



## TENDER COVER PAGE

MBD 1

YOU ARE HEREBY INVITED TO BID FOR REQUIREMENTS OF JOHANNESBURG WATER

BID NUMBER: JW 14406

CLOSING DATE: 05 DECEMBER 2024

CLOSING TIME: 10:30 AM

DESCRIPTION: LINBRO PARK TOWER (WITH ASSOCIATED WORKS)

CIDB REQUIREMENTS: TENDERERS SHOULD HAVE A CONTRACTOR CIDB GRADING OF 8CE OR HIGHER

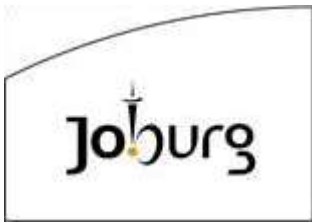
BRIEFING SESSION	COMPULSARY
BRIEFING DETAILS	<p>DATE AND TIME 11 NOVEMBER 2024 AT 13:00</p> <p>ADDRESS : JOHANNESBURG WATER RESERVOIR @ CNR CLULEE ROAD AND PEACE STREET, LINBRO PARK</p> <p>VENUE : LINBRO PARK</p> <p>TENDERS RECEIVED FROM NON-ATTENDED BIDDERS OF A COMPULSORY BRIEFING SESSION WILL NOT BE DISQUALIFIED</p> <p><b>Notes:</b> <i>For offsite briefing attendees to ensure that transport used is capable to access the gravel road for site viewing.</i></p>
TENDER SUBMISSION DETAILS	<p>BID DOCUMENTS MUST BE DEPOSITED IN THE TENDER BOX SITUATED AT GROUND FLOOR IN JOHANNESBURG WATER</p> <p>ADDRESS: TURBINE HALL, 65 NTEMI PILISO STREET, NEWTOWN, JOHANNESBURG, 2001</p> <p>PLEASE ALLOW SUFFICIENT TIME TO ACCESS JOHANNESBURG WATER OFFICES IN TURBINE HALL AND DEPOSIT YOUR TENDER DOCUMENT IN THE JOHANNESBURG WATER TENDER BOX SITUATED AT RECEPTION BEFORE TENDER CLOSING TIME.</p> <p>TIMES: THE BUILDING WILL OPEN 7 DAYS A WEEK FROM 06:00 UNTIL 18:00</p>

## BIDDER INFORMATION

BIDDER INFORMATION				
NAME OF BIDDER				
POSTAL ADDRESS				
PHYSICAL ADDRESS				
TELEPHONE NUMBER				
CELLPHONE NUMBER				
E-MAIL ADDRESS				
VAT REGISTRATION NUMBER				
TAX COMPLIANCE STATUS	TCS PIN		MAAA No	
OTHER STATUS	COIDA Registration No		CIDB No	

## EMPLOYER INFORMATION

DEPARTMENT	JW - PMU	DEPARTMENT	SCM
CONTACT PERSON	Seemole Tleane	CONTACT PERSON	Gcina Ndela
TELEPHONE NUMBER	011 688 1470	TELEPHONE NUMBER	011 688 1796
E-MAIL ADDRESS	<a href="mailto:Seemole.tleane@jwater.co.za">Seemole.tleane@jwater.co.za</a>	E-MAIL ADDRESS	<a href="mailto:gcina.ndela@jwater.co.za">gcina.ndela@jwater.co.za</a>



**DOCUMENTS DOWNLOADED FROM THE ETENDER PORTAL IS AT NO COST BUT MUST COMPLY WITH SUBMISSION REQUIREMENTS.**

**WITHOUT LIMITATION, JOHANNESBURG WATER TAKES NO RESPONSIBILITY FOR ANY DELAYS IN ANY COURIER OR POSTAL SYSTEM OR ANY LOGISTICAL DELAYS WITHIN THE PREMISES OF JOHANNESBURG WATER. JOHANNESBURG WATER LIKEWISE TAKES NO RESPONSIBILITY FOR OFFERS DELIVERED TO A LOCATION OTHER THAN THE TENDER BOX AS PER THE TENDER SUBMISSION DETAILS STATED IN THE TENDER. PROOF OF POSTING OR OF COURIER DELIVERY WILL NOT BE TAKEN BY JOHANNESBURG WATER AS PROOF OF DELIVERY. TENDER SUBMISSION DOCUMENTS MUST BE IN THE BOX BEFORE TENDER CLOSURE.**

**The current Johannesburg Water Supply Chain policy is applicable which is available on the JW website [www.johannesburgwater.co.za](http://www.johannesburgwater.co.za)**

**THE TENDERER IS ENCOURAGED TO SIGN THE TENDER SUBMISSION REGISTER WHEN SUBMITTING THEIR TENDERS.**

**PLEASE ENSURE YOU SUBMIT 1 x ORIGINAL TENDER HARD DOCUMENT  
(1 X Original Tender document and 1 X Electronic copy in memory stick/ USB).**

**Any documents required that are not submitted in the tender box at the deadline will be considered late.**

**The tenderer accepts that Johannesburg Water will not take responsibility for the misplacement or premature opening of the tender if the outer package is not sealed and marked as stated.**

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

**NAME OF CONTACT PERSON: .....**

**SIGNATURE OF BIDDER: .....**

**CAPACITY UNDER WHICH THIS BID IS SIGNED: .....**

**DATE: .....**

## **PART B**



## TERMS AND CONDITIONS FOR BIDDING

### 1. BID SUBMISSION:

- 1.1. BIDS MUST BE DELIVERED BY THE STIPULATED TIME TO THE CORRECT ADDRESS. LATE BIDS WILL NOT BE ACCEPTED FOR CONSIDERATION.
- 1.2. **ALL BIDS MUST BE SUBMITTED ON THE OFFICIAL FORMS PROVIDED– (NOT TO BE RE-TYPED) OR ONLINE**
- 1.3. THIS BID IS SUBJECT TO THE PREFERENTIAL PROCUREMENT POLICY FRAMEWORK ACT AND THE PREFERENTIAL PROCUREMENT REGULATIONS, 2022, THE GENERAL CONDITIONS OF CONTRACT (GCC) AND, IF APPLICABLE, ANY OTHER SPECIAL CONDITIONS OF CONTRACT.

### 2. TAX COMPLIANCE REQUIREMENTS

- 2.1 BIDDERS MUST ENSURE COMPLIANCE WITH THEIR TAX OBLIGATIONS.
- 2.2 BIDDERS ARE REQUIRED TO SUBMIT THEIR UNIQUE PERSONAL IDENTIFICATION NUMBER (PIN) ISSUED BY SARS TO ENABLE THE ORGAN OF STATE TO VIEW THE TAXPAYER'S PROFILE AND TAX STATUS.
- 2.3 APPLICATION FOR THE TAX COMPLIANCE STATUS (TCS) CERTIFICATE OR PIN MAY ALSO BE MADE VIA E-FILING. IN ORDER TO USE THIS PROVISION, TAXPAYERS WILL NEED TO REGISTER WITH SARS AS E-FILERS THROUGH THE WEBSITE [WWW.SARS.GOV.ZA](http://WWW.SARS.GOV.ZA).
- 2.4 FOREIGN SUPPLIERS MUST COMPLETE THE PRE-AWARD QUESTIONNAIRE IN PART B:3.
- 2.5 BIDDERS MAY ALSO SUBMIT A PRINTED TCS CERTIFICATE TOGETHER WITH THE BID.
- 2.6 IN BIDS WHERE CONSORTIA / JOINT VENTURES / SUB-CONTRACTORS ARE INVOLVED, EACH PARTY MUST SUBMIT A SEPARATE TCS CERTIFICATE / PIN / CSD NUMBER.
- 2.7 WHERE NO TCS IS AVAILABLE BUT THE BIDDER IS REGISTERED ON THE CENTRAL SUPPLIER DATABASE (CSD), A CSD NUMBER MUST BE PROVIDED.

### 3. QUESTIONNAIRE TO BIDDING FOREIGN SUPPLIERS

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

**IF THE ANSWER IS "NO" TO ALL OF THE ABOVE, THEN IT IS NOT A REQUIREMENT TO REGISTER FOR A TAX COMPLIANCE STATUS SYSTEM PIN CODE FROM THE SOUTH AFRICAN REVENUE SERVICE (SARS) AND IF NOT REGISTER AS PER 2.3 ABOVE.**

**NB: FAILURE TO PROVIDE ANY OF THE ABOVE PARTICULARS MAY RENDER THE BID INVALID.**



## **TENDER NOTICE AND INVITATION TO TENDER**



### **1. TENDER NOTICE AND INVITATION TO TENDER**

Johannesburg Water (SOC) Ltd invites the tenderer for the following:

**CONTRACT NO. JW 14406 LINBRO PARK TOWER (WITH ASSOCIATED WORKS)**

The tender document will be available in the form of a download from the Johannesburg Water website ([www.johannesburgwater.co.za/supply\\_chain/tenders](http://www.johannesburgwater.co.za/supply_chain/tenders)) starting from 02 November 2024.

All tenders and supporting documents must be submitted in a sealed envelope and be placed in the Tender box on the ground floor of the Johannesburg Water by no later than 10:30 am on 05 December 2024.

Address is as follows:

**TURBINE HALL, 65 NTEMI PILISO STREET, NEWTOWN, JOHANNESBURG, 2001**

Johannesburg Water (SOC) Ltd is not obliged to accept the lowest or any tender and Johannesburg Water reserves to appoint:

- a) in whole or in part.
- b) to more than one tenderer.
- c) to the highest points scoring bidder.
- d) to the lowest acceptable tender or highest acceptable tender in terms of the point scoring system.
- e) to a bidder not scoring the highest points (based on objective grounds in terms of section 2 (1) (f) of the PPPFA) (where applicable).
- f) not to consider any bid with justifiable reasons.

A valid and binding contract with the successful tender/s will be concluded once Johannesburg Water has awarded the contract. Johannesburg Water (SOC) Ltd and the successful tenderer/s will sign the contract agreement forms.



# Johannesburg Water SOC Ltd



**CONTRACT NO: JW 14406**

**LINBRO PARK TOWER (WITH ASSOCIATED WORKS)**

**VOLUME 1**

**TENDER AND CONTRACT**

Prepared by  
PMU  
PO Box 61542  
Marshalltown  
2107

V2.0  
August 2023



Employer:		Contractor:	
Witness:		Witness:	



The Tenderer is to indicate in the “Submitted (Yes/No)” column in the below table that they have completed the required section of the tender document. Completion of this checklist 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 for contract award – refer T2.2.4. The below will form part of the tender document, the tenderers are therefore encouraged to submit the returnable and or documentation with their tender offer to avoid elimination especially with regards to what is stated in the Required for Tender Evaluation column or not obtaining points for Specific Goals. Tenderers are encouraged to ensure that their Tax status remains Tax Compliant on CSD throughout the process to avoid delaying the process or being eliminated at award stage. For infrastructure related projects. Tenderer must have a CIDB Active Status at the requested CIDB requirement at evaluation stage to avoid disqualification.

All documentation listed in the Checklist below shall form part of the Contract.

