirements of the Standard Conditions of Contract. The sub-contractor(s)' nomination will be determined by the scope of work and the amount of work that is to be carried out.

b) required to utilise local labour for the completion of unskilled labour-based sections of the works, where practical.

c) Responsible for all work executed (QUALITY, CONTRACTUAL LIABILITIES) on his behalf or under his supervision and/or management by all sub-contractors, including nominated subcontractors. The Engineer shall, prior to the commencement date of the contract, determine the scope of work and the amount of work that is to be carried out by the nominated subcontractor(s). If applicable, the Contractor shall be expected to enter into a contract with the nominated subcontractor(s) in accordance with the requirements of the Standard Conditions of Contract.

***NOTA BENE**: The Engineer shall not negotiate directly with sub-contractors and all problems relating to payments, programming, workmanship, etc., are matters between the Contractor and his sub-contractors.*

C3.1.4 CONSTRUCTION

C3.1.4.1 WORKS SPECIFICATIONS

C3.1.4.1.1 Applicable SANS 2001 and SANS 1200 Standardized Specifications

These specifications are included under section C.3.2 of this document.

C3.1.4.1.2 Particular Specifications

The following Particular Specifications for work not covered by the SANS 1200 and SANS 2001 Standardized Specifications are also included hereunder:

C3.1.4.1.2.1 Civil

These additional specifications are included under section C.3.3.1 of this document.

C3.1.4.1.2.2 Mechanical

These additional specifications are included under section C.3.3.2 of this document.

C3.1.4.1.2.3 Electrical

These additional specifications are included under section C.3.3.3 of this document.

C3.1.4.1.2.3 Control and Instumentation

These additional specifications are included under section C.3.3.4 of this document.

C3.1.4.1.2.4 Structural

These additional specifications are included under section C.3.3.5 of this document.

C3.1.4.1.2.5 Landscape Architecture

These additional specifications are included under section C.3.3.6 of this document.

C3.1.4.1.3 Variations and Additions to the SANS 1200 Standardized Specifications

These specifications are included under section C.3.2 of this document.

C3.1.4.2 CONSTRUCTION PROGRAMMING

C3.1.4.2.1 Programmes and reports required

In addition to the requirements of Clause 5.6.2 of the Conditions of Contract, the following requirements shall prevail:

Contractual programme

A contractual programme, meaning: a chart showing the different sections of construction making up the Works and the order, resourcing, and sequence in which the work is to be carried out in order to achieve completion on the prescribed dates shall be submitted with the Contractor's tender. This programme shall, upon the Engineer's agreement in writing, become binding on the parties to the contract. Such a programme shall include for possible delays for inclement weather. The Contractual programme shall in addition clearly indicate any Contractor's float as may be applicable.

Construction programme

A construction programme, meaning: an agreed chart which shall be used to monitor the progress of the works, shall be submitted within 14 days of agreement of the contractual programme by the Engineer. This chart shall, as far as is practical, be based upon the agreed contractual programme, but shall not in any way relieve either party of their obligations or rights in terms of the contractual programme or the contract. The chart shall show the different sections of the Works suitably divided into elements and activities, clearly indicating the start and completion dates of each activity and element against which the progress shall be monitored. The Contractor is advised to determine the programming requirements of clause 5.6 in the Standard Conditions of Contract described below.

Reports required

The Contractor shall provide the Engineer a fortnightly report detailing the following:

a) Date of report.

b) Working days elapsed from start.

c) Working days left to contractual completion and/or key dates and forecast of any slippage envisaged.

d) Percentage of work complete per activities on construction programme and forecast remaining time and resources required.

e) Supervisory staff and labour force on site.

f) List of constructional plant.

g) Delays encountered.

h) Information required.

i) Variation Orders and site instructions received.

j) Claims status (if any).

k) Weather delays.

l) Signature of site agent.

The Contractor shall in addition provide the Employer with weekly returns showing the number and grade of Employees employed and the number and type of Constructional Plant on site.

C3.1.4.2 SITE ESTABLISHMENT

C3.1.4.2.1 Services and facilities provided by the Employer

(a) Water sources

A reticulated potable water supply is available in the vicinity of the Site. The responsible water supply authority in the area of the Site is Johannesburg Water. Should the Contractor wish to utilise such water supply, he shall himself be responsible for making his own arrangements with the responsible water supply authority for the supply of all water that he may require from such reticulation network for construction purposes as well as for domestic consumption. If so required by the responsible water supply authority, the Contractor shall further be responsible, at his own cost, for making or otherwise providing metered connections to the

available services at the positions specified by the water authority, as well as for the removal of such connections on completion of the Contract. No warranty is offered or given by the Employer that the existing available reticulated water supply will necessarily be adequate for the Contractor's purposes nor that such supply is in any way is guaranteed.

All charges as may be levied by the responsible water supply authority in respect of water consumed by the Contractor shall be for the Contractor's account and payment to the Contractor in respect thereof shall, be deemed to be included in the sums bid by the Contractor for the various Preliminary and General items listed in the Bill of Quantities, as well as in the rates bid by the Contractor for the various other items listed in the Bill of Quantities which require the consumption of water.

The Contractor shall, when reasonably required by the Engineer, produce documentary proof that all amounts as may have become due and payable by the Contractor to the responsible water authority have been promptly paid in full.

(b) Electricity supply

A reticulated electrical power supply is available in the vicinity of the Site. The responsible electricity supply authority in the area of the Site is City Power. Should the Contractor, wish to avail himself of such supply, he shall, at his own cost, be responsible for making his own arrangements with the responsible electricity supply authority for the supply of all electrical power he may require from such reticulation network for construction purposes as well as for domestic consumption. If so required by the responsible electricity supply authority, the Contractor shall, at his own cost, be responsible for making metered connections to the available services at the positions specified by the electricity supply authority, as well as for the removal of such connections on completion of the Contract. No warranty is offered or given by the Employer that the existing available reticulated electrical power supply will necessarily be adequate for the Contractor's purposes nor that its supply is in any way guaranteed.

All charges as may be levied by the responsible electricity supply authority in respect of electrical power consumed by the Contractor shall be for the Contractor's account and payment to the Contractor in respect thereof shall, be deemed to be included in the sums bid by the Contractor for the various Preliminary and General items listed in the Bill of Quantities, as well as in the rates bid by the Contractor for the various other items listed in the Bill of Quantities which require the consumption of electricity.

The Contractor shall, when reasonably required by the Engineer, produce documentary proof that all amounts as may have become due and payable by the Contractor to the responsible electricity supply authority have been promptly paid in full.

(c) Excrement disposal

The Contractor shall make use of Chemical Toilets. All costs for the maintenance and cleaning of the facilities shall be borne by the Contractor and shall be deemed to be included in the sums bid by the Contractor for the Various Preliminary and General items listed in the Bill of Quantities.

(d) Area for Contractor's site establishment

A specific area in close proximity to or on the Site of the Works will be made available by the Employer to the Contractor for the Contractor's site establishment. The specific area for the Contractor's site establishment will be identified to the Contractor by the Engineer and the Contractor shall have sole use of such area, free of charge, for the duration of the Contract. The Contractor shall use this area only for the purposes of erecting his site offices, workshops, stores and other facilities required for the execution of the Contract. The

Contractor shall not use the area nor allow it to be used for any purposes not directly associated with the execution of the Contract. The Contractor shall be responsible for arranging, at his own cost, for the provision of all services he may require in the area, as well as elsewhere on the Site.

Should the Contractor deem the area made available by the Employer to be inadequate or unsuitable for the Contractor's particular needs, then the Contractor shall be at liberty to make his own arrangements with the owners of other sites which he considers are better suited to his needs; provided always that the use by the Contractor of any area other than that made available to him by the Employer shall be subject to the prior written approval of the Engineer, which approval shall not be unreasonably withheld; and provided further that the Contractor shall have no claim against the Employer in respect of any costs incurred by him, either directly or indirectly in consequence of utilising any area other than that made available to him by the Employer, and which costs exceed those costs allowed for by the Contractor in his Bid.

C3.1.4.2.2 Facilities provided by the Contractor

(a) Facilities for the Engineer

The Contractor shall provide on the Site, for the duration of the Contract and for the exclusive use of the Engineer and/or his Representative (as applicable), the various facilities described hereunder. All such facilities shall be provided promptly on the commencement of the Contract and failure on the part of the Contractor to provide any facility required in terms of this specification shall constitute grounds for the Engineer to withhold payment of the Contractor's tendered Preliminary and General items until the facility has been provided or restored as the case may be.

(i) Office accommodation

The Contractor shall provide on the Site one (1) office for the exclusive use of the Engineer. Such office shall comply with and be furnished in accordance with the requirements of subclause 3.2 of SANS 1200 AB. The Contractor shall maintain the office(s) in accordance with the requirements of subclause 5.2 of SANS 1200 AB. Such office accommodation shall be provided within the Contractor's site establishment facilities.

(ii) Carports

The Contractor shall provide on Site for the duration of the Contract, three (3) carports for the sole use of the Client, the Engineer 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 Engineer's office.

Commented [TS1]: Need to confirm

(iii) Site meeting venue

The Contractor shall provide within his own site establishment facilities, a suitably furnished office or other venue capable of comfortably accommodating a minimum of **twelve** (12) persons at site meetings. The Engineer shall be allowed free use of such venue for conducting any other meetings concerning the Contract at all reasonable times.

Commented [TS2]: Need to confirm

(iv) Contract nameboards
The Contractor shall provide, erect and maintain two (2) contract nameboards at such positions and locations directed by the Engineer, which nameboards shall,

unless otherwise specified elsewhere in the Contract, comply with the recommendations for the standard board of the South African Association of Consulting Engineers, with regard to size, painting, decorating and detail, and the requirements described hereunder.

Each nameboard shall be made of tempered hardboard with a thickness of at least 12 mm, so braced on the reverse side as to prevent warping and shall be mounted on two or more, as necessary, firmly planted poles. The painting of the boards shall comply with the relevant requirements of CKS 193 and the colours of the paints shall be an acceptable match to the applicable colours given in SANS 1091. The Contractor shall keep the contract nameboards in good state of repair for the duration of the Contract and shall remove them on completion of the Contract.

(v) Survey equipment and assistants

Survey equipment

The Contractor shall, for the duration of the Contract, provide the following survey equipment for the exclusive use of the Engineer and his staff:

- 1 upright reading automatic level with tripod;
- 1 metric levelling staff with protective cover bag;
- 6 ranging rods;
- 1 100 metre Stilon tape measure;
- 1 ± 2 kg hammer.

Whenever reasonably required by the Engineer, the Contractor shall make available to the Engineer or his representative, the following additional survey equipment:

- 1 tacheometer with tripod;
- 1 survey staff for tacheometer;
- 1 Distomat, complete with tripod and fully charged battery.

All such survey equipment provided by the Contractor shall be in good condition, properly calibrated and fit for the purpose and shall be kept fully serviceable at all times by the Contractor at his own cost. The Contractor shall have any defective equipment repaired or replaced at his own cost within 12 hours after notification by the Engineer's staff. Where required by the Engineer, the Contractor shall at his own cost, promptly arrange for the recalibration of survey equipment provided.

(vi) Telephone facilities

Cellphones
The Contractor shall pay the Engineer the fixed cost items scheduled in the bill to provide these services.

(viii) Electricity supply for the Engineer

All electricity supply to the Engineer's office(s) and laboratory (if applicable), whether provided by the Contractor by way of a reticulated supply from a local authority or other authorised electricity supply, or by way of on-site generators, shall be regulated

by the Contractor to within limits such as to prevent damage due to fluctuations in the electrical current supply that may occur to any electrical plant and equipment provided by the Contractor or the Engineer.

The Contractor shall be liable for and pay to the Engineer on demand, all costs that the Engineer may incur in the repair or replacement of any electrical equipment provided by the Engineer on the Site. Reliance by the Contractor on the regulation of the electrical supply by the supplier or on current regulators fitted to generators shall not absolve the Contractor of his liabilities in terms of this Subclause and, where appropriate, the Contractor shall provide and install at his own cost, all such electrical current-regulating equipment as is necessary to prevent damage to the said equipment.

(ix) Site instruction book

The Contractor shall keep a triplicate book for site instructions on the Site at all times.

(b) Water

The Contractor shall, at his own expense, be responsible for obtaining and providing all water as may be required for the purposes of executing the Contract, including water for both construction purposes and domestic use, as well as for making all arrangements in connection therewith. The Contractor shall further, at his own expense, be responsible for providing all necessaries for procuring, storing, transporting and applying water required for the execution of the Contract, including but not limited to all piping, valves, tanks, pumps, meters and other plant and equipment, as well as for all work and superintendence associated therewith. The sources of all water utilised for the purposes of the Contract shall be subject to the prior approval of the Engineer, which approval shall not be unreasonably withheld. The Contractor shall comply with all prevailing legislation in respect of drawing water from natural and other sources and shall, when required by the Engineer, produce proof of such compliance. The distribution of water shall be carried out by the Contractor strictly in accordance with the applicable laws and regulations.

All water provided by the Contractor for construction purposes shall be clean, free from undesirable concentrations of deleterious salts and other materials and shall comply with any further relevant specifications of the Contract. The Contractor shall, whenever reasonably required by the Engineer, produce test results demonstrating such compliance. Water provided by the Contractor for human consumption shall be healthy and potable to the satisfaction of the health authorities in the area of the Site.

No separate payment will be made to the Contractor for the obtainment, providing and consumption of water, the costs of which will be deemed to be included in the Contractor's bid rates.

(c) Electricity

The Contractor shall, at his own expense, be responsible for obtaining and providing all electricity as he may require for the purposes of executing the Contract, including electricity for both construction purposes and domestic use, as well as for making all arrangements in connection therewith. The distribution of electricity shall be carried out by the Contractor strictly in accordance with the applicable laws and regulations. No separate payment will be made to the Contractor for the obtainment, providing and consumption of electricity, the costs of which will be deemed to be in the Contractor's bidded rates and prices.

(d) Excrement disposal

The Contractor shall, at his own expense, be responsible for safely and hygienically dealing with and disposing of all human excrement and similar matter generated on the Site during the course of the Contract, to the satisfaction of the responsible health authorities in the area of the Site and the Engineer. All such excrement shall be removed from the Site and shall not be disposed of by the Contractor on the Site. The Contractor shall further comply with any other requirements in this regard as may be stated in the Contract.

No separate payment will be made to the Contractor in respect of discharging his obligations in terms of this subclause and the costs thereof shall be deemed to be included within the Contractor's tendered Preliminary and General items.

C3.1.4.2.3 Site usage

The site shall only be used for the construction of the works.

C3.1.4.2.4 Permits and wayleaves

The Employer shall if required, be responsible to obtain all the wayleaves required for this Contract.

C3.1.4.2.5 Features requiring special attention

(a) Site maintenance

During progress of the work and upon completion thereof, the Site of the Works shall be kept and left in a clean and orderly condition. The Contractor shall store materials and equipment for which he is responsible in an orderly manner and shall keep the Site free from debris and obstructions.

b) Testing and quality control

(i) Contractor to engage services of an independent laboratory

Notwithstanding the requirements of the Specifications pertaining to testing and quality control, the Contractor shall engage the services of an approved independent laboratory to undertake all testing of materials, the results of which are specified in, or may reasonably be inferred from, the Contract. These results will be taken into consideration by the Engineer in deciding whether the quality of materials utilised, and workmanship achieved by the Contractor comply with the requirements of the Specifications. The aforegoing shall apply irrespective of whether the specifications indicate that the said testing is to be carried out by the Engineer or by the Contractor. The Contractor shall be responsible for arranging with the independent testing laboratory for the timeous carrying out of all such testing specified in the Contract, at not less than the frequencies and in the manner specified. The Contractor shall promptly provide the Engineer with copies of the results of all such testing carried out by the independent laboratory. For the purposes of this clause, an "independent laboratory" shall mean an "approved laboratory" (as defined in subclause PSA 7.2) which is not under the management or control of the Contractor and in which the Contractor has no financial interest, nor which has any control or financial interest in the Contractor.

The Engineer shall be entitled at times during the Contract to require that the Contractor arrange with the independent laboratory to carry out any tests, at such times and at such locations in the Works as the Engineer shall prescribe. The Contractor shall promptly and without delay arrange with the independent laboratory

for carrying out all such additional testing as required by the Engineer, and copies of the test results shall be promptly submitted to the Engineer.

(ii) Costs of testing

(a) Tests

The costs of all testing carried out by the independent laboratory, above shall be borne by the Contractor and shall be deemed to be included in the tendered rates and prices for the respective items of work as listed in the Schedule of Quantities and which require testing in terms of the Specifications. No separate payments will be made by the Employer to the Contractor in respect of any testing.

Where, as a result of the consistency of the materials varying or as a result of failure to meet the required specifications for the work, it becomes necessary to carry out additional tests (eg re-tests on rectified work and/or replacement materials), the costs of such additional testing shall be for the Contractor's account.

(b) Additional tests required by the Engineer

The costs of any additional tests required by the Engineer shall be reimbursed to the Contractor against substitution of the Provisional Sum allowed therefore in the Schedule of Quantities; provided always that the costs of any such additional tests ordered by the Engineer, the results of which indicate that the quality of the materials utilised and/or the standard of workmanship achieved are/is not in accordance with the specifications, shall not be reimbursable to the Contractor.

(c) Subcontractors

All matters pertaining to Subcontractors (including Nominated Subcontractors) and the work executed by them shall be dealt with directly between the Engineer and the Contractor in the context of all subcontract work being an integral part of the Works for which the Contractor is responsible. The Engineer will not liaise directly with any Subcontractors nor will he issue instructions concerning the subcontract works directly to any Subcontractor. It is the responsibility of the Contractor to ensure that all documentation or instructions issued to the Contractor are adequately communicated to the relevant Subcontractor. All matters arising from the subcontract agreements shall be dealt with directly between the Contractor and the Subcontractors and the Engineer will not become involved.

The identical Safety, Health and Environment requirements shall apply to Subcontractors and it is the duty of the Contractor to enforce the application of such requirements.

(d) Access to properties

The Contractor shall organise the work to cause the least possible inconvenience to the public and to the property owners adjacent to or affected by the work, and except as hereunder provided, shall at all times provide and allow pedestrian and vehicular access to properties within or adjoining or affected by the area in which he is working.

The Contractor shall ensure access to the site for the affected land owners is available 24 hours per day. The Contractor shall notify the affected land owner in writing at least 72 hours but not more than 120 hours in advance prior to work commencement within the affected property. The Contractor shall carry out the work expeditiously and with minimum inconvenience to the occupiers and to owners of adjacent property. The Contractor shall take

all necessary precautions for the protection of persons, livestock, buildings and property. The Contractor shall provide temporary fences separating the works from the Resident where required. Vehicular access must be maintained to properties at the end of each day's work unless the Contractor has made alternative arrangements with the occupiers.

If, as a result of restricted road reserve widths and the nature of the work, the construction of bypasses is not feasible, construction shall be carried out under traffic conditions to provide access to erven and properties. Notwithstanding the aforegoing, the Contractor may, with the prior approval of the Engineer (which approval shall not be unreasonably withheld), make arrangements with and obtain the acceptance of the occupiers of erven and properties to close off part of a street, road, footpath or entrance temporarily, provided that the Contractor duly notifies the occupiers of the intended closure and its probable duration, and reopens the route as punctually as possible. Where possible, such streets, roads, footpaths and entrances shall be made safe and reopened to traffic overnight. Such closure shall not absolve the Contractor from his obligations under the Contract to provide access at all times. Barricades, traffic signs, drums and other safety measures appropriate to the circumstances shall be provided by the Contractor to suit the specific conditions.

(e) Existing residential areas

Electricity and water supply interruptions in existing residential areas shall be kept to a minimum. The Engineer's approval shall be obtained prior to such interruptions and residents shall be notified in writing at least 24 hours but not more than 48 hours in advance. Supplies shall be normalised by 16:00 on the same day.

(f) Employment of unskilled and semi-skilled workers in labour-intensive works

(i) Requirements for the sourcing and engagement of labour

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 10845-8, Participation of Targeted Labour.

2) The rate of pay shall be as per sectoral guidelines.

3) Tasks established by the Contractor must be such that:

(aa) the average worker completes 5 tasks per week in 40 hours or less; and
(bb) the weakest worker completes 5 tasks per week in 55 hours or less.

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 g.i.3.

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:

6)

(aa) where the head of the household has less than a primary school education;

(bb) that have less than one full-time person earning an income;

(cc) where subsistence agriculture is the source of income;

(dd) those who are not in receipt of any social security pension income.

7) The Contractor must provide monthly statistics to Johannesburg Water indicating the number of new jobs created through this contract. This statistic must be provided with each monthly payment certificate using Councils electronic prescribed format, which will be provided by the Project Manager of this project to the successful Bidder. Failure to provide the required statistics Council may withhold payment.

(ii) Specific provisions pertaining to SANS 10845-8

1) Definition

Targeted labour: Unemployed persons who are employed as local labour on the project.

2) Contract participation goals

(aa) There 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.

(bb) 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.

3) Terms and conditions for the engagement of targeted labour

Further to the provisions of clause 3.4 of SANS 10845-8, written contracts shall be entered into with targeted labour.

4) Variations to SANS 10845-8

(aa) The definition for contract 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.

(bb) 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.

(iii) Training of targeted labour

1) The Contractor shall provide all the necessary on-the-job training to targeted labour to enable such labour to master the basic work techniques required to undertake the work in accordance with the requirements of the contract in a manner that does not compromise worker health and safety.

2) The cost of the formal training of targeted labour, will be funded by the provincial office of the Department of Labour. This training will 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.

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: 012 328 6820 or email cinderella.makunike@dpw.gov.za, Tel: 083 677 4026.

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.

5) The Contractor shall do nothing to dissuade targeted labour from participating in training programmes.

6) 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 g.iii.4 above.

7) Proof of compliance with the requirements of g.iii.2 to g.iii.6 must be provided by the Contractor to the Employer prior to submission of the final payment certificate.

(g) Employment of local labour

It is the intention that this Contract should make maximum use of the local labour force that is presently underemployed. To this end the Contractor shall limit the utilisation on the Contract of non-local employees to that of key personnel only and to employ and train local labour to the extent necessary for the execution and completion of this Contract. The Contractor shall fill in the form entitled Key Personnel in the Forms to be completed by the Tenderer. The data stated on the above-mentioned form will be strictly monitored during the Contract period and any deviations therefrom shall be subject to the prior approval of the Engineer, which approval shall not be unreasonably withheld.

The employment of casual labour will be done in co-operation with community leaders and local structures. The Bidder shall ensure that all remuneration paid to employees is in line with the relevant sectorial determination in terms of the Basic Conditions of Employment Act, No 75 of 1997, as determined by the Department of Labour.

(h) Monthly statements and payment certificates

The statement to be submitted by the Contractor in terms of Clause 6.10 of the Conditions of Contract shall be prepared by the Contractor at his own cost, strictly in accordance with the standard payment certificate prescribed by the Engineer, in digital electronic computer format. The Contractor shall, together with a copy of the digital electronic computer file of the statement, submit two (2) A4 size paper copies of the statement.

For the purposes of the Engineer's payment certificate, the Contractor shall subsequently be responsible, at his own cost, for making such adjustments to his statement as may be required by the Engineer for the purposes of accurately reflecting the actual quantities and amounts which the Engineer deems to be due and payable to the Contractor in the payment certificate.

The Contractor shall, at his own cost, make the said adjustments to the statement and return it to the Engineer within three (3) normal workings days from the date on which the Engineer communicated to the Contractor the adjustments required. The Contractor shall submit to the

Engineer five (5) sets of A4 size paper copies of such adjusted statement, together with a copy of the electronic digital computer file thereof.

Any delay by the Contractor in making the said adjustments and submitting to the Engineer the requisite copies of the adjusted statement for the purposes of the Engineer's payment certificate will be added to the times allowed to the Engineer in terms of Subclause 6.10.4 of the Conditions of Contract to submit the signed payment certificate to the Employer and the Contractor. Any such delay will also be added to the period in which the Employer is required to make payment to the Contractor.

(j) Construction in restricted areas

Working space is sometimes restricted. The construction method used in these restricted areas largely depends on the Contractor's Plant. Notwithstanding, measurement and payment will be strictly according to the specified cross-sections and dimensions irrespective of the method used, and the rates and prices tendered will be deemed to include full compensation for any difficulties encountered by the Contractor while working in restricted areas. Neither extra payment nor any claim for payment due to these difficulties will be considered.

(k) Notices, signs, barricades and advertisements

All notices, signs and barricades, as well as advertisements, may be used only if approved by the Engineer. The Contractor shall be responsible for their supply, erection, maintenance and ultimate removal and shall make provision for this in his tendered rates.

The Engineer shall have the right to instruct the Contractor to move any sign, notice or advertisement to another position, or to remove it from the Site of the Works if in his opinion it is unsatisfactory, inconvenient or dangerous.

(l) Workmanship and quality control

The onus to produce work that conforms in quality and accuracy of detail to the requirements of the Specifications and Drawings rests with the Contractor, and the Contractor shall, at his own expense, institute a quality control system and provide suitably qualified and experienced Engineers, foremen, surveyors, materials technicians, other technicians and technical staff, together with all transport, instruments and equipment to ensure adequate supervision and positive control of the Works at all times. The cost of supervision and process control, including testing carried out by the Contractor, will be deemed to be included in the rates tendered for the related items of work.

The Contractor's attention is drawn to the provisions of the various Standardized Specifications regarding the minimum frequency of testing required. The Contractor shall, at his own discretion, increase this frequency where necessary to ensure adequate control.

On completion and submission of every part of the work to the Engineer for examination and measurement, the Contractor shall furnish the Engineer with the results of the relevant tests, measurements and levels to demonstrate the achievement of compliance with the Specifications.

C3.1.4.2.6 Extension of time due to abnormal rainfall

(a) Extension of time in respect of delays resulting from wet climatic conditions on the Site will only be considered in respect of abnormally wet climatic conditions and shall be determined for each calendar month or part thereof, in accordance with the formula given below:

$$V = (Nw - Nn) + (Rw - Rn)/X$$

in which formula the symbols shall have the following meanings:

V = Potential extension of time in calendar days for the calendar month under consideration:
If V is negative and its absolute value exceeds Nn, then V shall be taken as equal to minus Nn.
When the value of V for any month exceeds the number of days in the particular month, V will be the number of days in the month.

Nw = Actual number of days in the calendar month under consideration on which a rainfall of Y mm or more was recorded on the Site

Nn = Average number of days, derived from existing records of rainfall in the region of the Site, on which a rainfall of Y mm or more was recorded for the calendar month

Rw = Actual rainfall in mm recorded on the Site in an approved rain gauge for the calendar month under consideration

Rn = Average rainfall in mm for the calendar month, derived from existing records of rainfall in the region of the Site

The factor (Nw - Nn) shall be deemed to be a fair allowance for variations from the average number of days during which the rainfall exceeds Y mm.

The factor (Rw - Rn)/X shall be deemed to be a fair allowance for variations from the average number of days during which the rainfall did not exceed Y mm but wet conditions prevented or disrupted work.

(b) The rainfall records at rainfall station at the Johannesburg International Airport for the period 2003 to 2012 are reproduced in the accompanying table, and the monthly averages (Rn and Nn) for this period shall, for the purposes of this Contract be taken as normal and as the values to be substituted for Rn and Nn in the formula above. The values of X and Y shall be 20 and 10 respectively.

The potential extension of time V has been calculated for each month and year of the period concerned to indicate the possible effect of the rainfall formula. The values of V were obtained by applying the rainfall formula and using the actual rainfall figures and the calculated values of Rn and Nn indicated in the table.

(c) The Contractor shall, at his own cost, provide and erect on the Site at a location approved by the Engineer, an approved rain gauge, which shall be fenced off in a manner which will prevent any undue interference by workmen and others. The Contractor shall, at his own cost, arrange for the reading of the rain gauge on a daily basis for the duration of the Contract. The gauge readings, as well as the date and time at which the reading was taken shall be recorded in a separate record book provided by the Contractor for this purpose. All entries in the rainfall record books shall be signed by the person taking the reading and the gauge shall be properly emptied immediately after each reading has been taken. If required by the Engineer, the Engineer shall be entitled to witness the reading of the gauge.

(d) The Contractor's claims in terms of Subclause 5.12 of the Conditions of Contract for extension of time in respect of delays resulting from wet climatic conditions on the Site during each month, shall be submitted in writing to the Engineer monthly; provided always that

(i) the period allowed to the Contractor in terms of Clause 10.1 of the Conditions of Contract in which to submit his claim for each month shall be reduced to seven (7) days, calculated from the last day of the month to which the claim applies; and

(ii) the 28-day period allowed to the Engineer in terms of Subclause 10.1.5 of the Conditions of Contract in which to give his ruling on the claim, shall be reduced to fourteen (14) days.

The Contractor's monthly claim shall be accompanied by a copy of the signed daily rainfall readings for the applicable month.

(e) The extent of any extension of time which may be granted to the Contractor in respect of wet climatic conditions (whether normal or abnormal) shall be determined as the algebraic sum of the "V" values for each month between the Commencement Date and the Due Completion Date of the Contract, calculated in accordance with subclause C3.4.2.6(a) above; provided always that

(i) rainfall occurring within the period of the Contractor's Christmas shut-down period (referred to in the Conditions of Contract) shall not be taken into account in the calculation of the monthly "V" values;

(ii) rainfall occurring during any period during which the Contractor was delayed due to reasons other than wet climatic conditions on the Site, and for which delay an extension of time is granted by the Engineer, shall not be taken into account in the calculation of the monthly "V" values;

(iii) if the algebraic sum of the "V" values for each month is negative, the time for completion will not be reduced on account of subnormal rainfall, and

(iv) where rainfall is recorded only for part of a month, the "V" value shall be calculated for that part of the month using pro rata values for Nn and Rn.

(f) The Engineer shall, simultaneous with granting any extension of time in terms of this clause, revise the Due Completion Date of the Contract to reflect an extension of time having been granted in respect of wet climatic conditions, to the extent of the algebraic sum of all the "V" values for all the preceding months of the Contract, less the aggregate of the "Nn" values for the remaining (unexpired) months of the Contract (viz less aggregate of the potential maximum negative "V" values for the remaining Contract Period). Thus, provided that where such period is negative, the Due Completion Date shall not be revised.

(g) Any extension of time in respect of wet climatic conditions granted in terms of this clause shall not be deemed to take into account delays experienced by the Contractor in repairing or reinstating damage to or physical loss of the Works arising from the occurrence of abnormal climatic conditions. Extension of time in respect of any such repairs or reinstatement regarding damage shall be the subject of a separate application for extension of time in accordance with the provisions of Clause 5.12 and Clause 10 of the Conditions of Contract.

Table 2: Statistical rainfall

STATISTICAL INFORMATION: JOHANNESBURG INTERNATIONAL AIRPORT: 2003-2012		
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	6.3	164.06
February	3.7	113.59
March	3.2	95.65
April	1.2	43.47
May	0.4	13.16
June	0.5	11.43
July	0.1	1.79
August	0.1	5.94
September	0.5	15.64
October	2.3	64.62
November	2.8	93.86
December	5.2	142.34
TOTAL	**26.3**	**765.55**

C3.1.4.3 PLANT AND MATERIALS

C3.1.4.3.1 Plant and materials supplied by the employer

The Employer shall not supply any plant or materials.

C3.1.4.3.2 Materials, samples and shop drawings

(a) Samples

Materials or work which do not conform to the approved samples submitted, will be rejected. The Engineer reserves the right to submit samples to tests to ensure that the material represented by the sample meets the specification requirements. The costs of any such tests conducted by or on behalf of the Engineer, the results of which indicate that the samples provided by the Contractor do not conform to the requirements of the Contract, shall be for the Contractor's account.

C3.1.4.4 CONSTRUCTION EQUIPMENT

C3.1.4.4.1 Requirements for equipment

The Contractor's equipment shall be adequate to construct the works.

C3.1.4.4.2 Equipment provided by the employer

The Contractor shall be responsible for the supply of all equipment, labour and materials for the Works. The Employer will not provide any equipment.

C3.1.4.5 EXISTING SERVICES

C3.1.4.5.1 Known services

All known services are indicated on the drawings. Exact positions cannot be guaranteed.

C3.1.4.5.2 Treatment of existing services

The Contractor shall ascertain and observe all conditions laid down by the relevant authorities for the execution of the work in the vicinity of their services. The Contract may include certain work involved in the moving, reinstating and protection of existing services that are affected by construction of the works. The Contractor's attention is drawn to all of the requirements as set out in the Amendments to the Standardised Specifications.

The Contractor shall expose by hand, and confirm the position and size of all existing services, and report back to the Engineer on its findings prior to commencing with work relating to the existing services. Any excavation in such areas shall only be executed after approval by the Engineer.

C3.1.4.5.3 Damage to services

If any services are damaged during excavations, the relevant service provider and the Engineer shall be notified immediately. The Contractor shall be responsible for all costs to repair damaged services.

C3.1.4.5.4 Reinstatement of services and structures damaged during construction

When the service provider does the permanent reinstatement, the cost involved shall be payable by the Contractor. When the Contractor does the permanent reinstatement, the method of reinstatement shall be approved by the services provider.

Johannesburg Water SOC Ltd

Johannesburg Water

CONTRACT JW14322 – UR 1327

CONSTRUCTION OF A 26ML CONCRETE RESERVOIR AND 2ML CONCRETE WATER TOWER IN BRIXTON WITH ASSOCIATED PIPE AND PUMP WORKS

VOLUME 2B:

GENERIC SPECIFICATIONS

Employer:		Contractor:	
Witness:		Witness:	

PREAMBLE TO SCOPE OF WORK

General

The Standard Specification for all associated civil work shall be the SANS 1200 and SANS 2001 – Standardized Specification for Civil Engineering Construction.

The Standardized Specifications applicable to this Contract are listed in the Project Specification.

These Specifications are not issued with this volume but are available at the Contractor's expense from: SA Bureau of Standards, Private Bag X191, Pretoria, 0001.

Scope

This Project Specification is set out in three portions:

Portion 1: SCOPE OF WORK covers a general description of the project, the facilities available and the requirements to be met.

Portion 2: GENERIC SPECIFICATIONS covers variations to the standardized specifications which are applicable to the contract.

Portion 3: PARTICULAR SPECIFICATIONS covers particular specifications which are applicable to the contract.

Status

Should any requirement of the Project Specification conflict with any requirement of the standardized or particular specifications, the requirements of the Project Specifications shall prevail.

C3.2 SPECIFICATIONS

C3.2.1 LIST OF APPLICABLE SPECIFICATIONS

C3.2.1.1 Applicable Standardized Specifications

For the purposes of this Contract, the following SANS 2001, SANS 1200, and other SANS Standardized Specifications for civil engineering construction are applicable:

SANS 1200 A : General
SANS 1200 AB : Engineer's office
SANS 1200 C : Site clearance
SANS 1200 D : Earthworks (Genera)
SANS 1200 DB : Earthworks (Pipe trenches)
SANS 1200 DK : Gabion and Pitching
SANS 1200 DM : Earthworks (Roads, subgrade)
SANS 1200 F : Piling
SANS 1200 H : Structural Steelwork
SANS 1200 HA : Structural Steelwork (Sundry items)
SANS 1200 HB : Cladding and sheeting
SANS 1200 HC : Corrosion protection of Structural Steelwork
SANS 1200 L : Medium-pressure pipelines
SANS 1200 LB : Bedding (Pipes)
SANS 1200 LC : Cable ducts
SANS 1200 LD : Sewer
SANS 1200 LE : Stormwater drainage
SANS 1200 LF : Erf Connections (Water)
SANS 1200 LG : Pipe Jacking
SANS 1200 M : Roads (General)
SANS 1200 ME : Subbase
SANS 1200 MF : Base
SANS 1200 MJ : Segmented paving
SANS 1200 MK : Kerbing and channelling
SANS 1200 MM : Ancillary Roadworks

C3.2.1.2 Particular Specifications

The following Particular Specifications for work not covered by the SANS 1200 Standardized Specifications are also included hereunder: The engineering specifications below shall take precedence over any other SANS specification for the project.

C3.2.1.2.1 Civil

These additional specifications are included under section C.3.3.1 of this document.

C3.2.1.2.2 Mechanical

These additional specifications are included under section C.3.3.2 of this document.

C3.2.1.2.3 Electrical

These additional specifications are included under section C.3.3.3 of this document.

C3.2.1.2.3 Control and Instrumentation

These additional specifications are included under section C.3.3.4 of this document.

C3.2.1.2.4 Structural

These additional specifications are included under section C.3.3.5 of this document.

C3.2.1.2.5 Landscape Architecture

These additional specifications are included under section C.3.3.6 of this document.

C3.2.2 VARIATIONS AND ADDITIONS TO THE SANS 1200 STANDARDIZED SPECIFICATIONS

Variations and additions to the following SANS 1200 Standardized Specifications were made.

SANS 1200 A	:	Preliminary and General
SANS 1200 AB	:	Engineer's office
SANS 1200 C	:	Site clearance
SANS 1200 D	:	Earthworks (General)
SANS 1200 DB	:	Earthworks (Pipe trenches)
SANS 1200 DK	:	Gabion and Pitching
SANS 1200 DM	:	Earthworks (Roads, subgrade)
SANS 1200 HA	:	Structural Steelwork (Sundry items)
SANS 1200 HB	:	Cladding and sheeting
SANS 1200 L	:	Medium-pressure pipelines
SANS 1200 LB	:	Bedding (Pipes)
SANS 1200 LC	:	Cable ducts
SANS 1200 LD	:	Sewer
SANS 1200 LE	:	Stormwater drainage
SANS 1200 LF	:	Erf Connections (Water)
SANS 1200 M	:	Roads (General)
SANS 1200 ME	:	Subbase
SANS 1200 MF	:	Base
SANS 1200 MJ	:	Segmented paving
SANS 1200 MK	:	Kerbing and channelling

The following variations and additions to the SANS 1200 Standardized Specifications referred to above 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 to which the variation or addition thereto applies.

C3.2.2.1 PSA GENERAL

C3.2.2.1.1 PSA 1 SCOPE

REPLACE THE CONTENTS OF SUBCLAUSE 1.1, INCLUDING THE NOTES, WITH THE FOLLOWING:

"1.1 This specification covers requirements, principles and responsibilities of a general nature which are generally applicable to civil engineering construction and building works contracts, as well as the requirements for the Contractor's establishment on the Site."

C3.2.2.1.2 PSA 2 INTERPRETATIONS

C3.2.2.1.2.1 PSA 2.3 DEFINITIONS

IN THE OPENING PHRASE BETWEEN THE WORDS "specification" *AND* "the following", *INSERT THE WORDS* "the definitions given in the Conditions of Contract and".

(a) General

ADD THE FOLLOWING DEFINITIONS:

" 'General Conditions' and 'Conditions of Contract': The General Conditions of Contract specified for use with this Contract, together with the Contract Data (GCC 2015).

'Specified': As specified in the Standardized Specifications, the Drawings or the Project Specifications. 'Specifications' shall have the corresponding meaning."

(c) 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 variations in the value of the Contract Price or the time allowed in the Contract for the completion of the work.

'Time-related charge': A charge, the amount of which varies in accordance with the Time for Completion of the Works, 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.' "

C3.2.2.1.2.2 PSA 2.4 ABBREVIATIONS

(a) Abbreviations relating to standard documents

ADD THE FOLLOWING ABBREVIATION:

"CKS: SANS Co-ordinating Specification."

C3.2.2.1.3 PSA 3 MATERIALS

C3.2.2.1.3.1 PSA 3.1 QUALITY

ADD THE FOLLOWING AT THE END OF SUBCLAUSE 3.1:

"All manufactured materials supplied shall be new materials unless the contrary is specified. All materials specified to be in accordance with SANS Specifications shall bear the SABS mark, where such a mark is available for the type of product."

C3.2.2.1.3.2 PSA 3.3 DELAY DUE TO SUPPLY OF MATERIALS

ADD THE ABOVE SUBCLAUSE TO CLAUSE 3:

If there are delays in the work because the required materials are unavailable, the Contractor must prove to the Engineer what the reasons for those delays are. To do so, the Contractor must submit to the Engineer:

- copies of the written orders the Contractor sent to suppliers to request the required materials
- copies of the written enquiries the Contractor sent to suppliers to follow up on orders they had placed with them.

The Engineer will then assess the information contained in the copies they receive from the Contractor. If the Engineer finds that the materials are unavailable because the Contractor did not order the materials in time, or did not properly follow up on orders they placed with suppliers, the

Engineer will consider the Contractor to have been negligent in carrying out their duties. In such a case, the Contractor will not get an extension of time. But if the Engineer finds that Contractor carried out all their duties properly, and the materials are unavailable simply because the suppliers could not provide the necessary materials in time, the Contractor may get an extension of time.

C3.2.2.1.4 PSA 4 PLANT

C3.2.2.1.4.1 PSA 4.1 SILENCING OF PLANT

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 plant 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."

C3.2.2.1.4.2 PSA 4.2 CONTRACTOR'S OFFICES, STORES AND SERVICES

ADD THE FOLLOWING PARAGRAPH BEFORE THE EXISTING FIRST PARAGRAPH IN SUBCLAUSE 4.2:

"The Contractor's buildings, sheds and other facilities erected or utilised on the Site for the purposes of the Contract shall be fenced off and shall contain all offices, stores, workshops, testing laboratories, toilet facilities, etc. as may be required by the Contractor. The facilities shall always be kept in a neat and orderly condition.

No personnel may reside on the Site. Only night-watchmen may be on the Site after hours."

DELETE "and first-aid services" *IN THE SECOND PARAGRAPH OF SUBCLAUSE 4.2 AND ADD THE FOLLOWING:*

"The Contractor shall provide on the Site and in close proximity to the actual locations where the work is being executed, one toilet per 10 workers, which toilets shall be effectively screened from public view and their use enforced. Such toilets shall be relocated from time to time as the location of the work being executed changes, so as to ensure that easy access to the toilets is maintained.

The Contractor shall, where applicable, make all necessary arrangements and pay for the removal of night soil."

C3.2.2.1.5 PSA 5 CONSTRUCTION

C3.2.2.1.5.1 PSA 5.1 SURVEY

C3.2.2.1.5.1.1 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 Engineer 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 Engineer, 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 provision 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 Engineer, were disturbed, damaged or destroyed by others beyond his control."

C3.2.2.1.5.2 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".

C3.2.2.1.5.3 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

C3.2.2.1.5.3.1 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 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 Engineer, obtain the most up-to-date plans as are available, showing the positions of services existing in the area where he intends to work. Neither the Employer nor the Engineer offers any 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 Engineer, 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 subclauses 4.4 and 5.1.2.2 of SANS 1200 D 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 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 Engineer 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 Engineer 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 his costs of providing, holding available on the Site and utilising the said detecting and testing equipment, nor for any costs incurred in preparing and submitting to the Engineer 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 Engineer 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.

C3.2.2.1.5.3.2 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 therefrom to the public and/or workmen, all in accordance with the requirements of the prevailing legislation and related regulations.

Unless otherwise instructed by the Engineer, 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 93% modified AASHTO density.

C3.2.2.1.5.3.3 PSA 5.4.3 Alterations and repairs to existing services

Unless the contrary is clearly specified in the Contract or ordered by the Engineer, the Contractor shall not carry out alterations to existing services. When any such alterations become necessary, the Contractor shall promptly inform the Engineer, 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 Engineer, 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 minimise damage to and interruption of the service. No repairs of telecommunication cables or electric power lines and cables shall be attempted by the Contractor.

Wayleaves should also be consulted regarding contact numbers for relevant service authorities.

C3.2.2.1.5.4 PSA 5.5 DEALING WITH WATER ON WORKS

The Contractor shall in particular keep free from water the entire working area. The temporary works should divert the bulk of the water. The Contractor shall supply, operate and maintain such pumping plant as may be necessary to remove, control and dispose any water, including seepage, that may enter the Works. The Engineer may take or order the Contractor to take additional precautions where he is not satisfied with the Contractor's arrangements. The Contractor shall not be relieved of his responsibility by reason of the Engineer taking or ordering additional precautions, or by reason of the engineer failing to do so. All expenditure incurred by Johannesburg Water in taking any additional precautions or otherwise in remedying the default of the Contractor and making good of the Works shall be recovered from the moneys due to the Contractor. The Contractor shall be responsible to effect all dewatering to enable the Contractor to access and execute the Works.

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.

C3.2.2.1.5.5 PSA 5.7 SAFETY

REPLACE THE CONTENTS OF SUBCLAUSE 5.7 WITH THE FOLLOWING:

"Pursuant to the provisions of the Conditions of Contract, and without in any way limiting the Contractor's obligations thereunder, the Contractor shall at his own expense (except only where specific provision (if any) is made in the Contract for the reimbursement to the Contractor in respect of particular items), provide the following:

(a) Provide to its Employees on the site of the works, all safety materials, clothing and equipment necessary to ensure full compliance with the provisions of the Occupational Health and Safety Act, 1993 (Act No 85 of 1993) as amended (hereinafter referred to as the Act) at all times, and shall institute appropriate and effective measures to ensure the proper usage of such safety materials, clothing and equipment at all times;

(b) Provide, install and maintain all barricades, safety signage and other measures to ensure the safety of workmen and all persons in, on and around the site, as well as the general public;

(c) Implement on the site of the works, such procedures and systems and keep all records as may be required to ensure compliance with the requirements of the Act at all times;

(d) Implement all necessary measures so as to ensure compliance with the Act by all Subcontractors engaged by the Contractor and their employees engaged on the works;

(e) Full compliance with all other requirements pertaining to safety as may be specified in the Contract.

The Employer and the Engineer shall be entitled, although not obliged, to make such inspections on the site as they shall deem appropriate, for the purpose of verifying the Contractor's compliance with the requirements of the Act. For this purpose, the Contractor shall grant full access to the site of all parts of the site and shall co-operate fully in such inspections and shall make available for inspection all such documents and records as the Employer's and/or Engineer's representative may reasonably require. Where any such investigations reveal, or where it comes to the Engineer's attention that the Contractor is in any way in breach of the requirements of the Act or is failing to comply with the provisions of this clause, the Engineer shall, in accordance with the provisions of Clause 5.11 of the Conditions of Contract, be entitled to suspend progress on the works or any part thereof until such time as the Contractor has demonstrated to the satisfaction of the Engineer, that such breach has been rectified.

The Contractor shall have no grounds for a claim against the Employer for extension of time and/or additional costs if the progress on the works or any part thereof is suspended by the Engineer in terms of this clause, and the Contractor shall remain fully liable in respect of the payment of penalties for late completion in accordance with the provisions of Clause 5.13.1 should the Contractor fail to complete the Works on or before the specified due completion date in consequence of the suspension. Persistent and repeated breach by the Contractor of the requirements of the Act and/or this clause shall constitute grounds for the Engineer to act in terms of Clause 9.2.1.3.6 of the Conditions of Contract and for the Employer to cancel the Contract in accordance with the further provisions of the said Clause 9.2.

ADD THE FOLLOWING SUBCLAUSES TO CLAUSE 5:

C3.2.2.1.5.6 "PSA 5.9 SITE MEETINGS

The Contractor or his authorised agent will be required to attend regular site meetings, which shall normally be held once a month on dates and at times determined by the Engineer, but in any case whenever reasonably required by the Engineer. Unless otherwise indicated in the Contract or instructed by the Engineer, such meetings shall be held at the Contractor's offices on the site. At such monthly meetings, matters such as general progress on the works, quality of work, problems, claims, payments, and safety shall be discussed, but not matters concerning the day-to-day running of the Contract.

C3.2.2.1.5.7 "PSA 5.10 SANITARY FACILITIES

The Contractor shall provide, maintain and finally remove from site adequate sanitary facilities. The sanitary facility shall be properly ventilated and clean at all times. The use of the sanitary facilities shall be strictly enforced.

C3.2.2.1.6 PSA 6 TOLERANCES

ADD THE FOLLOWING SUBCLAUSE TO CLAUSE 6:

C3.2.2.1.6.1 "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 'authorised' dimensions. These are specified dimensions or those shown on the Drawings or, if changed, as finally prescribed by the Engineer, without any allowance for the specified tolerances. Except if otherwise specified, all measurements for determining quantities for payment will be based on the 'authorised' dimensions.

If the work is constructed in accordance with the 'authorised' dimensions plus or minus the tolerances allowed, the calculation of quantities will be based on the 'authorised' dimensions, regardless of the actual dimensions to which the work has been constructed.

When the work is not constructed in accordance with the 'authorised' dimensions plus or minus the tolerances allowed, the Engineer 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 'authorised' dimensions, and where the actual dimensions are less than the 'authorised' dimensions minus the tolerance allowed, quantities for payment shall be calculated based on the actual dimensions as constructed."

C3.2.2.1.7 PSA 7 TESTING

C3.2.2.1.7.1 PSA 7.1 PRINCIPLES

ADD THE FOLLOWING NEW SUBCLAUSE:

C3.2.2.1.7.1.1 PSA 7.1.3 Cost of Testing

The cost of all testing to be carried out by the Contractor in terms of the requirements of the relevant SANS 1200 standards shall be included in the rates for the various work items listed in the Schedule of Quantities. No separate payments shall be made in this regard.

The Engineer may order the Contractor to arrange special check tests to be carried out by an approved independent laboratory. The cost of special check tests ordered by the Engineer shall be borne by the Employer if the test results indicate compliance with the specification and by the Contractor if the results indicate non-compliance with the specification.

C3.2.2.1.7.2 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 Engineer 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 or the Engineer;

(c) Any testing laboratory established and operated on the Site by or on behalf of the Employer or the Engineer.

(d) Any other laboratory that the Engineer approves in his absolute discretion."

C3.2.2.1.8 PSA 8 MEASUREMENT AND PAYMENT

C3.2.2.1.8.1 PSA 8.1 MEASUREMENT

C3.2.2.1.8.1.1 PSA 8.1.1 Method of measurement, all sections of the Schedule

DELETE THE WORDS "and South West Africa".

C3.2.2.1.8.1.2 PSA 8.1.2 Preliminary and General item or section

C3.2.2.1.8.1.2.1 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."

C3.2.2.1.8.1.2.2 PSA 8.1.2.2 Tendered sums

REPLACE THE CONTENTS OF THIS SUBCLAUSE WITH THE FOLLOWING:

"Except only where specific provision is made in the Specifications and/or the Bill of Quantities for separate compensation for any of these items, the Contractor's tendered sums under items PSA 8.3 and PSA 8.4 shall collectively cover all charges for:

- risks, costs and obligations in terms of the Conditions of Contract and of this standardized specification;
- head-office and site overheads and supervision;
- profit and financing costs;
- expenses of a general nature not specifically related to any item or items of the permanent or temporary work;
- providing such facilities on site as may be required by the Contractor for the proper performance of the Contract and for its personnel, including, but without limitation, providing offices, storage facilities, workshops, ablutions, services such as water, electricity, sewage and rubbish disposal, access roads and all other facilities required, as well as for the maintenance and removal on completion of the works of these facilities and cleaning-up of the site of the Contractor's establishment and reinstatement to not less than its original condition, and
- providing the facilities for the Engineer and his staff as specified in the Contract and their removal from the site on completion of the Contract."

C3.2.2.1.8.2 PSA 8.2 PAYMENT

C3.2.2.1.8.2.1 PSA 8.2.1 Fixed-charge and value-related items

REPLACE THE CONTENTS OF SUBCLAUSE 8.2.1 WITH THE FOLLOWING:

C3.2.2.1.8.2.1.1 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 Engineer.

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.

C3.2.2.1.8.2.1.2 PSA 8.2.1.2 Value-related items

Payment for the sum tendered under item 8.3.2 will be made in three separate instalments as follows:

(a) The first instalment, which is 40% of the sum, will be paid when the Contractor has fulfilled all his obligations to date under this specification, the General Conditions of Contract and the Special Conditions of Contract, and when the value of work certified for payment, excluding materials on site and payments for preliminary and general items, is equal to not less than 5% of the total value of the work listed in the Bill of Quantities.

(b) The second instalment, which is 40% of the sum, will be made when the amount certified for payment, including retention moneys but excluding this second instalment, exceeds 50% of the tender sum.

(c) The final payment, which is 20% of the sum, will be made when the works have been certified as completed and the Contractor has fulfilled all his obligations to date under this Specification, the General Conditions of Contract and the Contract Data.

No adjustments will be made to the final Contract price, should the value of the measured work finally completed be more or less that the tender sum.

C3.2.2.1.8.2.2 PSA 8.2.2 Time-related items

REPLACE THE CONTENTS OF SUBCLAUSE 8.2.2 WITH THE FOLLOWING:

"Subject to the provisions of subclauses 8.2.3 and 8.2.4, payment under item 8.4.1 (time-related item) will be made monthly in equal amounts, calculated by dividing the sum tendered for the item by the tendered Contract period in months, provided always that the total of the monthly amounts so paid for the item is not out of proportion to the value of the progress of the Works as a whole."

C3.2.2.1.8.3 PSA 8.3 SCHEDULED FIXED-CHARGE AND VALUE-RELATED ITEMS

REPLACE THE CONTENTS OF SUBCLAUSE 8.3.1 WITH THE FOLLOWING:

C3.2.2.1.8.3.1 "PSA 8.3.1 Fixed preliminary and general charges…….Unit: sum

The sums tendered shall include full compensation for all fixed-charge preliminary and general charges as described in subclause PSA 8.1.2.2. Payment will be made as described in subclause PSA 8.2.1.1.

ADD THE FOLLOWING NEW SUBCLAUSES TO CLAUSE 8.3

C3.2.2.1.8.3.1 "PSA 8.3.5 Additional Contractual Obligations

C3.2.2.1.8.3.1.1 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.

C3.2.2.1.8.3.1.2 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 2014 and all the requirements stipulated in the Employer's Health and Safety Specifications."

C3.2.2.1.8.3.1.2 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 or applicable regulations.

C3.2.2.1.8.4 PSA 8.4 SCHEDULED TIME-RELATED ITEMS

REPLACE THE CONTENTS OF SUBCLAUSE 8.4 WITH THE FOLLOWING:

C3.2.2.1.8.4.1 "PSA 8.4.1 Time-related preliminary and general charges……Unit: month

The sum tendered shall include full compensation for all time-related preliminary and general charges as described in subclause PSA 8.1.2.2. Payment will be made as described in subclause PSA 8.2.2."

ADD THE FOLLOWING NEW SUBCLAUSES TO CLAUSE 8.4.

C3.2.2.1.8.4.2 PSA 8.4.6 Additional Obligations

C3.2.2.1.8.4.2.1 PSA 8.4.6.1 OHS Act Obligation……Unit: Sum

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 2014 and all the requirements stipulated in the Employer's Health and Safety Specifications.

C3.2.2.1.8.4.2.2 PSA 8.4.6.2 Security services cost……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. This sum shall also cover the security requirements of the relevant privately owned properties impacted upon by the construction works, as well as negotiations with the owners of the properties in this regard.

C3.2.2.1.8.4.2.3 PSA 8.4.6.3 Electrical Safety Officer……..Unit: Month

The stated sum shall cover full compensation and all costs payable on a monthly basis, to provide a full time qualified and suitable experienced Electrical Safety Officer for the duration of the contract. The stated sum shall also cover for the ESO cellphone airtime. The ESO must provide proof that he has the necessary qualifications, competencies and registrations to carry out the required work.

C3.2.2.1.8.4.2.4 PSA 8.4.6.4 Community Liaison Officer……Unit: Prov Sum

The stated sum shall cover full compensation and all costs payable on a monthly basis, 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.

C3.2.2.1.8.5 PSA 8.5 SUMS STATED PROVISIONALLY BY THE ENGINEER

REPLACE THE CONTENTS OF SUBCLAUSE 8.5 WITH THE FOLLOWING:

C3.2.2.1.8.5.1 "PSA 8.5.1 Works executed by the Contractor……..Unit: Prov Sum

The Contractor will be reimbursed in substitution of the Provisional Sums (if any) allowed in the Bill of Quantities for work to be executed by the Contractor, in the amounts determined in accordance with the provisions of Clause 6.6 of the Conditions of Contract.

C3.2.2.1.8.5.2 PSA 8.5.2 Works executed by Nominated Subcontractors:

(a) Work to be executed by a Nominated Subcontractor……...Unit: Prov sum

(b) Overheads, charges and profit on item (a) above…….Unit: % or sum

Subitems (a) and (b) will be provided in the Schedule of Quantities for each different Nominated Subcontract included in the Contract.

The Contractor shall be reimbursed under subitem (a), in substitution of the respective Provisional Sums (if any) allowed in the Schedule of Quantities, the amounts actually paid or payable by the Contractor to the respective Nominated Subcontractors, in accordance with the provisions of Clause 6.6.

The Contractor shall be paid under subitem (b), either:

(a) where the unit of measurement for subitem (b) was specified as being a percentage, the respective percentage, as stated by the Contractor in his tender, of the amount certified by the Engineer for payment under the related subitem (a), all in accordance with the provisions of Clause 6.6.1.2.1, or

(b) where the unit of measurement for subitem (b) was specified as being a lump sum, an amount which is in the same proportion to the amount certified for payment under subitem (a) and the tendered lump sum is to the amount of the Provisional Sum stated under subitem (a) in accordance with the provisions of Clause 6.6.1.2.2., provided always that where the Contractor has failed for any reason to insert a percentage or sum (as applicable) for subitem in its tender, or

(c) where no provision was made in the tender documents for tenderers to make any such entry, the Contractor will be paid an amount equal to SEVEN AND ONE HALF PER CENT (7.5%) of the amount actually certified by the Engineer for payment under subitem (a).

The percentage or sum (as applicable) paid under subitem (b) as aforesaid, shall be deemed to include for full and final compensation to the Contractor for all costs as may be incurred and all charges and profits associated with the engagement, supervision, administration and management of the Nominated Subcontractor required of him in fulfilling its obligations under the Contract as the Principal Contractor."

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 Provisional Sums are at the disposal of the Engineer and will be paid if and when the need arises.

C3.2.2.1.8.6 PSA 8.6 PRIME COST ITEMS

REPLACE SUBCLAUSE 8.6 WITH THE FOLLOWING:

"PSA 8.6 PRIME COST SUMS

(a) Description of item to which Prime Cost Sum applies ……...Unit: PC Sum

(b) Charge required by Contractor on subitem (a) above …….Unit: %

Subitems (a) and (b) will be provided in the Bill of Quantities for each different item to which a Prime Cost Sum applies. The Contractor shall be reimbursed under subitem(s) (a) in substitution of the respective Prime Cost Sums included in the Contract, the actual price(s) paid or payable by him in respect of the goods, materials or services supplied, but excluding any charges for the Contractor's labour, profit, carriage, establishment or other charges related to such goods, services or materials.

The Contractor shall be paid under subitem (b), the respective percentage, as stated by the Contractor in his tender, of the amount certified by the Engineer for payment under the related subitem (a). The percentages tendered by the Contractor for each respective subitem (b) included in the Bill of Quantities shall be deemed to be in full and final compensation to the Contractor in respect of any charge by the Contractor for labour, carriage profit, establishment and for any other charges related to the goods, services or materials supplied under the related subitem (a).

If the Contractor shall have omitted within his tender to insert a tendered percentage under subitem (b), or tendered a zero percentage, the Contractor's tendered rate for subitem (b) shall be deemed to be zero and the Contractor shall not be entitled to any payment under subitem (b).

Note in connection with additional tests required by the Engineer:

When a PC sum is included in the Bill of Quantities for additional tests required by the Engineer, the Contractor shall be responsible for both the cost of normal testing and for the cost of any additional test that indicates that the specifications have not been complied with."

C3.2.2.1.8.7 PSA 8.7 DAYWORK

ADD THE FOLLOWING NEW SUB CLAUSES:

C3.2.2.1.8.7.1 PSA 8.7.1 Scope

This section covers the method of measurement and payment for work carried out on a day work basis.

C3.2.2.1.8.7.1.1 PSA 8.7.1.1 General Requirements

Work will be classified as day work only if the Engineer 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 will be issued at the discretion of the Engineer. Some or all of 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 Engineer for his approval and shall submit such receipts or vouchers to the Engineer as may be necessary for proving the amount claimed.

C3.2.2.1.8.7.1.2 PSA 8.7.1.2 Measurement and Payment - Day works

"Measurement and payment shall be in accordance with the provisions of Clause 6.5 of the Conditions of Contract."

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 plant/equipment and operator (excluding VAT) and shall apply only to vehicles and construction equipment approved in writing by the Engineer. 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, plant 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 Engineer will agree on the method of recording the working hours prior to the commencement of the work. Any long period of idling at any one time which in the opinion of the Engineer 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 shall include full compensation for all administrative costs, supervision, overheads, liabilities and obligations related to the running of the vehicles, constructional plant 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.

C3.2.2.1.8.8 PSA 8.8 TEMPORARY WORKS

C3.2.2.1.8.8.1 PSA 8.8.4 Existing Services

AMEND THE SUB CLAUSE AS FOLLOWS:

PSA 8.8.4 a) Supply or hire of specialist equipment…..…….Unit: Prov 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 Engineer.

PSA 8.8.4 b) Excavate by hand in soft material to expose existing services……Unit: m³

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 8.8.4 c) Temporary protection of exposed services……Unit: Sum

The sum shall cover the cost of the protection of temporarily exposed existing services, such that the services are not damaged or subject to deterioration while they are exposed. The exposed services shall be adequately barricaded. All Health and Safety aspects shall be fulfilled.

C3.2.2.1.8.8.2 PSA 8.8.5 Cost of Survey

DELETE THE EXISTING SUBCLAUSE AND REPLACE WITH:

a) Survey and setting out works……...…….……..Unit: Sum

Provision must be made to cover the complete survey of the route – water services and placement of line and level pegs by a professional surveyor every 50m and at all changes of direction and grade. The associated costs will be for the account of the Contractor. The survey shall form part of the construction programme.

The Survey shall include:

(a) Confirmation of cadastral boundaries and road reserves (whether marked by existing structures and fences or not). Setting out of pegs of cadastral boundaries

(b) Setting out of the pipe centre line as directed by the Engineer within available space, considering above

(c) Survey of as-built pipeline and production of as built record drawings showing coordinates (X; Y; Z) at:

a. Each change of direction

b. Each valve chamber

c. Beginning and end of road crossings

d. Connection to existing pipes

e. 50m spacing in straight sections and at every change in direction of the pipe.

(d) Verifying existing servitudes including:

a. Indicating the servitudes on maps

b. Verification of ownership of servitudes

(e) Confirming that the survey corresponds with benchmarks that may have been used by the Engineer during the design stage of the works.

The tendered rate includes all costs associated with the survey (establishment, accommodation, travel, title deeds, etc.). Payment shall be effected on the completion and acceptance of the survey and setting out.

C3.2.2.1.8.8.3 PSA 8.8.6 Special Water Control……..…..……..…..Unit: Sum

The tendered rate shall include all cost to ensure that no water enter or stand in excavated trenches, low laying areas or portions of the site under construction.

The tendered rate shall also include all cost to ensure that ingress of sub-surface water is controlled and pumped out of the excavated areas. All plant, labour and operation costs as well as equipment required to secure a dry working area and pumping of water shall be included in the tendered rate.

C3.2.2.1.8.8.4 PSA 8.8.7 Dealing with other Service Authorities, obtaining of wayleaves, etc.
……...……Unit: Sum

The Engineer has obtained some of the wayleaves from identified authorities (attached to Portion 3). By the time of contract award, some of the wayleaves may have expired. The contractor will be responsible to:

- Submit applications and re-issue all wayleaves which have expired into his name;
- Submit applications and issue wayleaves that have not yet been issued into his name;
- For wayleaves that are still valid (and issued in Zutari's name), the contractor shall issue a legal letter to Zutari (Pty) Ltd. that he takes full responsibility for compliance with wayleave conditions;

- Maintain wayleaves throughout the duration of the contract and
- Comply with conditions.

The tender rate shall include all costs for dealing with the following service authorities and for fulfilment of wayleave requirements:

- Johannesburg Water
- City Power
- City Parks
- Eskom
- Openserve / Telkom
- Rand Water
- Egoli Gas
- Sasol
- Liquid Telecom / Neotel
- Dark Fibre Africa
- MTN
- Metro Trading Company
- Johannesburg Roads Agency
- Transnet / Petronet
- Others which may be identified.

The Contractor shall also arrange for metered connections for electricity and water for the guardhouse and a connection to the nearest sewer system.

ADD THE FOLLOWING ITEMS:

C3.2.2.1.8.9 **"PSA 8.9 COMPLIANCE WITH OHS ACT AND CONSTRUCTION REGULATIONS (INCLUDING THE CONSTRUCTION REGULATIONS 2014)**……..Unit: sum

The tendered sum shall include full compensation to the Contractor for compliance with all the requirements of the OHS Act and Regulations (including the Construction Regulations 2014) at all times for the full duration of the Contract. The successful tenderer shall provide the Engineer with a complete breakdown of this tendered sum.

This sum will be paid to the Contractor in equal monthly amounts subject to proper/substantial compliance.

C3.2.2.1.8.10 **PSA 8.10 QUALITY ASSURANCE AND MANAGEMENT PLAN**……..Unit: sum

The tendered sum shall include full compensation for compiling and submitting an ISO9000 quality assurance and management plan to the Engineer and for maintaining, implementing, monitoring,

recording and complying to the approved plan for the full duration of the Contract. The sum shall include for all specialists required to fulfil the above functions.

Payment will be made on a successful and approved progress basis.

C3.2.2.1.8.11 PSA 8.11 COMPLIANCE WITH RECORD OF DECISION ISSUED BY GDARD AND THE ENVIRONMENTAL MANAGEMENT PLAN……Unit: sum

The tendered sum shall include full compensation for implementing, monitoring and complying with the environmental management plan for the full duration of the Contract. The sum shall also include for all specialists required to fulfil the above functions.

Payment will be made on a successful and approved progress basis.

C3.2.2.2 PSAB ENGINEER'S OFFICE

C3.2.2.2.1 PSAB 3 MATERIALS

C3.2.2.2.1.1 PSAB 3.1 NAMEBOARDS

REPLACE THE ENTIRE CLAUSE AND REPLACE WITH THE FOLLOWING:

"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 planted 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".

C3.2.2.2.1.2 PSAB 3.2 OFFICE BUILDING(S)

DELETE THIS SUBCLAUSE AND RE-TITLE THE SUBCLASE "FACILITIES FOR THE ENGINEER":

ADD THE FOLLOWING SUBCLAUSE:

C3.2.2.2.1.2.1 "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 Engineer.

The contractor must allow in their pricing and scheduling for the repurposing of the site establishment facilities to prefabricated classrooms and aftercare facilities for the school.

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 siting of all offices shall be to the Engineer's satisfaction and shall be decided upon in consultation with him/her and confirmed in writing before erection.

All office buildings 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 office building provided and will not be paid for separately.

All office buildings shall meet with the approval of the Engineer.

The offices shall comply with the following requirements.

Dimensions	Type 1 Office	Type 2 Office
Minimum floor area	26 m^2	26 m^2
Minimum window area	4.0 m^2	2.4 m^2
Minimum clear height	2.4 m	2.4 m
Parking for vehicles	3	3

Furniture and Equipment

Each office shall be equipped with the following:

(i) Office desk with a surface area of at least 1.5m2 with at least 3 drawers one of which can be locked.

(ii) Two office chairs.

(iii) Sufficient racks and hangers for hanging contract drawings. The hangers shall be of the "Barhold" type, with one hanger to five drawings.

(iv) 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.

(ii) Fifteen office chairs

(iii) Air-conditioner

(iv) Computer equipment as per PSAB4.1.

The Contractor must provide basic survey instruments: dumpy level, tripod stand and staff.

On completion of the Works, ownership of the buildings shall be transferred to Brixton Primary School, located on the corner of Symons Road and Caroline Street. The school is located where the Works will be implemented, and the buildings will therefore not be required to be transported to another site location. These offices are to be repurposed fit for use for a kitchen (Type 1 office) and a classroom facility (Type 2 office), according to manufacturer's specifications, by the Contractor.

C3.2.2.2.1.3 "PSAB 3.3 CARPORT

The Contractor shall construct the number of carports specified in C3.1.4.2.2 of the Scope of Work for the sole use of the Engineer 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 20m² and the floor shall be covered with a layer of crushed stone to alleviate dusty and muddy conditions. The carport(s) shall be positioned so as to provide easy and convenient access to the Engineer's office."

C3.2.2.2.2 PSAB 4 PLANT

C3.2.2.2.2.1 PSAB 4.1 TELEPHONE

REPLACE SUBCLAUSE 4.1 OF SANS 1200 AB WITH THE FOLLOWING:

"The Contractor shall at his own cost, arrange for the provision of airtime and data bundles for the duration of the contract, for the Engineer'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.

The Contractor shall also provide, insure, protect, secure and maintain computer facilities, for the duration of the contract, including the following:

- a laptop with a processor similar or equal to an Intel ® i3 processor, at least 4 GB Ram, a hard disk drive of at least 100 GB;
- an external hard disk drive of similar or larger capacity as the internal hard disk drive of the laptop for backups;
- an additional mouse, keyboard and screen;
- an A3 Colour printer with sufficient ink / toner, capable to scan, print, copy and fax;
- Wireless data modem;
- Data plan for at least 5GB data per month;
- Software to include Microsoft Office, Microsoft Project and a .pdf viewer.

All the equipment mentioned above will be handed back to the Contractor at the conclusion of the project."

ADD THE FOLLOWING NEW SUBCLAUSES TO CLAUSE 4 OF SANS 1200 AB:

C3.2.2.2.2.2 "PSAB 4.2 SURVEY EQUIPMENT

The Contractor shall provide on site and make available for the exclusive use of the Engineer and his staff, the survey equipment listed in C3.1.4.2.2 of the Scope of Work.

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 Engineer and his staff, the Contractor shall make available for use by the Engineer, the further survey equipment listed in C3.1.4.2.2 of the Scope of Work, at all times when such is reasonably required by the Engineer and his staff for the purposes of the Contract."

C3.2.2.2.3 PSAB 5 CONSTRUCTION

C3.2.2.2.3.1 PSAB 5.4 TELEPHONE

REPLACE THE CONTENTS OF SUBCLAUSE 5.4 OF SANS 1200 AB WITH THE FOLLOWING:

C3.2.2.2.3.1.1 PSAB 5.4.2 Cellphones

The Contractor shall ensure that airtime is provided for cellphone calls. The Contractor shall, on production of proof of purchase of airtime, be reimbursed for the cost of the Engineer's airtime purchased."

ADD THE FOLLOWING NEW SUBCLAUSES TO CLAUSE 5 OF SANS 1200 AB:

C3.2.2.2.3.2 "PSAB 5.6 COMPUTER EQUIPMENT

All computer equipment provided shall be kept fully serviceable at all times by the Contractor. The Contractor shall have any defective equipment repaired or replaced at his own cost within 12 hours after notification by the Engineer's staff.

A data connection with a minimum speed of 10 Megabytes/second should also be provided.

The Contractor shall further provide at his own cost, all paper and black ink cartridges and other consumables reasonably required by the Engineer."

ADD THE FOLLOWING NEW SUBCLAUSES TO CLAUSE 5 OF SANS 1200 AB:

C3.2.2.2.3.3 "PSAB 5.7 SURVEY EQUIPMENT

All survey equipment provided by the Contractor shall be kept fully serviceable at all times by the Contractor. The Contractor shall have any defective equipment repaired or replaced at his own cost within 12 hours after notification by the Engineer's staff.

Where required by the Engineer, the Contractor shall, at his own cost, promptly arrange for the recalibration of survey equipment provided."

C3.2.2.3 PSC SITE CLEARANCE

C3.2.2.3.1 PSC 3 MATERIALS

C3.2.2.3.1.1 PSC 3.1 DISPOSAL OF MATERIAL

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."

C3.2.2.3.2 PSC 5 CONSTRUCTION

C3.2.2.3.2.1 PSC 5.1 AREAS TO BE CLEARED AND GRUBBED

ADD THE FOLLOWING:

"Small diameter pipeline routes shall be cleared to a distance of 1,0m on both sides of the pipeline centre line and large diameter pipeline routes shall be cleared to a distance of 2,0m on both sides of the pipeline centre line. Route pegs or markers shall not be destroyed or damaged during clearing operations."

C3.2.2.3.2.2 PSC 5.2 CUTTING OF TREES

C3.2.2.3.2.2.1 PSC 5.2.3 Preservation of trees

C3.2.2.3.2.2.1.1 PSC 5.2.3.2 Individual trees

REPLACE THE LAST SENTENCE WITH THE FOLLOWING:

"An amount of R5000,00 will be deducted from moneys due to the Contractor as a penalty for every tree that is damaged or removed unnecessarily."

C3.2.2.3.2.3 PSC 5.5 RECLEARING OF VEGETATION

ADD THE FOLLOWING:

"When areas have to be recleared on the written instructions of the Engineer, such reclearing shall be carried out at the Contractor's own cost and the Contractor is therefore advised not to clear the areas too soon."

C3.2.2.3.3 PSC 8 MEASUREMENT AND PAYMENT

C3.2.2.3.3.1 PSC 8.1 BASIC PRINCIPLES

ADD THE FOLLOWING:

"Levels to be used for earthworks quantity calculations will be surveyed prior to clearing and grubbing, and again once the clearing operation has been completed."

C3.2.2.3.3.2 PSC 8.2 PAYMENT

C3.2.2.3.3.2.1 PSC 8.2.1 Clear and grub

REPLACE THE FIRST LINE WITH THE FOLLOWING:

"The area designated by the Engineer to be cleared and grubbed will be measured in square metre to the nearest square metre,"

C3.2.2.3.3.2.2 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

(d) 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 2.2m) 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."

C3.2.2.3.3.2.3 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:

C3.2.2.3.3.2.4 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 meter 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.

C3.2.2.3.3.2.5 PSC 8.2.11b Removal of man-made surfaces

The rate shall cover all plant, labour, material, saw cutting (asphalt and concrete), breaking up, lifting, loading, transportation, off-loading surfacing and storing (where applicable).

Unit: m²

a) 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.

b) Footways and driveways

i) Asphalt _ 50mm thickness

ii) Asphalt > 50 _ 100mm thickness

iii) Interlocking concrete segmental paving blocks (all colours)

iv) Concrete slabs (450 x 450mm)

v) Brick paving

vi) Unreinforced concrete _75mm thick

vii) Reinforced concrete _75mm thick

viii) Grassing

ix) Kerbing (all types of kerbing)
……..……... (Unit: m)

C3.2.2.3.3.2.6 PSC 8.2.12 Backfilling and reinstatement of man-made surfaces

The rate shall cover the cost of all associated plant, 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:

C3.2.2.3.3.2.7 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 Stabilised 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

C3.2.2.3.3.2.8 PSC 8.2.12.2 Backfilling and reinstatement footways

Unit:m²

a) Using removed materials:

i) Interlocking concrete segmental paving blocks (all colours)

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

C3.2.2.3.3.2.9 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 plant, labour, material, on-loading, transporting, off-loading and cleaning for the following: ……...Unit: m²

a) Face brick

i) 110mm wall

ii) 220mm wall

iii) 330mm wall

b) Plastered

i) 110mm wall

ii) 220mm wall

iii) 330mm wall

iv) 440mm wall

c) Steel palisade fences (height = 2.2m)

C3.2.2.4 PSD EARTHWORKS

C3.2.2.4.1 PSD 2 INTERPRETATIONS

C3.2.2.4.1.1 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."

C3.2.2.4.1.2 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 authorised 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"

C3.2.2.4.2 PSD 3 MATERIALS

C3.2.2.4.2.1 PSD 3.1 CLASSIFICATION FOR EXCAVATION PURPOSES

C3.2.2.4.2.1.1 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 Engineer if and 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 Engineer in good time shall entitle the Engineer to reclassify, at his discretion, such excavated material."

C3.2.2.4.2.1.2 PSD 3.1.2 Classes of excavation

REPLACE THE CONTENTS OF SUB-CLAUSE 3.1.2 WITH THE FOLLOWING:

(a) "Rock excavation shall mean material, other than in restricted excavation that cannot, before removal, be efficiently ripped by a bulldozer of mass approximately 35t, fitted with a single tine ripper suitable for heavy ripping, and of flywheel power of approximately 220kW.

(b) Rock shall be material that cannot be efficiently removed without blasting or without wedging or splitting.

(c) Soft excavation shall be excavation in all material other than rock as defined above, whether the material is suitable for use in the Works, or to be spoiled. The classification includes excavation in earthworks or any pavement layers of an existing pavement regardless of the nature of the material excavated, other than rock excavation.

(d) The Engineer shall decide under which one of the above classes any excavation shall be classified for purposes of payment. In the event of a disagreement between the Contractor and the Engineer, the Contractor shall, at its own cost, make available such mechanical plant as required by the Engineer in order to determine whether or not the material can reasonably be removed. The decision of the Engineer as to the classification shall be final and binding.

(e) Individual boulders greater than one cubic meter in volume shall be classified as rock when their nature and size are such that, in the opinion of the Engineer, they cannot be removed without recourse to one of the methods described under rock excavation. Where a portion of excavation contains 50% (fifty per cent) or more by volume of boulders of this order, such portion shall be considered as rock excavation throughout."

ADD THE FOLLOWING NEW SUB CLAUSE:

C3.2.2.4.2.1.3 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
Soft 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
Intermediate Intermediate excavation shall be excavation in material that require loosening with a hand spike (gwala) before being removed from the trench	Dense	Stiff to very stiff	7-15	6-8
Hard Hard excavation shall be excavation in material that requires prior breaking using mechanical equipment, such as pavement breakers with clay spades, before being removed from the trench.	Very dense		16-50	-15
Rock Rock excavation shall be excavation in material other than described above which by nature of the material requires prior breaking using mechanical equipment, such as pavement breakers with moil points, before being removed from the trench	-	-	>50	>15

C3.2.2.4.2.2 PSD 3.2 CLASSIFICATION FOR PLACING PURPOSES

C3.2.2.4.2.2.1 PSD 3.2.1 Materials suitable for embankments and terraces

REPLACE THE CONTENTS OF SUB-CLAUSE 3.2.1 WITH THE FOLLOWING:

"Materials types used for embankments and terraces are as indicated on the drawings and shall comply with the material types as specified in TRH 14.

The material type required for embankments and terraces shall be as stated on the construction drawings. Excavated material may be used as backfill only with the approval of the Engineer, provided the Contractor conducts sufficient on-site tests of excavated material to prove its compliance."

C3.2.2.4.2.2.2 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 50mm sieve;

(b) The material shall not contain large clay lumps that do not break up under the action of the compaction equipment; and

(c) The liquid limit of the material shall not exceed 40, neither shall the PI exceed 18."

C3.2.2.4.2.3 PSD 3.3 SELECTION

ADD THE FOLLOWING SUBCLAUSE:

C3.2.2.4.2.3.1 "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."

C3.2.2.4.3 PSD 4 PLANT

C3.2.2.4.3.1 PSD 4.4 DETECTORS

REPLACE THE CONTENTS OF SUBCLAUSE 4.4 WITH THE FOLLOWING:

"The Contractor shall, for the purposes of detecting and locating underground services in accordance with the provisions of subclause 5.4 of SANS 1200 A and subclause 5.1.2 of SANS 1200 D, at his own cost, provide and use detecting equipment which is suitable for the detection of underground cables and pipes."

C3.2.2.4.4 PSD 5 CONSTRUCTION

C3.2.2.4.4.1 PSD 5.1 PRECAUTIONS

C3.2.2.4.4.1.1 PSD 5.1.1 Safety

C3.2.2.4.4.1.1.1 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 SUBPARAGRAPH 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 Engineer shall be entitled to suspend all work under the Contractor until in the Engineer'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.

C3.2.2.4.4.1.1.2 PSD 5.1.1.2 Safeguarding of excavations

REPLACE "Machinery and Occupational Safety Act" *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.

C3.2.2.4.4.1.1.3 PSD 5.1.1.3 Explosives

REPLACE THE CONTENTS OF THIS SUBCLAUSE WITH THE FOLLOWING:

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 Engineer 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 sufficient 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 Engineer, 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 Engineer 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.

C3.2.2.4.4.1.1.4 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 Engineer will require the Contractor to remove the rock material by means of pneumatic or hydraulic breakers, e.g. jack-hammers or wood-peckers.

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.

C3.2.2.4.4.1.2 PSD 5.1.2 Existing services

C3.2.2.4.4.1.2.1 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 Engineer.

Unless otherwise instructed or agreed by the Engineer, no service shall be left exposed after its exact position has been determined and all excavations carried out for the purposes of exposing underground services shall be promptly backfilled and compacted to the following densities:

(a) In roadways: 93% Mod AASHTO density; and

(b) In all other areas: 90% Mod AASHTO density.

Where hand excavations to expose underground services have to be carried out in roadways, the Contractor shall reinstate the road layerworks 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 PSD 8.3.8.1.

Payment in respect of reinstating layerworks in roadways will be made in accordance with sub-clause 8.3.6.1 of SANS 1200 DB (as amended) should it be required."

C3.2.2.4.4.1.2.2 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 plant shall not be operated dangerously close to known services. Where necessary, excavation in close proximity to known services shall be carefully carried out with suitable hand tools, excluding picks wherever their use could damage the services. No additional payment will apply to such more difficult work.

Should any service not being a known service be discovered or encountered during the course of the Contract, the Contractor shall, in addition to complying with the requirements of subclause 5.4.2 of SANS 1200 A (as amended), immediately notify the Engineer thereof and implement such measures as will prevent damage of such service or, if it was damaged in the course of discovery, will prevent and minimise the occurrence of any further damage occurring."

C3.2.2.4.4.1.2.3 PSD 5.1.2.4 Negligence

DELETE SUBCLAUSE 5.1.2.4.

C3.2.2.4.4.1.3 PSD 5.1.3 Stormwater and groundwater

ADD THE FOLLOWING:

"The Contractor shall, where applicable and at the earliest practicable opportunity, install the permanent drainage specified or shown on the Drawings and shall at his own cost provide the temporary drainage required to protect the works."

C3.2.2.4.4.1.4 PSD 5.1.4 Nuisance

C3.2.2.4.4.1.4.1 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 Engineer 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 Engineer) and the return to Site, excavated material for use as backfill or bedding."

ADD THE FOLLOWING NEW SUBCLAUSE:

C3.2.2.4.4.1.4.2 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."

C3.2.2.4.4.1.5 PSD 5.1.5 Reinstatement and maintenance of roads

ADD THE FOLLOWING:

"Where crossings have been made, the roads shall be reinstated in accordance with the details specified in subclause 5.9 of SANS 1200 DB."

C3.2.2.4.4.1.4 PSD 5.1.6 Road traffic control

DELETE THE SECOND SENTENCE OF SUBCLAUSE 5.1.6.

C3.2.2.4.4.2 PSD 5.2 METHODS AND PROCEDURES

C3.2.2.4.4.2.1 PSD 5.2.2 Excavation

C3.2.2.4.4.2.1.1 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 tendered rate for item 8.3.5

will be deemed to include the cost of a working width of 600mm, but the Contractor may excavate a greater working width at no additional cost to the Employer."

REPLACE THE FIRST SENTENCE OF PARAGRAPH (e) WITH THE FOLLOWING:

"Where excavations have been carried below the authorised levels, the Contractor shall backfill such excavations to the correct level with approved gravel compacted to 93% of modified AASHTO density or to the density of the surrounding material, whichever is the higher density.

Where excavations for structures have been carried out in hard material, the Engineer may direct that over-excavation be backfilled with weak concrete if there is a danger of settlement or differential settlement of the foundations.

Where the sides of excavations against which concrete is to be cast have been over-excavated or have collapsed partially, the Contractor shall retrim the excavations if necessary and, unless other remedial measures are agreed to by the Engineer, shall cast the concrete for the structure, including the additional concrete that may be required as a result of the over-excavation or partial collapse. The cost of the additional concrete or remedial measures shall be for the Contractor's account."

C3.2.2.4.4.2.1.2 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 the such sites will be made separately in the applicable items as scheduled."

ADD THE FOLLOWING SUBCLAUSE IN SUBCLAUSE 5.2.2:

C3.2.2.4.4.2.1.2 "PSD 5.2.2.4 Selection and stockpiling

Approval or designation of the material in a particular 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 organise and carry out his operations in such a manner as will prevent the contamination of suitable embankment and backfill material with unsuitable materials. Any excavated material which becomes, in the Engineer's opinion, unsuitable for use in embankments or backfill as a result of contamination, shall be disposed of in a manner acceptable to the Engineer and shall be replaced by the Contractor with materials acceptable to the Engineer, all at the Contractor's cost.

When required, or when ordered by the Engineer, material shall be stockpiled for later use. The additional costs for stockpiling material shall be separately paid to the Contractor in the applicable items as scheduled."

C3.2.2.4.4.2.2 PSD 5.2.3 Placing and Compaction

ADD THE FOLLOWING SUBCLAUSE IN SUBCLAUSE 5.2.3:

C3.2.2.4.4.2.2.1 "PSD 5.2.3.3 Treatment of in-situ material

Prior to the backfilling of embankments, if in the opinion of the Engineer the in-situ material at the bottom of the excavation (this excavation occurs after the topsoil material has been removed) is suitable for use in place, the in-situ material shall be scarified to a depth of 150mm (one hundred and fifty millimeters), watered, shaped, and compacted to 90% (ninety per cent) of modified AASHTO maximum density. (100% (one hundred per cent) for sand)

In-situ treatment of soil shall be by means of Impact Compaction (Impact roller)."

C3.2.2.4.4.2.3 PSD 5.2.4 Finishing

ADD THE FOLLOWING SUBCLAUSES IN SUBCLAUSE 5.2.4:

C3.2.2.4.4.2.3.1 "PSD 5.2.4.6 Grassing

(a) Hydroseeding

Mulch shall be added to the hydro-seeding mix at a rate of 2,000kg/ha."

C3.2.2.4.4.2.3.2 PSD 5.2.4.7 Planting and maintaining the plants

(a) Watering, weeding, mowing and replanting

The mowing of grass to control weeds shall not be measured and paid for.

C3.2.2.4.4.2.4 PSD 5.2.5 Transport for earthworks

C3.2.2.4.4.2.4.1 PSD 5.2.5.1 Free-haul

REPLACE ALL EXCEPT PARAGRAPH (a) OF SUBCLAUSE 5.2.5 WITH THE FOLLOWING:

"(b) In respect of all materials not referred to in paragraph (a) above, and subject to the provisions of subclause PSD 5.2.5.3, the free-haul distance within which the Contractor will be required to move material without separate compensation shall be 1,0 km, irrespective of whether the material is hauled beyond the boundaries of the site or otherwise."

ADD THE FOLLOWING SUBCLAUSES IN SUBCLAUSE 5.2.5:

C3.2.2.4.4.2.4.2 PSD 5.2.5.3 Special cases relating to overhaul

(a) When material is excavated and stockpiled on the Engineer's instructions before being reloaded and transported to its point of final use, free-haul shall apply twice, firstly from the point of excavation to stockpile and secondly from stockpile to the point of final use (See subclause PSD 8.3.14).

(b) When material is to be spoiled on a site which has to be provided by the Contractor, or otherwise disposed of at the Contractor's initiative, the extra-over rate for excavation and disposal at spoil sites provided by the Contractor (see item PSD 8.3.15) shall include full compensation for all haul entailed by this operation and no overhaul shall apply."

C3.2.2.4.5 PSD 7 TESTING

C3.2.2.4.5.1 PSD 7.2 TAKING AND TESTING OF SAMPLES

REPLACE THE CONTENTS OF THIS SUBCLAUSE WITH THE FOLLOWING:

"The Contractor shall arrange with the approved independent laboratory engaged by the Contractor in terms of C3.4.2.5(b) of the Project Specifications to carry out sufficient tests on a regular basis as agreed between him and the Engineer to determine whether the degree of compaction, and, where applicable, the quality of materials used, comply with the Specifications and shall submit the results of these tests to the Engineer in a form approved by him.

The compaction requirements for fills shall be deemed complied with when at least 75% of the dry-density tests on any lot show values equal to or above the specified density and when no single value is more than five percentage points below the specified value."

C3.2.2.4.6 PSD 8 MEASUREMENT AND PAYMENT

C3.2.2.4.6.1 PSD 8.3 SCHEDULED ITEMS

C3.2.2.4.6.1.1 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."

C3.2.2.4.6.1.2 PSD 8.3.2 Bulk excavation

REPLACE THE CONTENTS OF ITEM WITH THE FOLLOWING:

"(a) Excavate in all materials and use for embankment or backfill as ordered, from:

(1) Necessary excavations……...Unit: m³

(2) Designated borrow pits……Unit: m³

(3) Commercial sources……Unit: m³

The unit of measurement shall be the cubic metre measured in place in accordance with subclause 8.2 of SANS 1200 D.

Separate items will be scheduled for embankments and backfills for different parts of the works.

The tendered rates shall cover the cost of complying with all the precautions required in terms of subclause 5.1 of SANS 1200 D (as amended), in addition to the cost of excavating in all materials, basic selecting, loading, transporting, off-loading, spreading or backfilling, watering, compacting, final grading, complying with the requirements for tolerances, providing for testing, finishing and tidying, all in accordance with the specifications.

In addition to the aforegoing, the tendered rate for subitem (b) shall further include for the costs of royalties (if applicable), whilst the tendered rate for subitem (c) shall also include for the costs of finding a source of suitable material, for making arrangements with the owner of the source, for procuring the material, for the payment of all requisite royalties, charges or damages, and for transporting the material to the site regardless of the distance involved. No payment will be made for the removal of overburden or stockpiling at the commercial source and no extra over payment shall apply for excavating in intermediate, hard or boulder material."

(b) Excavate in all materials to spoil……Unit: m³

The unit of measurement shall be the cubic metre of material excavated, measured in place in accordance with subclause 8.2 of SANS 1200 D.

The tendered rates shall cover the cost of complying with all the precautions required in terms of subclause 5.1 of SANS 1200 D (as amended), in addition to the cost of excavating, basic selecting, loading, transporting, off-loading at the spoil site, maintaining and finishing the spoil site, all in accordance with the specifications.

(c) Extra over subitems PSD 8.3.2(a)(1), PSD 8.3.2(a)(2) and PSD 8.3.2(b) for:

(1) Intermediate excavation……..Unit: m³

(2) Hard rock excavation……..Unit: m³
The rate shall cover the additional cost of the operations enumerated in subclauses 8.3.2.(a) and 8.3.2.(b) above for any portion of the excavation that is classified as intermediate, hard rock, boulder excavation class A or boulder excavation class B as applicable. (See Drawing D-2.).

(d) Extra over item PSD 8.3.2(c)(2) for hand excavation or other method (excluding blasting) to remove rock outcrops or rock underbreak after bulk excavation to form level site (alternative for soilcrete backfilling in rock overbreak) ……..Unit: m³

The unit shall be the cubic metre (including bulking of volume) of rock outcrops removed by hand or other labour intensive method.

The rate shall cover all additional costs of the operations including labour, plant, equipment, transport etc to break, excavate, load and removal off site of small rock outcrops not successfully removed during the bulk excavation operations.

C3.2.2.4.6.1.3 PSD 8.3.3 Restricted excavation

REPLACE THE WORDS "in 1 m increments" *AT THE END OF THE FIRST SENTENCE OF SUBITEM (a) WITH* "in the increments indicated in the Bill of Quantities".

REPLACE "in 5.2.2.1 – 5.2.2.3 (inclusive)" *AT THE END OF SUBCLAUSE (a) WITH* "in subclauses 5.2.2.1 to 5.2.2.5 (inclusive)".

ADD THE FOLLOWING SUB-SUBITEM:

"(c) Extra over subitem 8.3.3 (a) for hand excavation……Unit: m³

This item shall apply to hand excavation ordered by the Engineer or when the Engineer considers that, owing to circumstances, excavation by mechanical excavators is not practicable. It shall not apply to hand excavation for trimming or finishing an excavation made by mechanical means.

The tendered rate shall include full compensation for the additional cost of excavating by means of hand tools."

C3.2.2.4.6.1.4 PSD 8.3.4 Importing of materials

DELETE SUBITEM (a) OF 8.3.4.

C3.2.2.4.6.1.5 PSD 8.3.6 Overhaul

DELETE SUBCLAUSE 8.3.6.

C3.2.2.4.6.1.6 PSD 8.3.8 Existing services

C3.2.2.4.6.1.6.1 PSD 8.3.8.1 Location

REPLACE ITEM 8.3.8.1 WITH THE FOLLOWING:

"8.3.8.1 Hand excavation for locating and exposing existing services:

(a) In roadways ……..Unit: m³

(b) In all other areas ……...……..Unit: m³

The unit of measurement shall be the cubic metre of material excavated, measured in place according to the authorised or actual dimensions of the excavation, whichever is the lesser.

The tendered rates shall cover the cost of excavating in all materials by means of hand tools within authorised dimensions and at locations approved by the Engineer in accordance with the requirements of subclause PSA 5.4.1 for all precautionary measures necessary to protect the services from damage during excavation and backfilling, and for subsequent backfilling and compacting. Compaction of material in all areas except in roadways shall be to 93% of the modified AASHTO density.

The tendered rate for hand excavation in roadways shall include compensation for compacting excavated or selected backfill material to 93% of modified AASHTO density. Reinstating layerworks and surfacing shall be measured and paid for in terms of SANS 1200 DB.

The tendered rates shall also include for keeping excavations safe, for dealing with surface and subsurface water, for removing surplus excavated material from the site, for transporting all material and for supplying adequate supervision during both excavation and backfilling operations."

C3.2.2.4.6.1.7 PSD 8.3.10 Topsoiling

CHANGE THE UNIT TO "m³" *AND REPLACE THE CONTENTS OF THIS ITEM WITH THE FOLLOWING:*

"The unit of measurement shall be the cubic metre and the quantity shall be calculated from the authorised dimensions.

The tendered rate shall include loading of the topsoil from stockpiles, transporting, off-loading, spreading, shaping and lightly compacting the topsoil."

C3.2.2.4.6.1.8 PSD 8.3.11 Grassing or other Vegetation Cover

ADD THE FOLLOWING AFTER THE SECOND SENTENCE:

"The tendered rate shall be irrespective of the number of applications required to obtain the required spread rate."

C3.2.2.4.6.1.9 PSD 8.3.12 Road traffic signs and markings

REPLACE THE WORD "SEPARATE" IN THE FIRST SENTENCE OF ITEM 8.3.12 WITH THE FOLLOWING:

"Where the Engineer requires the provision of road traffic signs and/or road markings and/or any other measures additional to those to be provided by the Contractor in accordance with subclause 5.1.6, separate …".

ADD THE FOLLOWING ITEMS IN SUBCLAUSE 8.3:

C3.2.2.4.6.1.10 "PSD 8.3.14 Extra over items PSD 8.3.2 (a)(1) and PSD 8.3.3 for temporary stockpiling……Unit: m³

The unit of measurement shall be the cubic metre of material from necessary excavations, temporarily stockpiled by the Contractor on the instructions of the Engineer, before being used in embankments or backfill. Measurements shall be taken in place in compacted embankment or backfill as the case may be.

The tendered rate shall include for the costs, additional to those provided for in PSD 8.3.2(a)(1) and PSD 8.3.3, of off-loading, forming and maintaining the stockpile for as long as is required, reloading and transporting.

Payments to the Contractor under this item will only be made in respect of that material stockpiled on the instructions of the Engineer (which instruction shall state specifically that payments for such stockpiling will be paid for under this item) and no payments will be made to the Contractor under this item in respect of materials stockpiled by the Contractor on his own volition, nor for materials necessarily stockpiled by the Contractor in consequence of the sequence of operations adopted by him in the course of executing the works, whether such stockpiling was avoidable or otherwise."

C3.2.2.4.6.1.11 "PSD 8.3.15 Extra over items PSD 8.3.2(b) and PSD 8.3.3 for disposing of spoil material on a site provided by the Contractor……..Unit: m³

The unit of measurement shall be the cubic metre measured in accordance with subclause 8.2 of SANS 1200 D of surplus and/or unsuitable material disposed of, on the instruction of the Engineer, at a spoil site or spoil sites provided by the Contractor.

The tendered rate shall include full compensation for the additional cost of providing a spoil site or other means of disposing of surplus spoil material, for transporting the material regardless of the distance involved, for acceptance charges for such material and for all other incidental costs to dispose of the spoil material."

C3.2.2.4.6.1.12 "PSD 8.3.16 Temporary works: Control ground water inflow and ground water level around structures……Unit: Sum

Where this item is provided in the Bill, the tendered rate shall include all cost associated to keep the excavations dry, and the groundwater table low to prevent the structure from floating for the duration of the Contract. A drainage system form part of the construction scope and could be utilised to assist. In general the drainage system drains to a sump which shall be pumped down when the structure is at risk.

C3.2.2.5 PSDB EARTHWORKS (PIPE TRENCHES)

C3.2.2.5.1 PSDB 3 MATERIALS

C3.2.2.5.1.1 PSDB 3.1 CLASSES OF EXCAVATION

REPLACE THE CONTENTS OF THIS SUBCLAUSE WITH THE FOLLOWING:

"The excavation of material for the purpose of measurement and payment will not be classified as intermediate excavation nor as boulder excavation Class A or Class B. Soft excavation will hold to include any material classified in Sub-clause 3.1.2 as intermediate excavation, or boulder excavation as Classes A or B.

The now combined soft excavation will be excavation in material that can be ripped and efficiently be removed or loaded with the following plant.

(3) bulldozer of mass approximately 35 tonne fitted with a single tine rip-per suitable for heavy ripping, and of flywheel power approximately 220kW, or

(4) a track type excavator of mass approximately 32 tonne and of flywheel power approximately 200kW."

C3.2.2.5.1.2 PSDB 3.5 BACKFILL MATERIALS

ADD THE FOLLOWING PARAGRAPHS TO SUBCLAUSE 3.5:

"(c) Cement-stabilized backfilling

Backfilling shall, where directed by the Engineer, be stabilized with 5% cement. The aggregate shall consist of approved soil or gravel containing stones not bigger than 38mm and with a plasticity index not exceeding 10. The soil or gravel shall be mixed with 5% cement and shall be compacted in layers of 100mm thick to 93% of modified AASHTO density.

(d) Soilcrete backfilling

The aggregate for soilcrete shall be mixed with 5% cement and shall consist of approved soil or gravel containing stones not bigger than 38mm and with a plasticity index not exceeding 10. The soil or gravel shall be mixed in a concrete mixer with the cement and enough water to acquire a consistency that allows the mixture to be placed with vibrators to fill all voids between the pipe and the sides of the trench. Shuttering shall be used where necessary."

C3.2.2.5.1.3 PSDB 3.7 SELECTION

REPLACE THE WORDS "if he so wishes" *IN THE FIRST LINE OF THE SECOND PARAGRAPH WITH THE WORDS* "at his own cost".

C3.2.2.5.2 PSDB 5 CONSTRUCTION

C3.2.2.5.2.1 PSDB 5.1 PRECAUTIONS

C3.2.2.5.2.1.1 PSDB 5.1.2 Stormwater, Seepage and Dewatering of Excavation

C3.2.2.5.2.1.1.1 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."

C3.2.2.5.2.1.2 PSDB 5.1.3 Accommodation of traffic and access to properties

*REPLACE THE SEMICOLON AND THE WORD "*and*" AT THE END OF 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 in terms of subclause C3.4.2.5(f). Scope of Works 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 Engineer, such temporary access roads around, and/or steel or timber bridges over excavations in roads, pavements, entrances or accesses to properties.

Temporary pedestrian access bridges shall be at least 1.2m wide and temporary access bridges for vehicles shall be at least 3.6m wide. All temporary access bridges shall be fitted with handrails as well as protective mesh fencing on both sides.

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 Engineer has included in the Schedule of Quantities, particular payment items specifically therefor, 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:

C3.2.2.5.2.1.3 "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 300mm 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 Engineer, and brought to the surface for inspection by the Engineer.

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 Engineer's instructions, as relevant."

C3.2.2.5.2.2 PSDB 5.2 MINIMUM BASE WIDTHS

REPLACE PARAGRAPH (A) WITH THE FOLLOWING:

"Where two pipes are placed in the same trench, they shall be 300mm apart or as indicated on the Drawings and the specified side allowance shall still be applicable."

ADD THE FOLLOWING AFTER PARAGRAPH (B):

"The above is not applicable to trenches for subsurface drains.

Trenches for subsurface drains shall be excavated to the dimensions and gradients shown on the Drawings or directed by the Engineer.

The specified width of trenches and the width of the excavation measured for payment shall not be less than 0.5m, but the Contractor may reduce the actual width with the Engineer's permission."

ADD THE FOLLOWING SUB PARAGRAPH:

(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."

C3.2.2.5.2.3 PSDB 5.4 EXCAVATION

ADD THE FOLLOWING:

"Except where otherwise specified, trenches shall be of such a depth that the minimum cover over the pipes shall be 700mm except at road-crossings where the minimum cover shall be 1,000mm."

ADD THE FOLLOWING SUB CLAUSES:

C3.2.2.5.2.3.1 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.

(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 Engineer accordingly in writing, including a report from a professional engineer 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 Engineer 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 Engineer has authorised 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 Engineer 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, 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."

C3.2.2.5.2.3.2 PSDB 5.4.2 Hand Excavatability

C3.2.2.5.2.3.3 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.

C3.2.2.5.2.4 PSDB 5.6 BACKFILL

C3.2.2.5.2.4.1 PSDB 5.6.1 General

ADD THE FOLLOWING AFTER THE FIRST PARAGRAPH:

Trenches shall be backfilled level with adjacent surfaces immediately after completion of pipe laying and successful pressure testing. Should pipe laying not be completed before work is due to

cease for the day, the Engineer shall be entitled to instruct the Contractor to backfill the trench and re-excavate it the following day in order to complete pipe laying. The cost of the above activity shall be included in the Contractor's rates for excavation.

C3.2.2.5.2.4.2 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."

C3.2.2.5.2.4.3 PSDB 5.6.6 Completion of Backfilling

ADD THE FOLLOWING:

Backfilling should not lag more than 50m behind the laying operation.

C3.2.2.5.2.5 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."

C3.2.2.5.2.6 PSDB 5.9 REINSTATEMENT OF SURFACES

ADD THE FOLLOWING TO THIS SUB CLAUSE:

C3.2.2.5.2.6.1 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 plant, 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 plant, 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 Engineer, can be removed without cutting bricks or precast units.

ADD THE FOLLOWING NEW SUB CLAUSES:

C3.2.2.5.2.6.3 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:

C3.2.2.5.2.7 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 Employer 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:

C3.2.2.5.2.9 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 Engineer, such that no damage to or interruption of the services shall occur.

ADD THE FOLLOWING NEW SUB-CLAUSE:

C3.2.2.5.2.10 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:

C3.2.2.5.2.11 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 Engineer 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 Engineer could have been avoided.

C3.2.2.5.3 PSDB 7 TESTING

ADD THE FOLLOWING NEW SUBCLAUSE:

C3.2.2.5.3.1 PSDB 7.2 Inspection at Intermediate Stages of Construction

The Contractor shall call the Engineer, 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 Engineer 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 Engineer."

C3.2.2.5.4 PSDB 8 MEASUREMENT AND PAYMENT

C3.2.2.5.4.1 PSDB 8.1 BASIC PRINCIPLES

ADD THE FOLLOWING PARAGRAPH:

"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".

C3.2.2.5.4.2 PSDB 8.2 COMPUTATION OF QUANTITIES

REPLACE THE CONTENTS OF SUB-CLAUSE 8.2.3 WITH THE FOLLOWING:

"**PSDB 8.2.3** Wherever volumetric measurement is required, the volume will be computed according to the depths indicated on the drawings, or to the bottom of the specified bedding cradle, whichever is the greater, and the width determined from the applicable side allowance set out below (see drawing DB-4) plus the nominal width of the pipe. Side allowance shall be measured from the outside of the pipe. No allowance shall be made for the extra thickness of the collars or couplings.

Table 4: Pipe trench side clearances

All Pipes Excluding Ducts		
Nominal Diameter, mm		**Side clearance on each side, mm**
From	**To**	
0	125	200
125	700	300
700	1000	400
1000	2000	500
2000	-	600

The side allowance for ducts shall be 150mm (one hundred and fifty millimeters) and there shall be 300mm (three hundred millimeters) between a Telkom duct and any other duct/service placed in the same trench.

Where two or more pipes/ducts are to be placed in one trench, the specified base width shall be calculated as follows:

The trench width for the deeper service shall be calculated according to above specifications. The effective trench width for the shallower service shall then be the difference between its specified base width and the overlap with the trench of the deeper service.

The trench width for subsurface drains shall be as shown on the drawings."

C3.2.2.5.4.3 PSDB 8.3 SCHEDULED ITEMS

C3.2.2.5.4.3.1 PSDB 8.3.2 Excavation

(a) Excavate in all materials, for trenches, backfill compact and dispose of surplus material

*REPLACE "*of 1.0m" *IN THE FIRST SENTENCE OF 8.3.2(a) WITH:*

"as specified in the Bill of Quantities."

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 SUBITEM 2:

"No payments will be made under subitems (1) and (2) in respect of any materials measured and paid for under subitem 3 below."

AND ADD THE FOLLOWING NEW SUBITEMS IN 8.3.2(b):

"(3) Hand excavation where ordered by the Engineer in:

(a) Soft material…….Unit: m³

(b) Intermediate material…….Unit: m³

(c) Hard material……Unit: m³

The unit of measurement shall be the cubic metre of material, measured in place according to the authorised dimensions, which was excavated by hand on the specific prior written instructions of the Engineer; provided always that the Engineer'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 Engineer shall not be obliged to authorise 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) utilise 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: m²

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 Engineer ……Unit: m³

The unit of measurement shall be the cubic metre of backfill material, measured in place after compaction according to the authorised dimensions, which was stabilized on the Engineer'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 93% of modified AASHTO density.

(6) Soilcrete backfill where directed by the Engineer ……Unit: m³

The unit of measurement shall be the cubic metre of soilcrete placed on the Engineer's instructions in accordance with subclause PSDB 3.5(d), measured in place according to the authorised 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."

ADD THE FOLLOWING SUBITEMS IN 8.3.2 AFTER SUBITEM 8.3.2(c):

"(d) Excavate in all materials for stormwater inlet and outlet structures and for manholes, catchpits, valve chambers and the like, irrespective of depth, and backfill around structures:Unit: cubic metre (m³)

The unit of measurement shall be the cubic metre of material excavated, measured in place according to the authorised dimensions, and excluding the volume of material excavated and paid for under subitem (a).

The tendered rate shall include for the costs of excavating in all materials, backfilling, compacting, trimming and tidying the final surface around the structure, disposing of surplus and unsuitable materials within the free-haul distance and, where applicable, selecting and keeping separate, excavated material suitable for use as backfill.

(e) Excavate open drains in all materials..... Unit: cubic metre (m³)

The tendered rates shall include full compensation for excavating in all materials within the dimensions specified or authorised by the Engineer and to the specified lines and profiles, for the disposal of surplus and unsuitable excavated material where applicable, and in the case of item (d), for backfilling with suitable approved material compacted to 90% of modified AASHTO density around the structures.

(f) Extra over subitems (d) and (e) for excavating in:

(1) Intermediate material .....Unit: cubic metre (m³)

(2) Hard rock material .....Unit: cubic metre (m³)

Measurement and payment shall be in accordance with the provisions of 8.3.2(b) of SANS 1200 D (as amended)."

C3.2.2.5.4.3.2 PSDB 8.3.3 Excavation ancillaries

C3.2.2.5.4.3.2.1 PSDB 8.3.3.3 Compaction in road reserves

REPLACE THE HEADING OF THIS SUBITEM WITH THE FOLLOWING:

"PSDB 8.3.3.3 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."

C3.2.2.5.4.3.2.2 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."

C3.2.2.5.4.3.3 PSDB 8.3.4 Particular items

(a) Shore trench opposite structure or service

REPLACE THE HEADING OF THIS SUBITEM WITH THE FOLLOWING:

(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 Engineer over and above the Standard Specifications for safety of excavations as specified in SANS 1200 DB, subclause 5.1."

(b) Temporary works: Control water inflow from …….. to ……..

REPLACE THIS SUBITEM WITH THE FOLLOWING:

(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."

C3.2.2.5.4.3.4 PSDB 8.3.5 Existing services that Intersect or Adjoin a Pipe Trench

(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 THE NEW SUBCLAUSE PSDB 8.3.5 c) TO CLAUSE 8.3.5 AS FOLLOWS:

(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 stabilised 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 THE NEW SUBCLAUSE PSDB 8.3.6.2 TO CLAUSE 8.3.6 AS FOLLOWS:

C3.2.2.5.4.3.5 PSDB 8.3.6 Finishing

C3.2.2.5.4.3.5.1 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 meter of a reinstated surface. 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 plant, 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 Engineer, 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:

C3.2.2.5.4.3.5.2 PSDB 8.3.6.3 Reinstatement of kerbs and channels……Unit: m²

The unit of measurement shall be square metre of area reinstated. The rate shall cover the cost of all labour, plant and material required and shall also include for the disposal of all unsuitable materials.

ADD THE NEW SUBCLAUSE PSDB 8.3.6.3 TO CLAUSE 8.3.6 AS FOLLOWS:

C3.2.2.5.4.3.5.3 PSDB 8.3.6.4 Reinstatement of grassed surfaces ……Unit: m²

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:

C3.2.2.5.4.3.5.4 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.

C3.2.2.5.4.3.6 PSDB 8.3.7 Accommodation of traffic

DELETE ITEM 8.3.7.

REPLACE THE HEADING AND CONTENTS OF ITEM 8.3.7 WITH THE FOLLOWING

"PSDB 8.3.7 Accommodation of traffic ……..……Unit: sum

The tendered sum shall, (except where particular items are scheduled to cover particular costs) include full compensation for compliance with the requirements of 5.1.3 of SANS 1200 DB (as amended), including the construction and maintenance of bypasses and the use of existing roads as bypasses during the construction period.

It shall also include full compensation: for the provision, maintenance and removal of all traffic control measures, including temporary traffic signs, road markings, lighting, barricading, flagmen and, where necessary, communications equipment to regulate traffic; for the construction of temporary drainage works; for the maintenance of drainage works; and for arrangements for moving and subsequently reinstating services for the purposes of accommodating traffic, attending to traffic problems and complying with the requirements of the Road Traffic Ordinance and the relevant local authorities.

The tendered lump sum shall be adjusted to a time-related item, in the event of any extension of time for completion being granted by the Engineer in accordance with the Conditions of Contract with the Preliminary and General costs. This item will then form part of the Preliminary and General costs to be adjusted.

Payment shall be made in equal monthly instalments over the entire period allowed for completion, provided that where any extension of time for completion is granted, the amount which shall be payable under this item in any subsequent monthly payment certificate shall be the outstanding unpaid amount of the lump sum, divided by the number of months remaining until the due completion date of the Contract, as revised in accordance with the Conditions of Contract."