Table 1

Ref	Description of Returnable/s or Documentation that will form Part of Contract and must therefore to be Completed and / or Submitted by the Tenderer	Required for Tender Evaluation	Required for Tender Award	Required After Tender Award	Submitted (Yes/No)
	<b>Tender Cover:</b>				
	Name of Tender	•			
	Contact Person	•			
	Telephone Number	•			
	Central Supplier Database Registration	•			
	CIDB Registration Number, minimum required CIDB grading for the tender and Active Status – if applicable	•			
	COIDA Registration Number			•	
	Tax SARS PIN No.		•		
	MAAA No. for Tax Compliant Status		•		
	Bank Details Form		•		
	<b>Mandatory Documents at Particular Stage:</b>				
	CIDB grading of 8CE or higher. Active Status at the required CIDB grading or higher at the time of Evaluation.	•			
	Mandatory Tender Briefing Meeting	•			
	<b>Complete and sign the Form of Offer</b>	•			
	<b>Sign BOQ</b>	•			
T2.1	Signed Certificate of Authority to Sign	•	•		
	<b>Administrative Documentation:</b>				
	MBD 1 - Invitation to Bid - Completed and signed	•	•		
	Acknowledgement of Project Tender Drawings	•	•		
	Acknowledgement of SHE Specification & Annexures	•	•		
T2.2.4	MBD 4 - Declaration of interest -	•	•		
	Employer:		Contractor:		
	Witness:		Witness:		



	Completed and signed				
	MBD 5 - Declaration for procurement above R10 Million (all applicable taxes included) Completed and signed.	•	•		
	MBD 6.1 - Preference Points Schedule – Specific Goals and Price Points - Completed and signed.	•			
T2.2.4	MBD 8 - Bidder's past supply chain management practices – Completed and signed.	•	•		
T2.2.4	MBD 9 - Certificate of Independent Bid Determination – Completed and signed.	•	•		
	Municipal Rates and Taxes for the Tenderer - Current municipal rates for the <b>company</b> not older than 90 days (if leasing/renting, submitted proof such as lease agreement where premises are rented), OR Confirmation that suitable arrangements are in place for arrear municipal obligations with your local municipality. OR Current municipal rates which is not older than 90 days or valid lease agreement with affidavit from owner of the property in cases stated in Proof of Good standing with regards to municipal Accounts document in the Tender.	•	•		
	Municipal Rates and Taxes - Current municipal rates for the <b>directors</b> of the entity not older than 90 days (if leasing/renting, submitted proof such of lease agreement where premises are rented), OR Confirmation that suitable arrangements are in place for arrear municipal obligations with your local municipality. OR Current municipal rates which is not older than 90 days or valid lease agreement with affidavit from owner of the property in cases stated in Proof of Good standing with regards to municipal Accounts document in the Tender.	•	•		
	3-year financial statements (audited where applicable)	•	•		
	Any qualifications. If "Yes", reference to such qualification/s must be indicated on a cover letter. Please be aware that alterations on the tender document may result in your tender being <b>eliminated as the qualification may impede on the</b>	•			

Employer:		Contractor:	
Witness:		Witness:	



	<b>ability to evaluate like with like.</b>				
4.	<b>Functionality Documentation:</b>				
	Documentary Evidence Required for Criteria 1 - <b>(Contactable Reference Letters)</b>	•			
	Documentary Evidence Required for Criteria 2 – <b>(Contactable Reference Letters)</b>	•			
	Documentary Evidence Required for Criteria 3 – <b>(Contactable Reference Letters)</b>	•			
	Documentary Evidence Required for Criteria 4 – <b>(CV &amp; Qualifications)</b>	•			
	Documentary Evidence Required for Criteria 5 – <b>(CV &amp; Qualifications)</b>	•			
	Documentary Evidence Required for Criteria 6 – <b>(CV &amp; Qualifications)</b>	•			
	Documentary Evidence Required for Criteria 7 – <b>(Page/ pages of specific Method)</b>	•			
5.	<b>Specific Goals:</b>				
	Business located within the boundaries of COJ Municipality	•			
	Business owned by 51% or more Women	•			
6.	<b>Pricing Schedule:</b>				
	Bill of Quantities/ Schedule of Quantities completed in accordance with the award strategy	•			
	Alterations authenticated – Refer to Conditions of Tender	•			
7.	<b>Terms and Conditions:</b>				
	General Conditions of Contract	•			
	Special Conditions	•			
	Tender Data	•			
8.	<b>Other Documents</b>				
	Form of Acceptance ... (do not complete, it will only be completed after award)			•	
	Third Liability Insurance			•	
	Insurance of Works			•	
	Common Law Liability Insurance			•	
	Insurance of Construction Plant and Equipment			•	
	Valid Registration with Compensation for Occupation Injuries and Diseases Act			•	
	Performance Security – where applicable for industrial related services			•	
	Bank Details Form			•	

Employer:		Contractor:	
Witness:		Witness:	



Contract No. JW 14406  
Description: Linbro Park Tower (With Associated Works)  
Volume 1 Tender and Contract  
Section T1 Tender and Contract

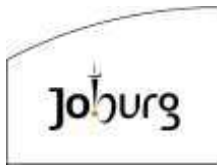


**Tenderers will be notified of such missing and incomplete documents and will be offered a period of 3 days to complete or submit those pages i.e., Municipal Bidding Documents (MBD) and other documents that require completion and signatures that do not have a bearing on functionality, price and preference points for specific goals. Tenders that are received contrary to the above requirements will be disqualified after three (3) days period has lapsed.**

**If locality is a specific goal in MBD6.1 – the requested documentation may not be used to allocate points for specific goals.**

Signature: \_\_\_\_\_ Date \_\_\_\_\_

Employer:		Contractor:	
Witness:		Witness:	



# **Johannesburg Water (SOC) Ltd**



**CONTRACT NO. JW 14406**

**LINBRO PARK TOWER (WITH ASSOCIATED WORKS)**

**VOLUME 1**

**TENDERING PROCEDURES**



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## T1.1 TENDER DATA

### T1.1.1 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](http://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.

### T1.1.2 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	<p>The tender documents issued by the Employer comprise:</p> <p><b>Volume 1:</b></p> <p><b>Tender Part 1: Tendering Procedures</b> T1.1 Tender Notice and Invitation to Tender T1.2 Tender Data</p> <p><b>Tender Part 2: Returnable Documents</b> T2.1 List of Returnable Documents T2.2 Returnable Schedules, including the Enterprise Declaration Affidavit which may be bound in a separate volume</p> <p><b>Contract Part 1: Agreement and Contract Data</b> C1.1 Form of Offer and Acceptance C1.2 Contract Data C1.3 Forms of Securities</p> <p><b>Contract Part 2: Pricing Data</b> C2.1 Pricing Instructions C2.2 Bill of Quantities/Schedule of Rates</p> <p><b>Volume 2A</b></p> <p><b>Contract Part 3: Scope of Work</b> C3.1 Scope of Work C3.2 Particular Specifications</p> <p><b>Contract Part 4: Site Information</b> C4.1 Site Information</p> <p><b>Volume 3</b> Occupational Health and Safety Specification and Environmental Specification and Management Plan</p>



Clause number	Tender Data
	<b>Volume 4:</b> Tender Drawings
C.1.4	<p>The Employer's representative is: Contact Person: Seemole Tleane Telephone: 011 688 1470 E-mail address: <a href="mailto:seemole.tleane@jwater.co.za">seemole.tleane@jwater.co.za</a></p> <p>The SCM representative is :Gcina Ndela 011 688 1796 <a href="mailto:Gcina.ndela@jwater.co.za">email:Gcina.ndela@jwater.co.za</a> [REDACTED]</p>
C.2.1	<p><b>Eligibility criteria and requirements</b> <b>CIDB registration and grading:</b></p> <ol style="list-style-type: none"><li>1) Only tenderers who are registered with the CIDB and were 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 an <b>8CE</b> class of construction work, are eligible to submit tenders. Tenders must have an Active status at the required CIDB grading at time of tender evaluation for the bidder to meet the eligibility criteria and requirement.</li><li>2) Joint ventures are eligible to submit tenders provided that:<ol style="list-style-type: none"><li>i) every member of the joint venture is registered with the CIDB; and</li><li>ii) 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 an <b>8CE</b> class of construction work.</li></ol></li></ol> <p>Failure to meet to Eligibility criteria and requirements will result in disqualification.</p>
C.2.7	<p>Tenderers should forward their contact details to the contact persons as stated on the Tender Cover Page and Invitation to tender so that they will be sent any communication pertaining to this tender.</p>
C.2.8	<p>Replace the contents of the clause with the following:</p> <p>"Request clarification of the tender documents, if necessary, by notifying the Employer's Officials indicated on the Tender Notice and Invitation to Tender in writing at least seven (7) working days before the closing time stated in the foregoing notice"</p>
C.2.9	<p>Add the following to the clause:</p> <p>"Accept that the submission of a Tender shall be construed as an acknowledgement by the Tenderer that they are satisfied with the insurance cover, the Employer will affect under the contract."</p>
C.2.10.5	<p>Add the following to the clause:</p> <p>"If no offer is made for an item, a line must be drawn through the space in pen.</p> <p>All prices and details must be legible / readable to ensure the tender will be considered for adjudication."</p>



Clause number	Tender Data
C.2.11	<p>The evaluation on price alteration will be conducted as follows:</p> <p>Where the tender award strategy is to evaluate and award per item or category, the following must apply:</p> <ul style="list-style-type: none"> <li>• 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.</li> <li>• 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.</li> </ul> <p>Where the tender award strategy is to evaluate and award total bid offer, the following must apply:</p> <ul style="list-style-type: none"> <li>• 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.</li> <li>• 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.</li> <li>• If there is an unauthenticated alteration on the total bid offer and the amount in words is not authenticated, the bidders will be disqualified for the entire tender.</li> </ul> <p>Where the tender pricing schedule or bill of quantities is requesting rates/price from bidder/s without providing a total, the following will apply:</p> <ul style="list-style-type: none"> <li>• (i) If there is an unauthenticated alteration on the unit rate/price the bidder must be disqualified.</li> </ul> <p><b>Please note: Corrections may not be made using correction fluid, correction tape or the like, bid received contrary to this will be disqualified.</b></p>
C.2.12.1	<p>Replace Contents</p> <p>Alternative offers will not be permitted.</p>
C.2.12.2	<p>Failure to complete bid amount on the form of offer and sign full will result in the elimination of the tender.</p>
C.2.13.3	<p>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)</p>
C.3.9	<p>Replace Existing Clause</p> <p>Arithmetic Errors</p> <p><b>Construction related tenders</b></p> <p>JW undertakes to check the highest scoring bid for arithmetical errors and correcting them as follows:</p> <p>JW shall check for arithmetic errors using the following sequence:</p> <ol style="list-style-type: none"> <li>Check the amount in words against the amount in figures on the <i>Form of Offer</i>,</li> <li>Check the Form of Offer against the Summary Schedule Total,</li> <li>Check the Section Sub-Totals per section against the Summary Total for summation errors,</li> </ol>



Clause number	Tender Data
	<p>(iv) Check the Section Sub-Totals in the Summary Schedule against Section Sub-Totals in the Bill of Quantities.</p> <p>(v) Check the Section Sub-Totals against the Item Totals for summation errors.</p> <p>(vi) Check the Item Totals against the product of the Item Rate and the Quantity Provided.</p> <p>If a bill of quantities or price schedule applies JW will request the bidder to correct the arithmetic errors as follows:</p> <p>(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.</p> <p>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:</p> <p>(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.</p> <p>(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.</p> <p>Clarification session(s) shall be held with Tenderer where there is pricing discrepancies, errors are highlighted and identified corrections are explained.</p> <p>Tenderer is afforded an opportunity to provide clarification, accept or reject identified corrections in writing.</p> <p>(i) In the event that the Tenderer accepts identified corrections, JW will proceed with evaluation.</p> <p>(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.</p> <p>This is not an opportunity for Tenderers to change the bid offer. A bidder that does not agree to the above will be disqualified.</p> <p>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.</p> <p>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</p>