C3.2.2.6 PSDK GABIONS AND PITCHING

C3.2.2.6.1 PSDK 3 MATERIALS

C3.2.2.6.1.1 PSDK 3.2 PITCHING

C3.2.2.6.1.1.1 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

"

C3.2.2.6.2 PSDK 5 CONSTRUCTION

C3.2.2.6.2.1 PSDK 5.3 PITCHING

C3.2.2.6.2.1.1 PSDK 5.3.3 Grouted pitching

REPLACE THE WORDS "(table 4)" IN THE SECOND LINE OF THE FIRST PARAGRAPH WITH "(table 2)".

C3.2.2.7 PSDM EARTHWORKS (ROADS, SUBGRADE)

C3.2.2.7.1 PSDM 3 MATERIALS

C3.2.2.7.1.1 PSDM 3.2 CLASSIFICATION FOR PLACING PURPOSES

C3.2.2.7.1.1.1 PSDM 3.2.3 Selected layer

REPLACE THE CONTENTS OF THIS SUBCLAUSE WITH THE FOLLOWING:

"The following requirements shall apply in respect of the selected layer:

(a) Maximum particle size: 60% of compacted layer thickness

(b) Unstabilized selected layer

(i) Upper selected layer

Minimum CBR at 93% of modified AASHTO density: 15
Maximum PI: 12 (the Engineer has the right to alter this requirement to 3 x the grading modulus + 10)

(ii) Lower selected layer

Minimum CBR at 90% of modified AASHTO density: 7
Maximum PI: 12 (the Engineer has the right to alter this requirement to 3 x the grading modulus + 10)

(c) Stabilized selected layer
Minimum grading modulus of natural material: 0,75
UCS of stabilized material 300 kPa - 500 kPa at 93% of modified AASHTO density
Maximum PI for stabilized material: 10"

C3.2.2.7.2 PSDM 5 CONSTRUCTION

C3.2.2.7.2.1 PSDM 5.2 METHODS AND PROCEDURES

C3.2.2.7.2.1.1 PSDM 5.2.2 Cut and borrow

C3.2.2.7.2.1.1.1 PSDM 5.2.2.3 Use of material

ADD THE FOLLOWING PARAGRAPH:

"(e) Commercial sources

The provisions of subclause PSD 5.2.2.5 of SANS 1200 D as amended shall apply."

C3.2.2.7.2.1.1.2 PSDM 5.2.2.7 Catchwater mounds and channels and mitre banks and channels

ADD THE FOLLOWING SENTENCE:

"Catchwater mounds and mitre banks shall be compacted to a minimum density of 90% of modified AASHTO density."

C3.2.2.7.2.1.2 PSDM 5.2.3 Treatment of the road-bed

C3.2.2.7.2.1.2.1 PSDM 5.2.3.2 Removal of unsuitable ground

REPLACE THE SECOND SENTENCE OF PARAGRAPH (A) WITH THE FOLLOWING:

"The excavated spaces shall then be backfilled with approved imported material compacted to the required density."

ADD THE FOLLOWING SENTENCE TO PARAGRAPH (b):
"Unsuitable excavated material will be paid for as cut to spoil."

C3.2.2.7.2.1.2.2 PSDM 5.2.3.3 Treatment of road-bed

ADD THE FOLLOWING PARAGRAPH:

"(c) Three-pass roller compaction

Any portion of the roadbed that is shown on the Drawings or is specified or is directed by the Engineer to be given three-pass roller compaction because of its inadequate natural density, shall be prepared by shaping where necessary and compacting with a roller, complying with the requirements specified below.

Compaction shall comprise three complete coverages by the wheels of the specified roller over every portion of the area that is being compacted. While it is not the intention that the Contractor should apply water to the roadbed for this type of compaction, and while no rigid moisture control will be exercised during compaction, the Contractor shall nevertheless satisfy the Engineer that everything is being done to take full advantage of favourable soil moisture conditions during the rainy season, and that such compaction is as far as possible carried out when the roadbed is neither excessively dry nor excessively wet.

The Engineer has the authority to decide when conditions are favourable for compaction and where such compaction is to be carried out at any particular time, and he has the right to instruct the Contractor to water the roadbed at the Contractor's expense when, in the opinion of the Engineer, the Contractor failed, neglected or refused to comply with these requirements.

The rollers to be used for roller-pass compaction shall conform to the following requirements:

Grid roller: The grid roller shall have a mass of not less than 13.5t when ballasted, shall be loaded to this mass if required, and shall be moved at a speed of not less than 12km/h.

Vibratory roller: The vibratory roller shall be capable of exerting a combined static and dynamic force of not less than 120kN/m width for every metre of loose-layer thickness at an operating frequency not exceeding 25Hz and shall move at a speed not exceeding 4km/h."

C3.2.2.7.2.1.3 PSDM 5.2.4 Fill

C3.2.2.7.2.1.3.1 PSDM 5.2.4.3 Finishing

(e) Topsoiling

REPLACE THE SECOND SENTENCE WITH THE FOLLOWING:

"The thickness of the topsoil shall be as directed by the Engineer."

C3.2.2.7.2.1.4 PSDM 5.2.5 Selected layer

REPLACE THE CONTENTS OF THIS SUBCLAUSE WITH THE FOLLOWING:

"Except with regard to density, the requirements of subclause 5.2.4 shall apply. The degree of compaction shall be:

Selected : 93% of modified AASHTO density

C3.2.2.7.2.1.5 PSDM 5.2.6 Gravel surfacing

REPLACE THE THIRD SENTENCE OF THIS SUBCLAUSE WITH THE FOLLOWING:

"The relevant requirements in subclause 5.2.4.2 shall apply, except that the material shall be compacted to 93% of modified AASHTO density."

C3.2.2.7.2.1.6 PSDM 5.2.8 Transport

REPLACE THE CONTENTS OF THIS SUBCLAUSE WITH THE FOLLOWING:

"The provisions of subclause PSD 5.2.5 of SANS 1200 D, as amended, shall apply."

C3.2.2.7.3 PSDM 7 TESTING

C3.2.2.7.3.1 PSDM 7.3 ROUTINE INSPECTION AND TESTING

REPLACE TABLE 2 AND THE CONTENTS OF SUBCLAUSE 7.3.2 WITH THE FOLLOWING:

"PSDM 7.3.2 The dry density requirements for a particular lot of selected layer or wearing course shall be deemed to be satisfied if the average density and the results of individual tests meet the requirements specified in table 2 below. Refer to subclause PSD 7.2 for the requirements for fill.

TABLE 2: DENSITIES

1	2	3	4	5
Layer	Specified density (% of modified AASHTO density)	Number of tests per lot	Average density, %	Minimum density for any single test, %
Selected layer	93	3 and 4 5 6	93,1 93,4 93,6	89,4 89,2 89,0

"

C3.2.2.7.4 PSDM 8 MEASUREMENT AND PAYMENT

C3.2.2.7.4.1 PSDM 8.2 COMPUTATION OF QUANTITIES

REPLACE SUBCLAUSES 8.2.1 TO 8.2.3 (INCLUSIVE) WITH THE FOLLOWING:

C3.2.2.7.4.1.1 "PSDM 8.2.1 The provisions of subclause 8.2.1 of SANS 1200 D shall apply.

C3.2.2.7.4.1.2 PSDM 8.2.2 The provisions of subclause 8.2.2 of SANS 1200 D shall apply.

C3.2.2.7.4.1.3 PSDM 8.2.3 The provisions of subclause 8.2.2 of SANS 1200 D shall apply."

C3.2.2.7.4.1.4 PSDM 8.2.5 Verifying quantities

REPLACE THE FIRST SENTENCE WITH THE FOLLOWING:

"Before any earthworks are commenced but after completion of any site preparation, the Engineer will, upon a written request from the Contractor, provide cross-sections for the purpose of measurement of earthworks quantities."

C3.2.2.7.4.2 PSDM 8.3 SCHEDULED ITEMS

C3.2.2.7.4.2.1 PSDM 8.3.3 Treatment of roadbed

(a) Roadbed preparation and compaction of material to

ADD THE FOLLOWING:

"The unit of measurement shall be the cubic metre of material recompacted as specified and the volume shall be determined from levelled cross-sections on which are superimposed the levels to which the roadbed is to be constructed. When material is imported to make up the required volume, such material will be paid for as cut or borrow to fill as relevant."

ADD THE FOLLOWING:

"(c) Three-pass roller compaction:

(i) Grid roller……Unit: square metre (m²)

(ii) Vibratory roller……Unit: square metre (m²)

The units of measurement shall be the square metre of roadbed compacted as specified in subclause PSDM 5.2.3.3(c) for the areas designated by the Engineer.

The tendered rates shall include full compensation for shaping the areas, providing the rollers and compacting the roadbed by means of three roller passes over the entire area."

C3.2.2.7.4.2.2 PSDM 8.3.4 Cut to fill, borrow to fill

REPLACE THE LAST SENTENCE OF THIS ITEM WITH THE FOLLOWING:

"The unit of measurement shall be the cubic metre of fill and the volume will be calculated in accordance with the authorised dimensions of the embankment and levelled cross-sections.

The tendered rates shall include full compensation for excavating the material as if in soft material, for selecting, loading, transporting for the free-haul distance, off-loading, watering, mixing and compacting the material as specified. Borrow to fill in this item relates to material from designated borrow areas (provided by the Employer).

Where it is required that material be obtained from commercial sources, payment for procuring the material will be made under item PSDM 8.3.17."

C3.2.2.7.4.2.3 PSDM 8.3.5 Selected layer compacted to 93% of modified AASHTO maximum density

REPLACE THE HEADING AND THE CONTENTS OF THIS ITEM WITH THE FOLLOWING:

"PSDM 8.3.5 Selected layer using material from designated borrow pits or excavation:

(a) Compacted to 90% of modified AASHTO density……..Unit: cubic metre (m³)

(b) Compacted to 93% of modified AASHTO density……..Unit: cubic metre (m³)

The unit of measurement shall be the cubic metre and the quantity will be calculated from the authorised dimensions of the compacted layer.

The tendered rates shall include full compensation for excavating the material as if in soft material for loading, transporting for the free-haul distance, off-loading, spreading, watering, mixing, breaking down and compacting the layer."

C3.2.2.7.4.2.4 PSDM 8.3.6 Extra over items 8.3.4 and 8.3.5 for excavating and breaking down material in

REPLACE THE HEADING OF THIS ITEM WITH THE FOLLOWING:

"PSDM 8.3.6 Extra over items 8.3.4, 8.3.5 and 8.3.16 for excavating and breaking down material in"

REPLACE THE WORDS "items 8.3.4 and 8.3.5" WITH THE WORDS "items 8.3.4, 8.3.5 and 8.3.16".

C3.2.2.7.4.2.5 PSDM 8.3.7 Cut to spoil or stockpile from

REPLACE THE HEADING WITH THE FOLLOWING:

"PSDM 8.3.7 Cut to spoil from"

C3.2.2.7.4.2.6 PSDM 8.3.12 Overhaul

REPLACE THIS ITEM WITH THE FOLLOWING:

"PSDM 8.3.12 Overhaul

(a) Limited overhaul……Unit: cubic metre (m^3)

(b) Long overhaul……Unit: cubic metre-kilometre (m^3-km)

Overhaul will be paid in accordance with item 8.3.6 of SABS 1200 D."

C3.2.2.7.4.2.7 PSDM 8.3.14 Borrow pits

REPLACE THE CONTENTS OF THIS ITEM AS FOLLOWS:

"(a) Opening up and closing down of borrow pit……..Unit: sum

(b) Dealing with overburden……Unit: cubic metre (m^3)

The provisions of subclauses 8.3.4(b) and 8.3.4(c) of SANS 1200 D shall apply respectively to items (a) and (b) above."

C3.2.2.7.4.2.8 PSDM 8.3.16 Gravel surface layer

REPLACE THE CONTENTS OF THIS ITEM WITH THE FOLLOWING:

"The unit of measurement shall be the cubic metre of gravel surface layer and the quantity will be determined from the authorised dimensions of the compacted layer.

The tendered rate shall include full compensation for excavating the material as if in soft material, for loading and transporting the material for the free-haul distance, off-loading, spreading, breaking down, watering, mixing and compacting the material."

ADD THE FOLLOWING ITEMS:

"PSDM 8.3.17 Extra over items 8.3.4, 8.3.5 and 8.3.16 for obtaining material from commercial sources……..……..Unit: cubic metre (m³)

The tendered rate shall include full compensation for the additional cost of finding a suitable source of material, for procuring the material and paying all royalties or other charges to the owner of the source, for transporting the material to the point of use regardless of the distance hauled and for excavating in intermediate, hard or boulder material as required.

Items PSDM 8.3.6, PSDM 8.3.12 and PSDM 8.3.14 do not apply to material obtained from commercial sources.

C3.2.2.7.4.2.9 PSDM 8.3.18 Final finishing and cleaning up of the site of the works……Unit: sum

The tendered sum shall include full compensation for the clearing, disposal of material, finishing, tidying and all other work required to finish and clean up the Site of the works and affected areas by removing excess earth, stones, boulders, debris and other waste material, by clearing stormwater inlets and outlets and pipe barrels, by clearing the surfacing of all dirt, mud and foreign material, and by neatly finishing off all junctions, intersections and kerbing.

All material resulting from the finishing operations shall be disposed of to a spoil site furnished by the Contractor.

The tendered rate shall make provision for the reinstatement of existing driveways to their original condition where these have been affected by the works, as these items will not be measured and paid for separately.

C3.2.2.7.4.2.10 PSDM 8.3.19 Sidewalks:

(a) Fill compacted to 90% of modified AASHTO density and obtained from:

(i) Designated borrow pits……...Unit: cubic metre (m³)

(ii) Commercial sources……..Unit: cubic metre (m³)

(iii) Excavations……Unit: cubic metre (m³)

(b) In-situ material scarified to a depth of 150 mm and compacted to 90% of modified AASHTO density……..Unit: cubic metre (m³)

(c) Excavated material removed to spoil……..Unit: cubic metre (m³)

The tendered rates shall include full compensation for constructing the sidewalks to the profiles indicated either on the Drawings or by the Engineer, for working in restricted areas, for using material classified as soft material with a maximum particle size of 60mm, and for carrying out the work in accordance with the Specifications.

Additional payment will be made under item PSDM 8.3.12 if overhaul is applicable to subitems (a)(i), (a)(iii) and (c) above.

C3.2.2.7.4.2.11 PSDM 8.3.20 Variations in the number of roller passes (applicable to subitem 8.3.3(c)):

(a) Vibratory rollers…….Unit: m²-pass

(b) Oscillatory rollers……..Unit: m²-pass

(c) Grid rollers…….Unit: m²-pass

(d) Tamping rollers……..Unit: m²-pass

(e) Impact rollers…….Unit: m²-pass

(f) Pneumatic-tyred rollers……Unit: m²-pass

The unit of measurement shall be the square-metre coverage and shall be computed by multiplying the number of square metres to which the changed pass efforts apply by the increased or decreased number of roller passes.

Where a change in the compaction effort is requested, the Contractor will be compensated at the tendered rates for the above items in respect of the increased number of square-metre roller passes of each type of roller required over and above that specified in the relevant standard effort. His compensation will be decreased simultaneously, at the applicable rates, by the number of square-metre roller passes of each type of roller which is either decreased or completely left out.

The tendered rate for each additional square metre-pass ordered by the Engineer over and above the specified number of passes, shall include full compensation for all supervision, labour, plant, equipment, fuel, materials, work and incidentals necessary for completing the work. The same rates shall be accepted by the Contractor during computation of a decrease in his compensation where the number of roller passes for each specific type of roller is decreased."

C3.2.2.8 PSHA STRUCTURAL STEELWORK (SUNDRY ITEMS)

C3.2.2.8.1 PSHA 3 MATERIALS

C3.2.2.8.1.1 PSHA 3.1 STRUCTURAL STEEL

ADD THE FOLLOWING:

"Where stainless steel is to be used, the grade of stainless steel shall be grade 304L."

C3.2.2.8.2 PSHA 5 CONSTRUCTION

C3.2.2.8.2.1 PSHA 5.2 FABRICATION AND ASSEMBLY

C3.2.2.8.2.1.1 PSHA 5.2.4 Welding

The Contractor shall submit with his shop drawings full details of welding procedures. All welds shall be continuous. Unless otherwise approved no longitudinal or overhead welding shall be carried out on site. Under no circumstances will cutting and welding of grid covers and frames be permitted on site.

Welders undertaking manual welding of permanent steelwork shall be experienced and competent artisans.

C3.2.2.8.2.1.2 PSHA 5.2.6 Handrails

ADD THE FOLLOWING:

"Handrail stanchions shall be spaced at 1,300mm centres unless otherwise indicated on the drawings or approved by the Engineer in writing. Handrails and stanchions shall be of the material as scheduled and all stanchion anchors shall be 12mm diameter unless otherwise indicated on the Drawings."

C3.2.2.8.2.1.3 PSHA 5.2.7 Ladder and step irons

ADD THE FOLLOWING:

"Ladders shall be stainless steel and step irons shall be galvanised mild steel with corrosion protection coatings as specified."

C3.2.2.8.2.1.4 PSHA 5.2.8 Open grid floors

ADD THE FOLLOWING SUBITEM:

C3.2.2.8.2.1.4.1 "PSHA 5.2.8.3 All open grid floors and frames shall be galvanised mild steel with corrosion protection coatings as specified.

All open grid floor panels shall be open-ended as specified, except where bonding is specified on the Drawings. Cut outs shall be provided where indicated on the Drawings"

C3.2.2.8.3 PSHA 8 MEASUREMENT AND PAYMENT

C3.2.2.8.3.1 PSHA 8.3 SCHEDULED ITEMS

C3.2.2.8.3.1.1 PSHA 8.3.1 Structural steel (type of structure indicated)

Change "Unit : t" to " Unit : t or No".

ADD THE FOLLOWING AFTER THE LAST SENTENCE:

"Alterations to existing structural steelwork will be described in the schedule and measured in number. Rates for these items shall include full compensation for all labour tools, storing, additional steelwork, reinstallation, cleaning up, grinding, etc as described in the schedule and shown on the drawings."

C3.2.2.8.3.1.2 PSHA 8.3.2 Handrails

REPLACE SUBITEM (c)(3) WITH THE FOLLOWING:

"(c)(3) Extra over rails for bends, end closures and accessories:

(i) (Description of item stated)…….Unit: No.

(ii) Etc for other descriptions"

C3.2.2.8.3.1.3 PSHA 8.3.3 Ladders, complete and installed (Drawing number or type and length stated)

REPLACE THIS ITEM WITH THE FOLLOWING:

"PSHA 8.3.3 Ladders, complete and installed (Drawing number or type and length stated)

Separate items will be scheduled for ladders of different materials, dimensions and height …….Unit: No.

The tendered rates shall include full compensation for the cost of supplying the specified or scheduled ladders complete, including welding where applicable."

C3.2.2.8.3.1.4 PSHA 8.3.4 Flooring, complete and installed with frames (Drawing number stated)

REPLACE THIS ITEM WITH THE FOLLOWING:

PSHA 8.3.4 Flooring, complete and installed with frames:

(a) Open grid floors…….Unit : m²

(b) Floor-plate floors…….Unit : m² or t

(c) Frames and kerbs for flooring……...Unit : m

Separate items will be scheduled for grid floors, floor-plate floors, frames and kerbs of different materials, dimensions, weight and different methods of fixing.

The tendered rates shall include full compensation for the cost of supplying the specified or scheduled types of flooring, frames or kerbing complete, including welding where applicable."

C3.2.2.8.3.1.5 PSHA 8.3.6 Corrosion protection

REPLACE THIS ITEM WITH THE FOLLOWING:

"PSHA 8.3.6 Corrosion protection……Unit: Sum

Separate items will be scheduled for different systems of corrosion protection. Separate subitems will also be scheduled for different elements to be coated/protected.

The tendered sums shall include full compensation for all material, preparation, etc, related to the specified corrosion protection system in accordance with the Particular Specification for corrosion protection".

C3.2.2.9 PSHB CLADDING AND SHEETING

C3.2.2.9.1 PSHB 3 MATERIALS

ADD THE FOLLOWING SUBCLAUSES:

C3.2.2.9.1.1 "PSHB 3.1 THICKNESS OF SHEETING

ADD THE FOLLOWING PARAGRAPHS:

"The roof sheeting of the open-sided shelters provided over pumps, etc. shall be as follows:

- 0,56 mm stainless steel (Grade 304) with IBR profile and “Colomet” finish on both sides or equal approved.
- 1,25 mm thick polycarbonate sheeting.

The sheeting shall match the dewatering building."

C3.2.2.9.1.2 PSHB 3.11 SHADE NETTING

C3.2.2.9.1.2.1 PSHB 3.11.1 General

For the purposes of this specification, the terms "shade netting" and "shade cloth" shall have the same meaning.

Shade netting shall comply with the requirements specified in table PSHB 3.11.1/1, unless scheduled otherwise or shown otherwise on the Drawings.

TABLE PSHB 3.11.1/1: SHADE NETTING PROPERTIES	
PARAMETER	VALUE
Material	Nylon
Base colour	Dark blue
Supplementary colours of decorative motifs and patterns	None
Translucency (light let through)	40%

C3.2.2.9.1.2.2 PSHB 3.11.2 Jointing of adjacent sheets

A joint shall be either heat-welded continuously along its full length with a maximum overlap of 20mm, or machine-stitched as directed by the Engineer. Edges shall be prepared in accordance with subclause PSHB 3.11.3.1.

Where machine-stitching is directed by the Engineer, a UV-resistant nylon thread of not less than 200kg breaking strain at a stitch spacing not exceeding 10mm shall be used. All stitching shall be uniform and regular, and shall be subject to the final approval of the Engineer.

Where the use of sheets with decorative motifs or patterns are specified, its general arrangement and layout shall be subject to the prior approval of the Engineer. Where such approval is granted by the Engineer, the decorative motif or pattern of a jointed sheet shall blend in with and match the decorative motif or pattern of the adjacent sheet to which it is jointed, and no irregularities in the motif or pattern shall be permitted. Any resulting off-cuts and wastage shall not be measured and paid for.

C3.2.2.9.1.2.3 PSHB 3.11.3 Fixing of sheet edges to structural elements

Where the outer edge of a single sheet or a set of multiple jointed sheets is to be fixed to a structural element, it shall be fixed along its entire length as follows:

C3.2.2.9.1.2.3.1 PSHB 3.11.3.1 Preparation of free sheet edge before fixing to structural element

The free edge of each sheet, before fixing to a structural element, shall be free from burs and loose threads, and shall be trimmed to an exact size permitting a wide enough strip for preparation of edge reinforcing.

Edge reinforcing shall be either factory-manufactured or heat-treated on site to fuse all loose threads in a manner which prevents irregularities and fraying when stretched. Where heat-treated on site, the reinforcing strip shall be equivalent to a factory-manufactured edge reinforcing in all respects.

C3.2.2.9.1.2.3.2 PSHB 3.11.3.2 Fixing method to be to manufacturer's specification

Where no fixing method is specified by the shade netting manufacturer, the following requirements shall be complied with:

(a) Fixing to eyelets

Eyelets shall be welded to structural steel members or anchored in concrete with PVC-sheathed threads, to the satisfaction of the Engineer. Each eyelet shall consist of a 20mm closed circular ring manufactured from a 3mm mild steel round bar. Eyelets shall be spaced apart at not more than 200mm.

Where welded to a structural steel member, the corrosion protection of each eyelet shall be of the same standard of corrosion protection and decorative finish as the structural steel member.

Where fixed to concrete, the corrosion protection of each eyelet shall consist of hot-dip galvanizing to SANS 121 for Class C articles.

Where fixed to structural members other than steel or concrete, the fixing methods for eyelets to the structural member shall be subject to the prior approval of the Engineer.

The reinforced edge of each sheet shall be tied to the eyelets with a UV-resistant nylon thread of not less than 200kg breaking strain with double knots that shall be sealed by heat treatment to prevent self-loosening due to the effects of the temperature. Heat treatment of knots shall consist of applying a heated object to the knot long enough to ensure fusion between threads without adversely affecting its strength.

(b) Fixing around thin structural members

Where fixing to a structural member such as a circular profile with a cross-sectional circumference of less than 300 mm is required, then the edge of the sheet shall be wrapped around the member and heat treated to effect bonding along a continuous edge with the rest of the sheet. The strength of the bond as regards strength, quality and finish, shall be as specified for joints in subclause PSHB 3.11.2.

C3.2.2.9.1.2.3.3 PSHB 3.11.4 Fixing of continuous sheet over top of supporting structural element

Fixing of a continuous sheet over the top of a supporting structural element shall not be permitted, to allow for uniform movement due to temperature expansion and contraction of single sheets or sets of jointed sheets without warping. Only edges of sheets shall be fixed to structural members.

Notwithstanding the requirements specified in the above paragraph, the Engineer may require that a supporting structural element be fixed to the top where excessive sagging of shade netting becomes apparent at high ambient temperatures, and then only at certain points and in a manner which shall not adversely affect the aesthetic appearance.

All shade netting shall thus be primarily spanned from outer edge to outer edge at a maximum tension which shall not exceed the maximum working tension and other working properties of the shade netting during periods of maximum contraction."

C3.2.2.9.2 PSHB 5 CONSTRUCTION

C3.2.2.9.2.1 PSHB 5.1 RESPONSIBILITY

C3.2.2.9.2.1.1 PSHB 5.1.4 Installation Details

ADD THE FOLLOWING PARAGRAPH:

"The sheeting, cladding, gable trims and gutter shall be fitted and fixed according to the manufacturer's specifications for the wind conditions at the site (see SABS 0160). The cladding and sheeting shall be securely fixed."

C3.2.2.9.3 PSHB 8 MEASUREMENT AND PAYMENT

C3.2.2.9.3.1 PSHB 8.1 PRINCIPLES

C3.2.2.9.3.1.1 PSHB 8.1.1 Cladding and sheeting

ADD THE FOLLOWING:

"The rate tendered shall cover the cost of the supply, delivery, installation and fixing of new cladding, sheeting, flashing and ancillary items, including corrosion protection or coloured finish of cladding. Everything necessary for the proper completion of the work shall be included. Rainwater goods will be measured separately."

C3.2.2.10 PSL MEDIUM-PRESSURE PIPELINES

C3.2.2.10.1 PSL 2 INTERPRETATIONS

C3.2.2.10.1.1 PSL 2.4 ABREVIATIONS

ADD THE FOLLOWING:

HDPE: High density polyethylene

mPVC: Modified Polyvinyl chloride

C3.2.2.10.2 PSL 3 MATERIAL

C3.2.2.10.2.1 PSL 3.1 GENERAL

ADD THE FOLLOWING PARAGRAPHS:

"The contract specifications for materials and construction activities will conform to SANS 1200, SANS 1914-5 and Johannesburg Water requirements. The project specifications will include specific items to ensure proper implementation, control reporting on labour based construction and methods as included in the specifications.

Materials for this Contract must be obtained from manufacturers who operate an effective quality management system such as that described in SANS 9001 or ISO 9000.

Each type of pipe delivered to the Site shall be of a standard length corresponding to the standard lengths offered by the pipe manufacturer in his catalogue, with a maximum permissible variation in length of ± 2%.

A pipe that is shorter or longer than the defined standard will be rejected by the Engineer, except when such non-standard lengths are required in terms of the Contract and have been specifically manufactured or cut as such by the pipe manufacturer or supplier."

C3.2.2.10.2.2 PSL 3.4 STEEL PIPES, FITTINGS AND SPECIALS

C3.2.2.10.2.2.1 PSL 3.4.3 Pipes of nominal bore over 150mm

OMIT PARAGRAPH (C) AND INSERT THE FOLLOWING:

“Steel pipes and fittings shall be manufactured in accordance with API 5L X42 with a wall thickness of 12mm; 10mm, 8mm or 6mm, depending on the section of pipe in question. External lining to be Polyisobutene Visco Elastic (STOPAQ or similar approved, or other as specified by the Employer) and internal lining to be Solvent Free Epoxy with a target thickness of 600 microns. Pipe lengths to be 12.192 m.

Straight joints and bends to be fillet welded on site. The pipe manufacturer shall submit to the Engineer the steel maker's certificates covering all steel used. These certificates shall indicate the process of manufacture, the chemical analysis and the physical properties of the steel except that, at the option of the pipe manufacturer, the physical properties of the steel may be determined from specimens taken from finished pipe.”

C3.2.2.10.2.3 PSL 3.7 OTHER TYPES OF PIPES

C3.2.2.10.2.3.1 PSL 3.7.1 uPVC Pipes

ADD THE FOLLOWING TO THE SUB CLAUSE

"uPVC Pipe's systems shall conform to SANS 966-1998 Part1 or II as applicable and have integral pipe end sockets of the rubber ring joint type. All uPVC - pipes shall be in 6m lengths. Fittings and specials for uPVC pipes shall be manufactured in Grade 14 cast iron, rated to at least 1600kPa working pressure. Unless otherwise specified fittings and specials shall be bitumen dipped.

C3.2.2.10.2.3.2 PSL 3.7.2 Polyethylene pipes

REPLACE THE CONTENTS OF THIS SUBCLAUSE WITH THE FOLLOWING:

"Polyethylene pipes shall be HDPE type IV pipes with compression fittings and shall comply with SANS ISO 4427 PE 100, PN 20 or as scheduled.

HDPE pipes of diameter up to and including 63 mm shall conform with SANS 4427 Part 2 for Type IV pipes. HDPE pipes greater than 63 mm shall conform with SANS 4427 Part 3 for Type V pipes. Unless otherwise specified, pipes shall be Class 16 and plain ended for butt welding".

ADD THE FOLLOWING NEW SUBCLAUSE:

C3.2.2.10.2.3.3 PSL 3.7.3 High Impact uPVC Pipes

Class 16 uPVC pipes shall conform to SANS 1283 (alternatively ISO 4422) shall be used unless otherwise indicated. Jointing shall be effected by means of approved "press-on" shouldered ends and cast iron and steel victaulic clamps. Unless otherwise specified, pipes shall be Class 16.

Where the cutting of any pipe is necessary, shouldered ends shall be fixed to the pipe by means of an approved machine capable of clamping the pipe without causing any damage to the pipe and pressing on the shouldered end by means of a hydraulic operated jack applying a uniform axial force to locate the shouldered end truly in position. The use of impact force to either the pipe or shouldered end will not be permitted. No on-site fixing of shouldered ends shall be permitted."

ADD THE FOLLOWING NEW SUBCLAUSE:

C3.2.2.10.2.3.4 PSL 3.7.4 mPVC Pipes

High Impact mPVC Class 16 and shall conform to SANS 1283 for diameter up to and including 315mm with a fully end load restraint coupling system approved by Johannesburg Water.

C3.2.2.10.2.4 PSL 3.8 JOINTING MATERIALS

ADD THE FOLLOWING NEW SUBCLAUSE:

C3.2.2.10.2.4.1 PSL 3.8.2 Flexible couplings

OMIT THE EXISTING CLAUSE AND INSERT THE FOLLOWING:

"All flexible couplings shall be "Viking Johnson" couplings without centre register, or approved similar.

Rubber rings shall be of the wedge-type and shall be manufactured from natural or synthetic rubber only. Reclaimed rubber shall not be used in the manufacture of the rubber rings."

C3.2.2.10.2.4.2 PSL 3.8.3 Flanges and Accessories

ADD THE FOLLOWING TO THE EXISTING CLAUSE:

The dimensions and drilling of standard flanges shall comply with the requirements of SANS 1123 and SANS 1476 for a working pressure as specified. Flanges shall be machined flat, i.e. without a raised joint face. Puddle flanges shall have the same dimensions as standard flanges but shall be undrilled.

Faces of flanges which will be in contact with jointing gaskets shall receive a protective coating of such thickness and consistence as will not impair the air/gas/water tightness of the joint."

ADD THE FOLLOWING NEW SUBCLAUSE:

C3.2.2.10.2.4.3 PSL 3.8.8 Victaulic joints

Joints for uPVC and medium steel pipelines shall conform to SANS 815: Standard specifications for shouldered end pipes, fittings and couplings.

ADD THE FOLLOWING NEW SUBCLAUSE:

C3.2.2.10.2.4.4 PSL 3.8.9 HDPE Pipe joints

Joints for HDPE pipe shall be by means of welding or electro fusion, welded flanges or approved external compression type fittings (Plasson or similar approved)."

C3.2.2.10.2.5 PSL 3.9 CORROSION PROTECTION

C3.2.2.10.2.5.1 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 Polyisobutene Visco-elastic (STOPAQ or similar approved, or other as specified by the Employer) and internally with Solvent Free Epoxy.

The target thickness of the lining material shall be 600 microns, and not less than 500 micron and test certificates of the lining thickness must be furnished to the Engineer for his approval."

C3.2.2.10.2.5.1.1 PSL 3.9.2.3 Repairs to epoxy coatings

ADD THE FOLLOWING TO THE EXISTING CLAUSE:

C3.2.2.10.2.5.1.1.1 PSL 3.9.2.3.1 General

(a) Where the damage is extensive the remedial procedures shall be agreed in writing with the Engineer.

(b) All repairs shall comply with the requirements of the repair-product manufacturer's data sheet. The Engineer 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.

C3.2.2.10.2.5.1.1.2 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 Engineer, 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.

C3.2.2.10.2.5.1.1.3 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 500mm². 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 Engineer, be carried out as follows:

(a) (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.

C3.2.2.10.2.5.1.1.3 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.

(c) Allow to react, and then rinse off with clean, potable water to remove all residues prior to surface preparation, all in accordance with Clause 4 of SANS 10064.

(d) The surfaces shall be tested after degreasing and show no oil, grease and chemical contamination after degreasing.

(e) Care shall be taken to avoid entrapment of cleaning agents in recesses or other retention areas.

ADD THE FOLLOWING NEW SUBCLAUSE:

C3.2.2.10.2.5.1.2 PSL 3.9.2.4 Repair of Damaged Polyisobutene Visco-elastic

C3.2.2.10.2.5.1.2.1 PSL 3.9.2.4.1 General

Damaged Polyvisobutene Visco-elastic shall be repaired in accordance with the procedures detailed in the manufacturer's specifications for the repair of Polyisobutene Visco-elastic.

C3.2.2.10.2.5.2 PSL 3.9.3 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 Specifications as ordered by the Engineer.

C3.2.2.10.2.5.3 PSL 3.9.5 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 bimetallic action".

C3.2.2.10.2.5.4 PSL 3.9.6 Corrosive soil

ADD THE FOLLOWING:

"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 3.9.2 with Polyisobutene Visco-elastic (STOPAQ or similar approved, or other as specified by the Employer). Application shall be strictly in accordance with the manufacturer's instructions.

C3.2.2.10.2.6 PSL 3.10 VALVES

REPLACE THE CONTENTS OF THIS SUBCLAUSE WITH THE FOLLOWING:

"Valves shall comply with the following requirements:

(a) They shall close anti-clockwise and shall have a non-rising spindle and handwheel.

(b) They shall be class 16 valves complying with SANS 664.

(c) They shall comply with the requirements of SANS 1123 table 1000 and 1600."

C3.2.2.10.3 PSL 5 CONSTRUCTION

C3.2.2.10.3.1 PSL 5.1 LAYING

C3.2.2.10.3.1.1 PSL 5.1.4 Depth and Cover

C3.2.2.10.3.1.1.1 PSL 5.1.4.2 Cover

ADD THE FOLLOWING TO THIS SUBCLAUSE:

"The minimum cover to finished surface over water mains shall be at least 1000 mm in trafficked areas and at least 800 mm elsewhere. At valves the depth of the pipeline shall be increased if necessary to ensure a minimum cover of 100mm over the valve cap. The cover shall be maintained as close as possible to the minimum without local sags or humps and shall not be increased above the minimum by more than 200mm without the approval of the Engineer."

C3.2.2.10.3.2 PSL 5.2 JOINTING METHODS

C3.2.2.10.3.2.1 PSL 5.2.2 Flanges (steel pipelines)

DELETE THE EXISTING CLAUSE AND REPLACE WITH THE FOLLOWING:

"Insertion pieces (flange packing) and sets of bolts for connection of valves to pipes or specials shall be included in the scope of work for this Contract. All insertion pieces and sets of bolts as specified in Subclause 3.8.3 of SANS 1200 L Specification, shall be supplied and installed by the Contractor."

C3.2.2.10.3.2.2 PSL 5.2.3 Welding (steel pipelines of diameter 450mm or greater)

DELETE THE EXISTING CLAUSE AND REPLACE WITH THE FOLLOWING:

(a) General

"Field welding of pipes which have been lined will be permitted only for pipes of DN600 and larger where a man is able to enter the pipe to make good the lining after welding and testing in accordance with Clause 7.2 of SANS 1200L has been completed. Pipes of lesser diameter may be field welded where concrete linings will be made after the pipeline has been laid and all welds have been tested and approved.

At the discretion of the Engineer, roll welding will be permitted, provided pipe alignment is maintained by use of skids or of structural framework to accommodate two or more lengths of pipe with an adequate number of roller dollies to prevent sag in the pipe. The entire root bead, however, shall be made with the pipe in a stationary position.

All pipes welded in the trench shall be properly laid and aligned before welding commences. Bell holes shall be excavated at all field welds. The Contractor shall not lift the pipe to provide adequate access for the welders to enable them to stovepipe weld the joint.

The alignment of abutting ends shall be such that the offset will not exceed 1.7 mm. Line up clamps shall be used for joint "fit-ups". The use of "bridges and wedges" or any method that may induce unnecessary stresses is forbidden.

Both ends of coated and lined pipes shall be wrapped for a distance of at least 800 mm on either side of the weld by means of an asbestos mat or other approved material to ensure that weld spatter or other damage is not caused to the coating and lining during the welding process. The pipe trench shall be kept free of all dirt and water in the vicinity of the weld until after all corrosion protection measures have been completed and approved. "

(b) Welding procedure and qualification of welders

Welding shall be done by only qualified welders who satisfy the requirements of API 1104, Clause 3.0. Before any welding of pipeline materials commences, the qualification of welders shall have been approved, all detailed welding procedure specifications with weld diagrams required for their completion shall have been submitted for approval in a neat form and the welding procedure qualification tests shall have been successfully concluded all in accordance with the relevant standard specifications. Each welder shall mark the pipe adjacent to the weld with the figure assigned to him.

Sufficient records shall be kept by the Contractor to ensure that all field welds can be subsequently identified with the welder concerned.

As far as practicable all out of trench welding shall preferably be done by an automatic submerged process and the Contractor shall provide all necessary plant to carry out this process. MSEAP welding may be used where in-trench welding is done.

Heat treatment for welding shall be in accordance with API 1104 if required by same and the Contractor shall provide an approved shield to protect the pipe joint from wind and weather during heat treatment and welding.

(c) Line up

Pipes shall be lined up in such a manner as to prevent damage thereto. If the pipe to be used has a longitudinal seam, these seams shall be staggered by not less than twenty degrees and welded sections, or single lengths, shall be assembled in such a manner that this seam shall remain in the top quadrant of the pipe during coating operations and after lowering into the trench.

(d) Cleaning of pipe ends

Before welding, all foreign matter shall be removed from the bevelled ends. If any of the ends of the pipe joints are damaged to the extent that satisfactory welding contact cannot be obtained, the damaged pipe ends shall be cut and bevelled with an approved bevelling machine. These field bevels of pipe ends shall be made to the satisfaction of the Engineer. Should laminations, split ends, or other defects in the pipe be discovered, the joints of pipes containing such defects shall be cropped, repaired, or removed from the line as designated by the Engineer.

(e) Inclement Weather

No welding shall be carried out during rain or high wind unless the welder and joint are adequately protected and sheltered, to ensure that the welding is not impaired.

(f) Protection of coatings and linings

Before welding commences, a suitable apron at least 800 mm wide shall be wrapped around both sides of the area to be welded to ensure that weld spatter does not damage the coating and lining.

(g) Butt-welding

Pipes and specials to be joined by field welding shall be supplied with ends bevelled for welding. All welding of joints shall comply with API 1104 and only approved type welding rods shall be used. If backing rings are permitted, they shall be placed in position and wedged up or adjusted so that the pipe ends are completely circular and properly mated. The space between abutting pipe ends, when aligned for welding, shall be such as to ensure complete penetration without burn-through. For pipes having the same dimensions, the spacing shall be approximately 1.5 mm. The alignment of the abutting pipe ends shall be such as to minimize the offset between pipe surfaces. For pipes of the same nominal wall thickness, the offset shall not exceed 1.5 mm. Internal line-up clamps shall be used wherever practicable and may be removed after the root bead is 50% completed, provided that the completed part of the root bead is in segments of approximately equal lengths, spaced about the circumference of the pipe. If conditions make it difficult to prevent movement of the pipe, or if the weld will be unduly stressed, the root bead shall be completed before releasing clamp tension.

External line-up clamps shall be used where it is impracticable to use internal line-up clamps. Partial root beads made when using external clamps shall be uniformly spaced about the circumference of the pipe, and shall have an accumulative length of not less than 50% of the pipe circumference before the clamps are removed.

Tack welding shall be carried out to maintain the root gap and position of the pipe ends during the welding proper. The number of tack-welds shall be kept to a minimum but shall not be less than four around the circumference of the pipe.

After proper preparation and tack welding, the root bead shall be carried out followed by successive filler passes, and capper pass in accordance with the approved welding procedure.

The filler and finish beads shall be deposited by an acceptable method and each filler bead shall be approximately 3 mm in thickness. Completed welds shall have a reinforcing of not less than 0.8 mm and not more than 1.5 mm above the pipe surface around the entire perimeter of the weld, and the width of the finish or cover shall be not more than 3 mm greater than the original groove. The number of beads required shall be governed by the wall thickness of the pipe, so that the completed weld will have the reinforcement previously specified; provided, however, that each weld shall consist of at least three beads. No two beads shall be started at the same point. No mitre welds will be permitted, and all welds are to be at ninety degrees (± 5o) to the axis of the pipe. All slag and scale shall be removed from each bead for visual inspection immediately after each bead is run.

In all field butt-welds where it is possible to work inside the pipe, the inside weld shall be done first.

The chemical composition of weld metal and parent metal shall be similar and the inner weld metal or reinforcement shall not extend more than 1 mm above the inside metal surface of a pipe or special, and any excess shall be removed by grinding.

Defects caused by stray welding arc flashes shall be removed by grinding, provided that the pipe wall thickness is not reduced to less than the specified minimum thickness, otherwise the portion shall be cut out and repaired.

(h) Fillet welding

Welding shall be as for butt-welding as applicable. All pipes of 600 mm ND and over shall be welded on both the outside and the inside.

(i) Repair of welds

Rectification of defective welds shall be in accordance with API 1104 and to the satisfaction of the Engineer. All costs related to the repair of defective welds shall be borne by the Contractor. Defective welds shall be repaired immediately they are found to be so. The Engineer has the right to stop the Contractor proceeding with further pipe laying in the event of the Contractor delaying the rectification of defective welds. Furthermore, no consideration will be given to any claims arising from delays in construction resulting from such action.

All welded joints which have been repaired shall be 100% radiographed or otherwise tested to the Engineer's satisfaction at the Contractor's own expense.

C3.2.2.10.2.2 PSL 5.6 VALVE AND HYDRANT CHAMBERS

C3.2.2.10.2.2.1 PSL 5.6.1 General

REPLACE THE WORDS "drawing L-1" *IN THE SECOND LINE WITH* "the Drawings".

C3.2.2.10.2.2.2 PSL 5.6.2 Construction of chambers

REPLACE THE WORDS "drawing L-1, L-2 and L-3" *IN THE FOURTH LINE WITH* "the Drawings".

C3.2.2.10.2.3 PSL 5.8 BRICKWORK IN CHAMBERS AND MANHOLES

ADD THE FOLLOWING TO THIS SUBCLAUSE:

"The joints of exposed faces shall be flush-trowelled, hard and smooth and shall be rubbed for the full width of the joint as the work proceeds to give a hard polished finish."

ADD THE FOLLOWING SUBCLAUSES:

C3.2.2.10.2.4 "PSL 5.11 STANDPIPES

Standpipes shall be erected in the positions and to the details shown on the Drawings.

C3.2.2.10.2.5 PSL 5.12 MARKER BLOCKS

Type 1 and Type 2 marker blocks shall be manufactured and positioned as shown on the Drawings.

C3.2.2.10.2.6 PSL 5.13 PIPELINE ROUTE MARKERS

Route markers for the various water pipelines shall be erected in the positions and shall be manufactured according to the details shown on the Drawings

C3.2.2.10.2.7 PSL 5.14 WORK ON EXISTING MAINS

Where connections are to be made to existing mains, the Contractor shall excavate back along the existing main only as far as is necessary to complete the connection satisfactorily and shall ensure that the existing mains are disturbed as little as possible. Backfilling shall be carefully placed and properly compacted beneath existing and new work to ensure that the mains, specials, etc. are properly bedded.
Work on existing mains and components of the reticulation system shall be carefully planned in consultation with the Engineer. The work shall be carried out expeditiously to ensure that the disruption of services and inconvenience to the local residents is kept to a minimum. All tie-ins shall be completed within a maximum of 10 hours.

The Contractor under strict supervision by the Engineer or The Employer will do all these connections.

Hand excavation must be used to expose the existing mains and erf connections where required. While every effort has been made to ensure that the information relating to these connections is correct the Engineer or The Employer takes no responsibility for the accuracy, or for the completeness of the information."

C3.2.2.10.2.9 PSL 5.15 CONNECTION TO THE EXISTING MAINS

The Contractor shall supply all necessary fittings / materials for under pressure connections suitable for all pipe sizes.

The Contractor shall confirm all measurement on site prior to ordering any pipe fittings."

C3.2.2.10.2.10 PSL 5.16 PIPELINE RENEWAL WORK

All material recovered as a result of the repairs or replacement of the components shall be returned to the Contractors store where they shall be cleaned, sorted and listed. A list of the recovered material shall be handed to the Engineer on a monthly basis. All recovered material shall be delivered to the Langlaagte Depot on a regular basis or at the end of the Contract.

C3.2.2.10.2.11 PSL 5.17 STERILISING OF WATER MAINS

All new water mains shall be sterilised at 10mg/l free chlorine for 12 hours and will then be thoroughly flushed.

C3.2.2.10.3 PSL 7 TESTING

C3.2.2.10.3.1 PSL 7.2 INITIAL TESTS ON WELDED STEEL PIPES

C3.2.2.10.3.1.1 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:

C3.2.2.10.3.1.2 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 Engineer 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.

(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 Engineer may permit repairs or alterations to be made to enable the pipe to pass the test.

(g) The Engineer may require one or more pipes to be tested to destruction. If practicable the Engineer 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."

C3.2.2.10.3.2 PSL 7.3 STANDARD HYDRAULIC PIPE TEST

C3.2.2.10.3.2.1 PSL 7.3.1 Test pressure and time of test

C3.2.2.10.3.2.1.1 PSL 7.3.1.2 The maximum working pressure for the different pipes is indicated by the class of the pipe.

C3.2.2.10.4 PSL 8 MEASUREMENT AND PAYMENT

C3.2.2.10.4.1 PSL 8.2 SCHEDULED ITEMS

C3.2.2.10.4.1.1 PSL 8.2.11 Anchor blocks/Thrust blocks and pedestals

INSERT "concrete" *BEFORE* "and" *IN THE LAST LINE OF THE LAST PARAGRAPH.*

ADD THE FOLLOWING:

"The tendered rates shall also include the wrapping of uPVC pipes and fittings with Densopol 80 or a similar approved material where the pipes and fittings come into contact with concrete."

ADD THE FOLLOWING NEW SUBCLAUSES:

C3.2.2.10.4.1.2 "PSL 8.2.16 Standpipes complete:

(a) (Give description with reference to drawing)……..Unit: number

(b) Etc. for other descriptions

The tendered rate shall include full compensation for all excavations for the pipe, for the drain, if required; the base of the concrete pedestal (for the tap); the supply and installation of all pipework and fittings including a 1,2m long section of the supply pipe measured from the rising pipe; the supply and installation of the taps; backfilling the drain with stone, and the trench with approved backfill material; all formwork and concrete, and; all equipment, labour and diverse material required to complete the standpipe as shown on the Drawings.

C3.2.2.10.4.1.3 PSL 8.2.17 Valve support assembly (give short description and drawing number):

(a) Specify material:

i) Description…….Unit: number

The rate shall cover the cost and include full compensation for all labour, plant, equipment, material, corrosion protection, transport, etc, manufacturing or providing and installing each item complete as scheduled and shown on the drawings.

C3.2.2.10.4.1.4 PSL 8.2.18 Pipeline route markers:

(a) (Give description with reference to drawing)……..Unit: number

(b) Etc for other descriptions

The tendered rate shall include full compensation for all excavation and backfill, labour, equipment and materials to manufacture and install the markers as shown on the Drawings.

C3.2.2.10.4.1.5 PSL 8.2.19 Connection to existing main supply pipe

(a) Description of connection, types and diameters involved……...Unit: number

(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. Includes arrangements for shut-down.

C3.2.2.10.4.1.6 PSL 8.2.20 Cathodic Protection.....Unit: Prov Sum

The rate shall include the cost for the supply and installation of Sacrificial Anode Cathodic Protection (SACP), in order to protect sections of pipeline located within roadways, servitudes, right-of-way which may be hard surfaced upon completion of the pipeline.

The SACP High Potential Magnesium Anodes shall be compliant with ASTM B843 Type M1C grade. The anode shall be located in 100% pure cotton bags with at least 75mm of Gypsum/Bentonite/Sodium Sulphate (75%/20%/5%) encapsulating each anode. Each anode shall have a 10m long SANS 1507 (600V/1000V) 10mm2 PVC/PVC cable (blue). The anodes shall be connected to the pipeline via a CP Test Station, that shall be vandal resistant and

approved by the client and shall permit the pipe potential and anode current and potential to be conveniently measured.

The Cathodic Protection shall be installed complete with a 30MPa concrete base and foundation of at least 500mm x 500mm x 500mm (L x W x D), which shall be located outside the road reserve to mitigate traffic and vehicular movement.

All test stations shall be compliant with SANS 52509 Annexure G Type D facilities (Coupons 1cm2).

All of the flexible couplings located within reservoir and/or water tower and/or inlet and outlet sites shall be electrically continuity bonded with two SANS 1507 (600V/1000V) 16mm2 PVC/PVC (red) cables. The cables shall be stud welded to the pipeline in accordance with ISO 14555 using the Capacitive Discharge Stud Welding technique. The pipeline coating shall be repaired utilizing an EN 12068 Class C type material, compatible with the pipeline coating, as approved by the client and engineer.

The pipeline extremities and any off takes shall be electrically isolated as per NACE SP0186, with Insulating Flange (IF) kits.

The contractor shall be responsible for following the pipeline construction schedule and ensuring that the SACP is installed with the pipeline construction due to access constraints and scheduling.

The contractor shall provide all of the required electrical, civil and mechanical resources and equipment to ensure the smooth liaison with all other contractors to permit the effective installation of the SACP system, in strict compliance with SANS ISO 15589-1. The SACP shall ensure the complete protection of the piping in line with SANS ISO 15589-1, and the potentials shall be measured in compliance with SANS 53509, and the IF kit tested and verified to SANS 53509 clause 6.2.

C3.2.2.10.4.1.6 PSL 8.2.21 Demolish Structure

The unit of measurement shall be sum for various types of structure.

The rate shall cover the cost of excavation, plant and labour required, demolishing the existing chambers, safeguarding the existing valves and specials from damage and safely disposing of the rubble material. It shall also cover the re-instatement of the structure, if applicable, to a state similar or better to pre-construction conditions. Structures to be demolished and reinstated will be identified and / or confirmed during the site visit.

C3.2.2.11 PSLB BEDDING (PIPES)

C3.2.2.11.1 PSLB 3 MATERIALS

C3.2.2.11.1.1 PSLB 3.1 SELECTED GRANULAR MATERIAL

REPLACE THE CONTENTS OF THIS SUBCLAUSE WITH THE FOLLOWING:

"Selected granular material shall have a PI not exceeding 6 and shall be free from sharp-edged particles exceeding 19mm."

C3.2.2.11.1.2 PSLB 3.2 SELECTED FILL MATERIAL

REPLACE THE CONTENTS OF THIS SUBCLAUSE WITH THE FOLLOWING:

"Selected fill material shall have a PI not exceeding 15 and shall be free from sharp-ended particles or particles exceeding 19 mm in size."

ADD THE FOLLOWING:

"Selected fill material used for bedding shall, where indicated on the Drawings be stabilized with 5% cement as specified under subclause PSDB 3.5(c)."

C3.2.2.11.1.3 PSLB 3.3 BEDDING

ADD THE FOLLOWING:

"uPVC and HDPE pipes are deemed to be flexible pipes for the purposes of this subclause."

C3.2.2.11.1.4 PSLB 3.4 SELECTION

C3.2.2.11.1.4.1 PSLB 3.4.1 Suitable material available from trench excavation

REPLACE THE WORDS "(but is not required)" IN THE FIFTH LINE WITH THE WORDS "(at his own cost)".

C3.2.2.11.2 PSLB 5 CONSTRUCTION

C3.2.2.11.2.1 PSLB 5.1 GENERAL

C3.2.2.11.2.1.1 PSLB 5.1.2 Details of bedding

ADD THE FOLLOWING PARAGRAPH:

"The dimension "X" for flexible and rigid pipes as indicated on drawing LB-1 will be 150mm (one hundred and fifty millimeters) unless otherwise indicated on the Drawing. The dimension "X" will be measured from the invert of the pipe."

C3.2.2.11.2.1.2 PLSB 5.1.4 Compacting

Replace "90% (ninety per cent)" with "90% (ninety per cent) (100% (one hundred per cent) for sand)".

C3.2.2.11.3 PSLB 7 TESTING

C3.2.2.11.3.1 PSLB 7.1 DENSITY

REPLACE THE SECOND SENTENCE IN THE FIRST PARAGRAPH WITH "The test will be carried out using the Troxler method."

ADD THE FOLLOWING SUB-CLAUSE

C3.2.2.11.3.1.1 PSLB 7.1.1 Submission of bedding compaction test results

The Contractor will be required to submit to the Engineer four (4) compaction test results of bedding for every 100metres. Bedding compaction to be 90% MOD AASTHO density. The compaction tests to be performed by the Troxler method.

C3.2.2.11.4 PSLB 8 MEASUREMENT AND PAYMENT

C3.2.2.11.4.1 PSLB 8.1 PRINCIPLES

C3.2.2.11.4.1.1 PSLB 8.1.3 Volume of bedding materials

The volume of bedding material shall be measured net i.e. the volume of the pipe is to be deducted.

C3.2.2.11.4.1.2 PSLB 8.1.5 Disposal of displaced material

REPLACE THE CONTENTS OF THIS SUBCLAUSE WITH THE FOLLOWING:

"Material displaced by the pipeline and by imported material from sources other than trench excavation, shall be disposed of at an approved site furnished by the Contractor. No haulage is payable for such material."

C3.2.2.11.4.1.3 PSLB 8.1.6 Free-haul

DELETE THE WORDS "of 0.5km" *IN THE FIRST LINE OF THIS SUBCLAUSE.*

C3.2.2.11.4.2 PSLB 8.2 SCHEDULED ITEMS

C3.2.2.11.4.2.1 PSLB 8.2.1 Provision of bedding from trench excavations

DELETE THIS SUB-CLAUSE AND REPLACE WITH THE FOLLOWING:

Without the need for screening or other treatments:

(a) Selected granular material.....Unit: m³

(b) Selected fill material.....Unit: m³

The rates shall cover the cost of acquiring, from any point along the trench excavation as be Selected by the Engineer within 5,0 km, bedding that complies with the relevant requirements of the specification, of delivering it to points alongside the trench spaced to suit the Contractor's methods of working, and of disposing of displaced material within a free haul distance 5,0 km.

Including for screening and/or other treatment:

(a) Selected granular material.....Unit: m³

(b) Selected fill material.....Unit: m³

The rates shall cover the cost of screening by means of mesh sieves or otherwise treating excavated material, at any point along the trench excavation as may be selected by the Engineer, in order to produce bedding that complies with the relevant specification, delivering it to points along the trench, within 5,0 km, spaced to suit the Contractor's methods of working, of making good any backfill deficiency there may be from points where screened backfill material has been acquired, and of disposing of displace material within a free haul distance of 5,0 km.

C3.2.2.11.4.2.1 PSLB 8.2.2 Supply only of bedding by importation

C3.2.2.11.4.2.1.1 PSLB 8.2.2.2 From borrow pits

DELETE THE WORDS IN BRACKETS IN THE FIRST FOUR LINES.

ADD THE FOLLOWING:

"The opening up of borrow pits and the removal of overburden are paid for under item 8.3.4 of SANS 1200 D."

C3.2.2.11.4.2.1.2 PSLB 8.2.2.3 From commercial sources (Provisional)

ADD THE FOLLOWING SUB-SUBITEM TO THIS CLAUSE:

(c) "Special bedding material

1) Description of material…… Unit: m²

2) Etc for other items

The unit of measurement shall be the square metre or cubic metre of material as specified.

The rate shall cover the cost as specified for (a) and (b)." The rate shall include the cost of acquiring from commercial sources, transporting regardless of distance, off loading and placing in the trench bottom clean where ordered by the Engineer.

ADD THE FOLLOWING ITEM:

C3.2.2.11.4.2.2 "PSLB 8.2.6 Extra over items 8.2.1 and 8.2.2 for bedding stabilized with 5% cement
……..Unit: m³

The tendered rate shall include full compensation for selecting, providing stabilization agent, mixing, backfilling and compacting the stabilized material to 93% of modified AASHTO density."

C3.2.2.11.4.2.3 PSLB 8.2.7 Compaction Test

Compaction testing using the troxler method……..Unit: number

C3.2.2.12 PSLC CABLE DUCTS

C3.2.2.12.1 PSLC 3 MATERIALS

C3.2.2.12.1.1 PSLC 3.1 DUCTS

ADD THE FOLLOWING:

C3.2.2.12.1.1.1 "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."

C3.2.2.12.1.2 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.”

C3.2.2.12.2 PSLC 8 MEASUREMENT AND PAYMENT

C3.2.2.12.2.1 PSLC 8.2 SCHEDULED ITEMS

C3.2.2.12.2.1.1 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."

C3.2.2.13 PSLD SEWER

C3.2.2.13.1 PSLD 3 MATERIALS

C3.2.2.13.1.1 PSLD 3.1 PIPES, FITTINGS AND PIPE JOINTS

C3.2.2.13.1.1.1 PSLD 3.1.1 Vitrified clay pipes

C3.2.2.13.1.1.1.1 PSLD 3.1.1.1 Vitrified clay pipes (rubber rings)

ADD THE FOLLOWING TO THIS SUB-CLAUSE:

All rubber rings must comply with the requirements of SANS 974.

C3.2.2.13.1.1.1.2 PSLD 3.1.1.2 Vitrified clay pipes (crushing strength)

DELETE THIS SUB-CLAUSE AND REPLACE WITH THE FOLLOWING:

Notwithstanding the requirements for crushing strength given in SANS 559 all vitrified clay pipes shall have a crushing strength of at least 45kN per meter of bearing surface.

C3.2.2.13.1.1.2 PSLD 3.1.8 uPVC Pipes

ADD THE FOLLOWING NEW SUB-CLAUSE:

uPVC pipes shall comply with the relevant requirements of SABS 967 and shall have suitable approved joints.

C3.2.2.13.1.2 PSLD 3.5 MANHOLES, CHAMBERS, ETC.

C3.2.2.13.1.2.1 PSLD 3.5.4 Concrete

ADD THE FOLLOWING TO THIS SUB-CLAUSE:

Only dolomitic aggregate shall be used for the manufacturing of concrete.

C3.2.2.13.1.2.2 PSLD 3.5.8 Manhole covers and frames

DELETE THIS SUB-CLAUSE AND REPLACE WITH THE FOLLOWING:

Only precast concrete manhole covers and frames will be allowable for use in this Contract. All covers must be provided with a 5mm thick steel lip ring. The dimensions of the covers must comply with the details given on the drawings. Where manholes are subject to traffic loads "heavy duty" covers capable of withstanding a test load of 135kN must be used. Where traffic loads will not be experienced covers capable of withstanding a test load of 40kN are required.

The concrete shall comply with SABS 1200 GA.

C3.2.2.13.1.3 PSLD 3.6 MARKER POSTS

ADD THE FOLLOWING TO THIS SUB-CLAUSE:

Marker posts must be provided at each house connection. It must consist of a 450mm long iron peg bent into a 16mm ø loop at the base and cast into a rectangular concrete block 225 * 225 * 150mm. Use class 15MPa/19mm concrete. The peg must protrude 20 mm above the concrete surface which must be level with the surrounding ground.

C3.2.2.13.2 PSLD 5 CONSTRUCTION

C3.2.2.13.2.1 PSLD 5.2 LAYING AND BEDDING

ADD THE FOLLOWING SUB-CLAUSES:

C3.2.2.13.2.1.1 PSLD 5.2.6 Clay pipes

(Up to and including 300mm diameter): When clay pipes of these diameters are laid between manholes, boxes or structures, laying shall commence at the lower end of the line with a stub end (500mm long cut from a standard full length pipe) for subsequent building into the manhole, box or structure, followed by a 500mm long standard short length (obtainable from the Suppliers or cut on Site) and thereafter by full length pipes with the last pipe cut at 1,000mm from the inner face of the wall of the upper manhole, box or structure. The remaining gap shall then be filled in with a 500mm long standard short length and a 500mm long stub end, the latter for building into the manhole, box or structure.

C3.2.2.13.2.1.2 PSLD 5.2.8 Reinforced concrete pipes

Where concrete pipes are laid between structures, manholes or junction boxes, laying of pipes shall commence at the manhole or junction box at the lower end of the pipeline with full length pipes with the last pipe cut to form a closure piece for building into the structure, manhole or junction box at the upper end of the pipeline. Only the last pipe at the upper end of the pipeline shall be cut to avoid problems with jointing.

C3.2.2.13.2.1.3 PSLD 5.2.10 Cut pipes

In the case of concrete pipes, after the cut end has been finished off it shall be painted with two coats of bituminous paint to provide protection to the exposed ends of the reinforcing steel in the pipe.

C3.2.2.13.2.2 PSLD 5.6 MANHOLES, INSPECTION CHAMBERS, ETC.

C3.2.2.13.2.2.1 PSLD 5.6.2 Benching

REPLACE THE FIRST SENTENCE WITH THE FOLLOWING:

All concrete for benching shall be class 20MPa/19mm and only dolomitic aggregate may be used.

C3.2.2.13.2.3 PSLD 5.9 CONNECTING SEWERS

C3.2.2.13.2.3.1 PSLD 5.9.1 Location and details

ADD THE FOLLOWING TO THIS SUB-CLAUSE:

House connections must be 500mm from boundary pegs or as shown on the drawings and must be clearly marked with marker posts.

OR

Where the main outfall sewer runs adjacent to stands, provision for future 100mm erf connections shall be made in the form of a Y-junction according to Drawing LD-8 of SABS 1200 LD. The 100mm leg to be plugged off with an end cap. The position of each future erf connection to be marked with a marker according to PSLD 3.6.

C3.2.2.13.2.3.2 PSLD 5.9.2 Marker posts

A marker post must be placed at the end of each house connection vertically above the pipe. The marker peg must be attached to the end cap of the pipe with a 4 mm thick galvanised steel wire. The depth of the invert below the ground level must be shown clearly on the concrete block for example D = 1.50m.

C3.2.2.13.3 PSLD 7 TESTING

C3.2.2.13.3.1 PSLD 7.1 GENERAL

C3.2.2.13.3.1.1 PSLD 7.1.6

DELETE THIS SUB-CLAUSE AND REPLACE WITH THE FOLLOWING:

Only air tests will be performed on pipes of all diameters.

C3.2.2.13.3.2 PSLD 7.2 TESTS AND ACCEPTANCE/REJECTION CRITERIA

C3.2.2.13.3.2.1 PSLD 7.2.2 Water Test

DELETE THIS SUB-CLAUSE AND REPLACE WITH THE FOLLOWING:

Where required or where directed by the Engineer, the water test must be carried out as follows:

- Block the low end of the pipe line with suitably braced plugs.
- Check that all connections and bends are tight and stable.
- Fill the pipe line until a head of 1.2m of water is achieved at the head of the line. The pressure at the low end should not exceed 6m head.
- Allow the pipe line to settle, i.e. to allow water absorption and the escape of air at the joints.
- Measure the loss over a 30 minutes period by adding water from a measuring vessel every 10 minutes in order to maintain the head at 1.2 metres.
- The leakage rate should not exceed the following values given in the Table below:

Allowable loss per 100 metres of line per hour	
Diameter	***Litres***
100	6,0
150	9,0
200	12,0
225	13,5
250	15,0
300	18,0
375	22,5
450	27,0

C3.2.2.13.3.2.2 PSLD 7.2.3 Rejection

DELETE THIS SUB-CLAUSE AND REPLACE WITH THE FOLLOWING:

Failure under the air test will be deemed to be cause for rejection. After such rejection, the Contractor may, where pipelines are above the water table, apply a water test to locate the source of failure, rectify these problems at his own cost and re-apply the air test.

C3.2.2.13.3.2.3 PSLD 7.2.6 Water tightness of manholes

ADD THE FOLLOWING TO THIS SUB-CLAUSE:

All manholes must comply with the following test requirements:

The manhole may be tested for water tightness, by filling it with water after sealing all connecting pipes with rubber plugs. The manhole must be left full for 48 hours to ensure that complete water absorption has taken place. After this period the manhole must be topped up to just below the cover and left for 24 hours. The lowering of the water level may not exceed 5mm and no moist patches or visible leaks may occur in either the shaft or the chamber. If the manhole does not comply with these requirements the faulty parts must be removed and the caulking of the whole leaking ring must be removed and resealed. This must be done until the manhole passes the test to the satisfaction of the Engineer.

C3.2.2.13.4 PSLD 8 MEASURMENT AND PAYMENT

C3.2.2.13.4.1 PSLD 8.2 SCHEDULED ITEMS

C3.2.2.13.4.1.1 PSLD 8.2.3 Manholes

ADD THE FOLLOWING TO THE SUB-CLAUSE:

The rate shall cover the cost of removing the existing cover, frame and base, providing the new precast base, rebuilding the manhole to the original level and, setting and grouting the cover and frame to the correct level.

C3.2.2.13.4.1.2 PSLD 8.2.6 Erf Connections

REPLACE THE SECOND SENTENCE WITH THE FOLLOWING:

The rate shall cover the cost of excavation to expose the existing connection at the junction with the sewer main (including excavation for working space), materials and labour for tying the connection into the new pipeline, backfilling, bedding and disposal of surplus material.

OR

The rate shall cover the cost of supplying and installing a Y-junction, an end cap and the marker post.

OR

DELETE THIS SUB-CLAUSE AND REPLACE WITH THE FOLLOWING:

(a) Double toilet unit……Unit: No

(b) Single toilet unit ……Unit: No

The rate shall cover the cost of additional excavation in all materials, backfilling, bedding, disposal of surplus material, the supply and laying of the Y-junction and the connection pipeline between the sewer line and the toilet structure and, supplying all the materials required and erecting the toilet structure as detailed on the drawings.

C3.2.2.13.4.1.3 PSLD 8.2.11 Connection to existing sewer at

REPLACE THIS ITEM WITH THE FOLLOWING:

"PSLD 8.2.11 Breaking into existing sewer and building a new manhole…..……Unit: No

The tendered rate shall include full compensation for excavation, building a new manhole over the sewer, breaking into the existing sewer, building the channelisation under wet conditions, ensuring the watertightness of the new connection, supplying all the necessary materials, removing surplus material, all labour and equipment required to make the connection, and liaison with the local authorities."

ADD THE FOLLOWING SUBCLAUSE

C3.2.2.13.4.1.4 "PSLD 8.2.13 Rodding Eye

Construct rodding eye ……Unit: No

The rate shall cover the cost of removing and disposing of the exiting rodding eye and, material and labour for constructing a new rodding to details given on the drawings.

C3.2.2.14 PSLE STORMWATER DRAINAGE

C3.2.2.14.1 PSLE 3 MATERIALS

C3.2.2.14.1.1 PSLE 3.1 CULVERT UNITS AND PIPES

(a) Precast concrete pipes

ADD THE FOLLOWING:

"spigot-and-socket joints with rubber rings shall be used as indicated on the Drawings. Rubber rings shall comply with the requirements of SANS 974-1."

(d) Skewed ends

ADD THE FOLLOWING:

"Skewed ends for pipe culverts may be cut on Site."

C3.2.2.14.1.2 PSLE 3.4 MANHOLES, CATCHPITS, AND ACCESSORIES

C3.2.2.14.1.2.1 PSLE 3.4.1 Bricks

ADD THE FOLLOWING:

"Bricks shall be engineering bricks complying with the requirements of SANS 227."

ADD THE FOLLOWING SUBCLAUSE:

C3.2.2.14.1.3 "PSLE 3.6 MATERIALS FOR SUBSURFACE DRAINS

(a) Pipes and fittings

Pipes for subsurface drains shall be normal duty, perforated or slotted uPVC pipes complying with SANS 791. Fittings shall be heavy duty and shall also comply with SANS 791.

The size of the perforations in perforated pipes shall in all cases be 8 mm in diameter ± 1.5mm, and the number of perforations per metre shall not be less than 26 for 100mm pipes and 52 for 150mm pipes. Perforations shall be spaced in two rows for 100mm pipes and in four rows for 150mm pipes, as shown on the Drawings.

Slotted pipes shall have a slot width of 8mm with a tolerance of 1.5mm in width. The arrangement of the slots is subject to the Engineer's approval, but the total slot area shall not be smaller than that specified for perforations.

(b) Crushed stone

Crushed stone shall be 19mm single-sized and shall comply with the requirements of SANS 1083.

(c) Geotextiles

Geotextiles shall be a non-woven, spun or thermic-bonded continuous filament fabric consisting of at least 85% by mass of polypropylene, polyester or other approved material and manufactured for civil-engineering applications by a recognised manufacturer.

(d) Selected granular material

Selected granular material shall comply with the requirements of SANS 1200 LB, subclause 3.1."

C3.2.2.14.2 PSLE 5 CONSTRUCTION

C3.2.2.14.2.1 PSLE 5.2 BEDDING AND LAYING

C3.2.2.14.2.1.1 PSLE 5.2.2 Pipe culverts

ADD THE FOLLOWING:

"The class of bedding required for the various pipe culverts is shown on the Drawings."

ADD THE FOLLOWING SUBCLAUSE:

C3.2.2.14.2.2 "PSLE 5.8 CONSTRUCTION OF SUBSURFACE DRAINS

After the completion of the excavations, the bottom portion of the trench shall be lined with geotextile sheeting as shown on the Drawings. The top edges of the vertical portions of the geotextile sheeting shall be tacked to the sides of the excavations with nails or by another suitable approved means. An overlap of at least 200mm shall be provided at each joint. Geotextile sheeting damaged during the installation or construction shall be replaced at the Contractor's cost.

A layer of crushed stone of the thickness shown on the Drawings shall be placed on the geotextile sheeting and lightly tamped and finished to the required gradient.

Pipes of the required size shall be firmly bedded on the permeable material, true to level and grade, and coupled where required. The trench shall then be backfilled with crushed stone to the height above the pipes shown on the Drawings or as directed by the Engineer.

Crushed stone shall be placed in layers of not more than 300mm at a time and shall be lightly compacted. Care shall be taken to prevent the contamination of crushed stone during construction of the subsurface drains and all material contaminated by soil or silt shall be removed and replaced by the Contractor at his own expense.

Perforated and slotted pipes shall be joined by couplers. Perforated pipes shall be laid with the perforations at the top or at the bottom, as directed. The higher end of subsurface drain pipes shall be sealed off with a loose concrete cap of class 20/19 concrete, as shown on the Drawings and at the lower end of the pipe shall be built into a concrete head wall providing a positive outlet, or it shall be connected to the stormwater pipes or culverts.

After all the crushed stone filter material and the protruding vertical filter material have been placed, the protruding vertical sections of the geotextile sheeting shall be folded back across the filter material so that the filter material will be completely enwrapped in the geotextile. An overlap of at least 200mm shall be provided between the portions folded back.

The remainder of the trench shall be immediately backfilled with approved impermeable material preferably obtained from the excavations, in layers not exceeding 150mm and compacted to 90% of modified AASHTO density, unless otherwise ordered by the Engineer. The trench shall be specially protected against the ingress of water, soil and silt until the backfilling with impermeable material has been completed.

Permeable material in subsoil drains shall not be taken to the surface but shall be discontinued at such heights as will be determined by the Engineer.

Any section of a subsurface drain constructed with pipes without perforations or slots shall be backfilled with impermeable backfill material as described above. Suitable excavated material may be used for backfilling. Payment for excavations as well as for backfilling with impermeable material will be made under SANS 1200 DB."

C3.2.2.14.3 PSLE 8 MEASUREMENT AND PAYMENT

C3.2.2.14.3.1 PSLE 8.2 SCHEDULED ITEMS

ADD THE FOLLOWING ITEMS:

C3.2.2.14.3.1.1 "PSLE 8.2.14 Pipes in subsurface drains:

(a) Normal duty uPVC pipes complete with couplings:

(i) (Diameter and whether perforated or not, indicated)……Unit: metre (m)

(ii) Etc. for other diameters

(b) Heavy-duty fittings:

(i) (Type and diameter indicated)……..Unit: number

(ii) Etc. for other types and diameters

The tendered rates per metre of pipe measured in place along its centre line including the length of fittings shall include full compensation for procuring, furnishing, laying and jointing the pipes as specified.

The tendered rates for fittings shall include full compensation for procuring, furnishing, laying and jointing the fittings as specified, irrespective of the type of fitting.

C3.2.2.14.3.1.2 PSLE 8.2.15 Geofabric (description of type, grade, etc.) …….Unit: square metre (m²)

The filter fabric will be measured in place after installation.

The tendered rate shall include full compensation for procuring, supplying, cutting, overlapping, jointing, placing and protecting the filter fabric as specified, as well as for wastage.

C3.2.2.14.3.1.3 PSLE 8.2.16 Crushed stone in subsurface drains……Unit: cubic metre (m³)

The tendered rate shall include full compensation for procuring, supplying, transporting and placing the material as specified. The quantity shall be calculated from the authorised dimensions.

Impermeable material will be paid under SANS 1200 DB.

C3.2.2.14.3.1.4 PSLE 8.2.17 Grade 20 MPa/19 mm concrete outlet structures for subsurface drains (including framework)…….Unit: cubic metre (m³)

The tendered rate shall include full compensation for procuring and supplying of all materials, providing and erecting formwork, reinforcing and mixing, transporting and placing concrete.

C3.2.2.14.3.1.5 PSLE 8.2.18 Concrete caps for subsurface drain pipes……Unit: number

The tendered rate shall include full compensation for supplying and installing the concrete caps.

C3.2.2.14.3.1.6 PSLE 8.2.19 Jointing with existing network……..…..Unit: sum

The tendered sum shall include full compensation for the cost of all labour, plant, materials, excavation, backfilling, compaction and overheads to join the subsurface drains to the existing stormwater network.

C3.2.2.14.3.1.7 PSLE 8.2.20 Breaking into existing manhole and install new pipe:

(a) (State pipe diameter and type)……Unit: sum

(b) Etc. for other diameters and types

The tendered rates shall include full compensation for the supply of all labour, plant and materials, making an opening in the existing manhole, installing the new pipe in the new opening, sealing around the pipe, breaking out the existing benching and channels where required and reconstructing them complete with rendering to suite the new pipe arrangement, disposing of all debris to the dumping site and backfilling around the manhole with selected material.

C3.2.2.14.3.1.8 PSLE 8.2.21 Breaking into existing stormwater pipe, installing new pipe and build new manhole:

(a) (State new pipe diameter and type)……..Unit: number

(b) Etc. for other new pipe diameters and types

The tendered rates shall include full compensation for the supply of all labour, plant and materials, removing a section of the existing stormwater pipe, installing the new pipe, constructing the complete, new manhole, sealing around the pipes, disposing of all debris to the dumping site and backfilling around the manhole with selected material.

C3.2.2.14.3.1.8 PSLE 8.2.22 Selected granular material……Unit: m³

The tendered rate shall include full compensation for procuring, supplying, transporting and placing the material as specified. The quantity shall be calculated from the authorised dimensions.

Impermeable material will be paid under SANS 1200 DB."

C3.2.2.15 PSLF ERF CONNECTION (WATER)

C3.2.2.15.1 PSLF 3 MATERIALS

C3.2.2.15.1.1 PSLF 3.1 PIPES, FITTINGS AND COUPLINGS

C3.2.2.15.1.1.1 PSLF 3.1.4 Polyethylene Pipes

REPLACE THE CONTENTS OF THIS SUBCLAUSE WITH THE FOLLOWING:

"Type IV Class 12 High density Polyethylene pipes must be used with an internal diameter as specified in the drawings and bill of quantities. P.V.C. or Nylon couplings and fittings similar to the "Plasson" type must be used. The pipes must comply with the relevant SANS 4427 requirements."

Commented [TS1]: Updated SANS reference.

ADD THE FOLLOWING SUBCLAUSE:

C3.2.2.15.1.1.2 "PSLF 3.1.8 Ferrule

A bronze or galvanised ferrule that can be closed off similar to the "Talbot" standard pattern and in accordance with BS 1400 must be supplied."

C3.2.2.15.2 PSLF 8 MEASUREMENT AND PAYMENT

C3.2.2.15.2.1 PSLF 8.2 SCHEDULED ITEMS

C3.2.2.15.2.1.1 PSLF 8.2.1 Provide erf connections complete……..…Unit: No

ADD THE FOLLOWING:

"The length of erf connection will be taken as the shortest distance between the watermain and the erf boundary."

C3.2.2.15.2.1.2 PSLF 8.2.2 Supply, install and test erf connection…….Unit: m

ADD THE FOLLOWING:

"The rate shall also include for the excavation, backfilling and disposal of the surplus material as well as for the supply and construction of sand bedding."

C3.2.2.15.2.1.3 PSLF 8.2.3 Supply and installation of specials……..…Unit: No

REPLACE THE CONTENTS OF THE SUBCLAUSE WITH THE FOLLOWING:

"Separate items are listed for specials of each type and size.

The rate shall cover the cost of excavating in all material (including disposal of surplus or unsuitable material), the supply of sand bedding, the supply and installation of specials, the connection to the watermain including all jointing material and testing, as well as backfilling with suitable material including the supply thereof."

C3.2.2.16 PSME SUBBASE

C3.2.2.16.1 PSME 3 MATERIALS

C3.2.2.16.1.1 PSME 3.2 PHYSICAL PROPERTIES

C3.2.2.16.1.1.1 PSME 3.2.1 Subbase material

REPLACE THE CONTENTS OF PARAGRAPH (a) WITH THE FOLLOWING:

"(a) The maximum particle dimension of the gravel shall not exceed 63mm."

REPLACE THE CONTENTS OF PARAGRAPH (d) WITH THE FOLLOWING:

"(d) The CBR at specified density shall be 45 for unstabilized material as well as for stabilized material prior to stabilization."

DELETE PARAGRAPH (e).

C3.2.2.16.1.1.2 PSME 3.2.2 Gravel shoulder and gravel wearing course material

REPLACE THE CONTENTS OF THIS SUBCLAUSE WITH THE FOLLOWING:

"The material used for gravel shoulders and gravel wearing course shall comply with the following:

(a) The PI shall not be less than 6 and not more than (3 x GM) + 10.

(b) The maximum particle dimension of the gravel shall not exceed 40mm.

(c) The CBR shall be greater than 15 at 93% of modified AASHTO density."

C3.2.2.16.2 PSME 5 CONSTRUCTION

C3.2.2.16.2.1 PSME 5.2 EXCAVATION

C3.2.2.16.2.1.1 PSME 5.2.2 Borrow pits

*INSERT THE WORDS "*designated by the Engineer and*" BETWEEN THE WORDS* "pits" *AND* "established" *IN THE FIRST LINE.*

ADD THE FOLLOWING SUBCLAUSES:

C3.2.2.16.2.2 "PSME 5.8 WEED-KILLER

The subbase layer shall be treated before compaction by applying and mixing in granular HYVAR X or TENOC X weed-killer in accordance with the manufacturer's instructions. An approved equivalent may be used.

C3.2.2.16.2.3 PSME 5.9 INSECTICIDE

An insecticide approved by the Engineer shall be applied strictly in accordance with the manufacturer's instructions over the total area of the subbase. The instructions indicate whether the poison is to be applied before or after compaction of the layer."

C3.2.2.16.3 PSME 8 MEASUREMENT AND PAYMENT

C3.2.2.16.3.1 PSME 8.1 BASIC PRINCIPLES

INSERT A SEMICOLON IN THE FIRST LINE OF PARAGRAPH (b) AFTER THE WORDS "will be paid for once only" *AND DELETE THE REST OF THE PARAGRAPH.*

AMEND PARAGRAPH (d) AS FOLLOWS:

"(d) that, in the case of material from a commercial source or from borrow pits selected by the Contractor, no additional payment will be made for the class of excavation, method of processing (except stabilizing), or overhaul."

C3.2.2.16.3.2 PSME 8.3 SCHEDULED ITEMS

C3.2.2.16.3.2.1 PSME 8.3.2 Construct the subbase course/shoulders/gravel wearing course with material from designated excavations

REPLACE THE CONTENTS OF subitem (a) *WITH THE FOLLOWING:*

"The rate for (a) shall include full compensation for excavating and selecting subbase material, for loading and transporting the material within the free-haul distance, and for either placing the material on the road or stockpiling the material for later use. When material is stockpiled, the rate shall include compensation for shaping and grading the stockpile so that it is free-draining."

C3.2.2.16.3.2.2 PSME 8.3.3 Construct the subbase course/shoulders/gravel wearing course with material from commercial sources or designated borrow areas

REPLACE THE HEADING OF THIS ITEM WITH THE FOLLOWING:

"PSME 8.3.3 Construct the subbase course/shoulders/gravel wearing course with material from commercial sources"

ADD THE FOLLOWING PARAGRAPH:

"This item shall also apply to the construction of subbase course/shoulders/gravel wearing course with material from borrow pits selected by the Contractor."

C3.2.2.16.3.2.3 PSME 8.3.9 Overhaul (haul exceeding 2km):

REPLACE THE CONTENTS WITH THE FOLLOWING:

"(a) Limited overhaul……..……Unit: cubic metre (m^3)

(b) Long overhaul……..Unit: cubic metre-kilometre (m^3-km)

Overhaul will be paid in accordance with item 8.3.6 of SANS 1200 D."

ADD THE FOLLOWING ITEM:

C3.2.2.16.3.2.4 "PSME 8.3.11 Treatment of subbase with:

(a) Weed-killer……....Unit: square metre (m^2)

(b) Insecticide…….Unit: square metre (m^2)

The tendered rates shall include full compensation for supplying, spreading and mixing-in or applying the poison.

Only areas that were treated on the written instructions of the Engineer will be measured for payment."

C3.2.2.17 PSMJ SEGMENTED PAVING

C3.2.2.17.1 PSMJ 8 MEASUREMENT AND PAYMENT

C3.2.2.17.1.1 PSMJ 8.2 SCHEDULED ITEMS

C3.2.2.17.1.1.1 PSMJ 8.2.2 Construction of paving complete

ADD THE FOLLOWING:

"The tendered rate shall also include full compensation for straight or curved cutting units to fit edge restraints or kerbing and for the removal of waste material from the Site."

C3.2.2.18 PSMK KERBING AND CHANNELLING

C3.2.2.18.1 PSMK 3 MATERIALS

C3.2.2.18.1.1 PSMK 3.1 CONCRETE

*REPLACE THE WORDS "*SABS 1200 G or SABS 1200 GA*" WITH "*SANS 2001 – CC1 (2007) Specification for Concrete Works (Structural)"

ADD THE FOLLOWING:

"The Contractor shall timeously submit the concrete mix design for cast-in-situ kerbing to the Engineer for approval and no kerbing shall be placed before the mix design has been approved."

C3.2.2.18.2 PSMK 5 CONSTRUCTION

C3.2.2.18.2.1 PSMK 5.11 TRANSITION SECTIONS AND INLET AND OUTLET STRUCTURES

DELETE THE WORDS "and with the requirements of the Project Specification" *IN THE SECOND PARAGRAPH.*

C3.2.2.18.3 PSMK 7 TESTING

C3.2.2.18.3.1 PSMK 7.2 CAST-IN-SITU AND EXTRUDED KERBING AND CHANNELLING

C3.2.2.18.3.1.1 PSMK 7.2.1 General tests

DELETE THIS SUBCLAUSE.

C3.2.2.18.3.1.2 PSMK 7.2.2 Alternative tests

REPLACE THE HEADING AND CONTENTS OF THIS SUBCLAUSE WITH THE FOLLOWING:

"PSMK 7.2.2 Tests

The Contractor shall carry out a minimum of three cube crushing tests per 1,000m of kerbing placed. The cost of such tests shall be deemed included in the rates tendered for kerbing.

One cube crushing test shall consist of a set of six cubes made with concrete taken from the mixer, the kerbing machine or from any part of the work as ordered.

If, after 28 days in an approved laboratory, after three cubes of any set of six cubes have been tested, the average crushing strength is found to be more than 3MPa below the specified strength, the kerbing represented by the cubes will be rejected.

The Contractor may apply for resubmission of the rejected section on the basis of cores drilled from this section and tested for the estimated actual crushing strength in accordance with SABS method 865 (excluding Appendix A). The cost of drilling and testing the cores is for the Contractor's account, regardless of the outcome of the tests on the cores. The number of cores required will be determined by the Engineer and the criterion for rejection or acceptance of the section represented by the cores shall be as specified above for cubes."

C3.2.2.18.3.2 PSMK 7.3 RESPONSIBILITY FOR THE COST OF TESTING

DELETE THIS SUBCLAUSE.

C3.2.2.18.4 PSMK 8 MEASUREMENT AND PAYMENT

C3.2.2.18.4.1 PSMK 8.2 SCHEDULED ITEMS

C3.2.2.18.4.1.1 PSMK 8.2.1 Concrete kerbing

REPLACE "5.8.2" IN THE THIRD LINE OF PARAGRAPH (e) WITH "5.8.3".

C3.2.2.18.4.1.2 PSMK 8.2.3 Variation of tests on extruded kerbing

DELETE THIS SUBCLAUSE.

ADD THE FOLLOWING ITEM:

C3.2.2.18.4.1.3 "PSMK 8.2.14 Removal of existing kerbing and:

(a) Disposing of them off the Site…….Unit: metre (m)

(b) Reusing them elsewhere on the Site…….Unit: metre (m)

The tendered rates shall include full compensation for providing all labour and equipment, excavations, lifting the kerbs and, in the case of subitem (a), loading and transporting the kerbs from the Site and, in the case of subitem (b), cleaning the kerbs, and temporarily storing them and relaying them elsewhere on the Site."

Johannesburg Water (SOC) Ltd

Johannesburg Water

CONTRACT JW14322

CONSTRUCTION OF A 26ML CONCRETE RESERVOIR AND 2ML CONCRETE WATER TOWER IN BRIXTON WITH ASSOCIATED PIPE AND PUMP WORKS

VOLUME 1

PART 4: SITE INFORMATION

Employer:		Contractor	
Witness:		Witness:	

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C4 SITE INFORMATION

C4.1 GENERAL

This section describes the site at the time of tender to enable the tenderer to price his tender and to decide upon his method of working and programming and risks.

C4.2 SITE LOCATION

The site is situated in Brixton, Johannesburg.

C4.3 ACCESS TO SITE AND RESTRICTIONS

Any permission as may become necessary shall be the responsibility of the Contractor to obtain.

Having been granted access to works areas by the Employer, other service authorities and private owners, the Contractor shall adhere to any agreed conditions of access and ensure the works area is left in a condition similar to when it was first accessed. It must be kept in mind that part of the site is located within a private business development and care must be taken not to compromise the safety / security of the workers or property of the development or those of adjacent developments / properties.

C4.4 EXISTING SERVICES, SERVITUDES AND WAYLEAVES

For detailed specification the Contractor shall refer to clauses C3.1.1.4 (Temporary Works), C3.1.4.5 (Existing services), and C3.1.4.2.4 (Permits and wayleaves).a

C4.5 SECURITY

The Contractor shall be responsible for the security of his personnel, materials, equipment and construction plant on and around the site of the Works and for the security of his camp (if applicable). The Employer in this regard will consider no claims.

Refer to clause PS6.1 (Security)

C4.6 NATURE OF GROUND AND SUBSOIL CONDITIONS

It shall be the Contractor's responsibility to acquaint himself with the conditions of the site. A geotechnical study has been done and is attached.

C4.7 GEOTECHNICAL REPORT AND BOREHOLE CORES

A geotechnical report is available upon request. It shall be the Contractor's responsibility to acquaint himself with the conditions of the site when submitting his or her rates.

C4.8 HYDROLOGICAL REPORT AND FLOODLINES

There are no supporting documents available with regard hydrological and floodline aspects.

Bill of Quantities

It is the Tenderer's responsibility to price all items in the Bill of Quantities in accordance with the enquiry document requirements, including but not limited to the Scope of works, drawings and conditions of contract . All items should be priced and where items are not required, they should be stated as Not Required.

ITEM NO.	PAY REF.	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
		SECTION NO. 1 - PRELIMINARIES AND GENERAL				
		PRELIMINARIES AND GENERAL				
		Note: It is the Tenderer's responsibility to price the Preliminaries and General in accordance with all the information provided in the enquiry document and complaince to all the OHS Acts, Environmental and Quality plans and Construction regulations				
		BILL NO. 1.1				
		FIXED CHARGE ITEMS				
		Value Added Tax				
		All rates and prices shall be net, exclusive of Value Added Tax				
		Reference to contract				
		The items in the *bill of provisional quantities* shall be read in conjunction with all other relevant parts of this document.				
		Note: All requirements not specified are deemed to be included in the general pricing.				
		Fixed Charge Items				
		The sums stated for items under this heading shall cover the cost of providing, establishing and commissioning on the site the facilities adequately equipped to enable all the work to commence and to proceed to completion as required in terms of the contract. The sums shall also cover (where appropriate) the cost of demolition of and the removal from site of all items established and shall include for making good and restoring the site to the satisfaction of the Project Manager and/or Engineer				
	8.3.3	**Specific requirements**				
1		Provision of security for Contract duration	Months	18		
		Total - Carried to Summary				

ITEM NO.	PAY REF.	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
		PRELIMINARIES AND GENERAL				
		BILL NO. 1.2				
		TIME RELATED ITEMS				
	8.4.1	**Contractual Requirements**	Sum	1		
	8.5	**Sums stated provisionally by the Engineer**				
1	8.5.2	Training of labour	Prov sum	1	250,000.00	250,000.00
2		Overheads, charges and profit on item 84	%	250,000.00	10%	25,000.00
3	PSSC 9	Provide administrative, planning and on the job training to SMME's	Prov sum	1.00	216,000.00	216,000.00
4	PSSC 10	Overhead, charges and profit on SMME training	%	216,000.00	10%	21,600.00
	8.7	**Daywork (Provisional)**				
5		Allowance for labour	Prov sum	1	2,000,000.00	2,000,000.00
		Total - Carried to Summary				

ITEM NO.	PAY REF.	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
		SUMMARY TOTAL PRELIMINARIES AND GENERAL				
		PRELIMINARIES (FIXED CHARGE ITEMS)				
		PRELIMINARIES (TIME RELATED ITEMS)				
		TOTAL SECTION				

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
		SECTION 2 : EXTERNAL WORKS				
		SECTION 2.1 : BULK EARTHWORKS				
	SANS 1200 C	**BILL NO.1 :SITE CLEARANCE**				
		Reference Drawing.: Reservoir and tower				
	PSC 8.2.1	**Clear and grub:**				
1		Total Site Areas	m²	13600		
	8.2.2	**Remove and grub large trees and tree stumps of girth:**				
2		Over 2,0 m and up to and including 3,0 m	No.	3		
		Total - Carried to Summary				

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
	SANS 1200 HA	**BILL NO.3 STRUCTURAL STEELWORK (SUNDRY ITEMS)**				
	8.3.2	**Handrails:**				
		Handrail assembly complete:				
1		Horizontal	m	50		
2		Sloping (measured on slope)	m	10		
3		Shaped Ends	No.	8		
		Total - Carried to Summary				

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
	PZ	**BILL NO.4 : PATENTED EARTH RETAINING SYSTEMS**				
	PZ.01	**Patented earth retaining systems:**				
		Loffelstein precast concrete blocks of type:				
1		L300, at 35°	m²	80		
		Total - Carried to Summary				

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
	SANS 2001 CC1	**BILL NO. 5 : CONCRETE (STRUCTURAL)**				
	SD8.6	**Manufacture (or supply) and erect precast concrete units:**				
1		Concrete access steps	No	1		
		Total - Carried to Summary				

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
		SUMMARY TOTAL BULK EARTHWORKS				
		SITE CLEARANCE				
		STRUCTURAL STEELWORK (SUNDRY ITEMS)				
		PATENTED EARTH RETAINING SYSTEMS				
		CONCRETE (STRUCTURAL)				
		TOTAL SECTION				

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
		SECTION 2 : EXTERNAL WORKS				
		SECTION 2.2 : ROADS				
	SANS 1200 D	**BILL NO.1 : EARTHWORKS**				
		Reference Drawing.: 113503-0000-DRG-1300				
	PSD 8.3.2	**Bulk excavation:**				
		Excavate in all materials and use for embankment or backfill as ordered from:				
1		Necessary excavations	m³	1402		
	PSD 8.3.2	Extra over items 1 to 2 above for :				
2		Hard rock excavation	m³	0		
3		Extra over item 140.02 for hand excavation	m³	10		
4	8.3.9	Extra over items 1 for backfill or for fill material against structures	m³	13		
5	PSD 8.3.15	Extra over items 1 for disposing of spoil material on a site provided by the Contractor	m³	3272		
		Total - Carried to Summary				

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
	SANS 1200 DM	**BILL NO. 2 : EARTHWORKS (ROADS, SUBGRADE)**				
	PSDM 8.3.3	**Treatment of roadbed:**				
		Roadbed preparation and compaction of material to:				
1		Scarify insitu material 150mm deep and recompact to 90% modified AASHTO maximum density	m³	1542		
2	PSDM 8.3.5	C4 layer compacted to 95% of modified AASHTO maximum density	m³	1542		
3		G7 compacted to 93% of modified AASHTO maximum density	m³	1542		
		Total - Carried to Summary				

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
	SANS 2001 CC1	**BILL NO.3 : PRECAST CONCRETE**				
	SD8.6	**Provide structral precast unit**				
1		300mm x 300mm Anchor Beams	m	35		
		Total - Carried to Summary				

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
	SANS 1200 ME	**BILL NO.4 : SUBBASE**				
	PSME 8.3.5	**Process subbase material by one of the following processes, as relevant, and use in the subbase:**				
1		Stabilization	m³	1542		
	PSME 8.3.8	**Stabilizing agent:**				
2		Portland cement	t	6		
	PSME 8.3.11	**Treatment of subbase with:**				
3		Weed killer	m²	9348		
4		Insecticide	m²	9348		
		Total - Carried to Summary				

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
	SANS 1200 MJ	**BILL NO.5 : SEGMENTED PAVING**				
	PSMJ 8.2.1	**Provision of edge restraints:**				
	PSMJ 8.2.2	Construction of paving complete:				
1		Type S-A blocks, 80 mm thick, grey interlocking pavers	m²	9348		
	PSMJ 8.2.3	Cutting blocks to fit edge restraints:				
2		Straight cutting	m	506		
3		Circular cutting	m	84		
4	PSMJ 8.2.4	Rolling to locked-up condition as specified in Clause 5.6.2	m²	9348		
		Total - Carried to Summary				

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
	SANS 1200 MM	**BILL NO.6 : ANCILLARY ROADWORKS**				
		ROAD MARKINGS				
	8.4.1	**Proprietary brand road marking material applied at nominal rate of 0,42 litre/m²:**				
		White lines (broken or unbroken):				
1		100 mm wide	m	300		
	8.4.1	**Non-reflectorized paint applied at nominal rate of 0,42 litre/m²:**				
		White lines (broken or unbroken):				
2		100 mm wide	m	300		
		Total - Carried to Summary				

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
	SANS 1200 MK	**BILL NO.7 : KERBING AND CHANNELLING**				
	PSMK 8.2.1	**Precast concrete kerbing:**				
1		Non mountable kerbs	m	650		
2		Mountable Kerb	m	20		
		Total - Carried to Summary				

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
		SUMMARY TOTAL ROADS				
		EARTHWORKS				
		EARTHWORKS (ROADS,SUBGRADE)				
		PRECAST ONCRETE (STRUCTURAL)				
		SUBBASE				
		SEGMENTED PAVING				
		ANCILLARY ROADWORKS				
		KERBING AND CHANNELING				
		TOTAL SECTION				

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
		SECTION 2 : EXTERNAL WORKS				
		SECTION 2.3 : STORMWATER				
	SANS 1200 D	**BILL NO.1 : EARTHWORKS**				
	PSD 8.3.2	**Bulk excavation:**				
		Excavate in all materials for stormwater attenuation pond and use for embankment or backfill as ordered from:				
1		Necessary excavations	m³	658		
2		Excavate in all materials for stormwater attenuation pond and dispose	m³	1136		
		Extra over items 1 and 2 for:				
3		Intermediate excavation	m³	807		
4		Hard rock excavation	m³	987		
	PSD 8.3.3	**Restricted excavation:**				
		Excavate for stormwater attenuation pond spillway in all materials, and use for backfill or embankment, or dispose:				
5		Depth up to 1,0 m	m³	10		
6		Depth over 1,0 m and up to 2,0 m	m³	10		
7		Depth over 2,0 m and up to 3,0 m	m³	14		
	PSD 8.3.3	Extra over items 5, 6, and 7 for:				
8		Intermediate excavation	m³	34		
9		Extra over items 5, 6, and 7 for hand excavation	m³	3		
	PSD 8.3.6	**Overhaul:**				
10		Limited overhaul	m³			Rate only
11		Long overhaul	m³-km			Rate only
	PSD 8.3.8	**Existing services:**				
		Hand excavation for locating and exposing existing services:				
12		In all other areas for stormwater attenuation pond and spillway	m³			Rate only
	8.3.9	**Extra over items 1, 2, 5, 6, and 7 for backfill or for fill material against**				
13		Attenuation pond and compact to 93% MOD AASHTO density	m³	182		
14		Attenuation pond cement stabilised and compact to 95% MOD AASHTO density	m³	182		
15		Stormwater attenuation pond spillway and compact to 95% MOD AASHTO density	m³	5		
	PSD 8.3.10	**Topsoiling:**				
		Use topsoil material for:				
16		Preparation layer for grassing at attenuation pond	m³	182		
	8.3.11	**Grassing or other vegetation cover:**				
17		Planting of grass cuttings on attenuation pond surface	m²	1213		
18	PSD 8.3.14	Extra over items 1, 5, 6, and 7 for temporary stockpiling	m³	692		
19	PSD 8.3.15	Extra over item 2 for disposing of spoil material on a site provided by the Contractor	m³	1136		
		Total - Carried to Summary				

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
	SANS 1200 DB	**BILL NO.2 : EARTHWORKS (PIPE TRENCHES)**				
	PSDB 8.3.2	**Excavate in all materials for trenches, backfill, compact and dispose of surplus material:**				
		Pipes over 400 mm dia up to 675 mm dia for depths:				
1		Up to 1,0 m	m	155		
2		Over 1,0 m up to 2,0 m	m	298		
3		Over 2,0 m up to 3,0 m	m	7		
4	PSDB 8.3.2	**Excavate in all materials for stormwater junction boxes and the like, irrespective of depth, and backfill around structures**	m³	114		
	PSDB 8.3.2	**Excavate open drains in all materials**				
5		Concrete stormwater channel	m³	194		
	PSDB 8.3.2	Extra over items 4 and 5 for excavating in:				
6		Intermediate material	m³	194		
	PSDB 8.3.3	**Excavation ancillaries:**				
		Make up deficiency in backfill material:				
7		From other necessary excavations on site for fill material against concrete stormwater channels and compact to 95% MOD	m³	58		
		Overhaul:				
8		Limited overhaul	m³			Rate only
9		Long overhaul	m³-km			Rate only
	PSD 8.3.8	**Existing services:**				
		Hand excavation for locating and exposing existing services:				
10		In all other areas for stormwater channel 5	m³			
		Total - Carried to Summary				

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
	SANS 1200 DK	**BILL NO.3 : GABIONS AND PITCHING**				
	PSDK 8.2.5	**Pitching:**				
		Grouted pitching:				
1		Light pitching at attenuation pond headwalls	m²	40		
		Total - Carried to Summary				

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
	SANS 1200 DM	**BILL NO.4 : EARTHWORKS (ROADS, SUBGRADE)**				
		Preparation of site:				
1	8.3.2	Removal of topsoil to a depth of 150 mm, at attenuation pond and the stockpiling and maintenance thereof	m³	184		
	PSDM 8.3.3	**Treatment of roadbed (stormwater channel layerworks):**				
		Layerworks preparation and compaction of material in 150mm layers to:				
2		Minimum of 90% MOD AASHTO maximum density for stone pitching	m³	10		
3		Minimum of 93% MOD AASHTO maximum density for attenuation pond	m³	184		
4		Minimum of 95% MOD AASHTO maximum density for rectangular concrete channels	m³	58		
5	8.3.11	Extra over item 1 for temporary stockpiling of material	m³	184		
		Overhaul:				
6		Limited overhaul	m³			Rate only
7		Long overhaul	m³-km			Rate only
		Total - Carried to Summary				

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
	SANS 2001 CC1	**BILL NO.5 : CONCRETE (STRUCTURAL)**				
		SCHEDULED FORMWORK ITEMS				
	SD8.2.1	**Rough:**				
		Sloping formwork to:				
1		Attenuation pond spillway	m²	99		
2		Concrete stormwater channels	m²	545		
		SCHEDULED REINFORCEMENT ITEMS				
	SD8.3.2	**High-tensile welded mesh in the following:**				
3		Stormwater channel mesh ref. 395	m²	389		
4		Attenuation pond spillway mesh ref. 395	m²	132		
		SCHEDULED CONCRETE ITEMS				
	SD8.4.3	**Strength concrete:**				
		Class 25 MPa/ 19 mm concrete in:				
5		Stormwater channel	m³	58		
6		Attenuation pond spillway	m³	12		
	SD8.4.4	**Unformed surface finishes:**				
		Wood-floated finishes to:				
7		Stormwater channels	m²	389		
8		Attenuation pond spillway	m²	132		
	SD8.5	**Joints:**				
		5mm thick 'Jointex' or similar approved joint former with 10mm tear-off strip, and sealing of joints with 10x10 'Flexolastic T' hot poured primerless tar based joint sealant or similar approved:				
9		Stormwater channel	m²	19		
10		Attenuation pond spillway	m²	4		
	SD8.4.8	**Screeds:** Channel floor screeds (1:3) with falls including V-joints to form panels and a smooth steel-trowelled finish/power float finish to top:				
11		15 Mpa stormwater rectangular channel	m²	389		
		Total - Carried to Summary				

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
	SANS 1200 HA	**BILL NO.6 : STRUCTURAL STEELWORK (SUNDRY ITEMS)**				
	8.3.4	**Flooring, complete and installed with frames:**				
1		Galvanised steel rectagrid RS40 with 50 x 4.5mm bearers	m²	68		
		Total - Carried to Summary				

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
	SANS 1200 LB	**BILL NO.7 : BEDDING (PIPES)**				
	8.2.2	**Supply of bedding by importation:**				
		From commercial sources:				
1		Selected granular material	m³	216		
2		Selected fill material	m³	275		
		Encasing of pipes in concrete:				
3		Class 25 MPa/19 mm	m³	62		
		Total - Carried to Summary				

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
	SANS 1200 LE	**BILL NO.8 : STORMWATER DRAINAGE**				
	8.2.1	**Supply and lay concrete pipe culverts on class B bedding:**				
		Type SC 75D-load pipes with Spigot and Socket joints				
1		450mm dia	m	102		
2		600mm dia	m	189		
3		675mm dia	m	10		
		Type SC 100D-load pipes with Spigot and Socket joints				
4		450mm dia	m	120		
5		600mm dia	m	18		
6		675mm dia	m	22		
	8.2.8	**Supply and install manholes and the like:**				
		Brickwork manholes as shown on drawing no. 113503-0000-DRG-WD-1461				
7		Up to 1.0m depth	number	0		
8		1.0m to 1.5m depth	number	8		
9		1.5m to 2.0m depth	number	3		
10		2.0m to 2.5m depth	number	2		
11		2.5m to 3.0m depth	number	0		
12		3.0m to 3.5m depth	number	2		
		Grid inlets as shown on drawing no. 113503-0000-DRG-WD-1462				
13		Up to 1.0m depth	number	1		
14		1.0m to 1.5m depth	number	9		
15		1.5m to 2.0m depth	number	1		
16		2.0m to 2.5m depth	number	11		
		Inlet or Outlet structure (headwalls) as shown on drawing no. 113503-0000-DRG-WD-1463				
17		Up to 1.0m depth	number	3		
		Supply and install manholes and the like:				
		Double grid inlets:				
18		As shown on drawing no 113503-0000-DRG-WD-1462 standard depth 1m	number	1		
		Junction boxes:				
19		As shown on drawing no 113503-0000-DRG-WD-1461 standard depth 2m	number	5		
		Extra over or under items 17, 18 and 19 for variation in depth of manholes from the standard depth designated for purposes of tendering:				
		Double grid inlets:				
20		As shown on drawing no 113503-0000-DRG-WD-1462 standard depth 1m	m			Rate Only
		Junction boxes:				
21		As shown on drawing no 113503-0000-DRG-WD-1461 standard depth 2m	m			Rate Only
	8.2.10	**Accessories:**				
		Manhole covers including frames:				
22		SANS 558 type 2A	number	15		
		Grid inlet cover frames:				
23		600mm x 600mm	number	22		

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
24		520mm x 790mm	number	1		
25		Step irons	number	240		
	PSLE 8.2.21	**Break into existing stormwater kerb inlet, install new pipe and build new kerb inlet**	sum	1		
		Total - Carried to Summary				

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
		SUMMARY TOTAL FOR STORMWATER				
		EARTHWORKS				
		EARTHWORKS (PIPE TRENCHES)				
		GABIONS AND PITCHING				
		EARTHWORKS (ROADS, SUBGRADE)				
		CONCRETE (STRUCTURAL)				
		STRUCTURAL STEELWORK (SUNDRY ITEMS)				
		BEDDING (PIPES)				
		STORMWATER DRAINAGE				
		TOTAL SECTION				

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
		SECTION 2 : EXTERNAL WORKS				
	SANS 1200 C	**SECTION 2.4 : SEWER & POTABLE**				
		BILL NO.1 : SITE CLEARANCE				
	8.2.8	**Demolish and remove structures/buildings:**				
1		Demolish and remove existing sewer pipe and manhole	sum	1		
		Total - Carried to Summary				

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
	SANS 1200 DB	**BILL NO.2 : EARTHWORKS (PIPE TRENCHES)**				
		TRENCHES FOR WATER PIPES				
	PSDB 8.3.2	Excavate in all materials for trenches, backfill, compact and dispose of surplus material:				
		Pipes up to 125 mm dia for depths:				
1		Up to 1,0 m	m	124		
		TRENCHES FOR SEWER PIPES				
	PSDB 8.3.2	Excavate in all materials for trenches, backfill, compact and dispose of surplus material:				
		Pipes up to 125 mm dia for depths:				
2		Up to 1,0 m	m	70		
		Total - Carried to Summary				

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
	SANS 1200 L	**BILL NO.3 : MEDIUM-PRESSURE PIPELINES**				
	8.2.1	**Supply, lay and bed on flexible bedding, complete with couplings:**				
		HDPE PE 100 PN 12.5 SDR 13.6 pipes:				
1		25 mm dia	m	124		
	8.2.2	**Extra over items 1 for supplying, laying and bedding of HDPE specials complete with couplings:**				
		90° elbows:				
2		25mm dia	No.	3		
		45° elbows:				
3		25mm dia	No.	4		
		Tees:				
4		25 mm dia x 100 mm dia	No.	1		
	PSL 8.2.11	**Anchor/thrust blocks and pedestals:**				
		Concrete:				
5		Class 30MPa/19 mm	m³	1		
		Total - Carried to Summary				

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
	SANS 1200 LB	**BILL NO.4 : BEDDING (PIPES)**				
		BEDDING FOR WATER PIPES				
	PSLB 8.2.2	Supply only of bedding by importation:				
		From commercial sources:				
1		Selected granular material	m³	22		
2		Selected fill material	m³	7		
	8.2.1	**BEDDING FOR SEWER PIPES**				
	PSLB 8.2.2	Supply only of bedding by importation:				
		From commercial sources:				
3		Selected granular material	m³	17		
4		Selected fill material	m³	11		
		Total - Carried to Summary				

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
	SANS 1200 LD	**BILL NO.5 : SEWERS**				
		Reference Drawing: 113503-0000-DRG-WS-1500				
	8.2.1	**Supply, lay, joint, bed on a flexible bedding and test pipeline:**				
		uPVC heavy duty class 34 to SANS 791 pipes:				
1		110mm dia	m	70		
	8.2.3	**Precast concrete manhole:**				
		With cover and frame:				
2		Depth 1 m up to 1.5 m	No.	2		
3		Depth 1.5 m up to 2.0 m	No.	0		
4		Depth 2.0 m up to 2.5 m	No.	1		
	8.2.5	**Cleaning eyes as shown on drawing 113503-0000-DRG-WS-1560 for:**				
5		Erf connections	No.	1		
	8.2.6	**Erf connections:**				
		uPVC pipes complete				
6		110mm dia	No.	1		
	8.2.10	**Accessories:**				
		Manhole covers including frames:				
7		SANS 448 Type 4	No.	3		
8	PSLD 8.2.11	Connection to existing sewer	Sum	1		
9	PSLD 8.2.13	Breaking into existing sewer and building a new manhole	No.	1		
		Total - Carried to Summary				

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
	SANS 1200 LF	**BILL NO.6 : ERF CONNECTIONS (WATER)**				
		Reference Drawing: 113503-0000-DRG-WW-1600				
1	8.2.1	Provide erf connections complete:	No.	1		
		Total - Carried to Summary				

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
		SUMMARY TOTAL SEWER AND POTABLE WATER				
		SITE CLEARANCE				
		EARTHWORKS (PIPE TRENCHES)				
		MEDIUM-PRESSURE PIPELINES				
		BEDDING (PIPES)				
		SEWERS				
		ERF CONNECTIONS (WATER)				
		TOTAL SECTION				