Clause number	Tender Data
	which it has been formally invited to clarify any issue, the tender offer will be regarded as non-responsive.
C.2.13.5	<p>The Employer's address for delivery of tender offers and identification details to be shown on the Tenderer's offer package are:</p> <p><b>Location of tender box:</b> Ground Floor Entrance</p> <p><b>Physical address:</b> Johannesburg Water (SOC) Ltd Turbine Hall 65 Ntemi Piliso Street Newtown Johannesburg 2001</p> <p><b>Identification details:</b> Tender reference number, Title of Tender and the closing date and time of the tender, <i>as well as the Tenderer's name, their Authorised Representative's name, postal address and telephonic contact numbers.</i></p>
C.2.13.6 & C.3.5	A two-envelope procedure will <b>not</b> 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.
C.2.16	The tender offer validity period is 150 days.
C.2.16.1	<p>Add the following to the clause :</p> <p>"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."</p>
C.2.19	The Tenderer must provide access during working hours to his premises for inspections on request.
C.2.23	<p>The Tenderer is required to submit with his tender:</p> <ol style="list-style-type: none"> <li>1) Valid SARS Compliance status Pin for Tenders issued by the South African Revenue Services.</li> <li>2) Proof of CSD registration i.e. MA xxxxxxxx number</li> <li>3) A Certificate of Contractor Registration issued by the CIDB.</li> <li>4) where the tendered amount inclusive of VAT exceeds R 10 million: <ol style="list-style-type: none"> <li>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;</li> <li>ii. if the bidder is not required by law to prepare financial statements, then the bidder is required to submit their unaudited financial statements prepared by an independent accounting professional.</li> </ol> </li> <li>5) Proof that the tenderer and directors of the tenderer are not in arrears for more than 90 days with municipal rates and taxes and municipal service charges, The latest municipal account is to be attached, or a signed copy of the valid lease agreement if the tenderer or director of the tenderer is currently leasing premises and not responsible for paying municipal accounts. <ol style="list-style-type: none"> <li>i. Should the municipal statement that was submitted with the tender document before tender closing date and time be in arrears for more than 90 days at time of award,</li> </ol> </li> </ol>



Clause number	Tender Data
	<p>the tenderer will be requested to submit the latest municipal statement which shows that the tenderer is not in arrears for more than 90 days. If the statement at that time is in arrears for more than 90 days, the tenderer must submit before the stipulated deadline, the written proof of an approved arrangement with the municipality.</p> <ul style="list-style-type: none"> <li>ii. The proof may be a copy of the agreement or an updated municipal statement which reflects the arrangement.</li> <li>iii. Should this tender be considered for award of the contract, based on proof of submission and should proof of such submission be found to be invalid, erroneous or inaccurate, the tenderer will no longer be considered for the award of the contract.</li> <li>iv. Statement must not be older than 90 days from the closing date of this tender. Attach latest municipal account statement behind this page.</li> <li>v. In cases where the director of the tenderer resides with their spouse, parent, partner or sibling the owner of the property that confirm where the director of the tenderer resides must submit an affidavit stating such and explaining the relationship. This would happen in the case where the submitted municipal statement or lease agreement is not in the name of the director of the tenderer. Point (i) will be applicable.</li> <li>vi. In cases where the business address of the tenderer is also the official residence of the director of the tenderer, the director of the tenderer must submit an affidavit stating such. Proof that the municipal statement is not in arrears for more than 90 days or a valid lease agreement must be submitted. Point (i) will be applicable.</li> </ul> <p>6) 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.</p> <p>7) 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.</p> <p>8) 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.</p>
C.2.24	<p>Add the following new clause:</p> <p><b>Canvassing and obtaining of additional information by tenderers</b> Accept that:</p> <ul style="list-style-type: none"> <li>1) 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.</li> <li>2) No Tenderer shall make any attempt to obtain particulars of any relevant information, other than that disclosed at the opening of tenders.</li> </ul>
C.2.25	<p>Add the following new clause:</p> <p><b>Prohibitions on awards to persons in service of the state</b> Accept that the Employer is prohibited to award a tender to a person -</p> <ul style="list-style-type: none"> <li>a) who is in the service of the state; or</li> <li>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</li> </ul>



Clause number	Tender Data
	<p>c) a person who is an advisor or consultant contracted with the municipality or municipal entity.</p> <p>“In the service of the state” means to be -</p> <ul style="list-style-type: none"> <li>i) a member of:- <ul style="list-style-type: none"> <li>• any municipal council;</li> <li>• any provincial legislature; or</li> <li>• the National Assembly or the National Council of Provinces;</li> </ul> </li> <li>ii) a member of the board of directors of any municipal entity;</li> <li>iii) an official of any municipality or municipal entity;</li> <li>iv) an employee of any national or provincial department;</li> <li>v) provincial public entity or constitutional institution within the meaning of the Public Finance Management Act, 1999 (Act No.1 of 1999);</li> <li>vi) a member of the accounting authority of any national or provincial public entity; or</li> <li>vii) an employee of Parliament or a provincial legislature.”</li> </ul> <p>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.</p>
C.2.26	<p>Add the following new clause:</p> <p><b>Awards to close family members of persons in the service of the state</b></p> <p>“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</p> <ul style="list-style-type: none"> <li>a) the name of that person;</li> <li>b) the capacity in which that person is in the service of the state; and</li> <li>c) the amount of the award.</li> </ul> <p>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.”</p>
C.2.27	<p>Add the following new clause:</p> <p><b>Tax Compliance</b></p> <p>In the case of a Joint Venture/Consortium the tax Compliance status Pin must be submitted for each member of the Joint Venture/Consortium.”</p>
C.2.28	<p>Add the following new clause:</p> <ul style="list-style-type: none"> <li>• Tenderers will be notified of such missing and incomplete documents and will be offered a period of three (3) days to complete or submit those pages i.e., Municipal Bidding Documents (MBD) and other documents that require completion and signatures that do not have a bearing on functionality, specific goals and price.</li> <li>• Tenderers that are received contrary to the above requirements will be disqualified after three (3) days period has lapsed.</li> <li>• In cases where locality is a specific goal and the bidder did not submit the required documentation, the tenderer upon submitting the municipal statement, lease</li> </ul>



Clause number	Tender Data
	agreement or letter from ward councillor confirming business address as per above, may not be eligible for points under specific goals if such documentation was not submitted with the tender document.
C.3.2	<p>Replace the contents of the clause with the following:</p> <p>If necessary, issue addenda that may amend or amplify the tender documents to each tenderer during the period from the date that tender documents are available until seven (7) Working days before the tender closing time stated in the Tender Data. If, as a result a tenderer applies for an extension to the closing time stated in the Tender Data, the Employer may grant such extension and, shall then notify all tenderers who collected tender documents.</p>
C.3.4.2	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
C.3.11	Replace Contents with Returnable Schedule MBD 6.1 for evaluation criteria



### **Mandatory**

Description		Complied	
		Yes	No
1	Attended the compulsory briefing meeting		
2	Active CIBD grading 8CE or higher -Active Status at the required. CIBD grading or higher at the time of Evaluation		
3	Completed and signed Form of Offer		

Tenderers who **FAIL** to meet the mandatory criteria or requirements of tender will result in disqualification.

### **Administrative**

Description				Complied	
No	Reference to Tender Document	Description	Requirement	Yes	No
	Certificate of Authority	Certificate of Authority or Board Resolution granting authority to sign.	Completed and signed certificate of authority to sign or signed board resolution.		
	MBD 1	Invitation to Bid Form	Complete and submit complete and signed MBD 1 Form.		
	CSD	Central Supplier Database Registration	Provide proof of CSD registration.		
	MBD 4	Declaration of Interest	Complete and submit complete and signed MBD 4 Form.		
	MBD 5	Declaration of Procurement Above R10m (All Applicable Taxes Included)	Complete and submit complete and signed MBD 5 Form.		
	T2.3.1	Acknowledgement of SHE Specification & Annexures	Complete and submit signed T2.3.1 form.		
	T2.3.2	Acknowledgement of Project Tender Drawings	Complete and submit signed T2.3.2 form.		



	MBD 6.1	Preference Points Claim in Terms of The Preferential Procurement Regulations 2022	Complete and submit complete and signed MBD 6.1 Form.		
	MBD 8	Declaration of Bidder's Past Supply Chain Management Practices	Complete and submit complete and signed MBD 8 Form.		
	MBD 9.	Certificate of Independent Bid Determination	Complete and submit complete and signed MBD 9 Form.		
	Annexure – Proof of Specific Goals – Ref:4.4	Valid BBBEE Certificate or certified copy thereof or a valid sworn affidavit	Submit applicable documentation with the tender submission		
	Annexure	Municipal statement of account for Director/s (not older than three [03] months from the closing date of tender or a valid lease agreement at time of tender closure).			
	Annexure	Municipal statement of account for Company (not older than three [03] months from the closing date of tender or a valid lease agreement at time of tender closure).			
	Annexure	Joint Venture Agreement signed by all parties (where applicable).			



## Functionality Requirements

CRITERIA NO #	CRITERIA	EVIDENCE	SUB-CRITERIA/CLAUSE	MAX SCORE	SCORE
1	Tenderers Experience with Respect to Elevated Reinforced Concrete water retaining structure (Tower) of 1ML capacity or more.  Or  Reinforced Concrete water retaining structure (Reservoir) of 6ML capacity	Supporting Documents Required include Reference Letters as per T2.1.7 (Or on Client Letter Head with all required Information) and Completion / Approval Certificates  <b>Note:</b> This reference letter must be completed by the referee/previous client of the tenderer and included in the tender submission. Alternatively, the Clients letterhead may be used provided it complies with the functional requirements. A separate form must be completed for each reference as a requirement in the evaluation criteria. The information provided will be verified and if found to be false or misrepresented, punitive measures will be instituted against the respective party including blacklisting in participating in any future government tenders.	Number of Elevated Reinforced Concrete Tower of 1ml or More Completed.	Tenderer Has not Completed any Project	0
			OR	Tenderer Has Completed at Least 1 Project. (Either Tower or 1 or more Reservoirs)	21
			Number of Reinforced Concrete Water Retaining Structure (Reservoir) of 6ml or More Completed	Tenderer has completed both (Tower and Reservoir).  Or  Tenderer has completed 2 or more Towers.	30
2	Tenderers Experience with Respect to pump stations projects each with a minimum flow of 250l/s or more.	Supporting Documents Required include Reference Letters as per T2.1.7 (Or on Client Letter Head with all required Information) and Completion / Approval Certificates. (Qualifying projects submitted in (1) above will be counted in this section)	Number of Pump Stations Projects Each with a Minimum Flow Of 250l/s.	0 Completed Projects	0



3			<p><b>Note:</b> This reference letter must be completed by the referee/previous client of the tenderer and included in the tender submission. Alternatively, the Clients letterhead may be used provided it complies with the functional requirements. A separate form must be completed for each reference as a requirement in the evaluation criteria. The information provided will be verified and if found to be false or misrepresented, punitive measures will be instituted against the respective party including blacklisting in participating in any future government tenders.</p>		1 - 2 Completed Projects	11
					>2 Completed Projects	15
	Tenderers Experience with Respect to Steel Pipe Projects	<p>Supporting Documents Required include Reference Letters as per T2.1.7 (Or on Client Letter Head with all required Information) and Completion / Approval Certificates.</p> <p><b>Note:</b> This reference letter must be completed by the referee/previous client of the tenderer and included in the tender submission. Alternatively, the Clients letterhead may be used provided it complies with the functional requirements. A separate form must be completed for each reference as a requirement in the evaluation criteria. The information provided will be verified and if found to be false or misrepresented, punitive measures will be instituted against the respective party including blacklisting in participating in any future government tenders.</p>	<p><b>Number of Completed Steel Pipe Projects of Diameter 450mm or More and Construction Cost of R15 Million or More And Inclusive of Cathodic Protection</b></p>	15	0 Completed Projects	0
					1 - 2 Completed Projects	11
					>2 Completed Projects	15