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
		SECTION 2 : EXTERNAL WORKS				
		SECTION 2.5 : SCOUR PIPELINE				
	SANS 1200 C	**BILL NO .1 : SITE CLEARANCE**				
		Clear and grub:				
1	PSC 8.2.1	Strips, 3m wide	m	46		
2	8.2.5	Take down existing fences	m			
		Total - Carried to Summary				

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
		SUMMARY TOTAL SCOUR PIPELINE				
		SITE CLEARANCE				
		TOTAL SECTION				

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
		SECTION 2 : EXTERNAL WORKS				
		SECTION 2.6 : COLLECTION CHAMBER				
	SANS 1200 HA	**BILL NO.3 : STRUCTURAL STEELWORK (SUNDRY ITEMS)**				
	8.3.3	**Ladders, complete and installed**				
1		Access ladders, complete with corrosion protection, as per drawing: 113503-0000-DRG-WD-1760	No	1		
	8.3.4	Flooring, complete and installed with frames:				
2		Frame, complete with corrosion protection	No.	1		
3		Grating (rectagrid), complete with corrosion protection	m²	8		
	8.3.5	**Erection or installation only:**				
		Flooring, complete and installed with frames:				
4		Ladders	Sum	1		
	8.3.6	**Corrosion protection:**				
5		Ladders	Sum	1		
		Total - Carried to Summary				

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
		SUMMARY TOTAL SCOUR COLLECTION CHAMBER				
		STRUCTURAL STEELWORK (SUNDRY ITEMS)				
		TOTAL SECTION				

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
		SECTION 2 : EXTERNAL WORKS				
		SECTION 2.7 : BULK PIPELINE PHASE 1				
	SANS 1200C	**BILL NO 1 : SITE CLEARANCE**				
	PSC 8.2.1	**Clear and grub:**				
1		Areas (chambers, structures, etc)	m²	48		
2		Strips, 1,5 m wide (water) Paving/Asphalt	m	880		
	8.2.2	**Remove and grub large trees and tree stumps of girth:**				
3		Over 1,0 m and up to and including 2,0 m	No	15		
4		Over 2,0 m and up to and including 3,0m	No	15		
	8.2.4	Reclear surfaces (only on instructions from the Engineer):				
5	8.2.10	Remove topsoil to nominal depth of 150 mm and stockpile	m³	396		
6	PSC 8.2.14	Final finishing and cleaning up of the site of the Works	Sum	1		
		Total - Carried to Summary				

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
		SUMMARY TOTAL BULK PIPELINE PHASE 1				
		SITE CLEARANCE				
		TOTAL SECTION				

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
		SECTION 2 : EXTERNAL WORKS				
		SECTION 2.8: BULK PIPELINE PHASE 2				
	SANS 1200C	**BILL NO.1 : SITE CLEARANCE**				
	PSC 8.2.1	**Clear and grub:**				
1		Areas (chambers, structures, etc)	m²	56		
2		Strips, 1,5 m wide (water) Paving/Asphalt	m	1030		
	8.2.2	**Remove and grub large trees and tree stumps of girth:**				
3		Over 1,0 m and up to and including 2,0 m	No	10		
4		Over 2,0 m and up to and including 3,0 m	No	10		
5	8.2.10	Remove topsoil to nominal depth of 150 mm and stockpile	m³	464		
6	PSC 8.2.14	Final finishing and cleaning up of the Site of the Works	Sum	1		
		Total - Carried to Summary				

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
	SANS 1200DK	**BILL NO. 4 : GABIONS AND PITCHING**				
	8.2.1	**Surface preparation for bedding of gabions: 1 no. Scour Valves**				
1		Cavities filled with approved excavated material or rock	m²	25		
	8.2.2	**Gabions:**				
		Gabion boxes of galvanized wire:				
2		100 mm x 100 mm mesh, 2,7 mm dia wire, 1,0 m x 1,0 m x 0,5 m boxes	m³	5		
		Gabion mattresses of galvanized wire, up to 0,3 m deep:				
3		80 mm x 100 mm mesh, 2,6 mm dia wire, 6,0 m x 2,1 m x 0,3 m mattress	m³	8		
	8.2.4	**Geotextile:**				
4		Grade 4 or approved equivalent	m²	31		
		Total - Carried to Summary				

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
		SUMMARY TOTAL BULK PIPELINE PHASE 2				
		SITE CLEARANCE				
		GABIONS AND PITCHING				
		TOTAL SECTION				

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
		SECTION 2 : EXTERNAL WORKS				
		SECTION 2.9 : BULK PIPLINE PHASE 3				
	SANS 1200C	**BILL NO.1 : SITE CLEARANCE**				
	PSC 8.2.1	**Clear and grub:**				
1		Areas (chambers, structures, etc)	m²	51		
2		Strips, 1,5 m wide (water) Paving/Asphalt	m	1407		
	8.2.2	**Remove and grub large trees and tree stumps of girth:**				
3		Over 1,0 m and up to and including 2,0 m	No	10		
4		Over 2,0 m and up to and including 3,0 m	No	10		
5	8.2.10	Remove topsoil to nominal depth of 150 mm and stockpile	m³	318		
6	PSC 8.2.14	Final finishing and cleaning up of the	Sum	1		
		Total - Carried to Summary				

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
	SANS 1200 DK	**BILL NO.4 : GABIONS AND PITCHING**				
	8.2.1	**Surface preparation for bedding of gabions: 1 no. Scour Valves**				
1		Cavities filled with approved excavated material or rock	m²	24		
	8.2.2	**Gabions:**				
		Gabion boxes of galvanized wire:				
2		100 mm x 100 mm mesh, 2,7 mm dia wire, 1,0 m x 1,0 m x 0,5 m boxes	m³	5		
		Gabion mattresses of galvanized wire, up to 0,3 m deep:				
3		80 mm x 100 mm mesh, 2,6 mm dia wire, 6,0 m x 2,0 m x 0,3 m mattress	m³	7		
	8.2.4	**Geotextile:**				
4		Grade 4 or approved equivalent	m²	39		
		Total - Carried to Summary				

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
		SUMMARY TOTAL BULK PIPELINE PHASE 3				
		SITE CLEARANCE				
		GABIONS AND PITCHING				
		TOTAL SECTION				

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
		SECTION 2 : EXTERNAL WORKS				
		SECTION 2.10 : BULK PIPELINE PHASE 4				
	SANS 1200 C	**BILL NO.1 : SITE CLEARANCE**				
	PSC 8.2.1	**Clear and grub:**				
1		Strips, 1,5 m wide (water) Paving/Asphalt	m	2137		
	8.2.2	**Remove and grub large trees and tree stumps of girth:**				
2		Over 1,0 m and up to and including 2,0 m	No	10		
3		Over 2,0 m and up to and including 3,0 m	No	10		
4	8.2.10	Remove topsoil to nominal depth of 150 mm and stockpile	m³	481		
5	PSC 8.2.14	Final finishing and cleaning up of the Site of the Works	Sum	1		
		Total - Carried to Summary				

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
		SUMMARY TOTAL BULK PIPELINE PHASE 4				
		SITE CLEARANCE				
		TOTAL SECTION				

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
		SECTION 2 : EXTERNAL WORKS				
		SECTION 2.11 : BULK PIPELINE PHASE 5				
	SANS 1200 C	**BILL NO .1 : SITE CLEARANCE**				
	PSC 8.2.1	**Clear and grub:**				
1		Strips, 1,5 m wide (water) Paving/Asphalt	m	1836		
	8.2.2	**Remove and grub large trees and tree stumps of girth:**				
2		Over 1,0 m and up to and including 2,0 m	No	10		
3		Over 2,0 m and up to and including 3,0 m	No	10		
4	8.2.10	Remove topsoil to nominal depth of 150 mm and stockpile	m³	413		
5	PSC 8.2.14	Final finishing and cleaning up of the Site of the Works	Sum	1		
		Total - Carried to Summary				

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
		SUMMARY TOTAL BULK PIPELINE PHASE 5				
		SITE CLEARANCE				
		TOTAL SECTION				

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
		SECTION 2 : EXTERNAL WORKS				
		SECTION 2.13 : LANDSCAPE				
	SANS 1200 C	**BILL NO.1 : SITE CLEARANCE**				
1	8.2.1	Clear and grub (areas)	m²			
2	8.2.9	Transport materials and debris to unspecified sites and dump (Provisional)	m3-Km	1		Rate Only
		Total - Carried to Summary				

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
	PLS 9	**BILL NO. 5 : LANDSCAPE SOFTSCAPING**				
1	9.7.1	Soil test	No	1		
2	9.7.2	Clearing of area for planting	m²	4863		
3	9.7.4	Topsoil from stockpile	m3	1		Rate Only
		150mm thick				
4	9.7.5	Topsoil imported to site	m³	64		
		150mm thick				
5	9..7.6	Compost to lawn	m³	11		
		25mm thick				
6	9.7.6	Compost to trees	m³	1.54		
		0.07/m3 tree				
7	9.7.7	Planter mix	m³	5		
8	9.7.8	Scarifying of areas	m²	429		
		300mm deep				
9	9.7.9	Shaping and trimming	m²	1217		
10	9.7.10	Fine grading of the following areas: Lawn (hydroseeding and sods)	m²	4863		
	9.7.11	**Fertilizer**				
11		Agricultural lime at 300kg/ha	kg	13		
12		Super phosphate at 0.15kg/m²	kg	183		
13		Superphosphate at 0.15kg/tree	kg	3		
14		2:3:2 (22) at 0.15kg/m²	kg	183		
15		2:3:2 (22) at 0.15kg/tree	kg	1		
16		Agriform tablets (2yr release) at 2 x21g tablets per tree	No	44		
17		Bonemeal at 0.1kg/tree	kg	2.2		
18	9.7.12	Mulch 50mm thick bark chips	m3	1		Rate Only
19	9.7.14	Trees Deliver and plant Combretum erythrophyllum (100L)	No	22		
20	9.7.15	Tree stakes and ties	No	22		
21	9.7.17	Groundcovers Tulbaghia violecea 4L @ 9/mÂ²	No	86		
22	9.7.18	Cynodon dactylon plugs	m²	226		
23	9.7.19	Hydroseeding Cynodon dactylon	m²	788		
24		Highveld grass mix	m²	3781		
		Total - Carried to Summary				

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
	PIR 14	**BILL NO. 7 : IRRIGATION**				
1	14.3.2	Provide 110 mm irrigation sleeves at positions	m	298		
		Indicated on drawing no. 113503 0000 DRG AL 7001 T0				
2	14.3.1	Supply, deliver and install irrigation as per specialist BOQ	Sum	1		
		Refer to drawing no: 113503 0000 DRG AL 7007 T0				
		Total - Carried to Summary				

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
	PLM 15	**BILL NO.8 : LANDSCAPE MAINTENANCE**				
1		Landscape Maintenance	month	3		
		Total - Carried to Summary				

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
	PA	**BILL NO.9 : FENCING**				
	PA 12.1	**Supply and erection of new fencing material complete to Drawing No:113503-0000-DRG-CC-1062:**				
1		Clearvu Mesh panel 3297 wide x 2100mm high	No	179		
2		Galvanized post, 2700 mm long	No	180		
3		Concrete post foundation (400x400x600)mm	m³	19		
4		Shark tooth spike rail, 100mm high	m	605		
5		Anti Burrow Ripper Flatwrap, 500mm wide	m	202		
	PA 12.2	**New gates:**				
6		Double Leaf Swing Gates with Clearvu Fencing complete to drawing 113503-0000-DRG-CC-1062	No	1		
7		Sliding Gates with Clearvu Fencing complete to drawing 113503-0000-DRG-CC-1062	No	3		
8	**PA 12.3**	**Drilling and blasting holes for posts and anchors**	No	72		
		Total - Carried to Summary				

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
		SUMMARY TOTAL LANDSCAPE				
		SITE CLEARANCE				
		SUBBASE				
		SEGMENTED PAVING				
		LANDSCAPE SOFTSCAPING				
		LANDSCAPE HARDSCAPING				
		IRRIGATION				
		LANDSCAPE MAINTENANCE				
		FENCING				
		TOTAL SECTION				

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
		SECTION 4 : RESERVOIR				
	PD.01	**BILL NO. 11 : BUILDING WORK**				
	PD 10.01	**Brickwork:**				
1		230mm thick NFX load-bearing engineering bricks with 14Mpa mortar (1:4 cement:sand)	m²	351		
	PD 10.02	**Plaster work:**				
		Internal Plaster				
2		15mm thick internal cement plaster, steel-float finish	m²	172		
		External Plaster				
3		15mm thick, external cement plaster wood float finish	m²	278		
	PD 10.03	**Floor screeds:**				
4		Average 75mm Thick 20Mpa screed to falls - Reservoir	m²	4,711		
5		Average 75mm Thick 25Mpa screed to falls - Pumphouse	m²	44		
	PD 10.04	**Doors and windows:**				
		Aluminium louvres complete with frame and glazed panels:				
7		900 x 900mm "Trox" or similar approved aluminium lourvers	No	9		
	PD 10.07	Joinery:				
		Items measured by number:				
8		Semi solid core flush panelled single door size 813 x 2032 x 44mm thick, cut 100mm short, with commercial veneered finish suitable for painting on both sides including pressed steel double rebated door frame suitable for 230mm wall, including all necessary ironmongery.	No	3		
	PD 10.08	Miscellaneous work:				
		(a) Paintwork				
		One coat wood primer and two coats eggshell enamel paint:				
9		Timber doors	m²	10		
		One coat universal undercoat and two coats eggshell enamel paint:				
10		Steel door frames	m²	1		
		One coat primer, one undercoat and two coats PVA emulsion paint on:				
11		Internal plastered walls	m²	278		
12		External plastered walls	m²	172		
	PD 10.09	**Miscellaneous items:**				
		Items measured by number:				
13		4800 x 3400mm high Purpose made Motorised galvanised steel security gates comprising 60kg/m2 steel frame and guide frame, complete with and including wheels, rails, cover plates, motor etc. as per drawings and specifications.	No	1		
		Items measured by length:				
14		150mm Wide brick reinforcement built in horizontally	m	356		
15		75 x 110mm Wide precast presstresed concrete lintels	m	38		
16		300mm wide Precast sills	m	22		
		Total - Carried to Summary				

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
		SUMMARY TOTAL RESERVOIR				
		BUILDING WORK				
		TOTAL SECTION				

ITEM NO.	DESCRIPTION	AMOUNT
	FINAL SUMMARY	
SECTION 1	PRELIMINARIES AND GENERAL	R -
SECTION 2	**EXTERNAL WORKS**	
SECTION 2.1	BULK EARTHWORKS	R -
SECTION 2.2	ROADS	R -
SECTION 2.3	STORMWATER	R -
SECTION 2.4	SEWER & POTABLE	R -
SECTION 2.5	SCOUR PIPELINE	R -
SECTION 2.6	COLLECTION CHAMBER	R -
SECTION 2.7	BULK PIPELINE PHASE 1	R -
SECTION 2.8	BULK PIPELINE PHASE 2	R -
SECTION 2.9	BULK PIPELINE PHASE 3	R -
SECTION 2.10	BULK PIPELINE PHASE 4	R -
SECTION 2.11	BULK PIPELINE PHASE 5	R -
SECTION 2.13	LANDSCAPE AND FENCING	R -
SECTION 4	**RESERVOIR**	
SECTION 4.1	RESERVOIR	R -
	TOTAL VALUE	**R -**

Bill of Quantities

It is the Tenderer's responsibility to price all items in the Bill of Quantities in accordance with the enquiry document requirements, including but not limited to the Scope of works, drawings and conditions of contract . All items should be priced and where items are not required, they should be stated as Not Required.

ITEM NO.	PAY REF.	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
		SECTION NO. 1 - PRELIMINARIES AND GENERAL				
		PRELIMINARIES AND GENERAL - MAIN CONTRACTOR				
		Note: It is the Tenderer's responsibility to price the Preliminaries and General in accordance with all the information provided in the enquiry document and complaince to all the OHS Acts, Environmental and Quality plans and Construction regulations				
		BILL NO. 1.1				
		FIXED CHARGE ITEMS				
		Value Added Tax				
		All rates and prices shall be net, exclusive of Value Added Tax				
		Reference to contract				
		The items in the *bill of provisional quantities* shall be read in conjunction with all other relevant parts of this document.				
		Note: All requirements not specified are deemed to be included in the general pricing.				
		Fixed Charge Items				
		The sums stated for items under this heading shall cover the cost of providing, establishing and commissioning on the site the facilities adequately equipped to enable all the work to commence and to proceed to completion as required in terms of the contract. The sums shall also cover (where appropriate) the cost of demolition of and the removal from site of all items established and shall include for making good and restoring the site to the satisfaction of the Project Manager and/or Engineer				
	SANS 1200 A 8.3	**Contractual Requirements**				
1		Performance bond 10%	Item	1		
	8.3.2	**Establishment of Facilities on Site**				
	SANS 1200 AB	**Facilities for the Engineer**				
2	8.2.1	a) Furnished offices (2 No - 1 No 20m² and 1 No 12m²)	Sum	1		
3	8.2.1	b) Telephone (and computer equipment)	Sum	1		
4	8.2.1	c) Nameboards (2 No)	Sum	1		
5	8.2.1	d) Carport	Sum	1		
6	SANS 1200 A 8.3.2.1	e) Kitchenette	Sum	1		
7	8.3.2.1	f) Ablution and latrine facilities both male and female	Sum	1		
8	8.3.2.1	g) Survey equipment and assistance	Sum	1		
9	8.3.2.1	h) Safety equipment, including hard hat, removable revolving orange light for vehicle & reflective vest	Sum	1		
	8.3.2.2	**Facilities for the Contractor**				
10		a) Offices and storage sheds	Sum	1		
11		b) Workshops	Sum	1		
12		c) Laboratories	Sum	1		
13		d) Living accommodation	Sum	1		
14		e) Ablution and latrine facilities	Sum	1		
15		f) Tools and equipment	Sum	1		
16		g) Water Supply, Electrical power and communications	Sum	1		
17		h) Dealing with water	Sum	1		
18		i) Access	Sum	1		
19		j) Transport to and establish on site all Construction plant and equipment	Sum	1		

ITEM NO.	PAY REF.	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
20		j) Attendance for local subcontractors and targeted enterprise use and development including monitoring, skills transfer, quality assurance and support	Sum	1		
	8.3.3	**Specific requirements**				
21		Provision of security for Contract duration	Sum	1		
22	8.3.4	**Remove Contractors Site Establishment and make good**	Sum	1		
		Other fixed charge obligations not covered above (Tenderer to list)				
23			Sum	1		
24			Sum	1		
25			Sum	1		
26			Sum	1		
	8.3.5	**Additional Contractual Obligations**				
27	8.3.5.1	Notice and warning to consumers	Sum	1		
28	8.3.5.2	OHS Act Obligations	Sum	1		
29	8.3.5.3	EMP Obligations	Sum	1		
		Total - Carried to Summary				**R -**

ITEM NO.	PAY REF.	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
		PRELIMINARIES AND GENERAL				
		BILL NO. 1.2				
		TIME RELATED ITEMS				
30	8.4.1	**Contractual Requirements**	Sum	1		
	8.4.2	**Operation and maintenance of facilities on site, for duration of construction, except where otherwise stated**				
	SANS 1200 AB	**Facilities for the Engineer**				
31	8.2.1	a) Furnished offices (2 No - 1 No 20m² and 1 No 12m²)	Sum	1		
32	8.2.1	b) Telephone (and computer equipment)	Sum	1		
33	8.2.1	c) Nameboards (2 No)	Sum	1		
34	8.2.1	d) Carport	Sum	1		
35	SANS 1200 A 8.3.2.1	e) Kitchenette	Sum	1		
36	8.3.2.1	f) Ablution and latrine facilities both male and female	Sum	1		
37	8.3.2.1	g) Survey equipment and assistance	Sum	1		
38	8.3.2.1	h) Safety equipment, including hard hat, removable revolving orange light for vehicle & reflective vest	Sum	1		
		Facilities for the Contractor				
39	8.4.2.2	a) Offices and storage sheds	Sum	1		
40	8.4.2.2	b) Workshops	Sum	1		
41	8.4.2.2	c) Laboratories	Sum	1		
42	8.4.2.2	d) Living accommodation	Sum	1		
43	8.4.2.2	e) Ablution and latrine facilities	Sum	1		
44	8.4.2.2	f) Tools and equipment	Sum	1		
45	8.3.2.2	g) Water Supply, Electrical power and telecommunications	Sum	1		
46	8.3.2.2	h) Dealing with water	Sum	1		
47	8.4.2.2	i) Access and security	Sum	1		
48	8.4.2.2	j) Plant	Sum	1		
49	8.4.2.2	k) First aid & medical services	Sum	1		
50	8.4.2.2	l) Attendance for local subcontractors and targeted enterprise use and development including monitoring, skills transfer, quality assurance and support	Sum	1		
51	8.4.2.2	m) Transport arrangements for labour from all communities to and from workplace to central collection / drop-off point	Sum	1		
		Supervision for Duration of Contract				
52	8.4.3	Site management	months	18		
53	8.4.3	Site manager	months	18		
54	8.4.3	Engineer	months	18		
55	8.4.3	Finance manager	months	18		
56	8.4.3	Safety manager	months	18		
57	8.4.3	Electrical safety officer	months	18		
58	8.4.3	Material orderer	months	18		
59	8.4.3	Site foremen	months	18		
60	8.4.4	Company and head office overhead costs for the duration of the Contract	months	18		

ITEM NO.	PAY REF.	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
	8.4.5	Other time related obligations not covered above (Tenderer to list)				
61			months	18		
62			months	18		
63			months	18		
64			months	18		
	PSA 8.4.6	**Additional Obligations**				
65	PSA 8.4.6.1	OHS Act Obligations	Sum	1		
66	PSA 8.4.6.2	Security Services Costs	Month	18		
67	PSA 8.4.6.3	Electrical Safety Officer	Month	18		
	8.5	**Sums stated provisionally by the Engineer**				
		Works executed by the Contractor				
68	8.5.1	Specials and fittings for tie-in to existing 675mm diameter water pipes.	Prov sum	1	50,000.00	R 50,000.00
69		Overheads, charges and profit on item 68	%	50,000.00	10%	5,000.00
70		Specials and fittings for Crosby Inlet Reconfiguration	Prov sum	1	2,000,000.00	2,000,000.00
71		Overheads, charges and profit on item 70	%	2,000,000.00	10%	200,000.00
		Works executed by Nominated Subcontractors				
72	8.5.2	Alteration to existing services by authorities	Prov sum	1	600,000.00	600,000.00
73		Overheads, charges and profit on item 72	%	600,000.00	10%	60,000.00
74	8.5.2	Control tests by independent laboratory	Prov sum	1	100,000.00	100,000.00
75		Overheads, charges and profit on item 74	%	100,000.00	10%	10,000.00
76	8.5.2	Provision of photographic records	Prov sum	1		
77		Overheads, charges and profit on item 76	%	-		
78	8.5.2	CLO and CSO	Prov sum	1	900,000.00	900,000.00
79		Overheads, charges and profit on item 78	%	900,000.00	10%	90,000.00
80	8.5.2	Temporary protection of services	Prov sum	1	50,000.00	50,000.00
81		Overheads, charges and profit on item 80	%	50,000.00	10%	5,000.00
82	8.5.2	Reinstatement of asphalt by JRA	Prov sum	1	689,183.04	689,183.04
83		Overheads, charges and profit on item 82	%	689,183.04	10%	68,918.30
84	8.5.2	Supply or hire of specialist equipment	Prov sum	1	2,000,000.00	2,000,000.00
85		Overheads, charges and profit on item 84	%	2,000,000.00	10%	200,000.00
86	8.5.2	Training of labour	Prov sum	1		-
87		Overheads, charges and profit on item 86	%	-	10%	-
88	PSAB 4.1	Telephone and data charges for Engineers Representative	Prov sum	1	27,000.00	27,000.00
89	8.5.2	Overheads, charges and profit on item 88	%	27,000.00	10%	2,700.00
90	PSSC 3	Fixed-Charge items for the sub-contractors Contractual Requirements	Prov sum			
91	PSSC 4	Overhead, charges and profit for the Main Contractor to provide for fixed-charge items for the sub-contractors Contractual Requirements	%	-		
92	PSSC 5	Time Related items for the sub-contractors Contractual Requirements	Prov sum			
93	PSSC 6	Overhead, charges and profit for the Main Contractor to provide for time related items for the sub-contractors Contractual Requirements	%	-		

ITEM NO.	PAY REF.	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
94	PSSC 9	Provide administrative, planning and on the job training to SMME's	Prov sum	1.00		-
95	PSSC 10	Overhead, charges and profit on SMME training	%	-	10%	-
	8.7	**Daywork (Provisional)**				
96		Allowance for labour	Prov sum	1		
97		Percentage adjustment to item 98	%	-		
98		Alowance for material	Prov sum	1		
99		Percentage adjustment to item 100	%	-		
100		Allowance for plant	Prov sum	1		
101		Percentage adjustment to item 102	%	-		
	8.8	**Temporary Works**				
102	8.8.2	Accommodation of traffic	Sum	1		
		Location and protection of existing services				
103	8.8.4	Electrical and other cables	Sum	1		
104	8.8.5	Survey and setting out of works	Sum	1		
105	8.8.6	Special water control	Sum	1		
106	8.8.7	Dealing with other service authorities, application for wayleaves, etc.	Sum	1		
	8.9	**Compliance with OHS Act Regulations (including the Construction Regulations, 2014)**				
107		Provisional sum for items not covered by the list below (items 108 to 110)	Sum	1		
		COVID-19 Healthy and Safe Work Practices				
108		a) Symptom screening of all working on site twice a day	Sum	1		
109		b) Symptom screening of all site visitors upon arrival	Sum	1		
109		c) Hand washing / sanitizing stations on site	Sum	1		
110		d) Physical barriers between work stations (offices)	Sum	1		
		Training Courses				
111		a) Life skills training	hrs			
112		b) Project specific technical skills training	hrs			
113		c) Train the SHE representative x2	hrs			
114		d) Induct training of all workers (ongoing)	hrs			
115		e) Community training: Locals (Foreman/ Brick layers)	hrs			
116		f) Training as per site specific requirements	hrs			
117		g) Training venue	Sum			
118		h) Remuneration of workers undergoing skills training	hrs			
119		i) Contractor's handling costs, profit and all other charges in respect of items 120 to 127 above	%			
120		**SHE Representative (Safety Officer)**	Sum	1		
		Fire Fighting Equipment:				
121		a) Provide 9kg fire fighting equipment suitable for the whole construction site	No			
122		b) Obtain inspection certificates of fire fighting equipment (Every 12 months)	Sum	1		
		First Aid:				
123		a) Provide a replenish basic First Aid Kit	Sum	1		
124		b) Provide a stretcher / fire blanket etc	Sum	1		

ITEM NO.	PAY REF.	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
125		c) Personal Protective Clothing (PPE)	Sum	1		
126		**Contractor's personnel medicals (CR 7(8))**	Sum	1		
		Identification Cards:				
127		Provide identification cards to employees	Sum	1		
		Safety Office Equipment:				
128		Safety posters programme	Prov Sum	1		
129		Danger signage / site office (Safety notices: Contractors' safety board)	Prov Sum	1		
130	8.10	**Quality Assurance and Management Plan**	Sum	1		
131	8.11	**Compliance with the Environmental Management Plan**	Sum	1		
		Total - Carried to Summary				**R -**

ITEM NO.	PAY REF.	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
		SUMMARY TOTAL PRELIMINARIES AND GENERAL				
		PRELIMINARIES (FIXED CHARGE ITEMS)				R -
		PRELIMINARIES (TIME RELATED ITEMS)				R -
		TOTAL SECTION				**R -**

ITEM NO.	PAY REF.	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
		SECTION NO. 1 - PRELIMINARIES AND GENERAL				
		PRELIMINARIES AND GENERAL - SMME				
		Note: It is the Tenderer's responsibility to price the Preliminaries and General in accordance with all the information provided in the enquiry document and complaince to all the OHS Acts, Environmental and Quality plans and Construction regulations				
		BILL NO. 1.1 - SMME				
1	PSSC 1	Value of Subcontracted works	Prov sum	1	18,427,939.37	R 18,427,939.37
2	PSSC 2	Management fee for the Main Contractor to oversee sub-contracted works. (the main contractor will retain liability and responsibility for the management, scheduling, and quality)	%	18,427,939.37	10%	1,842,793.94
		Total - Carried to Summary				**R 20,270,733.31**

ITEM NO.	PAY REF.	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
		SUMMARY TOTAL PRELIMINARIES AND GENERAL (SMME)				
		PRELIMINARIES (TIME RELATED ITEMS)				R 20,270,733.31
		TOTAL SECTION				**R 20,270,733.31**

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
		SECTION 2 : EXTERNAL WORKS				
		SECTION 2.1 : BULK EARTHWORKS				
	SANS 1200 C	**BILL NO.1 :SITE CLEARANCE**				
		Reference Drawing.: Reservoir and tower				
	PSC 8.2.1	**Clear and grub:**				
1		Total Site Areas	m²	13600		
	8.2.2	**Remove and grub large trees and tree stumps of girth:**				
2		Over 2,0 m and up to and including 3,0 m	No.	3		
		Total - Carried to Summary				**R -**

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
	SANS 1200 D	**BILL NO.2 : EARTHWORKS**				
	PSD 8.3.2	**Bulk excavation:**				
		Excavate in all materials and use for embankment or backfill as ordered from:				
1		Necessary excavations	m³	21180		
	PSD 8.3.3	**Extra over items 1 above for :**				
2		Hard rock excavation	m³	5360		
3		Extra over item 1 for hand excavation	m³	268		
	8.3.4	**Importing of materials:**				
4		Extra over items 1 for importation of materials from commercial sources	m³	7300		
5	8.3.7	Additional lateral support between Reservoir and School, if ordered	Sum	1		
6		Additional lateral support between Reservoir and Pump Station, if ordered	Sum	1		
7		Additional lateral support between Reservoir and Tower, if ordered	Sum	1		
8	8.3.9	Extra over items 1 and 2 for backfill or for fill material against structures	m³	21180		
9		Extra over items 1, 2 and 3 for temporary stockpiling	m³	26808		
10	PSD 8.3.15	Extra over items 1 2 and 3 for disposing of spoil material on a site provided by the Contractor	m³	28866		
		Total - Carried to Summary				**R -**

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
	SANS 1200 HA	**BILL NO.3 STRUCTURAL STEELWORK (SUNDRY ITEMS)**				
	8.3.2	**Handrails:**				
		Handrail assembly complete:				
1		Horizontal	m	50		
2		Sloping (measured on slope)	m	10		
3		Shaped Ends	No.	8		
		Total - Carried to Summary				**R -**

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
	PZ	**BILL NO.4 : PATENTED EARTH RETAINING SYSTEMS**				
	PZ.01	**Patented earth retaining systems:**				
		Loffelstein precast concrete blocks of type:				
1		L300, at 35°	m²	80		
		Total - Carried to Summary				**R -**

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
	SANS 2001 CC1	**BILL NO. 5 : CONCRETE (STRUCTURAL)**				
	SD8.6	**Manufacture (or supply) and erect precast concrete units:**				
1		Concrete access steps	No	1		
		Total - Carried to Summary				**R -**

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
		SUMMARY TOTAL BULK EARTHWORKS				
		SITE CLEARANCE				-
		EARTHWORKS				-
		STRUCTURAL STEELWORK (SUNDRY ITEMS)				-
		PATENTED EARTH RETAINING SYSTEMS				-
		CONCRETE (STRUCTURAL)				-
		TOTAL SECTION				**R** **-**

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
		SECTION 2 : EXTERNAL WORKS				
		SECTION 2.2 : ROADS				
	SANS 1200 D	**BILL NO.1 : EARTHWORKS**				
		Reference Drawing.: 113503-0000-DRG-1300				
	PSD 8.3.2	**Bulk excavation:**				
		Excavate in all materials and use for embankment or backfill as ordered from:				
1		Necessary excavations	m³	1402		
	PSD 8.3.2	Extra over items 1 to 2 above for :				
2		Hard rock excavation	m³	0		
3		Extra over item 140.02 for hand excavation	m³	10		
4	8.3.9	Extra over items 1 for backfill or for fill material against structures	m³	13		
5	PSD 8.3.15	Extra over items 1 for disposing of spoil material on a site provided by the Contractor	m³	3272		
		Total - Carried to Summary				**R -**

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
	SANS 1200 DM	**BILL NO. 2 : EARTHWORKS (ROADS, SUBGRADE)**				
	PSDM 8.3.3	**Treatment of roadbed:**				
		Roadbed preparation and compaction of material to:				
1		Scarify insitu material 150mm deep and recompact to 90% modified AASHTO maximum density	m³	1542		-
2	PSDM 8.3.5	C4 layer compacted to 95% of modified AASHTO maximum density	m³	1542		-
3		G7 compacted to 93% of modified AASHTO maximum density	m³	1542		-
		Total - Carried to Summary				**R** **-**

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
	SANS 2001 CC1	**BILL NO.3 : PRECAST CONCRETE**				
	SD8.6	**Provide structral precast unit**				
1		300mm x 300mm Anchor Beams	m	35		
		Total - Carried to Summary				**R -**

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
	SANS 1200 ME	**BILL NO.4 : SUBBASE**				
	PSME 8.3.5	**Process subbase material by one of the following processes, as relevant, and use in the subbase:**				
1		Stabilization	m³	1542		-
	PSME 8.3.8	**Stabilizing agent:**				
2		Portland cement	t	6		-
	PSME 8.3.11	**Treatment of subbase with:**				
3		Weed killer	m²	9348		-
4		Insecticide	m²	9348		-
		Total - Carried to Summary				**R** **-**

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
	SANS 1200 MJ	**BILL NO.5 : SEGMENTED PAVING**				
	PSMJ 8.2.1	**Provision of edge restraints:**				
	PSMJ 8.2.2	Construction of paving complete:				
1		Type S-A blocks, 80 mm thick, grey interlocking pavers	m²	9348		-
	PSMJ 8.2.3	Cutting blocks to fit edge restraints:				
2		Straight cutting	m	506		-
3		Circular cutting	m	84		-
4	PSMJ 8.2.4	Rolling to locked-up condition as specified in Clause 5.6.2	m²	9348		-
		Total - Carried to Summary				**R -**

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
	SANS 1200 MM	**BILL NO.6 : ANCILLARY ROADWORKS**				
		ROAD MARKINGS				
	8.4.1	**Proprietary brand road marking material applied at nominal rate of 0,42 litre/m²:**				
		White lines (broken or unbroken):				
1		100 mm wide	m	300		-
	8.4.1	**Non-reflectorized paint applied at nominal rate of 0,42 litre/m²:**				
		White lines (broken or unbroken):				
2		100 mm wide	m	300		-
		Total - Carried to Summary				**R -**

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
	SANS 1200 MK	**BILL NO.7 : KERBING AND CHANNELLING**				
	PSMK 8.2.1	**Precast concrete kerbing:**				
1		Non mountable kerbs	m	650		-
2		Mountable Kerb	m	20		-
		Total - Carried to Summary				**R -**

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
		SUMMARY TOTAL ROADS				
		EARTHWORKS				-
		EARTHWORKS (ROADS,SUBGRADE)				-
		PRECAST ONCRETE (STRUCTURAL)				-
		SUBBASE				-
		SEGMENTED PAVING				-
		ANCILLARY ROADWORKS				-
		KERBING AND CHANNELING				-
		TOTAL SECTION				**R -**

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
		SECTION 2 : EXTERNAL WORKS				
		SECTION 2.3 : STORMWATER				
	SANS 1200 D	**BILL NO.1 : EARTHWORKS**				
	PSD 8.3.2	**Bulk excavation:**				
		Excavate in all materials for stormwater attenuation pond and use for embankment or backfill as ordered from:				
1		Necessary excavations	m³	658		
2		Excavate in all materials for stormwater attenuation pond and dispose	m³	1136		
		Extra over items 1 and 2 for:				
3		Intermediate excavation	m³	807		
4		Hard rock excavation	m³	987		
	PSD 8.3.3	**Restricted excavation:**				
		Excavate for stormwater attenuation pond spillway in all materials, and use for backfill or embankment, or dispose:				
5		Depth up to 1,0 m	m³	10		
6		Depth over 1,0 m and up to 2,0 m	m³	10		
7		Depth over 2,0 m and up to 3,0 m	m³	14		
	PSD 8.3.3	Extra over items 5, 6, and 7 for:				
8		Intermediate excavation	m³	34		
9		Extra over items 5, 6, and 7 for hand excavation	m³	3		
	PSD 8.3.6	**Overhaul:**				
10		Limited overhaul	m³			
11		Long overhaul	m³-km			
	PSD 8.3.8	**Existing services:**				
		Hand excavation for locating and exposing existing services:				
12		In all other areas for stormwater attenuation pond and spillway	m³			
	8.3.9	**Extra over items 1, 2, 5, 6, and 7 for backfill or for fill material against**				
13		Attenuation pond and compact to 93% MOD AASHTO density	m³	182		
14		Attenuation pond cement stabilised and compact to 95% MOD AASHTO density	m³	182		
15		Stormwater attenuation pond spillway and compact to 95% MOD AASHTO density	m³	5		
	PSD 8.3.10	**Topsoiling:**				
		Use topsoil material for:				
16		Preparation layer for grassing at attenuation pond	m³	182		
	8.3.11	**Grassing or other vegetation cover:**				
17		Planting of grass cuttings on attenuation pond surface	m²	1213		
18	PSD 8.3.14	Extra over items 1, 5, 6, and 7 for temporary stockpiling	m³	692		
19	PSD 8.3.15	Extra over item 2 for disposing of spoil material on a site provided by the Contractor	m³	1136		
		Total - Carried to Summary				**R -**

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
	SANS 1200 DB	**BILL NO.2 : EARTHWORKS (PIPE TRENCHES)**				
	PSDB 8.3.2	**Excavate in all materials for trenches, backfill, compact and dispose of surplus material:**				
		Pipes over 400 mm dia up to 675 mm dia for depths:				
1		Up to 1,0 m	m	155		
2		Over 1,0 m up to 2,0 m	m	298		
3		Over 2,0 m up to 3,0 m	m	7		
4	PSDB 8.3.2	**Excavate in all materials for stormwater junction boxes and the like, irrespective of depth, and backfill around structures**	m³	114		
	PSDB 8.3.2	**Excavate open drains in all materials**				
5		Concrete stormwater channel	m³	194		
	PSDB 8.3.2	Extra over items 4 and 5 for excavating in:				
6		Intermediate material	m³	194		
	PSDB 8.3.3	**Excavation ancillaries:**				
		Make up deficiency in backfill material:				
7		From other necessary excavations on site for fill material against concrete stormwater channels and compact to 95% MOD	m³	58		
		Overhaul:				
8		Limited overhaul	m³			
9		Long overhaul	m³-km			
	PSD 8.3.8	**Existing services:**				
		Hand excavation for locating and exposing existing services:				
10		In all other areas for stormwater channel 5	m³			
		Total - Carried to Summary				**R -**

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
	SANS 1200 DK	**BILL NO.3 : GABIONS AND PITCHING**				
	PSDK 8.2.5	**Pitching:**				
		Grouted pitching:				
1		Light pitching at attenuation pond headwalls	m²	40		
		Total - Carried to Summary				**R -**

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
	SANS 1200 DM	**BILL NO.4 : EARTHWORKS (ROADS, SUBGRADE)**				
		Preparation of site:				
1	8.3.2	Removal of topsoil to a depth of 150 mm, at attenuation pond and the stockpiling and maintenance thereof	m³	184		
	PSDM 8.3.3	**Treatment of roadbed (stormwater channel layerworks):**				
		Layerworks preparation and compaction of material in 150mm layers to:				
2		Minimum of 90% MOD AASHTO maximum density for stone pitching	m³	10		
3		Minimum of 93% MOD AASHTO maximum density for attenuation pond	m³	184		
4		Minimum of 95% MOD AASHTO maximum density for rectangular concrete channels	m³	58		
5	8.3.11	Extra over item 1 for temporary stockpiling of material	m³	184		
		Overhaul:				
6		Limited overhaul	m³			
7		Long overhaul	m³-km			
		Total - Carried to Summary				**R -**

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
	SANS 2001 CC1	**BILL NO.5 : CONCRETE (STRUCTURAL)**				
		SCHEDULED FORMWORK ITEMS				
	SD8.2.1	**Rough:**				
		Sloping formwork to:				
1		Attenuation pond spillway	m²	99		
2		Concrete stormwater channels	m²	545		
		SCHEDULED REINFORCEMENT ITEMS				
	SD8.3.2	**High-tensile welded mesh in the following:**				
3		Stormwater channel mesh ref. 395	m²	389		
4		Attenuation pond spillway mesh ref. 395	m²	132		
		SCHEDULED CONCRETE ITEMS				
	SD8.4.3	**Strength concrete:**				
		Class 25 MPa/ 19 mm concrete in:				
5		Stormwater channel	m³	58		
6		Attenuation pond spillway	m³	12		
	SD8.4.4	**Unformed surface finishes:**				
		Wood-floated finishes to:				
7		Stormwater channels	m²	389		
8		Attenuation pond spillway	m²	132		
	SD8.5	**Joints:**				
		5mm thick 'Jointex' or similar approved joint former with 10mm tear-off strip, and sealing of joints with 10x10 'Flexolastic T' hot poured primerless tar based joint sealant or similar approved:				
9		Stormwater channel	m²	19		
10		Attenuation pond spillway	m²	4		
	SD8.4.8	**Screeds:**				
		Channel floor screeds (1:3) with falls including V-joints to form panels and a smooth steel-trowelled finish/power float finish to top:				
11		15 Mpa stormwater rectangular channel	m²	389		
		Total - Carried to Summary				**R -**

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
	SANS 1200 HA	**BILL NO.6 : STRUCTURAL STEELWORK (SUNDRY ITEMS)**				
	8.3.4	**Flooring, complete and installed with frames:**				
1		Galvanised steel rectagrid RS40 with 50 x 4.5mm bearers	m²	68		
		Total - Carried to Summary				**R -**

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
	SANS 1200 LB	**BILL NO.7 : BEDDING (PIPES)**				
	8.2.2	**Supply of bedding by importation:**				
		From commercial sources:				
1		Selected granular material	m³	216		
2		Selected fill material	m³	275		
		Encasing of pipes in concrete:				
3		Class 25 MPa/19 mm	m³	62		
		Total - Carried to Summary				**R -**

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
	SANS 1200 LE	**BILL NO.8 : STORMWATER DRAINAGE**				
	8.2.1	**Supply and lay concrete pipe culverts on class B bedding:**				
		Type SC 75D-load pipes with Spigot and Socket joints				
1		450mm dia	m	102		
2		600mm dia	m	189		
3		675mm dia	m	10		
		Type SC 100D-load pipes with Spigot and Socket joints				
4		450mm dia	m	120		
5		600mm dia	m	18		
6		675mm dia	m	22		
	8.2.8	**Supply and install manholes and the like:**				
		Brickwork manholes as shown on drawing no. 113503-0000-DRG-WD-1461				
7		Up to 1.0m depth	number	0		
8		1.0m to 1.5m depth	number	8		
9		1.5m to 2.0m depth	number	3		
10		2.0m to 2.5m depth	number	2		
11		2.5m to 3.0m depth	number	0		
12		3.0m to 3.5m depth	number	2		
		Grid inlets as shown on drawing no. 113503-0000-DRG-WD-1462				
13		Up to 1.0m depth	number	1		
14		1.0m to 1.5m depth	number	9		
15		1.5m to 2.0m depth	number	1		
16		2.0m to 2.5m depth	number	11		
		Inlet or Outlet structure (headwalls) as shown on drawing no. 113503-0000-DRG-WD-1463				
17		Up to 1.0m depth	number	3		
		Supply and install manholes and the like:				
		Double grid inlets:				
18		As shown on drawing no 113503-0000-DRG-WD-1462 standard depth 1m	number	1		
		Junction boxes:				
19		As shown on drawing no 113503-0000-DRG-WD-1461 standard depth 2m	number	5		
		Extra over or under items 17, 18 and 19 for variation in depth of manholes from the standard depth designated for purposes of tendering:				
		Double grid inlets:				
20		As shown on drawing no 113503-0000-DRG-WD-1462 standard depth 1m	m			
		Junction boxes:				
21		As shown on drawing no 113503-0000-DRG-WD-1461 standard depth 2m	m			
	8.2.10	**Accessories:**				
		Manhole covers including frames:				
22		SANS 558 type 2A	number	15		

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
		Grid inlet cover frames:				
23		600mm x 600mm	number	22		
24		520mm x 790mm	number	1		
25		Step irons	number	240		
	PSLE 8.2.21	**Break into existing stormwater kerb inlet, install new pipe and build new kerb inlet**	sum	1		
		Total - Carried to Summary				**R -**

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
		SUMMARY TOTAL FOR STORMWATER				
		EARTHWORKS				-
		EARTHWORKS (PIPE TRENCHES)				-
		GABIONS AND PITCHING				-
		EARTHWORKS (ROADS, SUBGRADE)				-
		CONCRETE (STRUCTURAL)				-
		STRUCTURAL STEELWORK (SUNDRY ITEMS)				-
		BEDDING (PIPES)				-
		STORMWATER DRAINAGE				-
		TOTAL SECTION				**R -**

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
		SECTION 2 : EXTERNAL WORKS				
	SANS 1200 C	**SECTION 2.4 : SEWER & POTABLE**				
		BILL NO.1 : SITE CLEARANCE				
	8.2.8	**Demolish and remove structures/buildings:**				
1		Demolish and remove existing sewer pipe and manhole	sum	1		
		Total - Carried to Summary				**R -**

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
	SANS 1200 DB	**BILL NO.2 : EARTHWORKS (PIPE TRENCHES)**				
		TRENCHES FOR WATER PIPES				
	PSDB 8.3.2	Excavate in all materials for trenches, backfill, compact and dispose of surplus material:				
		Pipes up to 125 mm dia for depths:				
1		Up to 1,0 m	m	124		
		TRENCHES FOR SEWER PIPES				
	PSDB 8.3.2	Excavate in all materials for trenches, backfill, compact and dispose of surplus material:				
		Pipes up to 125 mm dia for depths:				
2		Up to 1,0 m	m	70		
		Total - Carried to Summary				**R -**

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
	SANS 1200 L	**BILL NO.3 : MEDIUM-PRESSURE PIPELINES**				
	8.2.1	**Supply, lay and bed on flexible bedding, complete with couplings:**				
		HDPE PE 100 PN 12.5 SDR 13.6 pipes:				
1		25 mm dia	m	124		
	8.2.2	**Extra over items 1 for supplying, laying and bedding of HDPE specials complete with couplings:**				
		90° elbows:				
2		25mm dia	No.	3		
		45° elbows:				
3		25mm dia	No.	4		
		Tees:				
4		25 mm dia x 100 mm dia	No.	1		
	PSL 8.2.11	**Anchor/thrust blocks and pedestals:**				
		Concrete:				
5		Class 30MPa/19 mm	m^3	1		
		Total - Carried to Summary				**R -**

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
	SANS 1200 LB	**BILL NO.4 : BEDDING (PIPES)**				
		BEDDING FOR WATER PIPES				
	PSLB 8.2.2	Supply only of bedding by importation:				
		From commercial sources:				
1		Selected granular material	m³	22		
2		Selected fill material	m³	7		
	8.2.1	**BEDDING FOR SEWER PIPES**				
	PSLB 8.2.2	Supply only of bedding by importation:				
		From commercial sources:				
3		Selected granular material	m³	17		
4		Selected fill material	m³	11		
		Total - Carried to Summary				**R -**

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
	SANS 1200 LD	**BILL NO.5 : SEWERS**				
		Reference Drawing: 113503-0000-DRG-WS-1500				
	8.2.1	**Supply, lay, joint, bed on a flexible bedding and test pipeline:**				
		uPVC heavy duty class 34 to SANS 791 pipes:				
1		110mm dia	m	70		
	8.2.3	**Precast concrete manhole:**				
		With cover and frame:				
2		Depth 1 m up to 1.5 m	No.	2		
3		Depth 1.5 m up to 2.0 m	No.	0		
4		Depth 2.0 m up to 2.5 m	No.	1		
	8.2.5	**Cleaning eyes as shown on drawing 113503-0000-DRG-WS-1560 for:**				
5		Erf connections	No.	1		
	8.2.6	**Erf connections:**				
		uPVC pipes complete				
6		110mm dia	No.	1		
	8.2.10	**Accessories:**				
		Manhole covers including frames:				
7		SANS 448 Type 4	No.	3		
8	PSLD 8.2.11	Connection to existing sewer	Sum	1		
9	PSLD 8.2.13	Breaking into existing sewer and building a new manhole	No.	1		
		Total - Carried to Summary				**R -**

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
	SANS 1200 LF	**BILL NO.6 : ERF CONNECTIONS (WATER)**				
		Reference Drawing: 113503-0000-DRG-WW-1600				
1	8.2.1	Provide erf connections complete:	No.	1		
		Total - Carried to Summary				**R -**

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
		SUMMARY TOTAL SEWER AND POTABLE WATER				
		SITE CLEARANCE				-
		EARTHWORKS (PIPE TRENCHES)				-
		MEDIUM-PRESSURE PIPELINES				-
		BEDDING (PIPES)				-
		SEWERS				-
		ERF CONNECTIONS (WATER)				-
		TOTAL SECTION				**R -**

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
		SECTION 2 : EXTERNAL WORKS				
		SECTION 2.5 : SCOUR PIPELINE				
	SANS 1200 C	**BILL NO .1 : SITE CLEARANCE**				
		Clear and grub:				
1	PSC 8.2.1	Strips, 3m wide	m	46		
2	8.2.5	Take down existing fences	m	0		
		Total - Carried to Summary				**R -**

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
	SANS 1200 DB	**BILL NO.2 : EARTHWORK (PIPES TRENCHES)**				
		Reference Drawing: 113503-DRG-WD-1761 TRENCHES FOR WATER PIPES				
	PSDB 8.3.2	**Excavate in all materials for trenches, backfill, compact and dispose of surplus material:**				
		Pipes over 400mm dia up to 700mm dia for depths				
1		Over 2,0 m up to 3,0 m	m	0		
2		Over 3,0 m up to 4,0 m	m	33		
3		Over 4,0 m	m	10		
	PSDB 8.3.2	**Extra over item 142.01 above for:**				
4		Intermediate excavation	m³	32		
5		Hard rock excavation	m³	11		
		Hand excavation where ordered by the Engineer:				
6		Soft material	m³	20		
7		Intermediate material	m³	20		
8	PSDB 8.3.2	Hard material	m³	2		
		Total - Carried to Summary				**R -**

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
	SANS 1200 L	**BILL NO.3 : MEDIUM-PRESSURE PIPELINES**				
	8.2.1	**Reference Drawing: 113503-DRG-WD-1700 Supply, lay and bed on Class B bedding, complete with couplings:**				
	SANS 1200 L	Grade X42 to API 5L welded steel pipes with Single Coat Solvent Free Liquid Epoxy lining and Polyisobutene Visco-elastic coating (Stopaq) or similar approved				
1		700 mm dia x 8 mm thickness	m	22		
		Total - Carried to Summary				**R -**

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
	SANS 1200 LB	**BILL NO.4 : BEDDING (PIPES)**				
		Reference Drawing: 113503-DRG-WD-1761 BEDDING FOR WATER PIPES				
	8.2.2	**Supply of bedding by importation for steel pipe:**				
		From commercial sources:				
1		Selected granular material	m³	14		
2		Selected fill material	m³	17		
		Reference Drawing: 113503-DRG-WD-1463 BEDDING FOR STORMWATER PIPES				
	8.2.2	**Supply of bedding by importation for concrete pipe:**				
		From commercial sources:				
3		Selected granular material	m³	10		
4		Selected fill material	m³	15		
		Total - Carried to Summary				**R -**

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
	SANS 1200 LE	**BILL NO.6 : STORMWATER DRAINAGE**				
	8.2.1	**Supply and lay concrete pipe culverts on class B bedding:**				
1		Type SC 100D-load pipes with Spigot and Socket joints				
		450mm dia	m	24		
2	PSLE 8.2.21	**Break into existing stormwater manhole, install new pipe and build new manhole**	sum	1		
		Total - Carried to Summary				**R -**

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
		SUMMARY TOTAL SCOUR PIPELINE				
		SITE CLEARANCE				-
		EARTHWORKS (PIPE TRENCHES)				-
		MEDIUM PRESSURE PIPES				-
		BEDDING (PIPES)				-
		STORMWATER DRAINAGE				-
		TOTAL SECTION				**R -**

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
		SECTION 2 : EXTERNAL WORKS				
		SECTION 2.6 : COLLECTION CHAMBER				
		BILL NO 1 : EARTHWORKS				
		Reference Drawing:113503-DRG-WD-1760				
	PSD 8.3.3	**Restricted excavation:**				
		Excavate for chambers, in all materials, and use for backfill or embankment, or dispose:				
1		Necessary excavations	m³	77		
	8.3.5	**Extra excavation in all materials to provide working space around structure**				
2		Limited overhaul	m²	21		
		Total - Carried to Summary				**R -**

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
	SANS 2001 CC	**BILL NO.2 : CONCRETE (STRUCTURAL)**				
		SCHEDULED FORMWORK ITEMS				
	SD8.2.1	**Rough:**				
		Vertical formwork to:				
1		Outer Walls	m²	75		
	SD8.2.2	**Smooth:**				
2		Inner Walls	m²	53		
	SD8.2.5	**Narrow widths (up to 300 mm wide):**				
		Different widths in the following ranges:				
3		Over 50 mm and up to 100 mm	m	15		
4		Over 200 mm and up to 300 mm to:	m	15		
	SD8.2.6	**Box out holes/form voids:**				
		Small circular, of diameter up to and including 0,45 m, and in the following depth ranges:				
5		0 m up to and including 0,5 m	No	1		
		Large, circular, of diameter over 0,35 m up to and including 0,7 m and in the following depth ranges:				
6		0 m up to and including 0,5 m	No	1		
	SD8.3.1	**SCHEDULED REINFORCEMENT ITEMS**				
		High-tensile steel bars in the following:				
7		For scour and overflow collection chamber	t	2		
		SCHEDULED CONCRETE ITEMS				
	SD8.4.2	**Blinding layer:**				
		Class 15 MPa/19 mm concrete of:				
8		75 mm thickness	m²	15		
	SD8.4.3	**Strength concrete: (to drawings and specification)**				
		Class 30 MPa/ 19mm concrete in:				
9		Scour and overflow collection chamber	m³	29		
	SD8.4.4	**Unformed surface finishes:**				
		Wood-floated finishes to:				
10		Footing	m²	4		
		Steel-floated finishes to:				
11		Floor Slab and walls	m²	15		
		Total - Carried to Summary				**R -**

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
	SANS 1200 HA	**BILL NO.3 : STRUCTURAL STEELWORK (SUNDRY ITEMS)**				
	8.3.3	**Ladders, complete and installed**				
1		Access ladders, complete with corrosion protection, as per drawing: 113503-0000-DRG-WD-1760	No	1		
	8.3.4	**Flooring, complete and installed with frames:**				
2		Frame, complete with corrosion protection	No.	1		
3		Grating (rectagrid), complete with corrosion protection	m²	8		
	8.3.5	**Erection or installation only:**				
		Flooring, complete and installed with frames:				
4		Ladders	Sum	1		
	8.3.6	**Corrosion protection:**				
5		Ladders	Sum	1		
		Total - Carried to Summary				**R -**