4	<p>Post Qualification Experience of Contract Manager</p> <p>Only Contract Managers with qualifications of Bachelors' Degree (Civil Engineering / Construction Management) equivalent or higher. and Registration (Pr. Eng. / Pr. Technologist) or PrCPM / PrCM will obtain a score for experience of a Contract Manager. However, the time of registration of Contract Manager will not impact post qualification number of projects.</p>	<p>Tender must Provide CV of Contract Manager in the format given on T2.1.9</p> <p>Note: Tenderers may provide their own CVs but information provided should contain all information in T2.1.9</p> <p>Note: Copy of qualifications to accompany the CVs</p>	<p><b>Number of Projects Involving construction of Water Retaining Structures (Elevated Reinforced Concrete Tower)</b></p> <p><b>Or</b></p> <p><b>Construction of Reinforced Concrete Reservoirs</b></p> <p><b>And</b></p> <p><b>Construction Of Pump Station And Bulk Steel Pipe Work Completed)</b></p>	0 Completed Project	10	0
				1 - 2 Completed Projects		7
				>2 Completed Projects		10
5	<p>Post Qualification Experience of Site Personnel</p> <p>Site Manager with qualifications of National Diploma (Civil or Structural) Engineering or more and Registered as a Candidate Professional in the Built Environment or more will be considered</p>	<p>Tender must Provide CV of Site Manager in the format given on T2.1.9</p> <p>Note: Tenderers may provide their own CVs but information provided should contain all information in T2.1.9</p> <p>Note: Copy of qualifications to accompany the CVs</p>	<p><b>Number of Projects Involving construction of Water Retaining Structures (Elevated Reinforced Concrete Tower and Reservoirs).</b></p> <p><b>And</b></p> <p><b>Construction of Pump Station and Bulk Steel Pipe Work Completed as Site Agent / Site Manager)</b></p>	0 Completed Projects	10	0
				1 - 2 Completed Projects		7
				>2 Completed Projects		10



6	Foreman/ Supervisor with qualifications of National Diploma (Electrical/Mechanical) Engineering or more and Registered as a Candidate Professional in the Built Environment or more will be considered.	Tender must Provide CV of Site Foreman or Supervisor in the format given on T2.1.9  <i>Note: Tenderers may provide their own CVs but information provided should contain all information in T2.1.9</i>  <i>Note: Copy of qualifications to accompany the CVs</i>	<b>Construction of Pump Station and As Foreman / Supervisor / Resident Engineer/ Site Engineer/ Site)</b>	0 Completed Projects	5	0
				1 - 2 Completed Projects		3
				>2 Completed Projects		5
7	Tenderer to provide evidence of Company's approved Quality Control Plan Standard Procedures	Tenderer to provide their company's Quality Control Plan Standard Procedures approved by the company's relevant designated person.  OR ISO 9001 certification	<b>COMPANY'S APPROVED QUALITY CONTROL PLAN STANDARD PROCEDURES OR ISO CERTIFICATION 9001</b>	No submission of Quality Control Plan Standard Procedures or ISO 9001 certification	5	0
				Company has approved Quality Control Plan Standard Procedures		3
				Company has ISO 9001 certification		5
8	Post Qualification Experience of Safety Officer  Only Safety Officers with qualifications of National Diploma (Safety Management)/	Tender must Provide CV of Safety Officer in the format given on T2.1.9  All Civil Related projects will be considered.  <i>Note: Copy of</i>	<b>Number Of Civil/Structural Engineering Projects Completed As Safety Officer</b>	1 Completed Project	10	0



	(Environmental Health/Environmental Science/ Environmental Management), SAMTRAC / SHEOMTRAC/ SHEMTRAC / MESHTRAC /NEBOSH / Safety Officers Course (NQF 5) or more and Registered with SACPCMP in the “Construction Health and Safety” Sector will be considered.  However, the time of registration of Safety Officer will not impact post qualification number of projects.	<i>qualifications to accompany the CVs</i>		2 - 3 Completed Projects		7
				>3 Completed Projects		10
			MINIMUM QUALIFYING SCORE			70
			TOTAL			100

**NOTE 1: Where applicable, foreign qualifications MUST be accompanied by a SAQA verification certificate. Failure to submit SAQA verification certificate will lead to that qualification not being considered for allocation of points for that criterion.**

**NOTE 2: When an uncertified copy of professional registration is submitted and the requirement was to submit a certified copy, JW will verify the validity of the registration on the issuing bodies or institution's website. If the verification is confirmed on the website, the bidder meets the criteria. This will only be applicable for the recommended bidders.**

**NOTE 3: The time of registration of Contract Manager, Site Manager and Safety Officer will not impact post qualification number of projects.**

**NOTE 4: The information provided by bidders will be verified and if found to be false, punitive measures will be affected.**

**Acronyms:**

**ECSA:** Engineering Council of South Africa

**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



Clause Number	Tender Data												
	<p><b>4. STAGE FOR PRICE AND PREFERENCE POINTS EVALUATION:</b></p> <p><b>4.1. Pricing</b></p> <p>The following aspects will be considered in the financial offer:</p> <ol style="list-style-type: none"> <li>Costing for all items as described in the Pricing Schedule and applicable Strategies Review of financial offer and discrepancies between total and calculations.</li> <li>Identify any parameters that may have a bearing on the financial offer, e.g., contract period, price escalations or adjustments required and life cycle costs.</li> <li>The 90/10 preference point system will be applicable in this tender. Whereby 90 points will be allocated to price and 10 points will be allocated to the set specific goals per category as outlined on the pricing schedule. The bidder scoring the highest in terms of price and specific goal will be recommended for that specific category.</li> </ol> <p><b>4.2. Award and Allocation Strategy:</b></p> <table border="1"> <tr> <td>AWARD STRATEGY</td><td>The tender will be awarded to the highest scoring bidder in terms of price and Specific Goals</td></tr> <tr> <td>ALLOCATION STRATEGY</td><td>The tender will be allocated to the highest scoring bidder in terms of price and Specific Goals</td></tr> </table> <p><b>4.3. The maximum preference points for this bid are allocated as follows:</b></p> <table border="1"> <thead> <tr> <th></th><th>POINTS</th></tr> </thead> <tbody> <tr> <td>PRICE</td><td>90</td></tr> <tr> <td>SPECIFIC GOALS</td><td>10</td></tr> <tr> <td>Total points for Price and SPECIFIC GOALS</td><td>100</td></tr> </tbody> </table> <p><b>SPECIFIC GOALS</b></p> <p>In terms of Regulation 4(2); 5(2); 6(2) and 7(2) of the Preferential Procurement Regulations 2022, preference points must be awarded for specific goals stated in the tender. For the purposes of this tender the tenderer will be allocated points based on the goals stated in table 1 below as may be supported by proof/ documentation stated in the conditions of this tender.</p> <p>Specific goals may include contracting with persons, or categories of persons, historically disadvantaged by unfair discrimination on the basis of race, gender or disability.</p> <p>Race:</p> <ol style="list-style-type: none"> <li>Ownership by black people</li> <li>Black Designated Group: <ul style="list-style-type: none"> <li>Ownership by black people that are unemployed</li> </ul> </li> </ol>	AWARD STRATEGY	The tender will be awarded to the highest scoring bidder in terms of price and Specific Goals	ALLOCATION STRATEGY	The tender will be allocated to the highest scoring bidder in terms of price and Specific Goals		POINTS	PRICE	90	SPECIFIC GOALS	10	Total points for Price and SPECIFIC GOALS	100
AWARD STRATEGY	The tender will be awarded to the highest scoring bidder in terms of price and Specific Goals												
ALLOCATION STRATEGY	The tender will be allocated to the highest scoring bidder in terms of price and Specific Goals												
	POINTS												
PRICE	90												
SPECIFIC GOALS	10												
Total points for Price and SPECIFIC GOALS	100												



	<p>Ownership by black people who are youth</p> <p>Ownership by black people living in rural or underdeveloped areas or townships</p> <p>Ownership by black people with disabilities</p> <p>Ownership by black people who are military veterans</p> <p>Cooperative owned by black people</p> <p>Gender:</p> <p>III. Persons, or categories of persons, historically disadvantaged by unfair discrimination on the basis of gender are women. Ownership by persons that are classified as female or women according to the Department of Home Affairs of South African.</p> <p>Disability:</p> <p>IV. Persons, or categories of persons, historically disadvantaged by unfair discrimination on the basis of disability are disabled persons.</p> <p>Reconstruction and Development Programme (RDP) objectives as published in Government Gazette No. 16085 dated 23 November 1994 i.e.,</p> <p>Local Manufacture:</p> <p>I. Promotion of procurement of locally manufactured goods in South Africa to promote job creation in light of the high unemployment rate in South Africa which has a greater impact previously disadvantaged individuals and black youth.</p> <p>Locality:</p> <p>I. Promotion of procurement from local business in the geographical areas that JW operate in. This is also directed at creating employment in the areas JW operate in. The BSC may allocate points as follows:</p> <ul style="list-style-type: none"><li>• Promotion of enterprises located in the Gauteng Province</li><li>• Promotion of enterprises located in a specific region within COJ (the 7 regions. A to G)</li><li>• Promotion of enterprises located in the City of Johannesburg municipality</li><li>• Promotion of enterprises located rural or underdeveloped areas or townships.</li></ul> <p>QSE</p> <p>I. Promotion of procurement from QSE's that are black owned.</p> <p>EME:</p> <p>I. Promotion of procurement from EME's that are black own.</p> <p>SUB-CONTRACTING:</p> <p>Promotion of a company previously owned by a Historically Disadvantaged Individuals (HDI).</p> <p>Consider sub-contract only in cases where there are no company which can meet any of the specific goals. Check if the portion of the work cannot be subcontracted in terms of specific goals.</p> <p>One goal may be chosen, or a combination of goals may be decided upon including a sub-goal i.e., owned by black people that are disabled etc.,</p>
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#### JOINT VENTURE, CONSORTIUM OR EQUIVALENT:

For Joint Venture Agreements, Consortiums or equivalent, the agreement must show percentages of ownership and work to be completed by each party. This agreement must form part of the tender submission.

To determine the Joint Venture, Consortium or equivalent score for specific goals, JW will look at the consolidated BBBEE certificate to determine the points for specific goals that will be awarded to the tenderer. If a consolidated BBBEE certificate is not submitted, the parties to the joint venture, consortium or equivalent must submit their individual BBBEE certificates issued by a SANAS accredited verification agency or the documents listed below on 4.6 and the joint venture, consortium or equivalent agreement in order for JW to determine the proportional points for specific goals.

Documentation to be provided:

- JV, Consortium, or equivalent agreement
- Consolidated BBBEE certificate issued by an SANAS accredited verification agency. Certificate must be valid

Table 1:

The specific goals allocated points in terms of this tender	Number of points allocated (90/10 system)
Business owned by 51% or more-Women	6
Business located within the boundaries of COJ Municipality	4
<b>Total</b>	<b>10</b>

#### 4.4. The following verification documents must be submitted with the tender document:

SPECIFIC GOALS – ANY ONE OR A COMBINATION OF ANY	MEANS OF VERIFICATION THAT MAY BE SELECTED OR A COMBINATION THEREOF
Business owned by 51% or more-Women-	Valid BBBEE Certificate issued by SANAS accredited verification agency or DTI/CIPC BBBEE  Certificate for Exempted Micro Enterprises or  Affidavit sworn under oath, OR •CIPC registration document showing percentage of ownership and share certificate where applicable



	<ul style="list-style-type: none"> <li>CSD</li> </ul>
Business located within the boundaries of COJ Municipality	Proof of municipal account / valid lease agreement, letter from the Ward Council confirming the business address  <ul style="list-style-type: none"> <li>CSD</li> </ul>

**Note:** The joint venture, consortium, or equivalent agreement in order for JW to determine the proportional points for specific goals

**Example,** If there are two parties in a Joint Venture with a 50:50 ownership of the Joint Venture and one party is located within the boundaries of COJ and one is located in Tshwane, if one of the goals is locality and has total points of 4, the JV will only be entitled the proportional points of 2.

**4.5.** The following are the requirements for the Sworn Affidavit in terms of the BBBEE Sector Codes of Good Practice:

Affidavit Prescribed Formats	Category	Financial Threshold
<b>Generic Enterprises</b>		
	BO QSE	Between R10m and R50m
	BO EME	Less than R10m
<b>Sector Specific Enterprises</b>		
	BO QSE	Between R10m and R50m
	BO EME	Less than R10m
<b>Construction Sector Code</b>		
	EME Contractor	Less than R3m
	BO EME BEP	Less than R1.8m
<b>Financial Sector Code</b>		
	BO QSE	Between R10m and R50m
	BO EME	Less than R10m
<b>Information Communication Technology Sector Code (ICT)</b>		
	BO QSE	Between R10m and R50m
	BO EME	Less than R10m
<b>Marketing, Advertising &amp; Communication Sector Code (MAC)</b>		



> Public Relations	BO QSE	Between R5m and R10m
> Marketing, Advertising & Communications	BO EME	Less than R5m
<b>Property Sector Code</b>		
> Service-based	BO QSE	Between R5m and R10m
	EME	Less than R5m
> Agency-based	BO QSE	Between R2.5m and R35m
> Asset-based	EME	Less than R2.5m
	BO QSE	Between R80m and R400m
<b>Tourism Sector Code</b>		
	BO QSE	Between R5m and R45m
	BO EME	Less than R5m
<b>Specialised Enterprises</b>		
	BO QSE	Between R10m and R50m
	BO EME	Less than R10m

#### 4.6. Requirements for a valid BBBEE Certificate

- Copy of a certified valid BBBEE certificate (Only Valid BBBEE certificate must be accredited by SANAS) or valid Sworn Affidavit issued by the DTIC or the CIPC or in a similar format complying with commissioner of oath Act.
- Bidders who do NOT qualify as EME's and QSE's as outlined in 4.5, must submit B-BBEE verification certificates that are issued by an Agency accredited by SANAS.
- Bidders who fail to submit a certified copy of their valid B-BBEE certificate or valid sworn affidavit or valid DTI / CIPC B-BBEE certificate will score zero points for specific goals.

Valid Sworn Affidavits or certified copies of B-BBEE Certificate must comply with the requirements outlined in the Justices of the Peace and Commissioners of Oaths Act, no 16 of 1963 and its Regulations promulgated in Government Notice GNR 1258 of 21 July 1972 Justices of the Peace and Commissioners of Oaths Act, No. 16 of 1963. i.e.

- The deponent shall sign the declaration in the presence of the commissioner of oaths (COA).
- Below the deponent's signature the COA shall certify that the deponent has acknowledged that he knows and understands the contents of the declaration and the COA shall state the manner, place, and date of taking the declaration.
- The COA shall sign the declaration and print his full name and business address below his signature; and state his designation and the area for which he holds his appointment, or the office held by him if he holds his appointment ex officio.



	<p>(iv) Copy of certified copies will not be accepted.</p> <p><b>N.B. A tenderer failing to submit proof of specific goals claimed as per 4.4 will not be disqualified but will be allocated zero points for specific goals and will be allocated points for pricing.</b></p> <p><b>ADJUDICATION USING A POINT SYSTEM</b></p> <p>(a) The bidder obtaining the highest number of total points will be awarded the contract.</p> <p>(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;.</p> <p>(c) Points scored must be rounded off to the nearest 2 decimal places.</p> <p>(d) In the event that two or more bids have scored equal total points, the successful bid must be the one scoring the highest number of points for specific goals.</p> <p>(e) However, when functionality is part of the evaluation process and two or more bids have scored equal points including equal preference points for specific goals, the successful bid must be the one scoring the highest score for functionality.</p> <p>(f) Should two or more bids be equal in all respects, the award shall be decided by the drawing of lots.</p> <p><b>POINTS AWARDED FOR PRICE</b></p> <p><b>THE 90/10 PREFERENCE POINT SYSTEMS</b></p> <p>A maximum of 90 points is allocated for price on the following basis:</p> <p><b>90/10</b></p> $P_s = 90 \left( 1 - \frac{P_t - P_{\min}}{P_{\min}} \right)$ <p>Where</p> <p>P<sub>s</sub> = Points scored for comparative price of bid under consideration</p> <p>P<sub>t</sub> = Comparative price of bid under consideration</p> <p>i) P<sub>min</sub> = Comparative price of lowest acceptable bid</p>
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**



## **VOLUME 1**

### **RETURNABLE DOCUMENTS AND SCHEDULES**

## T2.1 LIST OF RETURNABLE DOCUMENTS

The tenderer must complete the following returnable documents:

<b><u>Document</u></b>	<b><u>Page</u></b>
<b>1. Returnable Schedules required for tender evaluation purposes</b>	
T2.1.1 Record of addenda to tender documents	RD.4
T2.1.2 Certificate of Authority	RD. 5
T2.1.3 Compulsory Enterprise Questionnaire	RD.10
T2.1.4 Preferential Procurement	RD.12
MBD 6.1 Preference points claim form in terms of the preferential procurement regulations	RD.12 RD.
MBD 4 Declaration of any potential conflict of interest	RD.
MBD 8 Declaration of bidder's past Supply Chain manage- ment practices	RD.22
MBD 5 Declaration for Procurement above R10 Million (VAT Included)	RD.24
MBD 9 Certificate of independent bid determination	RD.25
T2.1.5 Proposed qualifications	RD.29
T2.1.6 Schedule of the Tenderer's experience	RD.30
T2.1.7 Contactable reference template	RD.31
T2.1.8 Schedule of key personnel	RD.32
T2.1.9 Curriculum vitae of key personnel	RD.41

## T2.2 LIST OF RETURNABLE DOCUMENTS

<b><u>Document</u></b>	<b><u>Page</u></b>
<b>2. Other documents required only for tender evaluation purposes</b>	
T2.2.1 Certificate of Contractor Registration issued by the Construction In- dustry Development Board	RD.50
T2.2.2 SARS Tax Compliance Status Pin and Proof of CSD registration i.e. MA xxxxxxxxxx number	RD.51

## T2.3 LIST OF RETURNABLE SCHEDULES

<b><u>Document</u></b>	<b><u>Page</u></b>
<b>3. Other documents that will be incorporated into the contract</b>	
T2.4.1 JW 6.4 Returnable Annexure A – SHE Acknowledgment Form	RD.52
T2.4.2 JW 6.5 Returnable Annexure B: Acknowledgement of Tender Drawings	RD.53

*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

<b><u>Document</u></b>	<b><u>Page</u></b>
<b>1. Returnable Schedules required only for tender evaluation purposes</b>	
T2.1.1 Record of addenda to tender documents	RD.4
T2.1.2 Certificate of authority	RD.5
T2.1.3 Compulsory Enterprise Questionnaire	RD.10
T2.1.4 Preferential Procurement	RD.12
T2.1.5 Proposed qualifications	RD.29
T2.1.6 Schedule of the Tenderer's experience	RD.30
T2.1.7 Contactable reference template	RD.31
T2.1.8 Schedule of key personnel	RD.32
T2.1.9 Curriculum vitae of key personnel	RD.41

### 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 CORPO- RATION	(III) PARTNERSHIP	(IV) JOINT VENTURE	(V) SOLE PROPRIE- TOR

### (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 ca-  
pacity of ....., was authorized to sign all documents in con-  
nection with the tender for Contract No. JW 14406 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:

- |  |   |
|--|---|
| <input type="checkbox"/> a member of any municipal council                                     | <input type="checkbox"/> 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) |
| <input type="checkbox"/> a member of any provincial legislature                                | <input type="checkbox"/> a member of an accounting authority of any national or provincial public entity  |
| <input type="checkbox"/> a member of the National Assembly or the National Council of Province | <input type="checkbox"/> an employee of Parliament or a provincial legislature  |
| <input type="checkbox"/> a member of the board of directors of any municipal entity            |   |
| <input type="checkbox"/> an official of any municipality or municipal entity                   |   |

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

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

\*insert separate page if necessary

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

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

- |  |   |
|--|---|
| <input type="checkbox"/> a member of any municipal council                                     | <input type="checkbox"/> 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) |
| <input type="checkbox"/> a member of any provincial legislature                                | <input type="checkbox"/> a member of an accounting authority of any national or provincial public entity  |
| <input type="checkbox"/> a member of the National Assembly or the National Council of Province | <input type="checkbox"/> an employee of Parliament or a provincial legislature  |
| <input type="checkbox"/> a member of the board of directors of any municipal entity            |   |
| <input type="checkbox"/> an official of any municipality or municipal entity                   |   |

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:

- authorizes the Employer to verify the tax compliance status from the South African Revenue Services that my / our tax matters are in order;
- confirms that 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;
- confirms that no partner, member, director or other person, who wholly or partly exercises, or may exercise, control over the enterprise appears, has within the last five years been convicted of fraud or corruption;
- confirms that I / we are not associated, linked or involved with any other tendering entities submitting tender offers and have no other relationship with any of the tenderers or those responsible for compiling the scope of work that could cause or be interpreted as a conflict of interest; and
- confirms that the contents of this questionnaire are within my personal knowledge and are to the best of my belief both true and correct.

Signed .....

Date .....

Name .....

Position .....

Enterprise name .....

## **T2.1.4 Preferential Procurement**

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

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

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

#### **1. GENERAL CONDITIONS**

- 1.1 The following preference point systems are applicable to invitations to tender:
  - the 90/10 system for requirements with a Rand value above R50 000 000 (all applicable taxes included).
- 1.2 The applicable preference point system for this tender is the 90/10 preference point system.
- 1.3 Points for this tender (even in the case of a tender for income-generating contracts) shall be awarded for:
  - a) Price; and
  - b) Specific Goals.

The maximum points for this tender are allocated as follows:

	<b>POINTS</b>
<b>PRICE</b>	90
<b>SPECIFIC GOALS</b>	10
<b>Total points for Price and SPECIFIC GOALS</b>	<b>100</b>

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

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

## 2. DEFINITIONS

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

## 3. FORMULAE FOR PROCUREMENT OF GOODS AND SERVICES

### 3.1 POINTS AWARDED FOR PRICE

#### a) THE 90/10 PREFERENCE POINT SYSTEMS

A maximum 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 price of tender under consideration
- Pt = Price of tender under consideration
- Pmin = Price of lowest acceptable tender

#### 4. POINTS AWARDED FOR SPECIFIC GOALS

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

**Table 1: Specific goals for the tender and points claimed are indicated per the table below.**

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

The specific goals allocated points in terms of this tender	Number of points allocated (90/10 system)	Number of points claimed (90/10 system)
Business owned by 51% or more-Women	6	
Business located within the boundaries of COJ municipality	4	
Total	10	

#### 5. DECLARATION WITH REGARD TO COMPANY/FIRM

5.1 Name of company/firm.....

5.2 Company registration number: .....

5.3 TYPE OF COMPANY/ FIRM

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

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

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

<p>.....</p> <p><b>SIGNATURE(S) OF TENDERER(S)</b></p>
<p><b>SURNAME AND NAME:</b> .....</p> <p><b>DATE:</b> .....</p> <p><b>ADDRESS:</b> .....</p> <p>.....</p> <p>.....</p>

## 5.5 SUB-CONTRACTING

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

(***Tick applicable box***)

YES		NO	
-----	--	----	--

5.5.2 If yes, indicate:

- i) What percentage of the contract will be subcontracted \_\_\_\_\_ (minimum of 11%)  
ii) The name of the sub-contractor(s):

---

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---

- iii) The black sharehold of the sub-contractor(s):

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---

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---

- iv) Whether the sub-contractor(s) 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, 2022:

Designated Group: An EME or QSE which is at least 51% owned by:	EME √	QSE √
Black people		
Black people who are youth		
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		
<b>OR</b>		
Any EME		
Any QSE		

## 5.6 DECLARATION WITH REGARD TO COMPANY/FIRM

- 5.6.1 Name of company/firm: .....
- 5.6.2 VAT number registration number: .....
- 5.6.3 Company registration number: .....