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
	ZUT 7001	**BILL NO.4 : MANUFACTURING OF STEEL SPECIALS**				
	8.2.1	**Supply of specials: (Hot Dipped Galvanized to ZUT 0003 System 7)**				
1		Spool piece DN 700 x 8 mm Grade X42 to API 5L; flanged both ends SANS 1123 table 1600/3 (rf) with puddle flange, pipe special to be manufacture	No	1		
2		Short radius bend; 90 degree DN 700 x 8 mm Grade X42 to API 5L; flanged SANS 1123 table 1600/3 (rf); refer to typical fitting details	No	1		
		Total - Carried to Summary				**R -**

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
	ZUT 7003	**BILL NO.5 : LAYING OF STEEL PIPES AND SPECIALS**				
	8.2.1	**Laying of steel pipes and specials: (Hot Dipped Galvanized to ZUT 0003 System 7)**				
1		Spool piece DN 700 x 8 mm Grade X42 to API 5L; flanged both ends SANS 1123 table 1600/3 (rf) with puddle flange, pipe special to be manufacture	No	1		
2		Short radius bend; 90 degree DN 700 x 8 mm Grade X42 to API 5L; flanged SANS 1123 table 1600/3 (rf); refer to typical fitting details	No	1		
		Total - Carried to Summary				**R -**

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
		SUMMARY TOTAL SCOUR COLLECTION CHAMBER				
		EARTHWORKS				-
		CONCRETE (STRUCTURAL)				-
		STRUCTURAL STEELWORK (SUNDRY ITEMS)				-
		MANUFACTURING OF STEEL SPECIALS				-
		LAYING OF STEEL PIPES AND SPECIALS				-
		TOTAL SECTION				**R -**

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
		SECTION 2 : EXTERNAL WORKS				
		SECTION 2.7 : BULK PIPELINE PHASE 1				
	SANS 1200C	**BILL NO 1 : SITE CLEARANCE**				
	PSC 8.2.1	**Clear and grub:**				
1		Areas (chambers, structures, etc)	m²	48		
2		Strips, 1,5 m wide (water) Paving/Asphalt	m	880		
	8.2.2	**Remove and grub large trees and tree stumps of girth:**				
3		Over 1,0 m and up to and including 2,0 m	No	15		
4		Over 2,0 m and up to and including 3,0m	No	15		
	8.2.4	Reclear surfaces (only on instructions from the Engineer):				
5	8.2.10	Remove topsoil to nominal depth of 150 mm and stockpile	m³	396		
6	PSC 8.2.14	Final finishing and cleaning up of the site of the Works	Sum	1		
		Total - Carried to Summary				**R -**

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
	SANS 1200D	**BILL NO. 2 : EARTHWORKS**				
	PSD 8.3.3	**Restricted excavation:**				
		Excavate for chambers, restricted foundations, etc in all materials, and use for backfill or embankment, or dispose:				
1		Depth over 2,0 m and up to 4,0 m	m³	200		
		Extra over item 1 above for:				
2		Intermediate excavation	m³	50		
3		Hard rock excavation	m³	20		
4		Extra over item 1 for hand excavation	m³	20		
5	8.3.5	Extra excavation in all materials to provide working space around structure	m²	110		
	PSD 8.3.8	**Existing services:**				
6		Supply of specialist equipment for detection	sum	1		
7		The use of or hire of specialist equipment for detection	sum	1		
		Hand excavation for locating and exposing existing services:				
8		In roadways	m³	50		
9		In all other areas	m³	50		
		Dealing with services that are risk beacause of the construction of earthworks				
		Temporary protection of services:				
10		Telecommunication cables	sum	1		
11		Electrical cables	sum	1		
12		Egoli gas pipe	sum	1		
13		Sasol pipe	sum	1		
14		Stormwater pipe	sum	1		
15		Water pipe	sum	1		
16		Sewer pipe	sum	1		
17	PSD 8.3.10	Topsoiling	m³	396		
18	PSD 8.3.14	Extra over items 1 for temporary stockpiling	m³	100		
SANS 1200DM		**Treatment of roadbed:**				
	PSDM 8.3.3	Roadbed preparation and compaction of material to (under structure floor slabs):				
19		Minimum of 93% of modified AASHTO maximum density	m³	29		
		Total - Carried to Summary				**R -**

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
	SANS 1200 DB	**BILL NO .3 : EARTHWORKS (PIPE TRENCHES)**				
		TRENCHES FOR WATER PIPES				
	PSDB 8.3.2	**Excavate in all materials for trenches, backfill, compact and dispose of surplus material:**				
		Pipes over 600 mm dia up to 850 mm dia for depths:				
1		Over 1,0 m up to 2,0 m	m	110		
2		Over 2,0 m up to 3,0 m	m	759		
3		Over 3,0 m up to 4,0 m	m	7		
4		Over 4,0 m	m	4		
	PSDB 8.3.2	**Extra over item 1, 2, 3 and 4 above for:**				
5		Intermediate excavation	m³	638		
6		Hard rock excavation	m³	41		
		Hand excavation where ordered by the Engineer:				
7		Soft material	m³	100		
8		Intermediate material	m³	100		
9		Hard material	m³	10		
10		Soilcrete backfill where directed by Soilcrete backfill where	m³	100		
11		Excavate and dispose of unsuitable material from trench bottom	m³	679		
	PSDB 8.3.3	**Excavation ancillaries:**				
		Compaction in road crossings:				
12		93% of modified AASHTO density	m³	150		
	8.3.4	**Particular items:**				
13		Shore trench opposite structure or service	m	880		
		Temporary Works: Control water inflow in pipeline:				
14		For new tie-in connection to existing Brixton reservoir pipework	Sum	1		
15		For new tie-in connection into reticulation	Sum			
	8.3.5	**Existing services that intersect or adjoin a pipe trench:**				
		Services that intersect a trench:				
16		Fence crossings (all types)	No	1		
17		City Power electrical cable crossings	No	12		
18		DFA cable crossings	No	2		
19		Telkom cable crossings	No	4		
20		Egoli Gas pipe crossings	No	3		
21		Sasol pipe crossings	No	1		
22		Stormwater pipe crossings	No	3		
23		Water pipe crossings	No	44		
24		Sewer pipe crossings	No	2		
25		3 m wide driveways containing block paving	No	18		
26		3 m wide driveways containing block paving	No	16		
		Services that adjoin a trench:				
27		Water pipes	m	260		
	8.3.6	**Finishing:**				
		Reinstate road surfaces complete with all courses:				
28		Asphalt of thickness 40 mm in roadway	m²	830		
29		Paving blocks/bricks	m²	464		
30	PSDB 8.3.7	Accommodation of traffic	Sum	1		
		Total - Carried to Summary				**R -**

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
	SANS 2001 CC	**BILL NO.5 : CONCRETE (STRUCTURAL)**				
		SCHEDULED FORMWORK ITEMS				
	SD8.2.1	**Rough:**				
		Vertical formwork to:				
1		Outsides of Sumps (floor edge and sides)	m²	5		
	SD8.2.2	**Smooth:**				
		Vertical formwork to:				
2		Insides of chamber walls	m²	100		
3		Outsides of chamber walls	m²	113		
4		Insides of Sumps	m²	5		
5		Outsides of plinths and thrust blocks	m²	50		
6		Outsides of floor slabs	m²	15		
		Horizontal formwork to:				
7		Soffits of roof slabs	m²	19		
	SD8.2.6	**Box out holes/form voids:**				
		Small circular, of diameter up to and including 0,35 m, and in the following depth ranges:				
8		0 m up to and including 0,5 m for 300 mm dia ventilator sleeve in roof slab)	No	3		
		Large, circular, of diameter over 0,35 m up to and including 0,7 m and in the following depth ranges:				
9		0 m up to and including 0,5 m (for 560 mm dia manhole cover and frame in roof slab)	No	3		
		SCHEDULED REINFORCEMENT ITEMS				
10		**Mild-steel and high-tensile steel bars (all diameters)**	t	9.4		
	SD8.4.2	**Blinding layer:**				
		Class 15 MPa/19 mm concrete of:				
11		75 mm thickness	m²	48		
	SD8.4.3	**Strength concrete:**				
		Class 20 MPa/19 mm concrete in:				
12		Thrust blocks	m³	20		
13		Plinths	m³	10		
	SD8.4.3	Class 30 MPa/19 mm concrete in:				
14		Floor slabs and Sumps	m³	23		
15		Walls	m³	59		
16		Roof slabs and upstands	m³	12		
	SD8.4.4	**Unformed surface finishes:**				
		Wood-floated finishes to:				
17		Floors and Sumps	m²	37		
		Steel-floated finishes to:				
18		Roof slabs and upstands	m²	61		
19		Plinths and thrust blocks including forming half round segments for pipes	m²	50		
	SD8.6	**Manufacture (or supply) and erect precast elements for units**				
		The following types and sizes, complete with box-outs for covers, etc, lifting handles or hooks, reinforcing (allow min 120 kg/m³), smooth off- shutter finish to all surfaces, drip grooves, etc:				
20		3.275 m x 1.370 m x 200 mm thick roof slab panel as shown on drawings provided in enquiry document.	No			
21		3.075 m x 1.600 m x 200 mm thick roof slab panel as shown on drawing 13503-1000-DRG-WW-1162.	No	1		

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
22		3.075 m x 1.365 m x 200 mm thick roof slab panel as shown on drawing 13503-1000-DRG-WW-1162.	No	5		
23		3.075 m x 1.125 m x 200 mm thick roof slab panel as shown on drawing 113503-1000-DRG-WW-1162.	No	2		
24		2,45 m x 2,45 m x 150 mm thick roof slab panel, tapered down to 125 mm thick around edges as shown on drawing 113503-1000-DRG-WW-1161.	No	1		
25		Square manhole shaft unit size 2,0 m x 2,0 m x 1,0 m high internally with 125 mm thick walls complete with toggle type joints as supplied by SPC or equal approved as shown on drawing 113503-1000-DRG-WW-1161.	No	3		
	SD8.8	**HD bolts and miscellaneous metal work:**				
		Steel strap pipe fixing bracket complete with malthoid packings as shown on drawing 113503-1000-DRG-WW-1164/1165				
26		200 mm dia pipe	No			
27		3 mm thick x 2.02 m long x 1,60 m girth L-shaped galvanized steel plate fixed with chemical anchors at maximum 500 mm centres in both directions to concrete walls and floors as shown on drawings provided in enquiry document	No			
28		Galvanized mild steel grid formed of 100 mm x 3 mm thick x 1 600 mm long flat section base plate with 20 mm dia x 150 mm long studs welded on at 150 mm centres and six times bolted to concrete with chemical anchors as shown in drawings provided in enquiry document	No			
	SD8.13	**Miscellaneous work other than metal work :**				
		Malthoid insulation between steel pipes and steel straps:				
29		3 mm thick x 50 mm wide strips	m	8		
30		3 mm thick x 60 mm wide strips pipes and concrete surfaces:	m	8		
		Malthoid insulation between steel pipes and concrete surfaces :				
31		3 mm thick x 200 mm wide strips	m	5		
32		3 mm thick x 250 mm wide strips	m	4		
33		HPDE insulation pads 1,6 mm thick between steel pipes and	m²	10		
34		Cement : sand floor screeds with falls including a smooth towelled finish to finish to top	m²	10		
	SD8.12	**Cast in of pipes with or without puddle flanges:**				
		Up to 300 mm nominal bore:				
35		Through 300 mm thick wall	No			
	SD8.12	**Over 300 mm up to 600 mm nominal bore:**				
36		Through 200 mm thick floor slab	No	2		
37		Through 400 mm thick wall	No	2		
	SANS 1200LE 8.2.10	**Accessories:**				
		Manhole covers including frames:				
38		700mm diameter manhole cover and frame with lockable cover to sans 558 Type 4 Mild Steel	No	3		
	SANS 1200LE 8.2.10	**Step irons:**				
39		Calcamite 4 Ever type step irons	No			
40		Air breather as shown on drawings in enquiry documents including casting into precast or in-situ concrete roof slabs	No	4		
	SANS 1200 DB PSDB 8.3.2	**Soilcrete:**				
41		Soilcrete backfill where directed by the Engineer	m³	50		
		Total - Carried to Summary				**R -**

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
	SANS 1200 HA	**BILL NO.6 : STRUCTURAL STEELWORK (SUNDRY**				
	8.3.3	**Ladders, complete and installed:** Galvanized mild steel ladders Type A bolted to concrete walls complete as shown on drawings 113503-1000-DRG-WW-1161/1162				
1		Air Valve Chambers	No	1		
2		Isolating Valve Chamber	No	1		
		Total - Carried to Summary				**R -**

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
	SANS 1200 L	**BILL NO.7 : MEDIUM-PRESSURE PIPELINES**				
		1. Fittings are regarded as special pipes and not measured as extra over items				
		2. Direction changes < 5° not measured as specials and must be accommodated in the laying of the pipes				
		3. All new specials to be manufactured and lined and coated as per pipe specifications included in this Project Document				
		4. All Steel Pipelines shall be Spirally welded and butt welded (Longitudinal Welded pipes shall not be considered in these circumstances)				
	8.2.1	**Supply, lay and bed on bedding as shown on drawing 113503-1000-DRG-WW-1130 or fixed above ground inside structures, complete with on-site welding joints, testing, etc:**				
		Grade X42 to API 5L welded steel pipes, internally lined with Single Coat Solvent Free Liquid Epoxy lining (600 microns DFT) to SANS 1217 and externally coating with Polyisobutene Visco-elastic (Stopaq) or similar approved:				
1		610 mm dia x 8 mm thickness	m	880		
		Supply, joint Horizontal Drilling pipes:				
		HDPE PE 100 PN 16 SDR11 pipes, to SANS 4427, butt welded to SANS 0269				
2		630 mm dia (pipes in 6 m lengths)	m	50		
	8.2.2	**Extra over item 1 for the supplying laying, jointing and bedding below ground or installed in structures, of fittings, specials and valves on Grade X42 to API 5L, welded or flanged steel pipes, intrenally lined with Single Coat Solvent Free Liquid Epoxy lining (600 microns DFT) to SANS 1217 and externally coating with Polyisobutene Visco-elastic (Stopaq) or similar approved:**				
		ISOLATING VALVE CHAMBER (x 1):				
		Drawing NO 113503-1000-DRG-WW-1162: Steel grade X42, 8 mm wall thickness, Single Coat Solvent Free Liquid lining and Polyisobutene Visco-elastic coated (Stopaq) or similar approved, flange drilling to SANS 1123 T1600/3:				
3		219 mm dia x 90 degree steel bend, flanged, item 16	No	2		
		Drawing NO 113503-1000-DRG-WW-1162: Steel grade X42, 8 mm wall thickness, Single Coat Solvent Free Liquid lining and Polyisobutene Visco-elastic coated (Stopaq) or similar approved, flange drilling to SANS 1123 T1600/3:				
4		610 mm dia steel flange with 1500 mm long integral straight pipe, item 1	No	1		
5		400mm dia X 610mm dia steel reducer flanged both ends, item 2	No	1		
6		400 mm dia x 1450 mm steel puddle pipe, flanged both end, item 3	No	2		
7		400 mm dia x 219 mm dia steel tee, all ends flanged, item 4	No	2		
8		400 mm dia VOSA non-rising wedge gate valve or similar approved, item 5 (Mech)	No	2		
9		400 mm x 400 mm dia. equal steel tee , flanged both ends, item 6	No	1		
10		Orifice Plate Cla Val or similar approved, item 7	No	1		
11		400 mm dia. x 2000 mm steel straight pipe, flanged both ends, item 8	No	1		
12		400 mm dia Cla-Val flow control valve complete or similar approved, Item 9 (Mech)	No	1		
13		400 mm dia Cla-Val Strainer or similar approved, Item 10 (Mech)	No	1		
14		400 mm dia x 620 mm steel straight pipe, flanged both ends, Item 11	No	1		
15		610 mm dia x 610 mm equal steel tee, flanged, Item 12	No	1		

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
16		675 mm dia x 610 mm dia steel reducer, flanged both ends, item 13	No	2		
17		675 mm dia steel flange welded to exisitng 675 mm dia existing steel pipe, item 14	No	2		
18		610 mm dia x 1595 mm steel puddle pipe, flanged both ends, item 15	No	1		
19		209 mm x 1643 mm steel straight pipe, flanged both ends, Item 17	No	2		
20		200 mm dia VOSA non-rising wedge gate valve or similar approved, Item 18 (Mech)	No	2		
21		200 mm dia Cla-Val flow Strainer or similar approved, Item 19	No	1		
22		200 mm dia Cla-Val flow control valve complete or smilar approved, Item 20 (Mech)	No	1		
23		209 mm dia x 1000 mm steel straight pipe, flanged both ends, Item 21	No	1		
24		Orifice Plate Cla Val or similar approved, item 22	No	1		
25		200 mm dia Woltman WP-type meter or similar aproved, (Mech)	No	1		
26		209 mm dia x 209 mm equal steel tee, flanged, Item 23	No	1		
27		150 mm x 60 mm x 25 mm triangular shaped support bracket welded on, item 24	No	8		
28		580 mm dia steel flange fitting with 80 mm dia x 250 mm steel spool pipe and lifting hooks, item 25	No	1		
29		340 mm dia flange fitting with 80 mm dia x 250 mm steel spool pipe and lifting hooks, item 25	No	1		
30		100 mm dia non-rising spindle resilient seal gate valve, item 26	No	1		
31		100 mm dia Vent-O-Mat Series RBX double office air valve with anti shock office mechanism, item 27	No	1		
		AIR VALVE CHAMBERS (x 1):				
		Drawing NO 113503-1000-DRG-WW-1161: Steel grade X42, 8 mm wall thickness, Single Coat Solvent Free Liquid lining and Polyisobutene Visco-elastic coated (Stopaq) or similar approved, flange drilling to SANS 1123 T1600/3:				
32		610 mm dia x 350 mm dia x 1181 mm unequal steel tee, both ends flanged, item 1	No	1		
		Drawing NO 113503-1000-DRG-WW-1161: steel grade X42, 8 mm wall thickness, Single Coat Solvent Free Liquid lining and Polyisobutene Visco-elastic coated (Stopaq) or similar approved, flange drilling to SANS 1123 T1600/3:				
33		150 mm x 60 mm x 25 mm triangular shaped support bracket welded on, item 2	No	4		
34		100 mm dia. Steel pipe with 840 mm dia. Steel flange fitted on one end and 220 mm dia steel flange fitted on one end with lifting hooks, item 3	No	1		
35		100 mm dia non-rising spindle resilient seal gate valve, item 4	No	1		
36		100 mm dia Vent-O-Mat Series RBX double office air valve with anti shock office mechanism, item 5	No	1		
		Site welding, testing and repairs:				
37		610 mm dia pipe to fitting or special	No	4		
		IN-LINE PIPES:				
		Steel grade X42, 8 mm wall thickness, with Single Coat Solvent Free Liquid lining and Polyisobutene Visco-elastic coated (Stopaq) or similar approved, bevel ended:				
		Bends in change of 610 mm dia pipe directions:				
38		Over 5° up to 10°	No	1		
39		Over 10° up to 15°	No	2		
40		Over 15° up to 20°	No	1		

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
41		Over 25° up to 30°	No	1		
42		Over 40° up to 45°	No	1		
43		Over 50° up to 55°	No	1		
44		Over 70° up to 75°	No	1		
45		Over 85° up to 90°	No	1		
	8.2.15	**Special wrapping in corrosive soil:**				
		Denso tape wrapping to steel pipes, fittings etc:				
46		610 mm dia	m	50		
	PSL 8.2.18	Pipeline route markers:				
47		Type as shown on drawing 113503-1000-DRG-WW-1166	No	15		
	PSL 8.2.19	Connection to existing main supply pipe:				
48		Supply and install fittings and specials on bedding, complete with on-site welding, couplings, testing etc at reservoir steel pipeline tie-in:	No	1		
49		**CCTV pipe inspections**	m	880		
		Total - Carried to Summary				**R -**

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
	SANS 1200 LB	**BILL NO.8 : BEDDING (PIPES)**				
		Note: Beddings as shown on Drawing No. 113503-1000-DRG-WW-1167				
	PSLB 8.2.2	**Supply only of bedding by importation:**				
		From commercial sources:				
1		Selected granular material	m³	387		
2		Selected fill material	m³	557		
	8.2.4	**Encasing of pipes in concrete:**				
3		Class 24,5 MPa/19 mm (second phase) as shown in enquiry document.	m³	150		
		Total - Carried to Summary				**R -**

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
	SANS 1200 LG	**BILL NO. 9 : PIPE JACKING**				
	8.2.1	**Jacking establishment:**				
1		Fixed charges	sum	1		
2		Time-related charges	sum	1		
	8.2.2	**Supply of pipes to be jacked:**				
3		1 371 mm dia (OD), 100D concrete sleeve pipe (in-the-wall joint), according to SANS 677	m	50		
	8.2.3	**Jacking of pipes:**				
4		1 371 mm dia (OD), 100D concrete sleeve pipe (in-the-wall joint), according to SANS 677	m	50		
	8.2.4	**Excavation for jacking:**				
5		Soft excavation	m³	74		
6		Intermediate excavation	m³	22		
7		Hard rock excavation	m³	7		
8	8.2.5	**Extra over items 3 to 7 for unforeseen rock or boulders**	Prov sum	1	20,000.00	20,000.00
	8.2.9	**Stabilization of unstable areas or grouting of voids where ordered:**				
9		Provision and establishment of equipment on site, and removal on completion of operation	sum	1		
10		Operation of equipment	day	2		
11		Materials used	m³	34		
12	8.2.10	**Standing time for pipe jacking gang and the jacking equipment covered by item 1 and 2**	h	40		
		Total - Carried to Summary				**R -**

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
	PART PC	**BILL NO.10 : DIRECTIONAL DRILLING**				
1		**Design and site establishment**	Sum	1		
2		**Temporary works for directional drilling**	Sum	1		
		Directional drilling and installation of pipe or cable sleeve:				
3		630 mm dia HDPE pipe	m	50		
4		De-establish quipment on site	Sum	1		
5		Standing time for directional drilling team and equipment	h	40		
		Stabilization of unstable areas or grouting of voids where ordered:				
6		Provision and establishment of equipment on Site, and removal on completion of operation	Sum	1		
7		Operation of equipment	day	10		
8		Materials used	m³	10		
		Total - Carried to Summary				**R -**

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
		SUMMARY TOTAL BULK PIPELINE PHASE 1				
		SITE CLEARANCE				-
		EARTHWORKS				-
		EARTHWORKS(PIPE TRENCHES)				-
		CONCRETE (STRUCTURAL)				-
		STRUCTURAL STEELWORK(SUNDRY)				-
		MEDIUM-PRESSURE PIPELINES				-
		BEDDING (PIPES)				-
		PIPE JACKING				-
		DIRECTIONAL DRILLING				-
		TOTAL SECTION				**R** **-**

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
		SECTION 2 : EXTERNAL WORKS				
		SECTION 2.8: BULK PIPELINE PHASE 2				
	SANS 1200C	**BILL NO.1 : SITE CLEARANCE**				
	PSC 8.2.1	**Clear and grub:**				
1		Areas (chambers, structures, etc)	m²	56		
2		Strips, 1,5 m wide (water) Paving/Asphalt	m	1030		
	8.2.2	**Remove and grub large trees and tree stumps of girth:**				
3		Over 1,0 m and up to and including 2,0 m	No	10		
4		Over 2,0 m and up to and including 3,0 m	No	10		
5	8.2.10	Remove topsoil to nominal depth of 150 mm and stockpile	m³	464		
6	PSC 8.2.14	Final finishing and cleaning up of the Site of the Works	Sum	1		
		Total - Carried to Summary				**R -**

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
	SANS 1200D	**BILL NO .2 : EARTHWORKS**				
	PSD 8.3.3	**Restricted excavation:**				
		Excavate for chambers, restricted foundations, etc in all materials, and use for backfill or embankment, or dispose:				
1		Depth over 2,0 m and up to 4,0 m	m³	129		
2		Excavate for gabion boxes or mattresses in all materials, and use for backfill or embankment, or dispose	m³	25		
		Extra over items 1 to 2 above for:				
3		Intermediate excavation	m³	189		
4		Hard rock excavation	m³	39		
5		Extra over item 1 for hand excavation	m³	13		
6	8.3.5	**Extra excavation in all materials to provide working space around structure**	m²	270		
	PSD 8.3.8	**Existing services:**				
7		Supply of specialist equipment for detection	sum	1		
8		The use of or hire of specialist equipment for detection	sum	1		
		Hand excavation for locating and exposing existing services:				
9		In roadways	m³	50		
10		In all other areas	m³	50		
		Dealing with services that are risk beacause of the construction of earthworks				
		Temporary protection of services:				
11		Telecommunication cables	sum	1		
12		Electrical cables	sum	1		
13		Egoli gas pipe	sum	1		
14		Sasol pipe	sum	1		
15		Stormwater pipe	sum	1		
16		Water pipe	sum	1		
17		Sewer pipe	sum	1		
18	PSD 8.3.10	Topsoiling	m³	232		
19	PSD 8.3.14	Extra over items 1 and 2 for temporary stockpiling	m³	211		
		Treatment of roadbed:				
	PSDM 8.3.3	Roadbed preparation and compaction of material to (under structure floor slabs):				
20		Minimum of 93% of modified AASHTO maximum density	m³	36		
		Total - Carried to Summary				**R -**

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
	SANS 1200DB	**BILL NO. 3 : EARTHWORKS (PIPE TRENCHES)**				
	PSDB 8.3.2	**Excavate in all materials for trenches, backfill, compact and dispose of surplus material:**				
		Pipes over 125 mm dia up to 400 mm dia for depths:				
1		Over 1,0 m up to 2,0 m	m	498		
2		Over 2,0 m up to 3,0 m	m	97		
3		Over 3,0 m up to 4,0 m	m	2		
		Pipes over 400 mm dia up to 850 mm dia for depths:				
4		Over 1,0 m up to 2,0 m	m	156		
5		Over 2,0 m up to 3,0 m	m	274		
6		Over 3,0 m up to 4,0 m	m	3		
7		Over 4,0 m	m			
	PSDB 8.3.2	**Extra over items 1 - 7 above for:**				
8		Intermediate excavation	m³	638		
9		Hard rock excavation	m³	265		
		Hand excavation where ordered by the Engineer:				
10		Soft material	m³	100		
11		Intermediate material	m³	100		
12		Hard material	m³	10		
13		Soilcrete backfill where directed by the Engineer	m³	100		
14		Excavate and dispose of unsuitable material from trench bottom	m³	903		
		Compaction in road crossings				
15		93% of modified AASHTO density	m³	150		
		Particular items:				
16		For new tie-in connection to reservoir pipework	Sum	1		
17		For new tie-in connection into reticulation	Sum	1		
		Existing services that intersect or adjoin a pipe trench:				
		Services that intersect a trench:				
18		City Power electrical cable crossings	number	17		
19		DFA cable crossings	number	3		
20		Telkom cable crossings	number	6		
21		Egoli Gas pipe crossings	number	4		
22		Sasol pipe crossings	number	1		
23		Stormwater pipe crossings	number	5		
24		Water pipe crossings	number	6		
25		Sewer pipe crossings	number	3		
26		3 m wide driveways containing block paving	number	25		
		Finishing:				
		Reinstate road surfaces complete with all courses:				
27		Asphalt of thickness 40 mm in roadway	m²	858		
28		Paving blocks/bricks	m²	85		
29	PSDB 8.3.7	Accommodation of traffic	Sum	1		
		Total - Carried to Summary				**R -**

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
	SANS 1200DK	**BILL NO. 4 : GABIONS AND PITCHING**				
	8.2.1	**Surface preparation for bedding of gabions: 1 no. Scour Valves**				
1		Cavities filled with approved excavated material or rock	m²	25		
	8.2.2	**Gabions:**				
		Gabion boxes of galvanized wire:				
2		100 mm x 100 mm mesh, 2,7 mm dia wire, 1,0 m x 1,0 m x 0,5 m boxes	m³	5		
		Gabion mattresses of galvanized wire, up to 0,3 m deep:				
3		80 mm x 100 mm mesh, 2,6 mm dia wire, 6,0 m x 2,1 m x 0,3 m mattress	m³	8		
	8.2.4	**Geotextile:**				
4		Grade 4 or approved equivalent	m²	31		
		Total - Carried to Summary				**R -**

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
	SANS 2001 CC	**BILL NO. .5 : CONCRETE (STRUCTURAL)**				
		SCHEDULED FORMWORK ITEMS				
	SD8.2.1	**Rough:**				
		Vertical formwork to:				
1		Outsides of Sumps (floor edge and sides)	m²	10		
	SD8.2.2	**Smooth:**				
		Vertical formwork to:				
2		Insides of chamber walls	m²	150		
3		Outsides of chamber walls	m²	276		
4		Insides of Sumps	m²	5		
5		Outsides of plinths and thrust blocks	m²	100		
		Horizontal formwork to:				
6		Soffits of roof slabs	m²	14		
	SD8.2.6	**Box out holes/form voids:**				
		Small circular, of diameter up to and including 0,35 m, and in the following depth ranges:				
7		0 m up to and including 0,5 m (for 300 mm dia ventilator sleeve in roof slab)	No	12		
		Large, circular, of diameter over 0,35 m up to and including 0,7 m and in the following depth ranges:				
9		0 m up to and including 0,5 m (for 560 mm dia manhole cover and frame in roof slab)	No	8		
		SCHEDULED REINFORCEMENT ITEMS				
10		Mild-steel and high-tensile steel bars (all diameters)	t	9		
		SCHEDULED CONCRETE ITEMS				
	SD8.4.2	**Blinding layer:**				
		Class 15 MPa/19 mm concrete of:				
11		75 mm thickness	m²	73		
	SD8.4.3	**Strength concrete:**				
		Class 20 MPa/19 mm concrete in:				
12		Thrust blocks	m³	100		
13		Plinths	m³	10		
		Class 30 MPa/19 mm concrete in:				
14		Floor slabs and Sumps	m³	25		
15		Walls	m³	48		
16		Roof slabs and upstands	m³	14		
	SD8.4.4	**Unformed surface finishes:**				
		Wood-floated finishes to:				
17		Floors and Sumps	m²	46		
		Steel-floated finishes to:				
18		Roof slabs and upstands	m²	75		
19		Plinths and thrust blocks including forming half round segments for pipes	m²	50		

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
	SD8.6	**Manufacture (or supply) and erect precast elements for units bigger than 0,5 m³ of formed concrete:**				
		The following types and sizes, complete with box-outs for covers, etc, lifting handles or hooks, reinforcing (allow min 120 kg/m³), smooth off-shutter finish to all surfaces, drip grooves, etc:				
20		3.900 m x 1.735 m x 200 mm thick roof slab panel as shown on drawings provided in enquiry document	No			
21		3.275 m x 1.370 m x 200 mm thick roof slab panel as shown on drawing 113503-1000-DRG-WW-1163	No	6		
22		2.820 m x 1.350 m x 200 mm thick roof slab panel as shown on drawing 113503-1000-DRG-WW-1164	No	1		
23		2,820 m x 1,050 m x 200 mm thick roof slab panel as shown on drawing 113503-1000-DRG-WW-1164	No	4		
24		2,45 m x 2,45 m x 150 mm thick roof slab panel, tapered down to 125 mm thick around edges as drawing 113503-1000-DRG-WW-1161	No	2		
23		Square manhole shaft unit size 2,0 m x 2,0 m x 1,0 m high internally with 125 mm thick walls complete with toggle type joints as supplied by SPC or equal approved as shown on drawing 113503-1000-DRG-WW-1161	No	6		
	SD8.8	**HD bolts and miscellaneous metal work:**				
		Steel strap pipe fixing bracket complete with malthoid packings as shown on drawing 113503-1000-DRG-WW-1164/1165				
24		200 mm dia pipe	No	1		
25		3 mm thick x 2.02 m long x 1,60 m girth L-shaped galvanized steel plate fixed with chemical anchors at maximum 500 mm centres in both directions to concrete walls and floors as shown on drawings provided in enquiry document	No	1		
26		Galvanized mild steel grid formed of 100 mm x 3 mm thick x 1 600 mm long flat section base plate with 20 mm dia x 150 mm long studs welded on at 150 mm centres and six times bolted to concrete with chemical anchors as shown on drawings provided in enquiry document	No	13		
	SD8.13	**Miscellaneous work other than metal work:**				
		Malthoid insulation between steel pipes and steel straps:				
27		3 mm thick x 50 mm wide strips	m	8		
28		3 mm thick x 60 mm wide strips	m	8		
		Malthoid insulation between steel pipes and concrete surfaces:				
29		3 mm thick x 200 mm wide strips	m	5		
30		3 mm thick x 250 mm wide strips	m	4		
31		HPDE insulation pads 1,6 mm thick between steel pipes and concrete surfaces (at thrust blocks)	m²	10		
32		Cement : sand floor screeds with falls including a smooth towelled finish to finish to top	m²	10		
	SD8.12	**Cast in of pipes with or without puddle flanges:**				
		Up to 300 mm nominal bore:				
33		Through 250 mm thick wall	No			
34		Through 300 mm thick wall	No	1		
	SD8.12	**Over 300 mm up to 600 mm nominal bore:**				
35		Through 200 mm thick floor slab	No	2		
36		Through 250 mm thick wall	No	4		
37		Through 450 mm thick wall	No	4		

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
	SANS 1200 LE	**Accessories:**				
	8.2.10	Manhole covers including frames:				
38		700mm diameter manhole cover and frame with lockable cover to sans 558 Type 4 Mild Steel	No	8		
	8.2.10	**Step irons:**				
39		Calcamite 4 Ever type step irons	No	60		
40		Air breather as shown in enquiry documents including casting into precast or in-situ concrete roof slabs	No	12		
	SANS 1200 DB	**Soilcrete:**				
41	PSDB 8.3.2	Soilcrete backfill where directed by the Engineer	m³	50		
		Total - Carried to Summary				**R -**

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
	SANS 1200 HA	**BILL NO.6 : STRUCTURAL STEELWORK (SUNDRY**				
	8.3.3	**Ladders, complete and installed:**				
		Galvanized mild steel ladders Type A bolted to concrete walls complete as shown on drawings 113503-1000-DRG-WW-1161/1163/1164				
1		Air Valve Chambers	No	2		
2		Isolating Valve Chamber	No	2		
3		Scour Valve Chamber	No	1		
		Total - Carried to Summary				**R -**

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
	SANS 1200 L	**BILL NO.7 : MEDIUM-PRESSURE PIPELINES**				
		1. Fittings are regarded as special pipes and not measured				
		2. Direction changes < 5° not measured as specials and must be accommodated in the laying of the pipes				
		3. All new specials to be manufactured and lined and coated as per pipe specifications included in this Project Document				
		4. All Steel Pipelines shall be Spirally welded and butt welded (Longitudinal Welded pipes shall not be considered in these circumstances)				
	8.2.1	**Supply, lay and bed on bedding as shown on drawings provided in enquiry document 113503-1000-DRG-WW-1131 or fixed above ground inside structures, complete with on-site welding joints, testing, etc:**				
		Grade X42 to API 5L welded steel pipes, internally lined with Single Coat Solvent Free Liquid Epoxy lining (600 microns DFT) to SANS 1217 and externally coating with Polyisobutene Visco-elastic (Stopaq) or similar approved:				
1		610 mm dia x 8 mm thickness	m	433		
		Supply, joint Horizontal Drilling pipes:				
		HDPE PE 100 PN 16 SDR11 pipes, to SANS 4427, butt welded to SANS 0269				
2		630 mm dia (pipes in 6 m lengths)	m	30		
	8.2.1	**Supply, lay and bed pipes on flexible pipe bedding, complete with couplings:**				
		mPVC class 16 pipes to SANS 966-2:				
3		400 mm dia	m	597		
		PVC-O class 16 pipes to SANS 16422:				
		400 mm dia	m			Rate olny
	8.2.2	**Extra over items 1, 2 and 3 for the supplying laying, jointing and bedding below ground or installed in structures, of fittings, specials and valves on Grade X42 to API 5L, welded or flanged steel pipes, intrenally lined with Single Coat Solvent Free Liquid Epoxy lining (600 microns DFT) to SANS 1217 and externally coating with Polyisobutene Visco-elastic (Stopaq) or similar approved:**				
		ISOLATING VALVE CHAMBER (x 2):				
		Drawing NO 113503-1000-DRG-WW-1163: Steel grade X42, 8 mm wall thickness, Single Coat Solvent Free Liquid lining and Polyisobutene Visco-elastic coated (Stopaq) or similar approved, flange drilling to SANS 1123 T1600/3:				
4		219 mm dia x 90 degree steel bend, flanged, item 5	No	4		
5		219 mm dia x 446 mm steel straight pipe, flanged both sides, item 6	No	4		
		Drawing NO 113503-1000-DRG-WW-1163: Steel grade X42, 8 mm wall thickness, Single Coat Solvent Free Liquid lining and Polyisobutene Visco-elastic coated (Stopaq) or similar approved, flange drilling to SANS 1123 T1600/3:				
6		400mm dia steel flange with flange adaptor to mPVC pipe, item 1	No	4		
7		407 mm dia x 1 450 mm steelpuddle pipe, flanged both sides, item 2	No	4		
8		407 mm dia x 219 mm dia steel tee, all ends flanged, item 3	No	4		
9		400 mm dia VOSA non-rising wedge gate valve or similar approved, item 4 (Mech)	No	2		
10		200 mm dia VOSA non-rising wedge gate valve or similar approved, item 7 (Mech)	No	2		

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
	8.2.2	**AIR VALVE CHAMBERS (x 2):**				
		Drawing NO 113503-1000-DRG-WW-1161: Steel grade X42, 8 mm wall thickness, Single Coat Solvent Free Liquid lining and Polyisobutene Visco-elastic coated (Stopaq) or similar approved, flange drilling to SANS 1123 T1600/3:				
11		407 mm dia x 407 mm dia x 1181 mm steel tee, one end flanged,with flange adaptor to mPVC pipe, item 1	No	2		
		Drawing NO 113503-1000-DRG-WW-1161: steel grade X42, 8 mm wall thickness, Single Coat Solvent Free Liquid lining and Polyisobutene Visco-elastic coated (Stopaq) or similar approved, flange drilling to SANS 1123 T1600/3:				
12		150 mm x 60 mm x 25 mm triangular shaped support bracketwelded on, item 2	No	8		
13		100 mm dia. Steel pipe with 580 mm dia. Steel flange fitted on one end and 220 mm dia steel flange fitted on one end with lifting hooks, item 3	No	2		
14		100 mm dia non-rising spindle seal gate valve, item 4	No	2		
15		100 mm dia Vent-O-Mat Series RBX double office air valve with anti shock office mechanism,item 5	No	2		
	8.2.2	**SCOUR VALVE CHAMBERS (x 1):**				
		Drawing No. 113503-1000-DRG-WW-1164/1165: Steel grade X42, 8 mm wall thickness, Single Coat Solvent Free Liquid lining and Polyisobutene Visco-elastic coated (Stopaq) or similar approved, flange drilling to SANS 1123 T1600/3:				
16		407 mm dia x 4800 mm double puddle pipe, flanged both ends combination fitting comprising 407 mm dia x 219 mm dia flanged scour outlet, with 407 mm dia. X 610 mm dia. access pipe and flange adaptor to mPVC pipe item 1	No	1		
17		200 mm dia wedge gate valve,both ends flanged, item 2(Mech)	No	2		
18		219 mm dia x 614 mm spool pipe,both ends flanged, item 3	No	1		
19		219 mm dia x 1 100 mm puddle pipe flanged one end, item 4	No	1		
		IN-LINE PIPES:				
		Steel grade X42, 8 mm wall thickness,with Single Coat Solvent Free Liquid lining and Polyisobutene Visco-elastic coated (Stopaq) or similar approved, bevel ended:				
		Bends in change of 610 mm dia pipe directions:				
20		Over 5° up to 10°	No	1		
21		Over 10° up to 15°	No	1		
22		Over 15° up to 20°	No	1		
23		Over 35° up to 40°	No	2		
24		Over 85° up to 90°	No	2		
		Bends in change of 407 mm dia pipe directions:				
25		Over 5° up to 10°	No			
26		Over 60° up to 65°	No			
27		Over 70° up to 75°	No			
28		Over 85° up to 90°	No			
		Tees:				
29		610mm dia x 407mm dia unequal tee	No	1		
30		407 mm dia x 407mm dia equal tee	No	1		
		Flange adaptor:				
31		610 mm dia.	No	1		
32		407 mm dia.	No	1		

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
		Reducers, flanged:				
33		610 mm dia x 250mm dia	No	1		
34		610 mm dia x 315mm dia	No	1		
	8.2.2	**Extra over item 2 & 3 for the supplying, laying, and bedding of mPVC / PVC-O specials complete with couplings:**				
		11.25° bends:				
35		400 mm dia.	No	1		
		22½° bends:				
36		400 mm dia.	No	1		
		45° bends:				
37		400 mm dia.	No	1		
		90° bends:				
38		400 mm dia.	No	3		
		Site welding, testing and repairs:				
39		610 mm dia pipe to pipe fitting or special	No	2		
40		407 mm dia pipe to pipe fitting or special	No	2		
	8.2.15	**Special wrapping in corrosive soil:**				
		Denso tape wrapping to steel pipes, fittings etc:				
41		610 mm dia	m	50		
42		407 mm dia	m	50		
	PSL 8.2.18	Pipeline route markers:				
43		Type as shown on drawing 113503-1000-DRG-WW-1166	No	9		
	8.2.19	Connection to existing main supply pipe:				
44		Supply and install fittings and specials on bedding, complete with on-site welding, couplings, testing etc at existing reticulation pipeline tie-ins:	No	2		
45		**CCTV pipe inspections**	m	433		
		Total - Carried to Summary				**R -**

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
		BILL NO.8 BEDDING (PIPES)				
		BEDDING FOR WATER PIPES				
		NOTE: Beddings as shown on Drawing No. 113503-1000-DRG-WW-1167				
	PSLB 8.2.2	**Supply only of bedding by importation:**				
		From commercial sources:				
1		Selected granular material	m³	319		
2		Selected fill material	m³	515		
	8.2.4	**Encasing of pipes in concrete:**				
3		Class 24,5 MPa/19 mm (second phase) as shown on Enquiry documents	m³	80		
		Total - Carried to Summary				**R -**

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
	SANS 1200 LG	**BILL NO. 9 : PIPE JACKING**				
	8.2.1	**Jacking establishment:**				
1		Fixed charges	sum	1		
2		Time-related charges	sum	1		
	8.2.2	**Supply of pipes to be jacked:**				
3		1 371 mm dia (OD), 100D concrete sleeve pipe (in-the-wall joint), according to SANS 677	m	30		
	8.2.3	**Jacking of pipes:**				
4		1 371 mm dia (OD), 100D concrete sleeve pipe (in-the-wall joint), according to SANS 677	m	30		
	8.2.4	**Excavation for jacking:**				
5		Soft excavation	m³	44		
6		Intermediate excavation	m³	13		
7		Hard rock excavation	m³	5		
8	8.2.5	**Extra over items 3 to 7 for unforeseen rock or boulders**	Prov sum	1	20,000.00	20,000.00
	8.2.9	**Stabilization of unstable areas or grouting of voids where ordered:**				
9		Provision and establishment of equipment on site, and removal on completion of operation	sum	1		
10		Operation of equipment	day	2		
11		Materials used	m³	21		
12	8.2.10	**Standing time for pipe jacking gang and the jacking equipment covered by item 1 and 2**	h	40		
		Total - Carried to Summary				**R -**

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
PC 10	PART PC	**BILL NO.10 : DIRECTIONAL DRILLING**				
1		Design and site establishment	Sum	1		
2		Temporary works for directional drilling	Sum	1		
		Directional drilling and installation of pipe or cable sleeve:				
3		630 mm dia HDPE pipe	m	30		
4		De-establish quipment on site	Sum	1		
5		Standing time for directional drilling team and equipment	h	40		
		Stabilization of unstable areas or grouting of voids where ordered:				
6		Provision and establishment of equipment on Site, and removal on completion of operation	Sum	1		
7		Operation of equipment	day	10		
8		Materials used	m³	10		
		Total - Carried to Summary				**R -**

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
		SUMMARY TOTAL BULK PIPELINE PHASE 2				
		SITE CLEARANCE				-
		EARTHWORKS				-
		EARTHWORKS(PIPE TRENCHES)				-
		GABIONS AND PITCHING				-
		CONCRETE (STRUCTURAL)				-
		STRUCTURAL STEELWORK(SUNDRY)				-
		MEDIUM-PRESSURE PIPELINES				-
		BEDDING (PIPES)				-
		PIPE JACKING				-
		DIRECTIONAL DRILLING				-
		TOTAL SECTION				**R** **-**

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
		SECTION 2 : EXTERNAL WORKS				
		SECTION 2.9 : BULK PIPLINE PHASE 3				
	SANS 1200C	**BILL NO.1 : SITE CLEARANCE**				
	PSC 8.2.1	**Clear and grub:**				
1		Areas (chambers, structures, etc)	m²	51		
2		Strips, 1,5 m wide (water) Paving/Asphalt	m	1407		
	8.2.2	**Remove and grub large trees and tree stumps of girth:**				
3		Over 1,0 m and up to and including 2,0 m	No	10		
4		Over 2,0 m and up to and including 3,0 m	No	10		
5	8.2.10	Remove topsoil to nominal depth of 150 mm and stockpile	m³	318		
6	PSC 8.2.14	Final finishing and cleaning up of the	Sum	1		
		Total - Carried to Summary				**R -**

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
	SANS 1200 D	**BILL NO.2 : EARTHWORKS**				
	PSD 8.3.3	**Restricted excavation:**				
		Excavate for chambers, restricted foundations, etc in all materials, and use for backfill or embankment, or dispose:				
1		Depth over 2,0 m and up to 4,0 m	m³	136		
2		Excavate for gabion boxes or mattresses in all materials, and use for backfill or embankment, or dispose	m³	5		
		Extra over items 1 and 2 above for:				
3		Intermediate excavation	m³	116		
4		Hard rock excavation	m³	35		
5		Extra over item 1 for hand excavation	m³	20		
6	8.3.5	**Extra excavation in all materials to provide working space around structure**	m²	175		
	PSD 8.3.8	**Existing services:**				
		Supply of specialist equipment for detection	sum	1		
		The use of or hire of specialist equipment for detection	sum	1		
		Hand excavation for locating and exposing existing services:				
7		In roadways	m³	50		
8		In all other areas	m³	50		
		Dealing with services that are risk beacause of the construction of earthworks				
		Temporary protection of services:				
9		Telecommunication cables	sum	1		
10		Electrical cables	sum	1		
11		Egoli gas pipe	sum			
12		Sasol pipe	sum			
13		Stormwater pipe	sum	1		
14		Water pipe	sum	1		
15		Sewer pipe	sum	1		
16	PSD 8.3.10	Topsoiling	m³	318		
17	PSD 8.3.14	Extra over items 1 and 2 for temporary stockpiling	m³	141		
		Treatment of roadbed:				
	PSDM 8.3.3	Roadbed preparation and compaction of material to (under structure floor slabs):				
18		Minimum of 93% of modified AASHTO maximum density	m³	23		
		Total - Carried to Summary				**R -**

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
	SANS 1200 DB	**BILL NO.3 : EARTHWORKS (PIPE TRENCHES)**				
	PSDB 8.3.2	**Excavate in all materials for trenches, backfill, compact and dispose of surplus material:**				
		Pipes over 400 mm dia up to 850 mm dia for depths:				
1		Over 1,0 m up to 2,0 m	m	521		
2		Over 2,0 m up to 3,0 m	m	865		
3		Over 3,0 m up to 4,0 m	m	15		
4		Over 4,0 m	m	2		
	PSDB 8.3.2	**Extra over item 1 ,2,3 and 4 above for:**				
5		Intermediate excavation	m³	686		
6		Hard rock excavation	m³	242		
		Hand excavation where ordered by the Engineer:				
7		Soft material	m³	100		
8		Intermediate material	m³	100		
9		Hard material	m³	10		
10		Soilcrete backfill where directed by Engineer	m³	100		
11		Excavate and dispose of unsuitable material from trench bottom	m³	928		
	PSDB 8.3.3	**Excavation ancillaries:**				
		Compaction in road crossings				
12		93% of modified AASHTO density	m³	150		
	8.3.4	**Particular items:**				
13		Shore trench opposite structure or service	m	1403		
		Temporary Works: Control water inflow in pipeline:				
14		For new tie-in connection to reservoir pipework	Sum	1		
15		For new tie-in connection intoreticulation	Sum	1		
	8.3.5	**Existing services that intersect or adjoin a pipe trench:**				
		Services that intersect a trench:				
16		City Power electrical cable crossings	No	1		
17		Telkom cable crossings	No	1		
18		Water pipe crossings	No	5		
19		Sewer pipe crossings	No	4		
20		3 m wide driveways containing concrete paving	No	30		
		Finishing:				
		Reinstate road surfaces complete with all courses:				
21		Asphalt of thickness 40 mm in roadway	m²	1403		
22	PSDB 8.3.7	Accommodation of traffic	Sum	1		
		Total - Carried to Summary				**R -**

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
	SANS 1200 DK	**BILL NO.4 : GABIONS AND PITCHING**				
	8.2.1	**Surface preparation for bedding of gabions: 1 no. Scour Valves**				
1		Cavities filled with approved excavated material or rock	m²	24		
	8.2.2	**Gabions:**				
		Gabion boxes of galvanized wire:				
2		100 mm x 100 mm mesh, 2,7 mm dia wire, 1,0 m x 1,0 m x 0,5 m boxes	m³	5		
		Gabion mattresses of galvanized wire, up to 0,3 m deep:				
3		80 mm x 100 mm mesh, 2,6 mm dia wire, 6,0 m x 2,0 m x 0,3 m mattress	m³	7		
	8.2.4	**Geotextile:**				
4		Grade 4 or approved equivalent	m²	39		
		Total - Carried to Summary				**R -**

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
	SANS 2001 CC	**BILL NO.5 : CONCRETE (STRUCTURAL)**				
	SD8.2.1	**Rough:**				
		Vertical formwork to:				
1		Outsides of Sumps (floor edge and sides)	m²	8		
	SD8.2.2	**Smooth:**				
		Vertical formwork to:				
2		Insides of chamber walls	m²	110		
3		Outsides of chamber walls	m²	265		
4		Insides of Sumps	m²	4		
5		Outsides of plinths and thrust blocks	m²	100		
6		Outsides of floor slabs	m²			
		Horizontal formwork to:				
7		Soffits of roof slabs	m²	10		
	SD8.2.6	**Box out holes/form voids:**				
		Small circular, of diameter up to and including 0,35 m, and in the following depth ranges:				
8		0 m up to and including 0,5 m (for 300 mm dia ventilator sleeve in roof slab)	No	10		
		Large, circular, of diameter over 0,35 m up to and including 0,7 m and in the following depth ranges:				
9		0 m up to and including 0,5 m (for 560 mm dia manhole coverand frame in roof slab)	No	6		
		SCHEDULED REINFORCEMENT ITEMS				
10		Mild-steel and high-tensile steel bars (all diameters)	t	16		
	SD8.4.2	**Blinding layer:**				
		Class 15 MPa/19 mm concrete of:				
11		75 mm thickness	m²	51		
	SD8.4.3	**Strength concrete:**				
		Class 20 MPa/19 mm concrete in:				
12		Thrust blocks	m³	100		
13		Plinths	m³	10		
		Class 30 MPa/19 mm concrete in:				
14		Floor slabs and Sumps	m³	16		
15		Walls	m³	26		
16		Roof slabs and upstands	m³	9		
	SD8.4.4	**Unformed surface finishes:**				
		Wood-floated finishes to:				
17		Floors and Sumps	m²	30		
		Steel-floated finishes to:				
18		Roof slabs and upstands	m²	47		
19		Plinths and thrust blocks including forming half round segments for pipes	m²	50		

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
	SD8.6	**Manufacture (or supply) and erect precast elements for units bigger than 0,5 m³ of formed concrete:**				
		The following types and sizes, complete with box-outs for covers, etc, lifting handles or hooks, reinforcing (allow min 120 kg/m³), smooth off- shutter finish to all surfaces, drip grooves, etc:				
20		3.900 m x 1.735 m x 200 mm thick roof slab panel as shown on drawings provided in enquiry document	No			
21		3.275 m x 1.370 m x 200 mm thick roof slab panel as shown on drawing 113503-1000-DRG-WW-1163	No	3		
22		2.820 m x 1.350 m x 200 mm thick roof slab panel as shown on drawing 113503-1000-DRG-WW-1164	No	1		
23		2.820 m x 1.50 m x 200 mm thick roof slab panel as shown on drawing 113503-1000-DRG-WW-1164	No	4		
24		2.45 m x 2.45 m x 150 mm thick roof slab,tapered down to 125 mm thick around edges as shown on drawing 113503-1000-DRG-WW-1161	No	2		
25		Square manhole shaft unit size 2,0 m x 2,0 m x 1,0 m high internally with 125 mm thick walls complete with toggle type joints as supplied by SPC or equal approved as shown on Drawing 113503-1000-DRG-WW-1161	No	3		
	SD8.8	**HD bolts and miscellaneous metal work:**				
		Steel strap pipe fixing bracket complete with malthoid packings as shown on drawings 113503-1000-DRG-WW-1164/1165				
26		200 mm dia pipe	No	1		
27		3 mm thick x 2.02 m long x 1,60 m girth L-shaped galvanized steel plate fixed with chemical anchors at maximum 500 mm centres in both directions to concrete walls and floors as shown in enquiry document	No	1		
28		Galvanized mild steel grid formed of 100 mm x 3 mm thick x 1 600 mm long flat section base plate with 20 mm dia x 150 mm long studs welded on at 150 mm centres and six times bolted to concrete with chemical anchors as shown on drawings provided in enquiry document	No	13		
	SD8.13	**Miscellaneous work other than metal work:**				
		Malthoid insulation between steel pipes and steel straps:				
29		3 mm thick x 50 mm wide strips	m	8		
30		3 mm thick x 60 mm wide strips	m	8		
		Malthoid insulation between steel pipes and concrete surfaces:				
31		3 mm thick x 200 mm wide strips	m	5		
32		3 mm thick x 250 mm wide strips	m	4		
33		HPDE insulation pads 1,6 mm thick between steel pipes and concretesurfaces (at thrust blocks)	m²	10		
34		Cement : sand floor screeds with falls including a smooth towelled finish to finish to top	m²	10		
	SD8.12	**Cast in of pipes with or without puddle flanges:**				
		Up to 300 mm nominal bore:				
35		Through 300 mm thick wall	No	2		
	SD8.12	**Over 300 mm up to 600 mm nominal bore:**				
36		Through 200 mm thick floor slab	No	2		
37		Through 250 mm thick wall	No	2		
		Through 450 mm thick wall	No	2		

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
	SANS 1200 LE	**Accessories:**				
	8.2.10	Manhole covers including frames:				
38		700mm diameter manhole cover and framewith lockable cover to sans 558 Type 4 Mild Steel	No	6		
		Step irons:				
39		Calcamite 4 Ever type step irons	No	190		
40		Air breather as shown on drawings provided in enquiry complete including casting into precast or in-situ concrete roof slabs	No	8		
	SANS 1200 DB	**Soilcrete:**				
41	PSDB 8.3.2	Soilcrete backfill where directed by the Engineer	m³	50		
		Total - Carried to Summary				**R -**