## 5.7 TYPE OF COMPANY/ FIRM

- ☐ Partnership/Joint Venture / Consortium
- ☐ One person business/sole propriety
- ☐ Close corporation
- ☐ Company
- ☐ (Pty) Limited
- [TICK APPLICABLE BOX]

## 5.8 DESCRIBE PRINCIPAL BUSINESS ACTIVITIES

.....

.....

.....

.....

## 5.9 COMPANY CLASSIFICATION

- ☐ Manufacturer
- ☐ Supplier
- ☐ Professional service provider
- ☐ Other service providers, e.g. transporter, etc.
- [TICK APPLICABLE BOX]

## 5.10 MUNICIPAL INFORMATION

**Municipality where business is situated:** .....

**Registered Account Number:** .....

**Stand Number:** .....

- 5.11 Total number of years the company/firm has been in business: .....
- 5.12 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 Specific Goals in MBD 6.1 qualifies the company/ firm for the preference(s) shown and I / we acknowledge that:
- v) The information furnished is true and correct;

- vi) In the event of a contract being awarded as a result of points claimed as shown in MBD 6.1, the contractor is required to furnish documentary proof as requested in the Tender Data to the satisfaction of the purchaser that the claims are correct;
- vii) If the specific goals points have 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<sup>1</sup>.
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, shareholder<sup>2</sup>) .....

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. ....

.....

<sup>1</sup>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.

<sup>2</sup> 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 <i>audi alteram partem</i> rule was applied).	Yes <input type="checkbox"/>	No <input type="checkbox"/>
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)? <b>To access this Register, enter the National Treasury's website, <a href="http://www.treasury.gov.za">www.treasury.gov.za</a>, 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.</b>	Yes <input type="checkbox"/>	No <input type="checkbox"/>
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 <input type="checkbox"/>	No <input type="checkbox"/>
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 <input type="checkbox"/>	No <input type="checkbox"/>
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

- 2.1 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**

- 2.2 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.

- 2.3 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

## MBD 9

### **CERTIFICATE OF INDEPENDENT BID DETERMINATION**

1. This Municipal Bidding Document (MBD) must form part of all bids<sup>1</sup> 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)<sup>2</sup>. 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:

---

<sup>1</sup> Includes price quotations, advertised competitive bids, limited bids and proposals.

<sup>2</sup> 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.

**MBD 9**  
**CERTIFICATE OF INDEPENDENT BID DETERMINATION**

I, the undersigned, in submitting the accompanying bid:

\_\_\_\_\_  
(Bid Number and Description) in response to the invitation for the bid made by:

\_\_\_\_\_  
(Name of Municipality / Municipal Entity) do hereby make the following statements that I certify to be true and complete in every respect:

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

1. I have read, and I understand the contents of this Certificate;
2. I understand that the accompanying bid will be disqualified if this Certificate is found not to be true and complete in every respect;
3. I am authorized by the bidder to sign this Certificate, and to submit the accompanying bid, on behalf of the bidder;
4. Each person whose signature appears on the accompanying bid has been authorized by the bidder to determine the terms of, and to sign, the bid, on behalf of the bidder;
5. For the purposes of this Certificate and the accompanying bid, I understand that the word "competitor" shall include any individual or organization, other than the bidder, whether or not affiliated with the bidder, who:
  - (a) has been requested to submit a bid in response to this bid invitation;
  - (b) could potentially submit a bid in response to this bid invitation, based on their qualifications, abilities or experience; and
  - (c) provides the same goods and services as the bidder and/or is in the same line of business as the bidder
6. The bidder has arrived at the accompanying bid independently from, and without consultation, communication, agreement or arrangement with any competitor. However, communication between partners in a joint venture or consortium<sup>3</sup> 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;

<sup>3</sup> 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.

- (b) geographical area where product or service will be rendered (market allocation)
  - (c) methods, factors or formulas used to calculate prices;
  - (d) the intention or decision to submit or not to submit, a bid;
  - (e) the submission of a bid which does not meet the specifications and conditions of the bid; or
  - (f) bidding with the intention not to win the bid.
8. In addition, there have been no consultations, communications, agreements or arrangements with any competitor regarding the quality, quantity, specifications and conditions or delivery particulars of the products or services to which this bid invitation relates.
9. The terms of the accompanying bid have not been, and will not be, disclosed by the bidder, directly or indirectly, to any competitor, prior to the date and time of the official bid opening or of the awarding of the contract.
10. I am aware that, in addition and without prejudice to any other remedy provided to combat any restrictive practices related to bids and contracts, bids that are suspicious will be reported to the Competition Commission for investigation and possible imposition of administrative penalties in terms of section 59 of the Competition Act No. 89 of 1998 and or may be reported to the National Prosecuting Authority (NPA) for criminal investigation and or may be restricted from conducting business with the public sector for a period not exceeding ten (10) years in terms of the Prevention and Combating of Corrupt Activities Act No. 12 of 2004 or any other applicable legislation.

.....  
Signature

.....  
Date

.....  
Position

.....  
Name of Bidder

## T2.1.5 Proposed Amendments and 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 .....



## T2.1.7 Contactable Reference Template

To Johannesburg Water (SOC) Ltd

### CRITERIA 1

I, the undersigned being duly authorised to do so, hereby furnish a reference to Johannesburg Water relative to tender Contract No. **JW 14406** for the construction of **Linbro Park Tower and Pump Station (With associated Works)**.

Name of Tenderer: .....

Description of Services provided.

.....  
.....  
.....

Method of construction: .....

Concrete water retaining structure size: .....

Material Type: .....

Name of authorised person:

.....

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

Telephone/Mobile: .....

Email: .....

Completed on behalf (Name of Client)

.....

*NB: This document must be completed by the referee and included in the tender submission. Alternatively, the client's letterhead may be used for this purpose provided it complies with the functional criteria requirements. A separate form must be completed for each reference as required in the evaluation criteria. 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

To Johannesburg Water (SOC) Ltd

### CRITERIA 1

I, the undersigned being duly authorised to do so, hereby furnish a reference to Johannesburg Water relative to tender Contract No. **JW 14406** for the construction of **Linbro Park Tower and Pump Station (With associated Works)**.

Name of Tenderer: .....

Description of Services provided.

.....  
.....  
.....

Method of construction: .....

Concrete water retaining structure size: .....

Material Type: .....

Name of authorised person:

.....

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

Telephone/Mobile: .....

Email: .....

Completed on behalf (Name of Client)

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## T2.1.7 Contactable Reference Template

To Johannesburg Water (SOC) Ltd

### CRITERIA 2

I, the undersigned being duly authorised to do so, hereby furnish a reference to Johannesburg Water relative to tender Contract No. **JW 14406** for the construction of **Linbro Park Tower and Pump Station (With associated Works)**.

Name of Tenderer: .....

Description of Services provided.

.....  
.....  
.....

Method of construction: .....

Concrete water retaining structure size: .....

Material Type: .....

Name of authorised person:

.....

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

Telephone/Mobile: .....

Email: .....

Completed on behalf (Name of Client)

.....

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Description of Services provided.

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Method of construction: .....

Concrete water retaining structure size: .....

Material Type: .....

Name of authorised person:

.....

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

Telephone/Mobile: .....

Email: .....

Completed on behalf (Name of Client)

.....

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Description of Services provided.

.....  
.....  
.....

Method of construction: .....

Concrete water retaining structure size: .....

Material Type: .....

Name of authorised person:

.....

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

Telephone/Mobile: .....

Email: .....

Completed on behalf (Name of Client)

.....

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## T2.1.7 Contactable Reference Template

To Johannesburg Water (SOC) Ltd

### CRITERIA 3

I, the undersigned being duly authorised to do so, hereby furnish a reference to Johannesburg Water relative to tender Contract No. **JW 14406** for the construction of **Linbro Park Tower and Pump Station (With associated Works)**.

Name of Tenderer: .....

Description of Services provided.

.....  
.....  
.....

Method of construction: .....

Steel pipe project diameter size: .....

Material Type: .....

Contract value .....

Name of authorised person:

.....

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

Telephone/Mobile: .....

Email: .....

Completed on behalf (Name of Client)

.....

*NB: This document must be completed by the referee and included in the tender submission. Alternatively, the client's letterhead may be used for this purpose provided it complies with the functional criteria requirements. A separate form must be completed for each reference as required in the evaluation criteria. 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.*

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Name of Tenderer: .....

Description of Services provided.

.....  
.....  
.....

Method of construction: .....

Steel pipe project diameter size: .....

Material Type: .....

Contract value .....

Name of authorised person:

.....

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

Telephone/Mobile: .....

Email: .....

Completed on behalf (Name of Client)

.....

*NB: This document must be completed by the referee and included in the tender submission. Alternatively, the client's letterhead may be used for this purpose provided it complies with the functional criteria requirements. A separate form must be completed for each reference as required in the evaluation criteria. 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.*

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To Johannesburg Water (SOC) Ltd

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Description of Services provided.

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.....  
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Method of construction: .....

Steel pipe project diameter size: .....

Material Type: .....

Contract value .....

Name of authorised person:

.....

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

Telephone/Mobile: .....

Email: .....

Completed on behalf (Name of Client)

.....

*NB: This document must be completed by the referee and included in the tender submission. Alternatively, the client's letterhead may be used for this purpose provided it complies with the functional criteria requirements. A separate form must be completed for each reference as required in the evaluation criteria. 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.*

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Description of Services provided.

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Method of construction: .....

Concrete water retaining structure size: .....

Material Type: .....

Name of authorised person:

.....

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

Telephone/Mobile: .....

Email: .....

Completed on behalf (Name of Client)

.....

*NB: This document must be completed by the referee and included in the tender submission. Alternatively, the client's letterhead may be used for this purpose provided it complies with the functional criteria requirements. A separate form must be completed for each reference as required in the evaluation criteria. 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 they intend 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, Contracts Manager						
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)



<b>Project Name and Locality</b>	
<b>Project Dates and Value</b>	
<b>Project Position (e.g. Project Manager, Engineer, etc.)</b>	
<b>Description of Scope and Duties</b>	

<b>Project Name and Locality</b>	
<b>Project Dates and Value</b>	
<b>Project Position (e.g. Project Manager, Engineer, etc.)</b>	
<b>Description of Scope and duties</b>	

<b>Project Name and Locality</b>	
<b>Project Position (e.g. Project Manager, Engineer, etc.)</b>	
<b>Description of Scope and duties</b>	

<b>Project Name and Locality</b>	
<b>Project Dates and Value</b>	
<b>Project Position (e.g. Project Manager, Engineer, etc.)</b>	
<b>Description of Scope and duties</b>	

<b>Project Name and Locality</b>	
<b>Project Dates and Value</b>	
<b>Project Position (e.g. Project Manager, Engineer, etc.)</b>	
<b>Description of Scope and duties</b>	

*I, ..... , hereby declare that I am aware of the inclusion of my Curriculum Vita in the proposed project team and make myself available for this project.*

*Signature : .....*

*Date : .....*



<b>Project Dates and Value</b>	
<b>Project Position (e.g. Project Manager, Engineer, etc.)</b>	
<b>Description of Scope and Duties</b>	

<b>Project Name and Locality</b>	
<b>Project Dates and Value</b>	
<b>Project Position (e.g. Project Manager, Engineer, etc.)</b>	
<b>Description of Scope and duties</b>	

<b>Project Name and Locality</b>	
<b>Project Position (e.g. Project Manager, Engineer, etc.)</b>	
<b>Description of Scope and duties</b>	

<b>Project Name and Locality</b>	
<b>Project Dates and Value</b>	
<b>Project Position (e.g. Project Manager, Engineer, etc.)</b>	
<b>Description of Scope and duties</b>	



<b>Project Name and Locality</b>	
<b>Project Dates and Value</b>	
<b>Project Position (e.g. Project Manager, Engineer, etc.)</b>	
<b>Description of Scope and duties</b>	

*I, ..... , hereby declare that I am aware of the inclusion of my Curriculum Vita in the proposed project team and make myself available for this project.*

*Signature : .....*

*Date : .....*



<b>Project Dates and Value</b>	
<b>Project Position (e.g. Project Manager, Engineer, etc.)</b>	
<b>Description of Scope and Duties</b>	

<b>Project Name and Locality</b>	
<b>Project Dates and Value</b>	
<b>Project Position (e.g. Project Manager, Engineer, etc.)</b>	
<b>Description of Scope and duties</b>	

<b>Project Name and Locality</b>	
<b>Project Position (e.g. Project Manager, Engineer, etc.)</b>	
<b>Description of Scope and duties</b>	

<b>Project Name and Locality</b>	
<b>Project Dates and Value</b>	
<b>Project Position (e.g. Project Manager, Engineer, etc.)</b>	
<b>Description of Scope and duties</b>	



<b>Project Name and Locality</b>	
<b>Project Dates and Value</b>	
<b>Project Position (e.g. Project Manager, Engineer, etc.)</b>	
<b>Description of Scope and duties</b>	

*I, ....., hereby declare that I am aware of the inclusion of my Curriculum Vita in the proposed project team and make myself available for this project.*

Signature : .....

Date : .....

### **T2.2.1 Contractor's Certificate of Registration With CIDB**

***NB: The Tenderer shall attach hereto the Contractor's Certificate of Registration with CIDB OR provide the CIDB registration number that JW can use to verify CIDB requirements for this tender.***

***CIDB status to be active at the required CIDB grading at time of evaluation to avoid disqualification.***

SIGNATURE: .....

DATE: .....

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

## **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 i.e. MA xxxxxxxxxx number.***

SIGNATURE: .....

DATE: .....

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

### T2.3.1 JW 6.4 Returnable Annexure A: Acknowledgement of SHE Specification & Annexures

#### 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: Sign off form
- Annexure 4: Environmental 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.....

<b>Name of tenderer</b>	
<b>Name of Authorized person</b>	
<b>Authorized Signature*</b>	

## T2.3.2 JW 6.5 Returnable Annexure B: Acknowledgement of Tender Drawings

### 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:

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

DRAWING NUMBER	DESCRIPTION	REV
<b>GENERAL (GL) DRAWINGS</b>		
C01486-GL01	Orthographic Map Layout Sheet 1 Of 2	T0
C01486-GL01	Site Map General Layout Sheet 2 Of 2	T0
C01486-GL02	Site Layout and Key Plan Sheet 1 Of 2	T0
C01486-GL02	Site Layout and Key Plan Sheet 2 Of 2	T0
C01486-GL03	Roads and Stormwater Layout Sheet 1 Of 2	T0
C01486-GL03	Roads and Stormwater Layout Sheet 2 Of 2	T0
<b>STRUCTURAL (SC) ENGINEERING DRAWINGS (LAYOUTS)</b>		
C01486-SC01	LINBRO PARK TOWER: 3.0ML Tower layouts and sections (1 of 9)	T0
C01486-SC02	LINBRO PARK TOWER: 3.0ML Tower layouts and sections (2 of 9)	T0
C01486-SC03	LINBRO PARK TOWER: 3.0ML Tower layouts and sections (3 of 9)	T0
C01486-SC04	LINBRO PARK TOWER: 3.0ML Tower layouts and sections (4 of 9)	T0
C01486-SC05	LINBRO PARK TOWER: 3.0ML Tower layouts (5 of 9)	T0
C01486-SC06	LINBRO PARK TOWER: 3.0ML Tower layouts (6 of 9)	T0
C01486-SC07	LINBRO PARK TOWER: 3.0ML Tower elevation and detail (7 of 9)	T0
C01486-SC08	LINBRO PARK TOWER: 3.0ML Tower elevation and detail (8 of 9)	T0
C01486-SC09	LINBRO PARK TOWER: 3.0ML Tower elevation and detail (9 of 9)	T0
<b>STRUCTURAL (SC) ENGINEERING DRAWINGS (REINFORCEMENT)</b>		
C01486-SR01	LINBRO PARK TOWER: 3.0ML Tower Pile caps and beams reinforcement layout	T0
C01486-SR01-BS01	LINBRO PARK TOWER: 3.0ML Tower Pile caps and beams reinforcement bending schedule	T0
C01486-SR01-BS02	LINBRO PARK TOWER: 3.0ML Tower Pile caps and beams reinforcement bending schedule	T0
C01486-SR01-BS03	LINBRO PARK TOWER: 3.0ML Tower Pile caps and beams reinforcement bending schedule	T0
C01486-SR02	LINBRO PARK TOWER: 3.0ML Tower Columns reinforcement layout	T0
C01486-SR02-BS01	LINBRO PARK TOWER: 3.0ML Tower Columns reinforcement bending schedule	T0

DRAWING NUMBER	DESCRIPTION	REV
C01486-SR03	LINBRO PARK TOWER: 3.0ML Tower Central core reinforcement lay-out	T0
C01486-SR03-BS01	LINBRO PARK TOWER: 3.0ML Tower Central core reinforcement bending schedule	T0
C01486-SR04	LINBRO PARK TOWER: 3.0ML Tower Tank floor beams reinforcement layout	T0
C01486-SR04-BS01_02	LINBRO PARK TOWER: 3.0ML Tower Tank floor beams reinforcement bending schedule	T0
C01486-SR05	LINBRO PARK TOWER: 3.0ML Tower Floor slab reinforcement layout	T0
C01486-SR05-BS01	LINBRO PARK TOWER: 3.0ML Tower Floor slab reinforcement bending schedule	T0
C01486-SR05-BS02	LINBRO PARK TOWER: 3.0ML Tower Floor slab reinforcement bending schedule	T0
C01486-SR05-BS03	LINBRO PARK TOWER: 3.0ML Tower Floor slab reinforcement bending schedule	T0
C01486-SR05-BS04	LINBRO PARK TOWER: 3.0ML Tower Floor slab reinforcement bending schedule	T0
C01486-SR05-BS05	LINBRO PARK TOWER: 3.0ML Tower Floor slab reinforcement bending schedule	T0
C01486-SR06	LINBRO PARK TOWER: 3.0ML Tower Internal tank wall reinforcement layout	T0
C01486-SR06-BS01	LINBRO PARK TOWER: 3.0ML Tower Internal tank wall reinforcement bending schedule	T0
C01486-SR07	LINBRO PARK TOWER: 3.0ML Tower External tank wall reinforcement layout	T0
C01486-SR07-BS01	LINBRO PARK TOWER: 3.0ML Tower External tank wall reinforcement bending schedule	T0
C01486-SR08	LINBRO PARK TOWER: 3.0ML Tower Roof slab reinforcement layout	T0
C01486-SR08-BS01	LINBRO PARK TOWER: 3.0ML Tower Roof slab reinforcement bending schedule	T0
C01486-SR08-BS02	LINBRO PARK TOWER: 3.0ML Tower Roof slab reinforcement bending schedule	T0
<b>ELECTRO-MECHANICAL ENGINEERING (EM) DRAWINGS</b>		
C01486 - EM001	Pump Station Single Line Drawing	T0
C01486 - EM002	Pump Station General Arrangement Drawing	T0
C01486 - EM003	Pump Station Typical E-Stop Drawing	T0
C01486 - EM004	Pump Station -Small Power & Lighting Designs-Lights	T0
C01486 - EM005	Pump Station -Small Power & Lighting Designs-Plugs	T0
C01486 - EM006	Pump Station -Site Plan- Electrical Reticulation Layout	T0

DRAWING NUMBER	DESCRIPTION	REV
C01486 - EM007	Pump Station -Piping & Instrumentation Diagram	T0
C01486 - EM008	Pump Station Typical Trench Low Voltage Cabling	T0
<b>PUMP STATION (PS) ENGINEERING DRAWINGS</b>		
C01486 - PS01	Pump Station Floor Plan Sheet 1 Of 1	T0
C01486 - PS02	Pump Station Elevations Sheet 1 Of 2	T0
C01486 - PS02	Pump Station Elevations Sheet 2 Of 2	T0
C01486 - PS03	Pump Station Outlet Pipeline Layout Sheet 1 Of 11	T0
C01486 - PS03	Pump Station Inlet Pipeline Layout Sheet 2 Of 11	T0
C01486 - PS03	Pump Station Inlet Pipeline Section A-A & Fittings Schedule Sheet 3 Of 11	T0
C01486 - PS03	Pump Station Outlet Pipeline Section B-B, C-C & Fittings Schedule Sheet 4 Of 11	T0
C01486 - PS03	Pump Station Basement Concrete Layout And Details Sheet 5 Of 11	T0
C01486 - PS03	Pump Station Roof Concrete And Sections Details Sheet 6 Of 11	T0
C01486 - PS03	Pump Station Ground Foundations, Landing Layout Details Sheet 7 Of 11	T0
C01486 - PS03	Pump Station Roof Slab And Beam Reinforcement And Details Sheet 8 Of 11	T0
C01486 - PS03	Pump Station Roof Slab Reinforcement Sheet 9 Of 11	T0
C01486 - PS03	Pump Station Retaining Wall Reinforcement & Bending Schedules Sheet 10 Of 11	T0
C01486 - PS03	Pump Station Retaining Wall Sheet 11 Of 11	T0
C01486 - PS04	Chamber 09 - Tower Outlet Chamber Sheet 1 Of 4	T0
C01486 - PS04	Chamber 09 - Valve Chamber #09 Concrete Layout And Sections Sheet 3 Of 4	T0
C01486 - PS04	Chamber 09 - Valve Chamber #09 Rebar Layout 4 Of 4	T0
C01486 - PS05	Chamber 10 - Pumpstation Inlet Chamber Sheet 1 Of 3	T0
C01486 - PS05	Chamber 10 - Valve Chamber #10 Concrete Layout Sections And Details Sheet 2 Of 3	T0
C01486 - PS05	Chamber 10 - Valve Chamber #10 Rebar Layout Sheet 3 Of 3	T0
C01486 - PS06	Chamber 11 - Pumpstation Outlet Chamber Plans And Sections Sheet 1 Of 3	T0
C01486 - PS06	Chamber 11 - Pumpstation Outlet Chamber Elevations Sheet 2 Of 3	T0
C01486 - PS06	Chamber 11 - Pumpstation Outlet Chamber Concrete And Rebar Sheet 3 Of 3	T0
C01486 - PS07	Chamber 12 - Prv Chamber Layout Plans And Sections Sheet 1 Of 6	T0
C01486 - PS07	Chamber 12 - Prv Chamber Layout Elevations Sheet 2 Of 6	T0