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
	SANS 1200 HA	**BILL NO.6 : STRUCTURAL STEELWORK (SUNDRY)**				
	8.3.3	**Ladders, complete and installed:**				
		Galvanized mild steel ladders Type A bolted to concrete walls complete as shown on drawings 113503-1000-DRG-WW-1161/1163/1164				
1		Air Valve Chambers	No	2		
2		Isolating Valve Chamber	No	1		
3		Scour Valve Chamber	No	1		
		Total - Carried to Summary				**R -**

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
	SANS 1200 L	**BILL NO.7 : MEDIUM-PRESSURE PIPELINES**				
		1. Fittings are regarded as special pipes and not measured as extra over items				
		2. Direction changes < 5° not measured as specials and must be accommodated in the laying of the pipes				
		3. All new specials to be manufactured and lined and coated as per pipe specifications included in this Project Document				
		4. All Steel Pipelines shall be Spirally welded and butt welded (Longitudinal Welded pipes shall not be considered in these circumstances)				
	8.2.1	**Supply, lay and bed on bedding as shown on drawings provided in enquiry 113503-1000-DRG-1132 or fixed above ground inside structures, complete with on-site welding joints, testing, etc:**				
		Grade X42 to API 5L welded steel pipes, internally lined with Single Coat Solvent Free Liquid Epoxy lining (600 microns DFT) to SANS 1217 and externally coating with Polyisobutene Visco-elastic (Stopaq) or similar approved:				
1		610 mm dia x 8 mm thickness	m	1407		
		Supply, joint Horizontal Drilling pipes:				
		HDPE PE 100 PN 16 SDR11 pipes, to SANS 4427, butt welded to SANS 0269				
2		630 mm dia (pipes in 6 m lengths)	m	60		
	8.2.2	**Extra over item 1 for the supplying laying, jointing and bedding below ground or installed in structures, of fittings, specials and valves on Grade X42 to API 5L, welded or flanged steel pipes, intrenally lined with Single Coat Solvent Free Liquid Epoxy lining (600 microns DFT) to SANS 1217 and externally coating with Polyisobutene Visco-elastic (Stopaq) or similar approved:**				
		ISOLATING VALVE CHAMBER (x 1):				
		Drawing No. 113503-1000-DRG-WW-1163: Steel grade X42, 8 mm wall thickness, Single Coat Solvent Free Liquid lining and Polyisobutene Visco-elastic (Stopaq) coated or similar approved, flange drilling to SANS 1123 T1600/3:				
3		219 mm dia x 90 degree steel bend, flanged, item 5	No	2		
4		219 mm dia x 446 mm steel straight pipe, flanged both sides,item 6	No	2		
		Drawing NO 113503-1000-DRG-WW-1163: Steel grade X42, 8 mm wall thickness, Single Coat Solvent Free Liquid lining and Polyisobutene Visco-elastic (Stopaq) coated or similar approved, flange drilling to SANS 1123 T1600/3:				
5		610mm dia Steel flange with integral straight pipe, item 1	No	2		
6		610 mm dia x 1 450 mm steel puddle pipe, flanged both sides, item 2	No	2		
7		610 mm dia x 219 mm dia steel tee, all ends flanged, item 3	No	1		
8		600 mm dia VOSA non-rising wedge gate valve or similar approved, item 4 (Mech)	No	1		
9		200 mm dia VOSA non-rising wedge gate valve or similar approved, item 7 (Mech)	No	1		
		AIR VALVE CHAMBERS (x 2):				
		Drawing NO 113503-1000-DRG-WW-1161: Steel grade X42, 8 mm wall thickness, Single Coat Solvent Free Liquid lining and Polyisobutene Visco-elastic (Stopaq) coated or similar approved, flange drilling to SANS 1123 T1600/3:				
10		610 mm dia x 610 mm dia x 1181 mm steel tee, flanged both ends, item 1	No	2		

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
		Drawing NO 113503-1000-DRG-WW-1161: steel grade X42, 8 mm wall thickness, Single Coat Solvent Free Liquid lining and Polyisobutene Visco-elastic (Stopaq) coated, flange drilling to SANS 1123 T1600/3:				
11		150 mm x 60 mm x 25 mm triangular shaped support bracket welded on, item 2	No	8		
12		100 mm dia. Steel pipe with 840 mm dia. Steel flange fitted on one end and 220 mm dia steel flange fitted on one end with lifting hooks, item 3	No	2		
13		100 mm dia non-rising spindle resilient seal gate valve, item 4	No	2		
14		100 mm dia Vent-O-Mat Series RBX double office air valve with anti shock office mechanism, item 5	No	2		
		Site welding, testing and repairs:				
15		610 mm dia pipe to fitting or special	No	4		
	8.2.2	**SCOUR VALVE CHAMBERS (x 1):**				
		Drawing No. 113503-1000-DRG-WW-1163/1164: Steel grade X42, 8 mm wall thickness, Single Coat Solvent Free Liquid lining and Polyisobutene Visco-elastic (Stopaq) coated or similar approved, flange drilling to SANS 1123 T1600/3:				
16		610 mm dia x 4800 mm double puddle pipe, flanged both ends combination fitting comprising 610 mm dia x 219 mm dia flanged scour outlet, with 610 mm dia. X 610 mm dia. Access pipe item 1	No	1		
17		200 mm dia wedge gate valve,both ends flanged, item 2(Mech)	No	2		
18		219 mm dia x 614 mm spool pipe,both ends flanged, item 3	No	1		
19		219 mm dia x 1 100 mm puddle pipe flanged one end,item 4	No	1		
		Site welding, testing and repairs:				
20		610 mm dia pipe to fitting or special	No	4		
		IN-LINE PIPES:				
		Steel grade X42, 8 mm wall thickness,with Single Coat Solvent Free Liquid lining and Polyisobutene Visco-elastic (Stopaq) or similar approved coated, bevel ended:				
		Bends in change of 610 mm dia pipe directions:				
21		Over 5° up to 10°	No	1		
22		Over 10° up to 15°	No	3		
23		Over 20° up to 25°	No	3		
24		Over 30° up to 35°	No	1		
25		Over 40° up to 45°	No	1		
26		Over 45° up to 50°	No	1		
27		Over 65° up to 70°	No	1		
28		Over 70° up to 75°	No	1		
29		Over 85° up to 90°	No	3		
		Tees:				
30		610mm dia x 610mm dia equal tee	No	1		
	8.2.15	**Special wrapping in corrosive soil:**				
		Denso tape wrapping to steel pipes, fittings etc:				
31		610 mm dia	m	50		
	PSL 8.2.18	**Pipeline route markers:**				
32		Type as shown on drawing 113503-1000-DRG-WW-1166	No	9		

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
	PSL 8.2.19	**Connection to existing main supply pipe:**				
33		Supply and install fittings and specials on bedding, complete with on-site welding, couplings, testing etc existing reticulation pipeline tie-ins:	No	1		
34		**CCTV pipe inspections**	m	1407		
		Total - Carried to Summary				**R -**

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
	SANS 1200 LB	**BILL NO.8 : BEDDING PIPES**				
		NOTE: Beddings as shown on Drawing No. 113503-1000-DRG-WW-1167				
		Provision of bedding from trench excavation:				
	PSLB 8.2.2	Supply only of bedding by importation:				
		From commercial sources:				
1		Selected granular material	m³	576		
2		Selected fill material	m³	829		
	8.2.4	**Encasing of pipes in concrete:**				
3		Class 24,5 MPa/19 mm (second phase) as shown in enquiry document	m³	150		
		Total - Carried to Summary				**R -**

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
	SANS 1200 LG	**BILL NO. 9 : PIPE JACKING**				
	8.2.1	**Jacking establishment:**				
1		Fixed charges	sum	1		
2		Time-related charges	sum	1		
	8.2.2	**Supply of pipes to be jacked:**				
3		1 371 mm dia (OD), 100D concrete sleeve pipe (in-the-wall joint), according to SANS 677	m	60		
	8.2.3	**Jacking of pipes:**				
4		1 371 mm dia (OD), 100D concrete sleeve pipe (in-the-wall joint), according to SANS 677	m	60		
	8.2.4	**Excavation for jacking:**				
5		Soft excavation	m³	89		
6		Intermediate excavation	m³	27		
7		Hard rock excavation	m³	9		
8	8.2.5	**Extra over items 3 to 7 for unforeseen rock or boulders**	Prov sum	1	20,000.00	20,000.00
	8.2.9	**Stabilization of unstable areas or grouting of voids where**				
9		Provision and establishment of equipment on site, and removal on	sum	1		
10		Operation of equipment	day	2		
11		Materials used	m³	41		
12	8.2.10	**Standing time for pipe jacking gang and the jacking equipment covered by item 1 and 2**	h	40		
		Total - Carried to Summary				**R 20,000.00**

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
	PART PC	**BILL NO.10 : DIRECTIONAL DRILLING**				
1		Design and site establishment	Sum	1		
2		Temporary works for directional drilling	Sum	1		
		Directional drilling and installation of pipe or cable sleeve:				
3		630 mm dia HDPE pipe	m	60		
4		De-establish quipment on site	Sum	1		
5		Standing time for directional drilling team and equipment	h	40		
		Stabilization of unstable areas or grouting of voids where ordered:				
6		Provision and establishment of equipment on Site, and removal oncompletion of operation	Sum	1		
7		Operation of equipment	day	10		
8		Materials used	m³	10		
		Total - Carried to Summary				**R -**

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
		SUMMARY TOTAL BULK PIPELINE PHASE 3				
		SITE CLEARANCE				-
		EARTHWORKS				-
		EARTHWORKS (PIPE TRENCHES)				-
		GABIONS AND PITCHING				-
		CONCRETE (STRUCTURAL)				-
		STRUCTURAL STEELWORK (SUNDRY)				-
		MEDIUM-PRESSURE PIPELINES				-
		BEDDING (PIPES)				-
		PIPE JACKING				-
		DIRECTIONAL DRILLING				-
		TOTAL SECTION				**R** **-**

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
		SECTION 2 : EXTERNAL WORKS				
		SECTION 2.10 : BULK PIPELINE PHASE 4				
	SANS 1200 C	**BILL NO.1 : SITE CLEARANCE**				
	PSC 8.2.1	**Clear and grub:**				
1		Strips, 1,5 m wide (water) Paving/Asphalt	m	2137		
	8.2.2	**Remove and grub large trees and tree stumps of girth:**				
2		Over 1,0 m and up to and including 2,0 m	No	10		
3		Over 2,0 m and up to and including 3,0 m	No	10		
4	8.2.10	Remove topsoil to nominal depth of 150 mm and stockpile	m³	481		
5	PSC 8.2.14	Final finishing and cleaning up of the Site of the Works	Sum	1		
		Total - Carried to Summary				**R -**

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
	SANS 1200 D	**BILL NO.2 : EARTHWORKS**				
	PSD 8.3.8	**Existing services:**				
1		Supply of specialist equipment for detection	sum	1		
2		The use of or hire of specialist equipment for detection	sum	1		
		Hand excavation for locating and exposing existing services:				
3		In roadways	m³	50		
4		In all other areas	m³	50		
		Dealing with services that are risk beacause of the construction of earthworks				
		Temporary protection of services:				
5		Telecommunication cables	sum	1		
6		Electrical cables	sum	1		
7		Egoli gas pipe	sum			
8		Sasol pipe	sum			
9		Stormwater pipe	sum	1		
10		Water pipe	sum	1		
11		Sewer pipe	sum	1		
12	PSD 8.3.10	Topsoiling	m³	481		
		Total - Carried to Summary				**R -**

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
	SANS 1200 DB	**BILL NO.3 : EARTHWORKS (PIPE TRENCHES)**				
	PSDB 8.3.2	**Excavate in all materials for trenches, backfill, compact and dispose of surplus material:**				
		Pipes over 125 mm dia up to 400 mm dia for depths:				
1		Over 1,0 m up to 2,0 m	m	1397		
		Pipes over 400 mm dia up to 850 mm dia for depths:				
2		Over 1,0 m up to 2,0 m	m	740		
	PSDB 8.3.2	**Extra over item 1 and 2 above for:**				
3		Intermediate excavation	m³	100		
4		Hard rock excavation	m³	50		
		Hand excavation where ordered by the Engineer:				
5		Soft material	m³	100		
6		Intermediate material	m³	100		
7		Hard material	m³	10		
8		Soilcrete backfill where directed by Engineer	m³	100		
	PSDB 8.3.3	**Excavation ancillaries:**				
		Compaction in road crossings				
9		93% of modified AASHTO density	m³	150		
	8.3.4	**Particular items:**				
10		Shore trench opposite structure or service	m	100		
		Temporary Works: Control water inflow in pipeline:				
11		For new tie-in connection to reservoir pipework	Sum			
12		For new tie-in connection into existing reticulation	Sum	1		
13	PSDB 8.3.7	Accommodation of traffic	Sum	1		
		Total - Carried to Summary				**R -**

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
	SANS 1200 L	**BILL NO.4 : MEDIUM-PRESSURE PIPELINES**				
	8.2.1	**Supply, lay and bed pipes on flexible pipe bedding, complete with couplings:**				
		mPVC class 16 pipes to SANS 966:				
1		160 mm dia	m	440		
2		200 mm dia	m	126		
3		250 mm dia	m	276		
4		315 mm dia	m	555		
5		450 mm dia	m	740		
		Supply, joint Horizontal Drilling pipes:				
		HDPE PE 100 PN 16 SDR11 pipes, to SANS 4427, butt welded to SANS 0269				
6		160 mm dia (pipes in 6m lengths)	m	23		
7		200 mm dia (pipes in 6m lengths)	m	48		
8		450 mm dia (pipes in 6m lengths)	m	31		
	8.2.2	Extra over items 1 to 5 above for the supplying, laying, and bedding of mPVC specials complete with couplings:				
		22½° bends:				
9		160 mm dia	No	1		
10		200 mm dia	No	2		
		45° bends:				
11		200 mm dia	No	2		
		90° bends:				
12		200 mm dia	No	1		
13		315 mm dia	No	2		
14		450 mm dia	No	2		
	8.2.2	**Extra over item 12 to 39 for thesupplying, laying, and bedding of cast - iron or steel specials complete with couplings:**				
		Flanged Tees:				
15		160mm dia x 160mm dia	No	1		
16		200mm dia x 200mm dia	No	1		
17		250mm dia x 250mm dia	No	1		
18		315mm dia x 315mm dia	No	2		
19		450mm dia x 450mm dia	No	2		
		Blank flange drilled to SANS Table 16:				
20		160mm dia	No	1		
21		315mm dia	No	1		
		Reducers, flanged:				
22		160mm dia x 160mm dia	No	1		
23		200mm dia x 160mm dia	No	2		
24		250mm dia x 160mm dia	No	2		
25		315mm dia x 200mm dia	No	1		
26		315mm dia x 250mm dia	No	1		
27		450mm dia x 160mm dia	No	1		
28		450mm dia x 315mm dia	No	2		

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
		Flange adaptor:				
29		160mm dia	No	5		
30		200 mm dia	No	3		
31		250 mm dia	No	2		
32		315mm dia	No	4		
33		450 mm dia	No	4		
	8.2.2	Gate valves, flanged, class 16:				
34		160mm dia	No	2		
35		200 mm dia	No	2		
36		250 mm dia	No	2		
37		315mm dia	No	4		
38		450 mm dia	No	4		
		Anchor/thrust blocks and pedestals:				
		Concrete:				
39		Class 20MPa/19 mm	m³	20		
		Formwork:				
40		Rough	m²	10		
41		Smooth	m²	10		
		Valve and hydrant chambers, etc.:				
42		Valve chamber including concrete valve marker	No	10		
43		**Supply New Pressure Reducing Valve including fittings and concrete chamber Complete:**	Prov Sum	1		
		Total - Carried to Summary				**R -**

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
	SANS 1200 LB	**BILL NO.5 : BEDDING (PIPES)**				
		NOTE: Beddings as shown on Drawing No. 113503-1000-DRG-WW-1167				
	PSLB 8.2.2	**Supply only of bedding by importation:**				
1		Selected granular material	m³	853		
2		Selected fill material	m³	391		
		Total - Carried to Summary				**R -**

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
	PART PC	**BILL NO. 6 : DIRECTIONAL DRILLING**				
1		Design and site establishment	Sum	1		
2		Temporary works for directional drilling	Sum	1		
		Directional drilling and installation of 'pipe or cable sleeve:				
3		160 mm dia pipe	m	23		
4		200 mm dia pipe	m	48		
5		450 mm dia pipe	m	31		
6		De-establish quipment on site	Sum	1		
7		Standing time for directional drilling team and equipment	h	40		
		Stabilization of unstable areas or grouting of voids where ordered:				
8		Provision and establishment of equipment on Site, and removal on completion of operation	Sum	1		
9		Operation of equipment	day	10		
10		Materials used	m^3	30		
		Total - Carried to Summary				**R -**

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
		SUMMARY TOTAL BULK PIPELINE PHASE 4				
		SITE CLEARANCE				-
		EARTHWORKS				-
		EARTHWORKS(PIPE TRENCHES)				-
		GABIONS AND PITCHING				-
		CONCRETE (STRUCTURAL)				-
		STRUCTURAL STEELWORK(SUNDRY)				-
		MEDIUM-PRESSURE PIPELINES				-
		BEDDING (PIPES)				-
		DIRECTIONAL DRILLING				-
		TOTAL SECTION				**R** **-**

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
		SECTION 2 : EXTERNAL WORKS				
		SECTION 2.11 : BULK PIPELINE PHASE 5				
	SANS 1200 C	**BILL NO .1 : SITE CLEARANCE**				
	PSC 8.2.1	**Clear and grub:**				
1		Strips, 1,5 m wide (water) Paving/Asphalt	m	1836		
	8.2.2	**Remove and grub large trees and tree stumps of girth:**				
2		Over 1,0 m and up to and including 2,0 m	No	10		
3		Over 2,0 m and up to and including 3,0 m	No	10		
4	8.2.10	Remove topsoil to nominal depth of 150 mm and stockpile	m^3	413		
5	PSC 8.2.14	Final finishing and cleaning up of the Site of the Works	Sum	1		
		Total - Carried to Summary				**R -**

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
	SANS 1200 D	**BILL NO .2 : EARTHWORKS**				
	PSD 8.3.8	**Existing services:**				
1		Supply of specialist equipment for detection	sum	1		
2		The use of or hire of specialist equipment for detection	sum	1		
		Hand excavation for locating and exposing existing services:				
3		In roadways	m³	50		
4		In all other areas	m³	50		
		Dealing with services that are risk beacause of the construction of earthworks				
		Temporary protection of services:				
5		Telecommunication cables	sum	1		
6		Electrical cables	sum	1		
7		Egoli gas pipe	sum			
8		Sasol pipe	sum			
9		Stormwater pipe	sum	1		
10		Water pipe	sum	1		
11		Sewer pipe	sum	1		
12	PSD 8.3.10	Topsoiling	m³	413		
		Total - Carried to Summary				**R -**

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
	SANS 1200 DB	**BILL NO .3 : EARTHWORKS (PIPE TRENCHES)**				
	PSDB 8.3.2	**Excavate in all materials for trenches, backfill, compact and dispose of surplus material:**				
		Pipes over 125 mm dia up to 400 mm dia for depths:				
1		Over 1,0 m up to 2,0 m	m	1531		
		Pipes over 400 mm dia up to 850 mm dia for depths:				
2		Over 1,0 m up to 2,0 m	m	305		
	PSDB 8.3.2	**Extra over item 1 and 2 above for:**				
3		Intermediate excavation	m³	100		
4		Hard rock excavation	m³	50		
		Hand excavation where ordered by the Engineer :				
5		Soft material	m³	100		
6		Intermediate material	m³	100		
7		Hard material	m³	10		
8		Soilcrete backfill where directed by Engineer	m³	100		
	PSDB 8.3.3	**Excavation ancillaries:**				
		Compaction in road crossings				
9		93% of modified AASHTO density	m³	150		
	8.3.4	**Particular items:**				
10		Shore trench opposite structure or service	m	100		
		Temporary Works: Control water inflow in pipeline:				
11		For new tie-in connection to existing pipework	Sum	1		
12	PSDB 8.3.7	Accommodation of traffic	Sum	1		
		Total - Carried to Summary				**R -**

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
	SANS 1200 L	**BILL NO .4 : MEDIUM-PRESSURE PIPELINES**				
	8.2.1	**Supply, lay and bed pipes on flexible pipe bedding, complete with couplings:**				
		mPVC class 16 pipes to SANS 966:				
1		160 mm dia	m	98		
2		200 mm dia	m			
3		250 mm dia	m	1240		
4		315 mm dia	m	193		
5		400 mm dia	m	305		
		Supply, joint Horizontal Drilling pipes:				
		HDPE PE 100 PN 16 SDR11 pipes, to SANS 4427, butt welded to SANS 0269				
6		250 mm dia (pipes in 6m lengths)	m	25		
	8.2.2	Extra over items 1 to 5 above for the supplying, laying, and bedding of mPVC specials complete with couplings:				
		90° bends:				
7		250 mm dia	No	3		
8		400 mm dia	No	1		
	8.2.2	Extra over item 8 to 28 for the supplying, laying, and bedding of cast-iron or steel specials complete with couplings:				
		Flanged Tees:				
9		160mm dia x 160mm dia	No	2		
10		250mm dia x 250mm dia	No	2		
11		315mm dia x 315mm dia	No	1		
12		400mm dia x 400mm dia	No	1		
		Reducers, flanged:				
13		250mm dia x 160mm dia	No	3		
14		315mm dia x 160mm dia	No	1		
15		315mm dia x 250mm dia	No	1		
16		500mm dia x 315mm dia	No	1		
17		500mm dia x 250mm dia	No	1		
		Flange adaptor:				
18		160mm dia	No	4		
19		250 mm dia	No	3		
20		315mm dia	No	2		
21		400 mm dia	No	1		
		Gate valves, flanged, class 16:				
22		160mm dia	No	4		
23		250 mm dia	No	4		
24		315mm dia	No	1		
25		400 mm dia	No	2		
		Anchor/thrust blocks and pedestals:				
		Concrete:				
26		Class 20MPa/19 mm	m^3	20		

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
		Formwork:				
27		Rough	m²	10		
28		Smooth	m²	10		
		Valve and hydrant chambers, etc.:				
29		Valve chamber including concrete valve marker	No	10		
		Total - Carried to Summary				**R -**

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
	SANS 1200 LB	**BILL NO .5 : BEDDING (PIPES)**				
		NOTE: Beddings as shown on Drawing No. 113503-1000-DRG-WW-1167				
	PSLB 8.2.2	**Supply only of bedding by importation:**				
		From commercial sources:				
1		Selected granular material	m³	672		
2		Selected fill material	m³	322		
		Total - Carried to Summary				**R -**

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
	PART PC	**BILL NO .6 : DIRECTIONAL DRILLING**				
1		Design and site establishment	Sum	1		
2		Temporary works for directional drilling	Sum	1		
		Directional drilling and installation of pipe or cable sleeve:				
3		250 mm dia. HDPE pipe	m	25		
4		De-establish quipment on site	Sum	1		
5		Standing time for directional drilling team and equipment	h	40		
		Stabilization of unstable areas or grouting of voids where ordered:				
6		Provision and establishment of equipment on Site, and removal on completion of operation	Sum	1		
7		Operation of equipment	day	10		
8		Materials used	m³	10		
		Total - Carried to Summary				**R -**

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
		SUMMARY TOTAL BULK PIPELINE PHASE 5				
		SITE CLEARANCE				-
		EARTHWORKS				-
		EARTHWORKS(PIPE TRENCHES)				-
		GABIONS AND PITCHING				-
		CONCRETE (STRUCTURAL)				-
		STRUCTURAL STEELWORK(SUNDRY)				-
		MEDIUM-PRESSURE PIPELINES				-
		BEDDING (PIPES)				-
		DIRECTIONAL DRILLING				-
		TOTAL SECTION				**R** **-**

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
		SECTION 2 : EXTERNAL WORKS				
		SECTION 2.12 : CATHODIC PROTECTION				
	SANS 1200 L	**BILL NO .4 : MEDIUM-PRESSURE PIPELINES**				
1	PSL 8.2.20	Cathodic Protection Work by Contractor:	Prov Sum	1	1,500,000.00	1,500,000.00
		Total - Carried to Summary				**R 1,500,000.00**

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
		SUMMARY TOTAL CATHODIC PROTECTION				
		MEDIUM-PRESSURE PIPELINES				1,500,000.00
		TOTAL SECTION				**R 1,500,000.00**

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
		SECTION 2 : EXTERNAL WORKS				
		SECTION 2.13 : LANDSCAPE				
	SANS 1200 C	**BILL NO.1 : SITE CLEARANCE**				
1	8.2.1	Clear and grub (areas)	m²			
2	8.2.9	Transport materials and debris to unspecified sites and dump (Provisional)	m3-Km	1		
		Total - Carried to Summary				**R -**

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
	PLS 9	**BILL NO. 5 : LANDSCAPE SOFTSCAPING**				
1	9.7.1	Soil test	No	1		
2	9.7.2	Clearing of area for planting	m²	4863		
3	9.7.4	Topsoil from stockpile	m3	1		
		150mm thick				
4	9.7.5	Topsoil imported to site	m³	64		
		150mm thick				
5	9..7.6	Compost to lawn	m³	11		
		25mm thick				
6	9.7.6	Compost to trees	m³	1.54		
		0.07/m3 tree				
7	9.7.7	Planter mix	m³	5		
8	9.7.8	Scarifying of areas	m²	429		
		300mm deep				
9	9.7.9	Shaping and trimming	m²	1217		
10	9.7.10	Fine grading of the following areas: Lawn (hydroseeding and sods)	m²	4863		
	9.7.11	**Fertilizer**				
11		Agricultural lime at 300kg/ha	kg	13		
12		Super phosphate at 0.15kg/m²	kg	183		
13		Superphosphate at 0.15kg/tree	kg	3		
14		2:3:2 (22) at 0.15kg/m²	kg	183		
15		2:3:2 (22) at 0.15kg/tree	kg	1		
16		Agriform tablets (2yr release) at 2 x21g tablets per tree	No	44		
17		Bonemeal at 0.1kg/tree	kg	2.2		
18	9.7.12	Mulch 50mm thick bark chips	m3	1		
19	9.7.14	Trees Deliver and plant Combretum erythrophyllum (100L)	No	22		
20	9.7.15	Tree stakes and ties	No	22		
21	9.7.17	Groundcovers Tulbaghia violecea 4L @ 9/mÂ²	No	86		
22	9.7.18	Cynodon dactylon plugs	m²	226		
23	9.7.19	Hydroseeding Cynodon dactylon	m²	788		
24		Highveld grass mix	m²	3781		
		Total - Carried to Summary				**R -**

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
	PIR 14	**BILL NO. 7 : IRRIGATION**				
1	14.3.2	Provide 110 mm irrigation sleeves at positions	m	298		
		Indicated on drawing no. 113503 0000 DRG AL 7001 T0				
2	14.3.1	Supply, deliver and install irrigation as per specialist BOQ	Sum	1		
		Refer to drawing no: 113503 0000 DRG AL 7007 T0				
		Total - Carried to Summary				**R -**

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
	PLM 15	**BILL NO.8 : LANDSCAPE MAINTENANCE**				
1		Landscape Maintenance	month	3		
		Total - Carried to Summary				**R -**

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
	PA	**BILL NO.9 : FENCING**				
	PA 12.1	**Supply and erection of new fencing material complete to Drawing No:113503-0000-DRG-CC-1062:**				
1		Clearvu Mesh panel 3297 wide x 2100mm high	No	179		
2		Galvanized post, 2700 mm long	No	180		
3		Concrete post foundation (400x400x600)mm	m³	19		
4		Shark tooth spike rail, 100mm high	m	605		
5		Anti Burrow Ripper Flatwrap, 500mm wide	m	202		
	PA 12.2	**New gates:**				
6		Double Leaf Swing Gates with Clearvu Fencing complete to drawing 113503-0000-DRG-CC-1062	No	1		
7		Sliding Gates with Clearvu Fencing complete to drawing 113503-0000-DRG-CC-1062	No	3		
8	**PA 12.3**	**Drilling and blasting holes for posts and anchors**	No	72		
		Total - Carried to Summary				**R -**

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
		SUMMARY TOTAL LANDSCAPE				
		SITE CLEARANCE				-
		LANDSCAPE SOFTSCAPING				-
		LANDSCAPE MAINTENANCE				-
		FENCING				-
		TOTAL SECTION				**R -**

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
		SECTION 3 : TOWER				
	SANS 1200 F	**BILL NO. 1 : PILING**				
1		Establishment on Site for piling	SUM	1		
2		Move equipment to and set up at each pile position	No	38		
3		Standing time	h	1		
		Piles designed by contractor				
		Piles suitable for the following working loads etc including reinforcement, couplings, drilling, driving etc				
		Piles, 30m deep piles, 15Y25, R8 2 300c/c spiral,13m cage length, 40 Mpa concrete) Piles socketing into R3 shale rock.				
4		7000 kN - Load per pile(1050mm Dia.	No	38		
5		Extra Over for Tremmie Concreteing	m3	987		Included
6		Spoil removal to dedicated dumping site	m3	987		Main contractor
7		Pile Trimming to pile cut-off level	No	38		Main Contractor
		Testing				
8		Testing	No	38		
9		Establishment on site for integrity testing by	No	2		
		Testing specialist per visit				
10		Frequency response integrity testing	No	38		

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
		Total - Carried to Summary				**R -**

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
	SANS 2001 CC	**BILL NO. 2 : CONCRETE (STRUCTURAL)**				
		SCHEDULED FORMWORK ITEMS				
	SD8.2.1	**Rough:**				
		Vertical formwork to:				
1		Tower base	m²	166		
		Sloping formwork to:				
2		Curved (conical) to tower base	m²	47		
	SD8.2.2	**Smooth:**				
		Vertical formwork to:				
3		Curved external to tower shaft	m²	541		
4		Curved internal to tower shaft	m²	421		
5		Curved external and internal to upper tank walls	m²	640		
6		Curved internal & external to walls of tank access shaft,	m²	158		
7		Curved external & internal to short shaft above conical roof	m²	9		
		Sloping formwork to:				
8		Inclined (at 60 degrees) curved (conical) at shaft/tank junction, external (hopper)	m²	62		
9		Inclined (at 45 degrees) curved (conical), external face of tank (hopper)	m²	324		
10		Inclined (45 degrees) curved (conical), internal face of tank	m²	370		
11		Inclined (12 degrees) curved (conical) Soffit to tank roof	m²	306		
		Horizontal formwork to:				
12		Horizontal to soffit of tank floor	m²	24		
	SD8.2.5	**Smooth narrow widths:**				
		Different widths in the following ranges:				
13		Vertical curved to edge of slab at top of roof - 200 mm high	m	9		
14		Vertical to openings in shaft landings and slab at top of roof, up to 300 mm high	m	89		
15		Inclined curved (conical) to fillet below tank floor - 425 mm wide	m	21		
16		Horizontal curved soffit to lip of slab at top of roof (access hatch) - 200 mm wide complete with 30 mm dip	m	8		
17		Horizontal curved soffit to lip of tank 225 mm wide complete with 30 mm drip.	m	65		
18		Inside face of upstand at edge of tank roof 250 mm high,	m	64		
	SD8.2.6	**Box out holes/form voids:**				
19		1280 / 1000 mm dia box- outs in 800 mm tank floor for pipes	No	4		
20		2450 mm x 1830mm opening in 1000mm thick wall for heavy duty access door	No	1		
21		625 mm x 625 mm openings in 1000 mm, 800 mm and 600 mm thick walls for windows (high security glass bricks 4 No. 300x300)	No	24		
22		300 mm high x 200 mm wide recess in 1000 mm wall, 800 mm and 600 mm for landing slabs (reinforcement runs through)	m	80		
170.07	SD8.3.1	**SCHEDULED REINFORCEMENT ITEMS**				
		Mild-steel bars in the following:				
23		8 mm to 16 mm	t	2.00		

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
		High-tensile steel bars in the following:				
24		10 mm to 16 mm	t	70		
25		20 mm to 32 mm	t	162		
		SCHEDULED CONCRETE ITEMS				
	SD8.4.2	**Blinding layer:**				
		Class 15 MPa/19 mm FA concrete to:				
26		80 mm thick	m²	332		
	SD8.4.3	**Strength concrete:**				
		Class 25 MPa/38 mm FA concrete to:				
27		Tower base	m³	914		
		Class 35 MPa/19 mm FA concrete in:				
28		Tower shaft walls	m³	364		
29		Tank Floor, walls and access shaft	m³	402		
30		Tank roof	m³	72		
31		Shaft floor slabs (including ground floor screed)	m³	49		
32		Secondary concrete in box-outs for pipes (Inlet, outlet and scour/overflow	m³	4		
	SD8.4.4	**Unformed surface finishes:**				
		Wood-floated finishes to:				
33		Tower base below ground and top of tank acccess shaft	m²	268		
34		Roof upstand	m²	13		
		Power-floated finishes to:				
35		Tank floor, shaft floors and top of base/ ground floor	m²	213		
36		Power-floated finish to tank roof	m²	328		
	SD8.5	**Joints:**				
		Joints as detailed on the Drawings and/or specified in the Project Specifications:				
37		Type A (in tank sloped wall, 45 degrees)	m	96		
38		Type B (in tank vertical wall and bottom of water tank)	m	93		
39		Type C (in tank wall, between vertical side and sloped side)	m	65		
40		Type D (in wall of tank access shaft)	m	34		
	SD8.8	**Miscellaneous metal work:**				
	SD8.10	**Cleaning, Sterilising and Testing for watertightness:**				
41		Roof drainage .01 Full flow	No	8		
42		Clean and sterilise water tank	SUM	1		
43		Test tower for watertightness	SUM	1		
	SD8.13	**Cast in of pipes with or without puddle flanges:**				
		Over 300 mm up to 600 mm nominal bore:				
44		DN 500 pipes through 900 mm tank floor	No	4		
45		DN 500 pipes through 300 mm shaft slabs	No	18		
46		DN 500 pipes through 1000 mm shaft walls	No	3		
		Total - Carried to Summary				**R -**

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
	SANS 1200 HA	**BILL NO .3 : STRUCTURAL STEELWORK (SUNDRY ITEMS)**				
	8.3.1	**Structural Steel**				
1		Structural Steel Staircase Complete with all, handrails, grating, fixing bolts, cleats etc.	t	6.00		
		Doors				
2		TDX maximum security door from interlock systems complete with all. For access into tower	No	1		
	8.3.2	**Handrails:**				
3		Galvanised fixed handrail assembly complete and installed on Concrete floors (around staircase opening)	m	34		
4		Tank shaft	m	7		
5		Roof	m	64		
6		Galvanised removable handrails, with floor sockets complete and installed on concrete floors around access way opening	m	26		
	8.3.3	**Ladders, complete and installed:**				
7		Stainless steel ladder with safety cage inside water tank,	No	1		
8		Galvanised steel ladder with safety cage in tank shaft	No	1		
	8.3.4	**Flooring, complete and installed with frames:**				
9		Trap door and frame (galvanised), access to tank roof	No	1		
		Total - Carried to Summary				**R -**

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
		BILL NO .4 : TOWER STEEL CLADDING				
	SANS 1200 H	**Structural Steelwork**				
	8.3.1	**Supply and fabrication of steelwork:**				
		Hot-dipped galvanised steel for Tower cladding				
1		305 x 305 x97kg/m Universal column	t	156		
		Delivery to Site:				
		Normal delivery:				
2		305 x 305 x97kg/m Universal column	t	156		
		Erection on Site:				
3		305 x 305 x97kg/m Universal column	t	156		
		Supply, deliver and erect				
4		Nuts, bolts and plates for connection	t	7.74		
		Corrosion Protection of Structural Steelwork				
		Surface dressing and repairs at place of fabrication				
5		305 x 305 x97kg/m Universal column	t	156.4		
		Total - Carried to Summary				**R -**

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
		SUMMARY TOTAL TOWER				
		PILLING				-
		CONCRETE STRUCTURAL				-
		STRUCTURAL STEELWORK (SUNDRY)				-
		TOWER STEEL CLADDING				-
		TOTAL SECTION				**R -**

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
		SECTION 4 : RESERVOIR				
	SANS 1200 D	**BILL NO.1 : EARTHWORKS**				
	PSD 8.3.3	**Restricted excavation:**				
1		Excavate for footings in all materials, and use for backfill or embankment, or dispose	m³	31		
		Extra over Bulk excavation and restricted excavation items above for :				
2		Intermediate excavation	m³	3		
3		Hard rock excavation	m³	2		
4	PSD 8.3.14	Extra over restricted excavation items, for temporary stockpiling	m³	31		
		Total - Carried to Summary				**R -**

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
	SANS 1200 DF	**BILL NO. 2 : EARTHWORKS-PIPE TRENCHES**				
	PSD 8.3.2	**TRENCHES FOR STORMWATER PIPES**				
		Excavate in all materials for trenches, backfill, compact and dispose of surplus material:				
		Pipes up to 125 mm dia for depths:				
1		Up to 1,0 m	m	1,028		
2		Over 1,0 m up to 2,0 m	m	61		
	PSD 8.3.2	**Extra over excavation items above for:**				
3		Intermediate excavation	m³	247		
		Total - Carried to Summary				**R -**

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
	SANS 2001 CC	**BILL NO. 3 : CONCRETE (STRUCTURAL)**				
		SCHEDULED FORMWORK ITEMS				
	SD8.21	**Rough:**				
		Vertical formwork to:				
1		Sides of bases and strip footings	m²	317		
2		Sides of walls	m²	56		
3		Sides of mass concrete	m²	43		
	SD8.2.2	**Smooth:**				
		Vertical formwork to:				
4		Sides of walls	m²	381		
5		Sides to buttress wall	m²	37		
6		Sides of rectangular columns	m²	477		
7		Sides of beams	m²	1,033		
8		Sides of plinths	m²	5		
9		Sides of upstand beams	m²	162		
10		Inner straight side of tapered walls	m²	1,347		
11		Sides of circular column 400mm diameter with total height 4.35m	No	32		
12		Sides of circular column 400mm diameter with total height	No	48		
13		600mm x 1500mm conical base tapered to 450mm at 45 degrees	No	48		
		Sloping formwork to:				
14		Outer sloping side of tapered walls	m²	1,369		
		Horizontal formwork to:				
15		Soffits of beams	m²	659		
16		Soffits of slabs	m²	44		
		Permanent formwork				
17		Bond-dek slab	m²	44		
	SD8.2.5	**Narrow widths (up to 300 mm wide):**				
		Different widths in the following ranges:				
18		Over 100 mm and up to 200 mm	m	72		
19		Over 200 mm and up to 300 mm:	m	50		
		Grooves, chases and splays in the following ranges:				
20		Over 20 mm x 20 mm and up to 100 mm x 100 mm (chamfers to edges of slabs and beams)	m	1,403		
21		Plastic corner combi to form 25mm drip to soffits of upstand	m	280		
	SD8.2.6	**Box out formwork to form holes, openings etc:**				
		Corbels				
22		Boxing out to form 175mm thick x 375mm overall deep x 750mm long tapered corbel	No	22		
23		Boxing out to form 475 x 300 x 700mm wide corbel	No	3		
		SCHEDULED REINFORCEMENT ITEMS				
	SD8.3.1	**High-tensile steel bars in the following:**				
24		All diameters	t	438.15		

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
		SCHEDULED CONCRETE ITEMS				
	SD8.4.2	**Blinding layer:**				
		Class 15 MPa/19 mm concrete of:				
25		50mm thick under footings	m²	46		
26		125mm thick under reservoir	m²	1,957		
27		200mm thick under reservoir	m²	2,039		
	SD8.4.3	**Strength concrete:**				
		Class 15 MPa/19mm mass concrete in:				
28		Filling under footings and around pipes	m³	656		
		Class 30 MPa/19mm concrete in:				
29		Stairs	m³	8		
30		Cable trenches	m³	7		
31		Strip footings	m³	5		
33		600mm x 1500mm diameter conical base tapered to 450mm diameter at 45 degrees	m³	20		
34		Surface beds	m³	937		
35		Pad footings	m³	3		
36		Bondek slab	m³	7		
37		Structural toppings	m³	379		
38		Sump pit	m³	1		
39		Beams	m³	326		
40		Slabs	m³	6		
41		Bases	m³	26		
42		Plinths	m³	1		
		Class 35 Mpa/19mm concrete in :				
43		Concrete walls	m³	74		
44		Butress walls	m³	9		
45		Corbels	m³	1		
46		Circular columns	m³	57		
47		Rectangular columns	m³	45		
		Class 35 Mpa/19mm F30 concrete in :				
48		Wall foundations	m³	1,220		
49		Tapered walls	m³	580		
	SD8.4.4	**Unformed surface finishes:**				
		Power float finishes to:				
50		Finishing concrete smooth with a power float to surface beds, slabs and beams	m²	10,953		
	SD8.5	**Joints:**				
		Expansion joints as detailed on the Drawings and/or specified in the Project Specifications:				
51		20mm wide x 320mm thick Expansion joint in walls, comprising "Fosroc" hydrocell non-absorbent closed-cell polyethylene joint filler, SIKA FMS 350 internal water stop with steel plates, 200/2 "Sikadur combiflex" joint sealing system, and "Fosroc" Thioflex 600 polysulphide joint sealant or similar approved (Type:JT4)	m	5		

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
52		20mm wide x 300mm thick Expansion joint in surfacebeds, comprising "Fosroc" hydrocell non-absorbent closed-cell polyethylene joint filler, "Sika AM350 rearguard", and 200/2 "Sikadur combiflex" joint sealing system, or similar approved (Type: JT3B)	m	195		
53		20mm wide x 200mm thick Expansion joint cast comprising "Fosroc" hydrocell non-absorbent closed-cell polyethylene joint filler, "Sika" AM350 rearguard 200/2 "Sikadur" combiflex joint sealing system with or similar approved(Type:JT3A)	m	418		
		Construction joints as detailed on the Drawings and/or specified in the Project Specifications:				
54		300mm wide Horizontal construction joint in walls, comprising "Sika swell s-2" bentonite free polyurethane hydrophilic waterstop ,"Lanko 228" flexible waterproofing mortar of minimum of 2 coats (1.5mm thick) or similar approved (Type:J6)	m	276		
55		20mm wide x Roof expansion joint comprising "Fosroc" hydrocell non-absorbent closed cell polyethylene joint filler, "Fosroc thioflex 600" polysulphide joint sealant, polyethylene bond breaker with " Sika tricosal LF 320" tricomer with M10x115 chemical anchor bolts @ 200 c/c & 40x6mm galvanised stainless steel plates either side of joint or similar approved (Type:JT7)	m	198		
		Contraction joints as detailed on the Drawings and/or specified in the Project Specifications:				
56		300mm deep Contraction joint comprising "Sika A350" external waterstop or simila and 200/2 "Sikadur combiflex" joint sealing system withr approved (Type:JT1 and JT2)	m	1,122		
57		300mm deep Contraction joint comprising "Sika tricosal FS 310 elastomer internal waterstop" , 75x3mm backing strip, 200/2 "Sikadur combiflex" joint sealing system or similar approved (Type:JT3, JT5)	m	223		
	8.7	**Grouting:**				
58		Under bases plates	m³	0.1		
		Freysinent elastometric bearings				
59		100 x 150 x 22mm Bearings with stainless steel plates on 8mm mortar bed installed to manufactures specifications.	No	63		
60		150 x 200 x 22mm Bearings with stainless steel plates on 8mm mortar bed installed to manufactures specifications.	No	76		
		Total - Carried to Summary				**R -**

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
	SANS 2001 CC	**BILL NO. 4 : PRESTRESSED CONCRETE**				
1		Establishing on Site, maintenance and dismantling of tensioning beds and equipment	SUM	1		
	SD8.6	**Manufacture of precast prestressed units:**				
2		200mm thick Hollow core pre-stressed planks	m²	4,542		
		Total - Carried to Summary				**R -**

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
	SANS 1200 H	**BILL NO. 5 : STRUCTURAL STEELWORK**				
	8.3.1	**Supply and fabrication of steelwork:**				
		Hot dipped galvanised steel for access slab, cat ladder, channels, walkways, staircases, pumphouse roof etc				
1		40 x 40 x 4mm Thick angle section (type:kb)	t	0.35		
2		40 x 40 x 5mm Thick angle section (type:a8)	t	1.59		
3		50 x 50 x 5mm Thick angle section (type:a15)	t	0.20		
4		50 x 50 x 6mm Thick angle section (type:a16)	t	0.09		
5		60 x 60 x 6mm Thick angle section (type:a20)	t	0.25		
6		70 x 70 x 8mm Thick angle section (type:a25)	t	0.22		
7		80 x 60 x 8mm Thick angle section (type:ua7)	t	0.32		
8		90 x 65 x 8mm Thick angle section (type:ua9)	t	0.39		
9		90 x 90 x 6mm Thick angle section (type:a90)	t	0.38		
10		120 x 120 x 10mm Thick angle section (type:a44)	t	0.25		
11		88.9 x 5mm Thick circular hollow section (type:hs1)	t	0.24		
12		88.9 x 6mm Thick circular hollow section (type:hs2)	t	0.23		
13		76.2 x 5mm Thick circular hollow section (type:hs3)	t	0.09		
14		150 x 75 x 20 x 3.0mm Thick cold formed lipped channel (type:lc15)	t	1.43		
15		180 x 70 x 21.1kg/m Parallel flange channel (type:pc2)	t	2.54		
16		200 x 75 x 24.3kg/m Parallel flange channel (type:pc4)	t	0.49		
17		300 x 100 x 45.4kg/m Parallel flange channel (type:pc7)	t	0.64		
18		152 x 152 x 23kg/m Universal column (type:uc1)	t	0.75		
19		254 x 254 x 107.1kg/m Universal beam (type:uc13)	t	4.04		
	8.3.2	**Delivery to Site:**				
		Normal delivery:				
20		40 x 40 x 4mm Thick angle section (type:kb)	t	0.35		
21		40 x 40 x 5mm Thick angle section (type:a8)	t	1.59		
22		50 x 50 x 5mm Thick angle section (type:a15)	t	0.20		
23		50 x 50 x 6mm Thick angle section (type:a16)	t	0.09		
24		60 x 60 x 6mm Thick angle section (type:a20)	t	0.25		
25		70 x 70 x 8mm Thick angle section (type:a25)	t	0.22		
26		80 x 60 x 8mm Thick angle section (type:ua7)	t	0.32		
27		90 x 65 x 8mm Thick angle section (type:ua9)	t	0.39		
28		90 x 90 x 6mm Thick angle section (type:a90)	t	0.38		
29		120 x 120 x 10mm Thick angle section (type:a44)	t	0.25		
30		88.9 x 5mm Thick circular hollow section (type:hs1)	t	0.24		
31		88.9 x 6mm Thick circular hollow section (type:hs2)	t	0.23		
32		76.2 x 5mm Thick circular hollow section (type:hs3)	t	0.09		
33		150 x 75 x 20 x 3.0mm Thick cold formed lipped channel (type:lc15)	t	1.43		
34		180 x 70 x 21.1kg/m Parallel flange channel (type:pc2)	t	2.54		
35		200 x 75 x 24.3kg/m Parallel flange channel (type:pc4)	t	0.49		

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
36		300 x 100 x 45.4kg/m Parallel flange channel (type:pc7)	t	0.64		
37		152 x 152 x 23kg/m Universal column (type:uc1)	t	0.75		
38		254 x 254 x 107.1kg/m Universal beam (type:uc13)	t	4.04		
	8.3.3	**Erection on Site:**				
39		40 x 40 x 4mm Thick angle section (type:kb)	t	0.35		
40		40 x 40 x 5mm Thick angle section (type:a8)	t	1.59		
41		50 x 50 x 5mm Thick angle section (type:a15)	t	0.20		
42		50 x 50 x 6mm Thick angle section (type:a16)	t	0.09		
43		60 x 60 x 6mm Thick angle section (type:a20)	t	0.25		
44		70 x 70 x 8mm Thick angle section (type:a25)	t	0.22		
45		80 x 60 x 8mm Thick angle section (type:ua7)	t	0.32		
46		90 x 65 x 8mm Thick angle section (type:ua9)	t	0.39		
47		90 x 90 x 6mm Thick angle section (type:a90)	t	0.38		
48		120 x 120 x 10mm Thick angle section (type:a44)	t	0.25		
49		88.9 x 5mm Thick circular hollow section (type:hs1)	t	0.24		
50		88.9 x 6mm Thick circular hollow section (type:hs2)	t	0.23		
51		76.2 x 5mm Thick circular hollow section (type:hs3)	t	0.09		
52		150 x 75 x 20 x 3.0mm Thick cold formed lipped channel (type:lc15)	t	1.43		
53		180 x 70 x 21.1kg/m Parallel flange channel (type:pc2)	t	2.54		
54		200 x 75 x 24.3kg/m Parallel flange channel (type:pc4)	t	0.49		
55		300 x 100 x 45.4kg/m Parallel flange channel (type:pc7)	t	0.64		
56		152 x 152 x 23kg/m Universal column (type:uc1)	t	0.75		
57		254 x 254 x 107.1kg/m Universal beam (type:uc13)	t	4.04		
58		Nuts, bolts and plates for connections	t	1.07		
		Holding down (HD) bolts				
59		M16 Grade 8.8 with bolts and nuts	No	160		
	8.3.7	**Handrails:**				
		Stainless steel balustrading formed with 43mm diameter x 3mm thick stanchions at 1200mm centres, 33mm diameter x 2.6mm thick top and bottom rails, filled with 15mm diameter vertical bars at 125mm centres, finished on all surfaces with a epoxy coated painted finish and erected complete in strict accordance with manufactures instructions				
60		Horizontal top mounted 1100mm high bolted to steel Rectagrid walkway including ends	m	40		
61		Raking top mounted balustrading 1100mm high bolted to Rectagrid walkway	m	22		
	8.3.8	**Ladders, complete and installed:**				
62		Stainless steel ladder 4500mm high. according to drawing 11350-2000-DRG-SS-2160-TO	No	7		
	8.3.9	**Flooring, complete and installed with frames:**				
63		370mm wide x 1240mm long x 6mm thick "Vastrap" plate continuous treads with flat section stringers and both side bolted to steel member (bolts and stringer measured elsewhere).	No	25		
64		370mm wide x 1100mm long x 6mm thick "Vastrap" plate continuous treads with flat section stringers and both side bolted to steel member (bolts and stringer measured elsewhere).	No	21		

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
65		Stainless steel Rectagrid RS40 with 40 x 5mm placed on 40 x 40 x 5mm angle section (angle section measured elsewhere)	m²	64.00		
66		Stainless steel Rectagrid RS40 with 80 x 5.5mm placed on 90 x 90 x 10mm angle section (angle section measured elsewhere)	m²	5.00		
67		40 x 40 x 5mm Thick stainless steel angle section with 200 x 20 x 5 fishtail lugs welded at 500mm c/c welded along length , cast into concrete	t	0.12		
68		90 x 90 x 10mm Thick stainless steel angle section with 200 x 20 x 5 fishtail lugs welded at 500mm c/c welded along length , cast into concrete	t	0.03		
	8.3.12	**Additional items**				
		Manhole cover for access opening				
69		600 x 900mm Hinged manhole cover with locking bar (Type 9E)	No	6		
		Total - Carried to Summary				**R -**

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
	SANS 1200HB	**BILL NO. 6 : CLADDING AND SHEETING**				
	8.2.2	**Supply and install cladding and sheeting:**				
		0.58mm thick concealed fix " Klip-lok 406" or similar approved light industrial Z275 spelter galvanised steel sheeting with "Globalcoat" or similar approved finish and colour to one side, "Globalcoat Grey" or similar approved finish to other side with and including accessories fixed structural steel members.				
1		Curved roof coverings with pitches not exceeding 25Â°, fixed to steel purlins	m²	279		
	8.2.3	**Supply and install ancillaries:**				
		0.8mm thick concealed fix " Klip-lok 406" or similar approved light industrial Z275 spelter galvanised steel sheeting with "Globalcoat" or similar approved finish and colour to one side, "Globalcoat Grey" or similar approved finish to other side with and including accessories fixed structural steel members.				
2		Side wall flashing as per drawing no.113503 - 2000 - DRG - SS - 2109.	m	39		
3		Narrow or broad flute closers	m	66		
		4mm Thick Alulite 4040 insulation sheeting installed according to suppliers specification				
4		Under curved roof	m²	279		
		Total - Carried to Summary				**R -**

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
	SANS 1200 HB	**BILL NO. 7 : CORROSION AND SHEETING**				
	8.21	**Surface dressing and repairs at place of fabrication**				
1		40 x 40 x 4mm Thick angle section (type:kb)	t	0.35		
2		40 x 40 x 5mm Thick angle section (type:a8)	t	1.59		
3		45 x 45 x 5mm Thick galvanised angle section with 200 x 20 x 5 fishtail lugs welded 500mm c/c	t	0.79		
4		50 x 50 x 5mm Thick angle section (type:a15)	t	0.20		
5		50 x 50 x 6mm Thick angle section (type:a16)	t	0.09		
6		60 x 60 x 6mm Thick angle section (type:a20)	t	0.25		
7		70 x 70 x 8mm Thick angle section (type:a25)	t	0.22		
8		80 x 60 x 8mm Thick angle section (type:ua7)	t	0.32		
9		90 x 65 x 8mm Thick angle section (type:ua9)	t	0.39		
10		90 x 90 x 6mm Thick angle section (type:a90)	t	0.38		
11		120 x 120 x 10mm Thick angle section (type:a44)	t	0.25		
12		88.9 x 5mm Thick circular hollow section (type:hs1)	t	0.24		
13		88.9 x 6mm Thick circular hollow section (type:hs2)	t	0.23		
14		76.2 x 5mm Thick circular hollow section (type:hs3)	t	0.09		
15		150 x 75 x 20 x 3.0mm Thick cold formed lipped channel (type:lc15)	t	1.43		
16		180 x 70 x 21.1kg/m Parallel flange channel (type:pc2)	t	2.54		
17		200 x 75 x 24.3kg/m Parallel flange channel (type:pc4)	t	0.49		
18		300 x 100 x 45.4kg/m Parallel flange channel (type:pc7)	t	0.64		
19		152 x 152 x 23kg/m Universal column (type:uc1)	t	0.75		
20		254 x 254 x 107.1kg/m Universal beam (type:uc13)	t	4.04		
		Total - Carried to Summary				**R -**

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
	SANS 1200 LE	**BILL NO. 8 : STORMWATER DRAINAGE**				
	PSLE 8.2.14	**Accessories:**				
		Besaans-du plessis or similar approved				
1		100mm Stainless steel holderbat fix to wall with stainless steel HSL K8 anchors @ 1500mm c/c max	No	22		
		Saint Gobain Prod No 3570 or similar approved				
2		100mm 45 degree Full bore outlet cast into slab including hydrophilic water bar with puddle flange.	No	22		
		Pipes in subsurface drains:				
		Normal duty uPVC pipes complete with couplings:				
3		100 diameter perforated	m	22		
4		110 diameter perforated	m	872		
		Heavy-duty fittings:				
5		110mm dia x 90 degree bend	No	20		
6		110mm x 110mm dia T-junction	No	32		
7		110mm x 45 degree bend	No	2		
8	PSLE 8.2.15	Geofabric, (Geotextile Kaymat U24) or similar approved	m²	1,636		
9	PSLE 8.2.16	Class 15/19 non-fines concrete for subsurface drains	m³	242		
10		Clean sand compacted to 100% MOD ASHTO	m³	172		
		Total - Carried to Summary				**R -**

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
	SANS 2001 CC	**BILL NO. 9 : MISCELLANEOUS WORK FOR RESERVOIRS**				
1	SD8.10	Testing for water tightness	Sum	1		
		Miscellaneous items:				
		Measured by linear metre:				
		Kaytech GPA 250 or similar approved wick drain including "Bidim A2" filter jacket installed according manufacturers specification.				
2	SD8.4.11	In between soil and concrete 5000mm centers	m	303		
		Measured by area:				
3	SD8.4.11	10mm thick Power floated mortar skin between non fines concrete and DPC	m2	1957		
		4 mm Derbigum CG3 & CG4 fusion bonded waterproofing including turn-ups,sealing along edges and bituminous paint coat:				
4	SD8.4.11	On flat roofs including sides and tops of upstand beams	m²	4,711		
		Protective roof sheeting				
	SANS 1200 HB	2-Layers 3-ply Bitiminous roofing felt				
5	8.2.2	2 layers 3-ply bituminous roofing felt	m²	202		
		Total - Carried to Summary				**R -**

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
	SANS 2001 CC	**BILL NO. 10 : NO-FINES CONCRETE**				
		Class 15 Mpa /19mm concrete in:				
1	SD8.4.7	75mm thick NF 19 Cast-in-situ	m³	398		
		Total - Carried to Summary				**R -**

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
	PD.01	**BILL NO. 11 : BUILDING WORK**				
	PD 10.01	**Brickwork:**				
1		230mm thick NFX load-bearing engineering bricks with 14Mpa mortar (1:4 cement:sand)	m²	351		
	PD 10.02	**Plaster work:**				
		Internal Plaster				
2		15mm thick internal cement plaster, steel-float finish	m²	172		
		External Plaster				
3		15mm thick, external cement plaster wood float finish	m²	278		
	PD 10.03	**Floor screeds:**				
4		Average 75mm Thick 20Mpa screed to falls - Reservoir	m²	4,711		
5		Average 75mm Thick 25Mpa screed to falls - Pumphouse	m²	44		
	PD 10.04	**Doors and windows:**				
		Aluminium louvres complete with frame and glazed panels:				
7		900 x 900mm "Trox" or similar approved aluminium lourvers	No	9		
	PD 10.07	**Joinery:**				
		Items measured by number:				
8		Semi solid core flush panelled single door size 813 x 2032 x 44mm thick, cut 100mm short, with commercial veneered finish suitable for painting on both sides including pressed steel double rebated door frame suitable for 230mm wall, including all necessary ironmongery.	No	3		
	PD 10.08	**Miscellaneous work:**				
		(a) Paintwork				
		One coat wood primer and two coats eggshell enamel paint:				
9		Timber doors	m²	10		
		One coat universal undercoat and two coats eggshell enamel paint:				
10		Steel door frames	m²	1		
		One coat primer, one undercoat and two coats PVA emulsion paint on:				
11		Internal plastered walls	m²	278		
12		External plastered walls	m²	172		
	PD 10.09	**Miscellaneous items:**				
		Items measured by number:				
13		4800 x 3400mm high Purpose made Motorised galvanised steel security gates comprising 60kg/m2 steel frame and guide frame, complete with and including wheels, rails, cover plates, motor etc. as per drawings and specifications.	No	1		
		Items measured by length:				
14		150mm Wide brick reinforcement built in horizontally	m	356		
15		75 x 110mm Wide precast presstresed concrete lintels	m	38		
16		300mm wide Precast sills	m	22		
		Items measure by area:				
		250 micron green medium density polyethylene damp-proof sheeting:				

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
17		Two layers 250 micron Waterproofing sheet under surface bed and cable trenches etc.	m²	2,290		
18		One layer 250 micron Waterproofing sheet under surface beds, cable trenches etc	m²	378		
		375 micron Consol Plastics Brikgrip Embossed DPC				
19		One layer 375 micron Consol Plastics Brikgrip Embossed DPC	m²	22		
		Total - Carried to Summary				**R -**

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
		SUMMARY TOTAL RESERVOIR				
		EARTHWORKS				-
		EARTHWORKS-PIPE TRENCHES				-
		CONCRETE (STRUCTURAL)				-
		PRESTRESSED CONCRETE				-
		STRUCTURAL STEELWORK				-
		CLADDING AND SHEETING				-
		CORROSION PROTECTION				-
		STORMWATER DRAINAGE				-
		MISC RESERVOIRS				-
		NO-FINES CONCRETE				-
		BUILDING WORK				-
		TOTAL SECTION				**R -**

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
		SECTION 4 : RESERVOIR				
		SECTION 4.2 : MECHANICAL				
	ZUT 0002	**BILL NO. 1 : OPERATING AND MAINTENANCE MANUALS**				
1	5.1	Supply and delivery of O&M manuals for all mechanical items	Sum	1		
		Total - Carried to Summary				**R -**

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
	ZUT 5019	**BILL NO. 2 : HORIZONTAL SPLIT CASING CENTRIFUGAL PUMPS**				
		Refer to drawing 113503-0000-DRG-MM-5010				
	22.1	**Supply and delivery of pumps**				
1		Horizontal split casing centrifugal pump, complete with motor, coupling, baseframe and anciliaries	No	2		
	22.2	**Installation, testing and commissioning of pumps**				
2		Horizontal split casing centrifugal pump, complete with motor, coupling, baseframe and anciliaries	No	2		
	ZUT 5020	**Submersible centrifugal pumps**				
		Refer to drawing 113503-0000-DRG-MM-5070				
	16.1	**Supply and delivery of pumps**				
3		Submersible pump, complete with duckfoot, guides and quick coupling	No	1		
	16.2	**Installation, testing and commissioning of pumps**				
4		Submersible pump, complete with duckfoot, guides and quick coupling	No	1		
		Total - Carried to Summary				**R -**

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
	ZUT 7004	**BILL NO. 3 : VALVES**				
		Refer to drawing 113503-0000-DRG-MM-5000 and sub-assembly drawings				
	12.1	**Supply and deliver to site**				
1		DN600 PN16 wedge gate valves, non-rising spindle c/w gearbox	No	2		
2		DN500 PN16 wedge gate valves, non-rising spindle c/w gearbox	No	3		
3		DN450 PN16 wedge gate valves, non-rising spindle c/w gearbox	No	4		
4		DN400 PN16 wedge gate valves, non-rising spindle c/w gearbox	No	5		
5		DN400 PN16 Wedge gate valve	No	1		
6		DN350 PN16 Wedge gate valve	No	1		
7		DN600 PN16 Swing type non return valve	No	1		
8		DN400 PN16 Swing type non return valve	No	2		
9		DN100 PN16 Swing type non return valve	No	1		
10		DN450 PN16 Ball float valve	No	2		
11		DN400 PN16 Pressure reducing valve (PRV)	No	1		
12		DN100 PN16 RSV gate valves	No	6		
13		DN100 PN16 Air valve	No	2		
14		DN50 PN16 Ball valves	No	5		
15		DN25 PN16 Ball valves	No	10		
16		DN600 PN16 Dismantling Joint	No	2		
17		DN500 PN16 Dismantling Joint	No	3		
18		DN450 PN16 Dismantling Joint	No	4		
19		DN400 PN16 Dismantling Joint	No	6		
20		DN350 PN16 Dismantling Joint	No	1		
21		DN250 PN16 Dismantling Joint	No	2		
	12.2	**Installation of plant**				
22		DN600 PN16 wedge gate valves, non-rising spindle c/w gearbox	No	2		
23		DN500 PN16 wedge gate valves, non-rising spindle c/w gearbox	No	3		
24		DN450 PN16 wedge gate valves, non-rising spindle c/w gearbox	No	4		
25		DN4000 PN16 wedge gate valves, non-rising spindlee c/w gearbox	No	5		
26		DN400 PN16 Wedge gate valve	No	1		
27		DN350 PN16 Wedge gate valve	No	1		
28		DN600 PN16 Swing type non return valve	No	1		
29		DN400 PN16 Swing type non return valve	No	2		
30		DN100 PN16 Swing type non return valve	No	1		
31		DN450 PN16 Ball float valve	No	2		
32		DN400 PN16 Pressure reducing valve (PRV)	No	1		

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
33		DN100 PN16 RSV gate valves	No	6		
34		DN100 PN16 Air valve	No	2		
35		DN50 PN16 Ball valves	No	5		
36		DN25 PN16 Ball valves	No	10		
37		DN600 PN16 Dismantling Joint	No	2		
38		DN500 PN16 Dismantling Joint	No	3		
39		DN450 PN16 Dismantling Joint	No	4		
40		DN400 PN16 Dismantling Joint	No	6		
41		DN350 PN16 Dismantling Joint	No	1		
42		DN250 PN16 Dismantling Joint	No	2		
		Total - Carried to Summary				**R -**

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
	ZUT 7001	**BILL NO. 4 : MANUFACTURING OF STEEL SPECIALS**				
		Refer to the drawings, specification and data sheets for information relating to the pipe material, lining and coating				
	8.2.1	**Supply of specials**				
		Refer to drawing 113503-0000-DRG-MM-5020; Reservoir Inlet Pipework				
1		Item 1: DN 600 Pipe Spool	No	1		
2		Item 2: DN 450 Pipe Spool	No	2		
3		Item 5: DN 450 Pipe Spool	No	1		
4		Item 6: DN 450 Pipe Spool	No	1		
5		Item 7: DN 450 Pipe Spool	No	1		
6		Item 8: DN 450 Pipe Spool	No	12		
7		Item 9: DN 450 Pipe Spool	No	1		
8		Item 10: DN 450 Pipe Spool	No	1		
9		Item 11: DN 450 Pipe Spool	No	1		
10		Item 12: DN 450 Pipe Spool	No	1		
11		Item 14: DN 450 Pipe Spool	No	1		
12		Item 15: DN 450 Pipe Spool	No	1		
13		Item 16: DN 450 Pipe Spool	No	1		
14		Item 17: DN 450 Pipe Spool	No	1		
15		Item 18: DN 450 Pipe Spool	No	1		
		Refer to drawing 113503-0000-DRG-MM-5030; Reservoir Outlet Pipework				
16		Item 1: DN 450 Pipe Spool	No	2		
17		Item 2: DN 450 Pipe Spool	No	1		
18		Item 5: DN 450 Pipe Spool	No	2		
19		Item 6: DN 600 Pipe Spool	No	1		
20		Item 10: DN 600 Pipe Spool	No	1		
21		Item 11: DN 600 Pipe Spool	No	1		
22		Item 12: DN 450 Pipe Spool	No	1		
23		Item 16: DN 450 Pipe Spool	No	1		
24		Item 18: DN 100 Pipe Spool	No	1		
25		Item 19: DN 450 Full-face flange insulating gasket kit	No	2		
		Refer to drawing 113503-0000-DRG-MM-5010; Pump Pipework				
26		Item 2: DN 500 Reducing Pipe Spool	No	2		
27		Item 3: DN 500 Pipe Spool	No	2		
28		Item 6: DN 500 Pipe Spool	No	2		
29		Item 7: DN 500 Pipe Spool	No	2		
30		Item 9: DN 400 Reducing Pipe Spool	No	2		
31		Item 10: DN 400 Pipe Spool	No	2		
32		Item 12: DN 500 Full-face flange insulating gasket kit	No	2		
33		Item 14: DN 400 Pipe Spool	No	1		
34		Item 15: DN 400 Pipe Spool	No	1		

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
35		Item 16: DN 400 Pipe Spool	No	1		
36		Item 17: DN 400 Pipe Spool	No	1		
37		Item 18: DN 400 Pipe Spool	No	1		
38		Item 19: DN 400 Pipe Spool	No	1		
39		Item 20: DN 400 Pipe Spool	No	1		
40		Item 21: DN 400 Pipe Spool	No	1		
41		Item 22: DN 50 Pipe Spool	No	1		
42		Item 24: DN 50 Pipe Spool	No	1		
		Refer to drawing 113503-0000-DRG-MM-5050; Bypass				
43		Item 1: DN 400 Pipe Spool	No	1		
44		Item 2: DN 400 Pipe Spool	No	1		
45		Item 6: DN 400 Pipe Spool	No	1		
46		Item 8: DN 400 Pipe Spool	No	1		
47		Item 9: DN 500 Pipe Spool	No	1		
48		Item 12: DN 500 Pipe Spool	No	1		
49		Item 14: DN 500 Pipe Spool	No	2		
50		Item 15: DN 500 Pipe Spool	No	1		
		Refer to drawing 113503-0000-DRG-MM-5040; Scour and Overflow Pipework				
51		Item 1: DN 350 Reducing Pipe Spool	No	1		
52		Item 2: DN 350 Reducing Pipe Spool	No	1		
53		Item 3: DN 350 Pipe Spool	No	3		
54		Item 4: DN 350 Pipe Spool	No	1		
55		Item 7: DN 350 Pipe Spool	No	1		
56		Item 8: DN 700 Reducing Pipe Spool	No	1		
57		Item 9: DN 700 Pipe Spool	No	1		
58		Item 10: DN 700 Pipe Spool	No	2		
59		Item 11: DN 700 Pipe Spool	No	1		
60		Item 12: DN 350 Full-face flange insulating gasket kit	No	1		
61		Item 13: DN 700 Pipe Spool	No	1		
62		Item 14: DN 700 Pipe Spool	No	1		
63		Item 15: DN 700 Full-face flange insulating gasket kit	No	1		
		Refer to drawing 113503-0000-DRG-MM-5060; Tower Pipework				
64		Item 1.1: DN 400 Pipe Spool	No	1		
65		Item 1.2: DN 400 Pipe Spool	No	3		
66		Item 1.3: DN 400 Pipe Spool	No	1		
67		Item 1.4: DN 400 Pipe Spool	No	1		
68		Item 1.5: DN 400 Pipe Spool	No	1		
69		Item 1.6: DN 400 Full-face flange insulating gasket kit	No	1		
70		Item 2.1: DN 500 Pipe Spool	No	1		
71		Item 2.2: DN 500 Pipe Spool	No	1		

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
72		Item 2.3: DN 500 Pipe Spool	No	2		
73		Item 2.4: DN 500 Pipe Spool	No	1		
74		Item 2.5: DN 500 Pipe Spool	No	1		
75		Item 2.6: DN 500 Full-face flange insulating gasket kit	No	1		
76		Item 3.1: DN 500 Pipe Spool	No	1		
77		Item 3.2: DN 500 Pipe Spool	No	2		
78		Item 3.3: DN 500 Pipe Spool	No	1		
79		Item 3.4: DN 500 Pipe Spool	No	1		
80		Item 3.7: DN 400 Pipe Spool	No	1		
81		Item 3.8: DN 400 Pipe Spool	No	1		
82		Item 3.9: DN 500 Pipe Spool	No	1		
83		Item 3.10: DN 500 Pipe Spool	No	1		
84		Item 3.11: DN 500 Pipe Spool	No	1		
85		Item 3.12: DN 500 Pipe Spool	No	1		
86		Item 3.13: DN 500 Pipe Spool	No	1		
87		Item 3.14: DN 500 Full-face flange insulating gasket kit	No	1		
88		Item 3.15: DN 400 Full-face flange insulating gasket kit	No	1		
		Refer to drawing 113503-0000-DRG-MM-5060; Sump Pump Assembly				
89		Item 2: DN 100 Pipe Spool	No	1		
90		Item 4: DN 100 Pipe Spool	No	2		
91		Item 5: DN 100 Pipe Spool	No	1		
		Total - Carried to Summary				**R -**

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
	ZUT 7003	**BILL NO. 5 : LAYING OF STEEL SPECIALS**				
	8.2.1	**Lay and bed steel pipes and specials complete with couplings**				
		Refer to drawing 113503-0000-DRG-MM-5020; Reservoir Inlet Pipework				
1		Item 1: DN 600 Pipe Spool	No	1		
2		Item 2: DN 450 Pipe Spool	No	2		
3		Item 5: DN 450 Pipe Spool	No	1		
4		Item 6: DN 450 Pipe Spool	No	1		
5		Item 7: DN 450 Pipe Spool	No	1		
6		Item 8: DN 450 Pipe Spool	No	12		
7		Item 9: DN 450 Pipe Spool	No	1		
8		Item 10: DN 450 Pipe Spool	No	1		
9		Item 11: DN 450 Pipe Spool	No	1		
10		Item 12: DN 450 Pipe Spool	No	1		
11		Item 14: DN 450 Pipe Spool	No	1		
12		Item 15: DN 450 Pipe Spool	No	1		
13		Item 16: DN 450 Pipe Spool	No	1		
14		Item 17: DN 450 Pipe Spool	No	1		
15		Item 18: DN 450 Pipe Spool	No	1		
		Refer to drawing 113503-0000-DRG-MM-5030; Reservoir Outlet Pipework				
16		Item 1: DN 450 Pipe Spool	No	2		
17		Item 2: DN 450 Pipe Spool	No	1		
18		Item 5: DN 450 Pipe Spool	No	2		
19		Item 6: DN 600 Pipe Spool	No	1		
20		Item 10: DN 600 Pipe Spool	No	1		
21		Item 11: DN 600 Pipe Spool	No	1		
22		Item 12: DN 450 Pipe Spool	No	1		
23		Item 16: DN 450 Pipe Spool	No	1		
24		Item 18: DN 100 Pipe Spool	No	1		
25		Item 19: DN 450 Full-face flange insulating gasket kit	No	2		
		Refer to drawing 113503-0000-DRG-MM-5010; Pump Pipework				
26		Item 2: DN 500 Reducing Pipe Spool	No	2		
27		Item 3: DN 500 Pipe Spool	No	2		
28		Item 6: DN 500 Pipe Spool	No	2		
29		Item 7: DN 500 Pipe Spool	No	2		
30		Item 9: DN 400 Reducing Pipe Spool	No	2		
31		Item 10: DN 400 Pipe Spool	No	2		
32		Item 12: DN 500 Full-face flange insulating gasket kit	No	2		
33		Item 14: DN 400 Pipe Spool	No	1		
34		Item 15: DN 400 Pipe Spool	No	1		

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
35		Item 16: DN 400 Pipe Spool	No	1		
36		Item 17: DN 400 Pipe Spool	No	1		
37		Item 18: DN 400 Pipe Spool	No	1		
38		Item 19: DN 400 Pipe Spool	No	1		
39		Item 20: DN 400 Pipe Spool	No	1		
40		Item 21: DN 400 Pipe Spool	No	1		
41		Item 22: DN 50 Pipe Spool	No	1		
42		Item 24: DN 50 Pipe Spool	No	1		
		Refer to drawing 113503-0000-DRG-MM-5050; Bypass				
43		Item 1: DN 400 Pipe Spool	No	1		
44		Item 2: DN 400 Pipe Spool	No	1		
45		Item 6: DN 400 Pipe Spool	No	1		
46		Item 8: DN 400 Pipe Spool	No	1		
47		Item 9: DN 500 Pipe Spool	No	1		
48		Item 12: DN 500 Pipe Spool	No	1		
49		Item 14: DN 500 Pipe Spool	No	2		
50		Item 15: DN 500 Pipe Spool	No	1		
		Refer to drawing 113503-0000-DRG-MM-5040; Scour and Overflow Pipework				
51		Item 1: DN 350 Reducing Pipe Spool	No	1		
52		Item 2: DN 350 Reducing Pipe Spool	No	1		
53		Item 3: DN 350 Pipe Spool	No	3		
54		Item 4: DN 350 Pipe Spool	No	1		
55		Item 7: DN 350 Pipe Spool	No	1		
56		Item 8: DN 700 Reducing Pipe Spool	No	1		
57		Item 9: DN 700 Pipe Spool	No	1		
58		Item 10: DN 700 Pipe Spool	No	2		
59		Item 11: DN 700 Pipe Spool	No	1		
60		Item 12: DN 350 Full-face flange insulating gasket kit	No	1		
61		Item 13: DN 700 Pipe Spool	No	1		
62		Item 14: DN 700 Pipe Spool	No	1		
63		Item 15: DN 700 Full-face flange insulating gasket kit	No	1		
		Refer to drawing 113503-0000-DRG-MM-5060; Tower Pipework				
64		Item 1.1: DN 400 Pipe Spool	No	1		
65		Item 1.2: DN 400 Pipe Spool	No	3		
66		Item 1.3: DN 400 Pipe Spool	No	1		
67		Item 1.4: DN 400 Pipe Spool	No	1		
68		Item 1.5: DN 400 Pipe Spool	No	1		
69		Item 1.6: DN 400 Full-face flange insulating gasket kit	No	1		
70		Item 2.1: DN 500 Pipe Spool	No	1		
71		Item 2.2: DN 500 Pipe Spool	No	1		
72		Item 2.3: DN 500 Pipe Spool	No	2		

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
73		Item 2.4: DN 500 Pipe Spool	No	1		
74		Item 2.5: DN 500 Pipe Spool	No	1		
75		Item 2.6: DN 500 Full-face flange insulating gasket kit	No	1		
76		Item 3.1: DN 500 Pipe Spool	No	1		
77		Item 3.2: DN 500 Pipe Spool	No	2		
78		Item 3.3: DN 500 Pipe Spool	No	1		
79		Item 3.4: DN 500 Pipe Spool	No	1		
80		Item 3.7: DN 400 Pipe Spool	No	1		
81		Item 3.8: DN 400 Pipe Spool	No	1		
82		Item 3.9: DN 500 Pipe Spool	No	1		
83		Item 3.10: DN 500 Pipe Spool	No	1		
84		Item 3.11: DN 500 Pipe Spool	No	1		
85		Item 3.12: DN 500 Pipe Spool	No	1		
86		Item 3.13: DN 500 Pipe Spool	No	1		
87		Item 3.14: DN 500 Full-face flange insulating gasket kit	No	1		
88		Item 3.15: DN 400 Full-face flange insulating gasket kit	No	1		
		Refer to drawing 113503-0000-DRG-MM-5060; Sump Pump Assembly				
89		Item 2: DN 100 Pipe Spool	No	1		
90		Item 4: DN 100 Pipe Spool	No	2		
91		Item 5: DN 100 Pipe Spool	No	1		
		Total - Carried to Summary				**R -**

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
	ZUT 1003	**BILL NO. 6 : LIFTING EQUIPMENT**				
	15.1	**Supply and delivery**				
1		Single Girder Electric Overhead Travelling Crane (SGEOT), 5 ton lifting capacity	No	1		
	15.2	**Installation, testing and commissioning**				
2		Single Girder Electric Overhead Travelling Crane (SGEOT), 5 ton lifting capacity	No	1		
		Ventilation for Plant Rooms				
	ZUT 1008	**Supply and delivery**				
3	17.1	MCC room filtered fresh air pressurisation unit comprising weather cowl, filter plenum with compact pocket filters, centrifugal fan (500 L/s at 140 Pa), weather louvres, mountings, isolator, controls, wiring and ancillaries	No	1		
4		MCC room split type air conditioning unit 24 000 BTUh cooling only	No	1		
		Installation, testing and commissioning				
5	17.1	MCC room filtered fresh air pressurisation unit comprising weather cowl, filter plenum with compact pocket filters, centrifugal fan (500 L/s at 140 Pa), weather louvres, mountings, isolator, controls, wiring and ancillaries	No	1		
6		MCC room split type air conditioning unit 24 000 BTUh cooling only	No	1		
		Pressure Gauges and Instrumentation				
	ZUT 0000	**Supply and delivery**				
7	7.1	Pressure gauges for pump suction and discharge	No	4		
		Installation, testing and commissioning				
8	7.2	Pressure gauges for pump suction and discharge	No	4		
		Spares				
		Supply and delivery				
		Supply and delivery of spare items …… …… …… …… …… ……				
		Total - Carried to Summary				**R -**

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
	ZUT 0000	**BILL NO. 7 : COMMISSIONING**				
1	7.2	Pre-commissioning of mechanical equipment	Sum	1		
2	7.2	Commissioning of integrated system	Sum	1		
		Total - Carried to Summary				**R -**

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
		SUMMARY TOTAL ELECTRICAL				
		O&M MANUALS ECE				-
		PUMPS ECE				-
		VALVES ECE				-
		PIPEWORK ECE				-
		MISCELLANEOUS ECE				-
		COMMISSIONING ECE				-
		TOTAL SECTION				**R -**

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
		SECTION 4 : RESERVOIR				
		SECTION 4.3 : ELECTRICAL				
		BILL NO.1 : ELECTRICAL APPLICATION				
		1. This Bill of Quantities shall be read in conjunction with the Installer's Scope of Work, Technical Specifications and the Engineer design drawings with all other Engineering decipline drawings.				
		2. All rates shall include Supply and Install. These items shall the items in this Bill shall include all wiring, cabling, connections, terminations, installation and termination accessories, possible cable-joints, cable-glands, cable-ties, cable-clips, clamps, shrouds, couplers, lugs, screw-caps, nuts, connectors, terminal strips, heat-shrink, insulating material, etc. for the electrical cables and conductors. It is the responsibility of the contractor to make a fully working system				
		3. It is the responsibility of the contractor to ensure all items are allowed for in this Bill of Quantities.				
		4. NB: It is the responsibility of the contractor to supply a fully operational and compliant system.				
		5. All items in this Bill of quantities are remeasurable and only installed Quantities will be paid for.				
		Electricity application (by Johannesburg Water)				
1		Application from the electricity power supply authority of City Power (Johannesburg) for a 400kVA, 400V, 3-phase power supply	Sum	1		
2		Electricity power supply authority of City Power (Johannesburg) power supply installation, including 400kVA mini-substation transformer with 25MPa concrete plinth, MV electrical cabling, cable markers, trenching, sleeves for cabling, IP 68 rated switch board and smart energy meter	Sum	1		
3		Liaison with main contractor	Sum	1		
4		Notices and safety / danger signs as per the OHS Act.	Sum	1		
		Ancillaries and accessories				
5		Any other item required for completion of the installation, not specified else where - specify	Sum	1	-	-
		Total - Carried to Summary				**R -**

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
		BILL NO. 2 : PRELIMINARY AND GENERAL				
		1. This Bill of Quantities shall be read in conjunction with the Installer's Scope of Work, Technical Specifications and the Engineer design drawings with all other Engineering decipline drawings.				
		2. All rates shall include Supply and Install. These items shall the items in this Bill shall include all wiring, cabling, connections, terminations, installation and termination accessories, possible cable-joints, cable-glands, cable-ties, cable-clips, clamps, shrouds, couplers, lugs, screw-caps, nuts, connectors, terminal strips, heat-shrink, insulating material, etc. for the electrical cables and conductors. It is the responsibility of the contractor to make a fully working system				
		3. It is the responsibility of the contractor to ensure all items are allowed for in this Bill of Quantities.				
		4. NB: It is the responsibility of the contractor to supply a fully operational and compliant system.				
		5. All items in this Bill of quantities are remeasurable and only installed Quantities will be paid for.				
		Liason with other parties				
1		Liaison with main contractor	Sum	1		
		Documentation				
2		"For Construction" drawings, hard copy and CD	Sets	3		
3		Detailed Scope of Works, Project Safety Plan and Safe Work Method Statement	Sets	3		
4		As-built drawings in Auto CAD/Revit format, on a CD	Sets	3		
5		Operators and Maintenance Manuals, hard copy and CD	Sets	3		
6		Commissioning Sheets and Installation Checklists	Sets	3		
7		Labeling of all devices, equipment and cables	Sum	1		
8		Drawings for approval (Engineers approval)	Sum	1		
		Testing and commissioning				
9		Test and commission of the bulk electrical supply and road lighting installation system and issue reports and certificates as required by the standards and specifications	Sum	1		
		Training:				
10		End-user training	Sum	1		
		Warranty:				
11		Mounting structure: Workmanship guarantee/Product replacement warranty of 10 years	Sum	1		
12		All inclusive post practical completion 12 month SLA for complete installation	Sum	1		
13		Balance of mechanical and electrical Works: Workmanship guarantee/Product replacement warranty of 10 years	Sum	1		
		Preliminary and General				
14		Time related P&G's	Sum	1		
15		Fixed P&G's	Sum	1		
16		Site establishment and disestablishment	Sum	1		

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
17		Other costs Allow for all costs which the Contractor may incur in terms of any or all of description in these documents and of the drawings which costs are not specifically covered in the schedule below. Submit full details. NOTE: *Value related P&G's should be included in the tendered rates*	Sum	1		
		Total - Carried to Summary				**R -**

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
		BILL NO. 3 : GENERATOR				
		1. This Bill of Quantities shall be read in conjunction with the Installer's Scope of Work, Technical Specifications and the Engineer design drawings with all other Engineering decipline drawings.				
		2. All rates shall include Supply and Install. These items shall the items in this Bill shall include all wiring, cabling, connections, terminations, installation and termination accessories, possible cable-joints, cable-glands, cable-ties, cable-clips, clamps, shrouds, couplers, lugs, screw-caps, nuts, connectors, terminal strips, heat-shrink, insulating material, etc. for the electrical cables and conductors. It is the responsibility of the contractor to make a fully working system.				
		3. It is the responsibility of the contractor to ensure all items are allowed for in this Bill of Quantities.				
		4. NB: It is the responsibility of the contractor to supply a fully operational and compliant system.				
		5. All items in this Bill of quantities are remeasurable and only installed Quantities will be paid for.				
		Back-up power diesel generator				
1		Supply, deliver, install and commissioning of a 350kVA (pf = 1) enclosed sound proof PRIME rated back-up diesel generator CANOPY set, including change-over panel with circuit breakers as specified in specifications.	Sum	1		
2		2000 litre diesel after commissioning	L	2,000		
3		Concrete plinth, including sleeves	Sum	1		
4		12-month SLA	Sum	1		
5		Extended Fuel Tank to ensure for 2-days diesel supply	Sum	1		
6		Min 2200L concrete catch-pit for diesel spillage	Sum	1		
		Ancillaries and accessories				
7		Any other item required for completion of the installation, not specified else where - specify	Sum	1	-	-
		Total - Carried to Summary				**R -**

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
		BILL NO. 4 : DISTRIBUTION BOARDS				
		1. This Bill of Quantities shall be read in conjunction with the Installer's Scope of Work, Technical Specifications and the Engineer design drawings with all other Engineering decipline drawings.				
		2. All rates shall include Supply and Install. These items shall the items in this Bill shall include all wiring, cabling, connections, terminations, installation and termination accessories, possible cable-joints, cable-glands, cable-ties, cable-clips, clamps, shrouds, couplers, lugs, screw-caps, nuts, connectors, terminal strips, heat-shrink, insulating material, etc. for the electrical cables and conductors. It is the responsibility of the contractor to make a fully working system				
		3. NB: It is the responsibility of the contractor to supply a fully operational and compliant system.				
		4. All items in this Bill of quantities are remeasurable and only installed Quantities will be paid for.				
		5. The electrical cable and wiring shall comply with the SANS wiring colour codes: **Protective earth (PE) - green-yellow** **Neutral (N) - black** **Line, single phase (L) - red** **Line, three phase (L1) - red** **Line, three phase (L2) - yellow** **Line, three phase (L3) - blue**				
		6. Supply, testing, deliver, off-loading, and commissioning of distribution boards complete with test certifications as per SANS 61439-1 and IEC 61439-1 standards for distribution boars, including factory inspection, all equipment pre fitted in the factory complete with busbars, accessories, earthing and conduit terminations in accordance with electrical specifications.				
		7. The distribution board requirements are shown on the single line diagrams (schematic diagrams) drawings.				
		8. Shop drawings shall be submitted to the Engineer for formal approval before any manufacturing commences.				
		Distribution Boards				
1		MCC - NEW BRIXTON RESERVIOR PUMP STATION	No	1		
2		All additional items necessary to provide a complete motor control centre installation as per speicification.	No	1		
3		DB - GH Refer to single line diagram for size and rating	No	1		
4	400.04	Pump 1 Control Panel Including VA meter, indicator lights, reset switch if motor is tripped, manual ON/OFF switches, etc. Surface mounted.	No	1		
5	400.05	Pump 2 Control Panel Including VA meter, indicator lights, reset switch if motor is tripped, manual ON/OFF switches, etc. Surface mounted.	No	1		
6	400.06	5 kVA, 230Vac Uninterruptable Power Supply (UPS) with 30min battery back-up, installed in floor standing panel with mounting over 800mm trench, including ventilation fan.	No	1		
		Energy Meter				
7		PM 3255 Energy meter to be installed in the change-over panel on the main supply cable side after the protection switch gear (main switch) of the normal power and generator power supply, including fuses and mounting accessories.	No	2		
8		NSX 630N with Micrologic 2.3 fixed in the 400kVA minisub low voltage (LV) compartment for the "Generator Change-over & Control panel" supply.	No	1		

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
		Switch Gear				
9		NSX 630N with Micrologic 2.3 fixed in the 400kVA minisub low voltage (LV) compartment for the "Generator Change-over & Control panel" supply.	No	1	-	-
		Certificate of Compliance				
10		Issue CoC completion of complete electrical installation	Sum	1	-	-
		Ancillaries and accessories				
11		Any other item required for completion of the installation, not specified else where - specify	Sum	1	-	-
		Total - Carried to Summary				**R -**

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
		BILL NO. 5 : LOW VOLTAGE CABLES				
		1. This Bill of Quantities shall be read in conjunction with the Installer's Scope of Work, Technical Specifications and the Engineer design drawings with all other Engineering decipline and Architectural drawings.				
		2. All rates shall include Supply and Install. These items shall the items in this Bill shall include all wiring, cabling, connections, terminations, installation and termination accessories, possible cable-joints, cable-glands, cable-ties, cable-clips, clamps, shrouds, couplers, lugs, screw-caps, nuts, connectors, terminal strips, heat-shrink, insulating material, etc. for the electrical cables and conductors. It is the responsibility of the contractor to make a fully working system				
		3. NB: It is the responsibility of the contractor to supply a fully operational and compliant system.				
		4. All items in this Bill of quantities are remeasurable and only installed Quantities will be paid for.				
		5. The electrical cable and wiring shall comply with the SANS wiring colour codes: **Protective earth (PE) - green-yellow** **Neutral (N) - black** **Line, single phase (L) - red** **Line, three phase (L1) - red** **Line, three phase (L2) - yellow** **Line, three phase (L3) - blue**				
		6. The Contractor shall supply, install and commission all the reticulation and distribution cables as specified in the cable schedules. The rate shall include for all the labeling materials required to complete the instalaltion. All cables will be installed in the ground and enter the DB's via sleeves.				
		PVC/PVC/SWA/PVC Cu				
1		185mm², 4-Core	m	160		
2		150mm², 4-Core	m	130		
3		16mm², 3-Core	m	315		
4		10mm², 3-Core	m	460		
		PVC/PVC/PVC Cu				
5		10mm², 5-Core	m	40		
6		4mm², 3-Core	m	330		
7		2.5mm², 3-Core	m	450		
		BCEW (Bare Cu Earth Wire)				
8		70mm², 1-Core	m	315		
9		2.5mm², 1-Core	m	360		
		Ancillaries and accessories				
10		Any other item required for completion of the installation, not specified else where - specify	Sum	1		
		Total - Carried to Summary				**R -**

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
		BILL NO. 6 : CABLE ROUTING & WIRE WAYS				
		1. This Bill of Quantities shall be read in conjunction with the Installer's Scope of Work, Technical Specifications and the Engineer design drawings with all other Engineering decipline and Architectural drawings.				
		2. All rates shall include Supply and Install. These items shall the items in this Bill shall include all wiring, cabling, connections, terminations, installation and termination accessories, possible cable-joints, cable-glands, cable-ties, cable-clips, clamps, shrouds, couplers, lugs, screw-caps, nuts, connectors, terminal strips, heat-shrink, insulating material, etc. for the electrical cables and conductors. It is the responsibility of the contractor to make a fully working system				
		3. It is the responsibility of the contractor to ensure all items are allowed for in this Bill of Quantities.				
		4. NB: It is the responsibility of the contractor to supply a fully operational and compliant system.				
		5. All items in this Bill of quantities are remeasurable and only installed Quantities will be paid for.				
		Marker tape				
1		Supply and install PVC marker type suitably to be laid in cable trenches, 150mm wide, yellow coloured and marked "DANGER: ELECTRIC CABLE BELOW"	m	350		
		Cable route marker				
2		500x300x300mm Concrete cable route marker with marker plate as per specification drawing	No	2		
		Cable trenching				
3		Excavation, backfilling, leveling and carting away of excess material to cable trenches as specified - 1000mm deep for MV cabling.	m	40		
4		Excavation, backfilling, leveling and carting away of excess material to cable trenches as specified - 600mm deep for LV cabling.	m	240		
5		Extra over excavation for excavation in soft rock (Provisional)	m³	80		
6		Extra over excavation for excavation in hard rock (Provisional)	m³	40		
7		Backfilling and compact of trench with imported soil (Provisional)	m³	40		
8		Backfilling of cable trench with imported sifted soft soil 200mm thick (Provisional)	m³	80		
		Services holes (Man holes)				
9		1400mm deep, 1600mm x 1600mm services holes (manhole) with a heavy duty cast iron cover and frame for sleeves and to pull cabling and wiring through	No	4		
		Cable tray				
		MILD STEEL HOT DIPTED GALV. PT-76 heavy duty Supply and install galv steel cable trays complete with all wall and floor mounting P2000 supports, splicing other fixing materials required as per suppliers specifications. Cable tray earth wire at every joint.				
10	604.01	457mm x 76mm - straight runs (excluding cover)	m	95		

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
	605	**Cable tray - Wire Mesh**				
		MILD STEEL HOT DIPTED GALV. GS-50 gridspan Wire Mesh Supply and install galv steel cable trays complete with all wall and floor mounting P2000 supports, splicing other fixing materials required as per suppliers specifications. Cable tray earth wire at every joint.				
11	605.01	300mm x 50mm - straight runs	m	46		
12	605.02	300mm - T-off	No	1		
13	605.03	**Miscellaneous** Steel angle irons for the support of motor feeder cables - 50mm x 50mm, including all materials required to complete the installation. Cable to be strapped to support with "Bandit " strapping.	m	30		
14		Unistrut 50mm x 50mm for the supporting of all types of cables, including all materials required to complete the installation and strapping of cables with "Bandit" strapping.	m	75		
		Conduits & Wire Ways				
15		160mm diameter PVC sleeves	m	85		
16		110mm diameter PVC sleeves	m	350		
17		25mm GALV. steel conduit	m	120		
18		32mm GALV. steel conduit	m	380		
19		25mm PVC. conduit	m	165		
		Wall Boxes				
20		All sizes up to 100x100x100	No	18		
		Statutory requirements				
21		Complying with statutory requirements with regard to trenching at public accessible areas, including all materials required..	Sum	1		
		Ancillaries and accessories				
22		Any other item required for completion of the installation, not specified else where - specify	Sum	1		
		Total - Carried to Summary				**R -**

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
		BILL NO.7 : SMALL POWER & LIGHTING				
		1. This Bill of Quantities shall be read in conjunction with the Installer's Scope of Work, Technical Specifications and the Engineer design drawings with all other Engineering discipline and Architectural drawings.				
		2. All rates shall include Supply and Install. These items shall the items in this Bill shall include all wiring, cabling, connections, terminations, installation and termination accessories, possible cable-joints, cable-glands, cable-ties, cable-clips, clamps, shrouds, couplers, lugs, screw-caps, nuts, connectors, terminal strips, heat-shrink, insulating material, etc. for the electrical cables and conductors. It is the responsibility of the contractor to make a fully working system.				
		3. It is the responsibility of the contractor to ensure all items are allowed for in this Bill of Quantities.				
		4. NB: It is the responsibility of the contractor to supply a fully operational and compliant system.				
		5. All items in this Bill of quantities are remeasurable and only installed Quantities will be paid for.				
		Supply, and install switched & unswitched socket outlets points, surface/flush mounted or flush in power skirting mounted, complete with cradle, galvanized wall-draw box, cover plate, including PVC/GALV. conduits and all conduit accessories, all mounting accessories, and wiring:				
1		16A, single switched socket outlet, recessed in wall. (BS-546, SANS-164)	No	3.00		
2		16A, WATER TIGHT (water & dust proof) single switched socket outlet, surface mounted on wall. (BS-546, SANS-164)	No	3.00		
3		64A, WATER TIGHT (water & dust proof) 5-PIN, 400V, industrial welding socket outlet, surface mounted on wall. (IEC 60 309-1, -2, -4)	No	1.00		
		Supply, and install switched & unswitched socket outlets points, surface/flush mounted or flush in power skirting mounted, complete with cradle, galvanized wall-draw box, cover plate, including PVC/GALV. conduits and all conduit accessories, all mounting accessories, and wiring:				
4	701.01	30A, WATER TIGHT (water & dust proof) 2-Pole lockable isolator switch, for extractor fans, surface mounted.	No	2		
5	701.02	30A, WATER TIGHT (water & dust proof) 2-Pole lockable isolator switch, for a 230 Vac overhead crane, surface mounted.	No	1		
6	701.03	20A, WATER TIGHT (water & dust proof) 4-Pole lockable isolator switch, for roller shutter door / or motorised sliding door, surface mounted.	No	1		
7	701.04	60A, WATER TIGHT (water & dust proof) 4-Pole lockable isolator switch, for a 230 Vac overhead crane, surface mounted.	No	1		
8	701.05	250A, INDUSTRIAL ISOLATOR SWITCH, WATER TIGHT (water & dust proof) 4-Pole lockable isolator switch, for a Water Pumps	No	2		
		EMERGENCY STOP				
9		Supply and install Emergency stop push buttons as per specification, installed in positions as indicated complete with mounting poles, plates, etc. as needed to complete the installation. Cable to be strapped to support	No	2		
	703	Supply, deliver and install luminaires, complete with all mounting accessories, wiring terminations. Install luminaires as per construction drawings:				

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
	703.02	**Type A: 81W LED, 4000K** LED industrial luminaire, surface mounted, IP66, with electronic control gear, BEKA LEDnova 5120, or similar performance specification	No	8		
	703.03	**Type Ae: 81W LED, 4000K** LED industrial luminaire, surface mounted, IP66, with electronic control gear, 60min self maintained battery back-up, BEKA LEDnova 5120, or similar performance specification	No	8		
10	703.01	2x 54W, T5 fluorescent , 4000K, IP65 Industrial luminaire with electronic control gear, BEKA VAPOURLINE, or similar performance specification	No	5		
10	703.04	2x 54W, T5 fluorescent , 4000K, IP65 Industrial luminaire with electronic control gear, 60min self maintained battery back-up, BEKA VAPOURLINE, or similar performance specification	No	1		
11	703.04	18W, LED, 4000K, IP65 Industrial luminaire with electronic control gear, BEKA-BEKABULK, or similar performance specification	No	7		
12	703.04	18W, LED, 4000K, IP65 Industrial luminaire with electronic control gear, 60min self maintained battery back-up, BEKA-BEKABULK, or similar performance specification	No	12		
13	703.05	138W, LED luminaire SCHREDER LEDlume MIDI 5098 64 CREE XP-G2 700mA NW flat extra clear glass - including electronic control gear BEKA, or similar performance specification	No	10		
14	703.06	279W, LED, 4000K, IP66 Flood light luminaire with electronic control gear, BEKA-LEDflood, or similar performance specification	No	1		
15	703.07	Aviation obstruction lights	No	4		
16	703.08	Decorative LED stip lighting, for water tower water level indication, including switching, power supply for driver, link to communications control instumentation for switching signal, IP65, UV protection, 45m LED strip.	No	5		
	704	Supply, deliver and install light switch points complete with cradle, cover plate, including all mounting and installation accessories with PVC/GALV. conduits and all conduit accessories, wall boxes, wiring, etc.:				
17	704.01	1 lever 1 way light switch, surface mounted	No.	3		
18	704.02	1 lever 1 way WATER TIGHT light switch (water & dust proof), surface mounted	No.	5		
19	704.03	Weather proof photo-cell light switch	No.	1		
	705	Glavanised steel light pole, including internal wiring, circuit breakers, connectors for 4-core cabling + earth, earthing electrode, surge protection, mounting accessories and concrete foundation with reinforcement, etc.				
20	705.01	Galvanised steel light pole, 8m	No.	10		
21	705.02	Solar power option for street lighting, including 80W LED luminare, solar panel, battery box, 2x 150Ah batteries, etc BEKA-SOLAR, or similar performance specification	No.	10		
	706.00	**Ancillaries and accessories**				
	706.01	Any other item required for completion of the installation, not specified else where - specify	Sum	1		
		Total - Carried to Summary				**R -**

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
		BILL 8: EARTHING & LIGHTNING PROTECTION				
		1. This Bill of Quantities shall be read in conjunction with the Installer's Scope of Work, Technical Specifications and the Engineer design drawings with all other Engineering decipline drawings.				
		2. It is the responsibility of the contractor to ensure all items are allowed for in this Bill ofQuantities.				
		3. NB: It is the responsibility of the contractor to supply a fully operational andcompliant system.contractor to supply a fully operational andcompliant system.				
		4. All items in this Bill of quantities are remeasurable and only installed Quantitieswill be paid for.				
1	800	Design, supply, deliver and install all equipment and materials required to complete the earthing and bonding installation system for the complete pump station, reservoir, water tower, guard house and external light poles as indicated below, by a specialist installation contractor. All rates shall allow for material and labour required per item to complete the installation.	Sum	1		
2	800.01	Conduct soil resistivity survey in open ground onsite at various positions ascertain resistivity ofground for lighting protection and equipmentearthing systems.	Sum	1		
3	800.02	Evaluation of soil resistivity survey, incl. soil,prospection sheet, graph & report	Sum	1		
4	800.03	Extensible copper earth electrodes 1.2m long16mm Ø mechanically driven into the ground,including couplings etc.	No	12		
5	800.04	Test joint boxes bonded to reinforcement steel including conduit and cover plates.	No	8		
6	800.05	70mm² BCEW strap between re-enforcing andtest box as well as the strap between test box &earthing electrode, complete.	m	80		
7	800.06	10mm² solid round aluminiumair termination conductor	m	65		
8	800.07	Aluminium stand-off bracket including PVCbacking sealing strip fixed with two screws tostructure (nearest earthed column)	No	68		
9	800.08	Air rod terminal finial complete with bracket,holding down bolts, etc. fixed to structure.	No	15		
10	800.09	Bonding of air termination conductor betweenroof, gutter, steel column, mast, etc	No	26		
11	800.1	Supply, deliver and install, 70 mm² BCEWconnected with U-bolt and plate to steelreinforcing. Exposed end of earth wire to beblack insulated conductor and connected to steelroof sheeting.	m	30		
12	800.11	Final testing of equipment earth grid systems oncompletion and issuing of test certificate	Sum	1		
13	800.12	Bonding of all the metal parts of the complete installation.	Sum	1		
	801.00	**Ancillaries and accessories**				
	801.01	Any other item required for completion of the installation, not specified else where - specify	Sum	1	-	
		Total - Carried to Summary				**R -**

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
		BILL NO. 9 : FIRE DETECTION				
		1. This Bill of Quantities shall be read in conjunction with the Installer's Scope of Work, Technical Specifications and the Engineer design drawings with all otherEngineering decipline drawings.				
		2. It is the responsibility of the contractor to ensure all items are allowed for in this Bill ofQuantities.				
		3. NB: It is the responsibility of the contractor to supply a fully operational andcompliant system.				
		4. All items in this Bill of quantities are remeasurable and only installed Quantitieswill be paid for.				
		Design, supply, deliver and install all equipment and materials required to complete the fire detection system installation for the complete pump station, by a specialist installation contractor. All rates shall allow for material and labour required per item to complete theinstallation.				
		Design, Supply and Install				
1		Design, supply, install and commissioning of acomplete automated addressable Fire Detectionsystem, by a specialist	Sum	1		
		Fire Alarm control panel				
2		Addressable fire alarm control panel, equippedfor multi loops and networked together, withpower supply and other specified requirementsto be linked to a repeater fire panel in the guard house, and to link with the Johannesburg Watermain control room via the telemetry panel.	No	1		
3		Addressable repeater Fire Alarm control panel inthe guard	No	1		
		Fire detectors				
4		Addressable smoke sensor, with andetector base	No	6		
5		Addressable thermal/smoke combination sensor,with an detector	No	2		
		Break glass units				
6		Addressable, indoor, resettable break glass unitwith surface box	No	2		
		Strobes & sounders				
7		Addressable combined sounder and strobe to bemounted on a detector base	No	3		
		Interface units				
8		Addressable input unit to monitor potential free contacts	No	3		
9		Addressable relay output unit to switch off valvechambers, water pump units, smoke extractorfans, trigger access control fire doors, etc.and other systems.	No	6		
10		Addressable Zone Interface Unit	No	3		
		Emergency exit sign lighting				
11		Emergency "EXIT" sign luminaire, switched by by fire alarm signa	No	2		
		Ancillaries and accessories				
12		Any other item required for completion of the installation, not specified else where - specify	Sum	1		
		Total - Carried to Summary				**R -**

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
		BILL NO. 10 : INSTRUMENTATION INSTALLATION				
		1. This Bill of Quantities shall be read in conjunction with the Installer's Scope of Work, Technical Specifications and the Engineer design drawings with all otherEngineering decipline drawings.				
		2. It is the responsibility of the contractor to ensure all items are allowed for in this Bill of Quantities.				
		3. NB: It is the responsibility of the contractor to supply a fully operational andcompliant system.				
		4. All items in this Bill of quantities are remeasurable and only installed Quantitieswill be paid for.				
		Supply, deliver and install all equipment andmaterials required to complete theinstrumentation system installation. All ratesshall allow for material and labour requiredper item to complete the installation.				
		Marshalling Cabinet				
1		Marshalling cabinet, 800mm(W) x 600mm(D) x 2200mm(H) complete with : - slotted trunking around perimeter on 'inside of cabinet - 5 horisontal rows of sloted trunking - 5 horisontal DIN rails - 4 horisontal rows of Phoenix universal terminal 'blocks, minimum 120 terminals per row	No	1.00		
		Junction Boxes				
2		Motor-pump Junction Box complete with 48 terminal strips, DIN rails, gland plates,mounting equipment, etc.	No	3.00		
		HMI - Data Panel for local control				
3		Colour graphics capable screen with minimum12 fully programmable buttons, internal memory,interface to PLC, etc. to complete installation.	No	1.00		
4		Programming to complete installation. Allow forall programming of data panel, PLC, etc. Datapanel to display all signals, and control all motorsand valves locally via interface to PLC. All signalstatus and values to be displayed.	No	1.00		
		Supply and install all instrumentation and accessories.Allow for installation of instrumentation listed below and specified on engineering drawings. All hook-up cables, hook-up boxes (Pratley Box) and all other materials required to complete the installation shall be allowed for.				
		Ultrasonic level Transmitter, IP55including transducer, flange mounted for process conecctionincluding 24V power supply and conduits,all mounting accessories and hook-up materials,				
5		Reservior, including 3x level switches	No	1.00		
6		Water Tower, including 3x level switches	No	1.00		
		Ultrasonic flow meter, IP65with 4-20mA into 250Ω output load,stainless steel membrane, including 24V power supply and conduits,all mounting accessories and hook-up materials,flow transmittes, etc.as specified in the specifications				
7		for DN500 piping	No	4.00		
8		for DN450 piping	No	2.00		
9		for DN400 piping	No	1.00		
		Pressure measurement, including transmitters,with 4-20mA into 250Ω output load, 24V powersupply, mounting accessories and hook-up.materialswith 4-20mA into 250Ω output load, 24V powersupply, mounting accessories and hook-up.materials				
10		PI-xx with PS-xx	No	4.00		
11		PIT	No	4.00		

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
		Temperature measurement,including transmitters,mounting accessories and hook-up materials.				
12		TIT-xx & TE bearing temperature	No	8.00		
13		TIT-xx & TE winding phase temperature	No	6.00		
		Vibration measurement, including transmitters, mounting accessories and hook-up materials.				
14		VIT-xx & VT bearing temperature	No	16.00		
		Process Switches including transmitters, mounting accessories and hook-up materials.				
15		XS-xx - typical: local /remote	No	12.00		
16		HS-xx & Position Switches	No	6.00		
17		HS-xx Control Switches	No	8.00		
		SURGE PROTECTION				
		Supply and install surge protection for the following signals inside the Marshalling cubicle. Including connection to earth bar.				
18		Analog Signal	No	1.00		
19		Digital	No	1.00		
20		Power	No	1.00		
21		Power Supply 24VDC 15Amp	No	1.00		
		Instrumentation Cables				
		Twisted pair instrument cable (Individually screened overall screened) Supply, installation on cable ladders, termination ton erminals, complete with ferrules and labels. Cable glands to be used.				
22		1 Pair	m	100.00		
23		2 Pair	m	460.00		
24		4 Pair	m	120.00		
25		6 Pair	m	120.00		
26		8 Pair	m	120.00		
27		24 Pair	m	140.00		
28		RS485 to IP Convertors	No	1.00		
		Cable / Instruments Support				
29		3R12 stainless steel 25mm x 25mm angle iron for support of instrument cables, including all materials required to complete the installation. Cable to be strapped to support with "Bandit" strapping.	m	28.00		
30		Stanchions for mounting of pressuretransmitters and gauges. Length 1.5mm x 50mm.Rate to include for all materials required to complete the installation.	No	6.00		
31		Workshop drawings for approval, on AutoCAD or DXF format including all Loop drawings.	Sum	1.00		
32		Manuals as specified	Sets	3.00		
33		Testing of System	Sum	1.00		
34	1017	40 inch LED screenfor school education purpose linked with theSCADA system to indicate reservior and watertower water levels, water flow, water pump operation, etc.Position to be coordinated at the school.	Sum	1.00		
35		Other: List all other equipment required to complete the installation specified.	Sum	1.00		
		Total - Carried to Summary				**R -**

ITEM NO.	PAYREF	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
		SUMMARY TOTAL ELECTRICAL				
		ELECTRICAL APPLICATION				-
		PRELIMINARY AND GENERAL				-
		GENERATOR				-
		DISTRIBUTION BOARDS				-
		LOW VOLTAGE CABLES				-
		CABLE ROUTING & WIRE WAYS				-
		SMALL POWER & LIGHTING				-
		EARTHING & LIGHTNING PROTECTION				-
		FIRE DETECTION				-
		INSTRUMENTATION INSTALLATION				-
		TOTAL SECTION				**R -**

ITEM NO.	DESCRIPTION	AMOUNT
	FINAL SUMMARY	
SECTION 1	PRELIMINARIES AND GENERAL	R -
SECTION 2	**EXTERNAL WORKS**	
SECTION 2.1	BULK EARTHWORKS	R -
SECTION 2.2	ROADS	R -
SECTION 2.3	STORMWATER	R -
SECTION 2.4	SEWER & POTABLE	R -
SECTION 2.5	SCOUR PIPELINE	R -
SECTION 2.6	COLLECTION CHAMBER	R -
SECTION 2.7	BULK PIPELINE PHASE 1	R -
SECTION 2.8	BULK PIPELINE PHASE 2	R -
SECTION 2.9	BULK PIPELINE PHASE 3	R -
SECTION 2.10	BULK PIPELINE PHASE 4	R -
SECTION 2.11	BULK PIPELINE PHASE 5	R -
SECTION 2.12	CATHODIC PROTECTION	R -
SECTION 2.13	LANDSCAPE AND FENCING	R -
SECTION 3	**TOWER**	
SECTION 3.1	TOWER	R -
SECTION 4	**RESERVOIR**	
SECTION 4.1	RESERVOIR	R -
SECTION 4.2	MECHANICAL	R -
SECTION 4.3	ELECTRICAL	R -
	TOTAL SCHEDULE OF QUANTITIES	**R -**
	CONTINGENCIES (10% of the total Schedule of Quantities)	R -
	ESCALATION	R -
	SUBTOTAL	**R -**
	VALUE ADDED TAX (15% of the Subtotal)	R -
	TENDER SUM CARRIED TO FORM OF TENDER	**R -**