DRAWING NUMBER	DESCRIPTION	REV
C01486 - PS07	Chamber 12 - Prv Chamber Retaining Wall Concrete Layout Sheet 3 Of 6	T0
C01486 - PS07	Chamber 12 - Prv Chamber Retaining Wall And Roof Rebar Layout Sheet 4 Of 6	T0
C01486 - PS07	Chamber 12 - Prv Chamber Roof Concrete Layout And Sections Sheet 5 Of 6	T0
C01486 - PS07	Chamber 12 - Prv Chamber Beams And Stairs Rebar Sheet 6 Of 6	T0
C01486 - PS08	Chamber 13 - Emergency Connection Chamber Sheet 1 Of 3	T0
C01486 - PS08	Chamber 13 - Emergency Connection Concrete Layout Chamber Sheet 2 Of 3	T0
C01486 - PS08	Chamber 13 - Emergency Connection Rebar Layout Chamber Sheet 3 Of 3	T0
C01486 - PS09	Longsection P3- Suction Pipeline From Existing Valve Chamber To Ps Sheet 1 Of 6	T0
C01486 - PS09	Longsection P4- Outlet From Pumpstation To Tower Layout Sheet 2 Of 6	T0
C01486 - PS09	Longsection P5- Connection From 1100mm Dia Pipeline Layout Sheet 3 Of 6	T0
C01486 - PS09	Longsection P6b- Tower Bypass Pipeline Layout Sheet 5 Of 6	T0
C01486 - PS09	Longsection P7- Outlet Pipeline From Tower Up To Network Layout Sheet 6 Of 6	T0
C01486 - PS09	Roads And Stormwater Layout Sheet 1 Of 2	T0
C01486 - PS21	Generator Room Roof Slab Layout And Details Sheet 2 Of 3	T0
C01486 - PS21	Generator Room Roof Slab Layout And Details Sheet 3 Of 3	T0
<b>STEEL PIPELINE (CP) ENGINEERING DRAWINGS</b>		
C01486-CP01	Details Of Air Valve Chamber	T0
C01486-CP02	Scour&Isolation Valve Chamber	T0
C01486-CP04	Padlock Pin & Ladder Details	T0
C01486-CP05	Pipe Support And Test Point	T0
C01486-CP07	Trench Excavation & Backfill For Steel Pipe	T0
C01486-CP08	Steel Pipe Tapers And Bends	T0
C01486-CP09	Protective Coating & Jointing	T0
C01486-CP10	Profile For Outlet Water Pipeline	T0
C01486-CP11	Longitudinal Section & Plan For Water Pipeline	T0
C01486-CP12	Pipe Jacking 1 Of 3	T0
C01486-CP13	Pipe Jacking 2 Of 3	T0
C01486-CP14	Pipe Jacking 3 Of 3	T0

DRAWING NUMBER	DESCRIPTION	REV
C01486-CP15	Valves Along The Outlet Pipeline	T0
C01486-CP16	Isolation Valve Detail	T0
C01486-CP17	Air Valve Chamber Concrete Layout & Details	T0
C01486-CP18	Air Valve Chamber Rebar Layout & Details	T0
C01486-CP19	Scour & Isolation Valve Chamber Concrete Layout	T0
C01486-CP22	Scour & Isolation Valve Rebar Layout & Details	T0
C01486-CP23	Isolation Valve Concrete Layout & Details	T0
C01486-CP24	Isolation Valve Rebar Layout & Details	T0
C01486-CP25	Thrust Block C Concrete & Rebar	T0
C01486-CP25	Trust Block A Concrete & Rebar	T0
C01486-CP26	Trust Block B Concrete & Rebar	T0
C01486-CP27	Profile For Water Outlet Pipeline	T0
C01486-CP29	Details Of Air Valve Chamber	T0
<b>CATHODIC PROTECTION (CP) ENGINEERING DRAWINGS</b>		
PES-PEP0221-CP-001	Cathodic Protection - Mega Big Headed Test Post (Bhtp) Detail	T0
PES-PEP0221-CP-002	Cathodic Protection - Bunker Test Post Enclosure	T0
PES-PEP0221-CP-003	Cathodic Protection - Cp Coupon Detail	T0
PES-PEP0221-CP-004	Cathodic Protection - Big Headed Test Post Pre/Coupon Monitoring Test Post	T0
PES-PEP0221-CP-005	Cathodic Protection - Continuity Bonding At Pipeline Valve Chambers	T0
PES-PEP0221-CP-006	Cathodic Protection - Valve Chamber Test Post	T0
PES-PEP0221-CP-007	Cathodic Protection - Ir Free Card (Type B)	T0
PES-PEP0221-CP-008	Cathodic Protection - Pipe Joint Continuity Bonding	T0
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Signed at ..... on this ..... Day of ..... 20.....

<b>Name of tenderer</b>	
<b>Name of Authorized person</b>	
<b>Authorized Signature*</b>	



Contract: JW14406

CONSTRUCTION OF LINBRO PARK TOWER (With Associated works



Volume 1 Tender and Contract

Section C1 Agreement and Contract Data

# Johannesburg Water SOC Ltd



**CONTRACT JW14406**

**CONSTRUCTION OF LINBRO TOWER AND ASSOCIATED WORKS**

**VOLUME 1**

**PART 1: AGREEMENT AND CONTRACT DATA**

Employer:		Contractor:	
Witness:		Witness:	



Contract: JW14406

CONSTRUCTION OF LINBRO PARK TOWER (With Associated works



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Employer:		Contractor:	
Witness:		Witness:	



Contract: JW14406

CONSTRUCTION OF LINBRO PARK TOWER (With Associated works



Volume 1 Tender and Contract

Section C1 Agreement and Contract Data

## 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:

**JW14406: LINBRO PARK TOWER AND PUMP STATION (WITH ASSOCIATED 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** \_\_\_\_\_

Employer:		Contractor:	
Witness:		Witness:	



Contract: JW14406

CONSTRUCTION OF LINBRO PARK TOWER (With Associated works



Volume 1 Tender and Contract

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## 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 (now the Contractor) within five days after the date of such receipt notifies the Employer in writing of any reason why he cannot accept the contents of this Agreement, this Agreement shall constitute binding contract between the parties,

Name(s)

Capacity

For the Employer

**Johannesburg Water SOC Ltd, Turbine Hall, 65 Ntengi Piliso, Newtown, Johannesburg**

(Name and address of organisation)

Name and signature  
of witness

Date

Employer:		Contractor:	
Witness:		Witness:	



Contract: JW14406

CONSTRUCTION OF LINBRO PARK TOWER (With Associated works



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**C1.1.3 Schedule of Deviations**

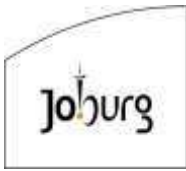
**Notes:**

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.

<b>1</b>	<b>Subject</b>	
	Details	
<b>2</b>	<b>Subject</b>	
	Details	
<b>3</b>	<b>Subject</b>	
	Details	
<b>4</b>	<b>Subject</b>	
	Details	
<b>5</b>	<b>Subject</b>	
	Details	
<b>6</b>	<b>Subject</b>	
	Details	
<b>7</b>	<b>Subject</b>	
	Details	
<b>8</b>	<b>Subject</b>	
	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 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.

Employer:		Contractor:	
Witness:		Witness:	



Contract: JW14406

CONSTRUCTION OF LINBRO PARK TOWER (With Associated works



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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, Newtown, Johannesburg***

**(Name and address of organisation)**

**Name and  
signature of  
witness**

\_\_\_\_\_

**Date**

\_\_\_\_\_

Employer:		Contractor:	
Witness:		Witness:	



Contract: JW14406

**CONSTRUCTION OF LINBRO PARK TOWER (With Associated works****Volume 1 Tender and Contract****Section C1 Agreement and Contract Data****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), 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:

<b>GCC Clause</b>	<b>Information</b>
1.1.1.13	The Defects Liability Period is 52 weeks from the date of the Certificate of Completion.
1.1.1.14	Time for achieving Practical Completion is 18 months
1. 1.1.15	The name of the Employer is William Chitsa of Johannesburg Water (SOC) Limited
1. 1.1.15	The name of the Employer's Agent is Mr Tendai Chikwata, who is Registered as a PrEng with Engineering Council of South Africa.
1.2.1.	The address of the Employer is: Physical                      Postal                      Tel: 011 688 1470 Turbine Hall                      P.O. Box 61542                      Fax: 011 688 1521 65 Ntemi Piliso Street                      Marshalltown                      Email: William.chitsa@jwater.co.za Newtown                      2107
1.2.1.2	The address of the Employer's Agent is: Physical                      Postal                      Tel: 011 045 2532 34 Dane Street                      P.O. Box 61542                      Fax: 086 611 1152 Glen Austin                      Marshalltown                      Email: tendai@technodesigns.co.za Midrand                      2107
3.2.3	Specific Approval – The Employer's Agent is required to obtain the Employer's approval for the following: <ul style="list-style-type: none"> <li>• Approval of Variation Orders</li> <li>• Approval to exceed the Contract Sum</li> <li>• Approval of Subcontracting Plan</li> </ul>
4.4.2	Add the following after this clause:  Apart from subcontractors identified by the Contractor for the execution of certain sections of the Works, subcontractors shall also include SMME's (Small Medium and Micro Enterprises), who are identified from the Local Community for the execution of certain sections of the works identified by the Contractor. The appointment of subcontractors and the allocation of work to subcontractors shall in addition to the provisions of the General Conditions of Contract, comply with, but not to be limited to, the provisions of <b>C1.2.1.2.14</b>  A value of 30% (thirty percent) of the Contract Price shall be subcontracted to SMME's

Employer:		Contractor:	
Witness:		Witness:	



Contract: JW14406

**CONSTRUCTION OF LINBRO PARK TOWER (With Associated works****Volume 1 Tender and Contract****Section C1 Agreement and Contract Data**

<b>GCC Clause</b>	<b>Information</b>
4.11.1	<p>Add the following to this clause:</p> <p>Competent Employees shall include, amongst others, the following key Personnel:</p> <ul style="list-style-type: none"> <li>• Contracts Manager</li> <li>• Site Manager / Site Agent</li> <li>• Safety Officer</li> </ul> <p>The minimum requirements in terms of qualifications and experience of these Key Personnel are listed in <b>C1.2.1.2.15</b></p>
5.3.1	<p>The documentation required before commencement with Works execution are:</p> <ul style="list-style-type: none"> <li>• Approved Health and Safety File (Clause 4.3)</li> <li>• Approved Environmental Management Plan (Clause 4.3)</li> <li>• Initial programme and cashflow projections (Clause 5.6)</li> <li>• Guarantee from Bank or Insurance Company (Clause 6.2)</li> <li>• Special Risks Insurance (Clause 8.6)</li> <li>• Ground Support Insurance (Clause 8.6 - Where Applicable)</li> <li>• Insurance of the works, Plant, etc. (Clause 8.6), including but not limited to: <ul style="list-style-type: none"> <li>○ SASRIA Policy</li> <li>○ Liability Insurance</li> <li>○ Insurance of Construction Machinery and Plant</li> <li>○ Insurance of Motor Vehicle Liability (Clause 8.6)</li> </ul> </li> <li>• Commissioner of COID</li> <li>• Signed Notification to the Department of Labour</li> <li>• Construction Permit were applicable.</li> <li>• Organogram of resources</li> <li>• Subcontract plan/ proposal which includes a priced BoQ and a number of Subcontractors that meets requirements as per conditions 11.3.</li> </ul>
5.3.2	The time to submit the documentation required before Commencement of the works is 28 days.
5.3.3	<p><b>Time to instruct commencement of the Works</b></p> <p>Delete Clause 5.3.3 and replace with the following:</p> <p>The Contractor shall commence with carrying out the Works upon written instruction from the Employer's Agent to commence with the Works.</p>
5.8.1	<p>Working days shall be Monday to Friday, between 07h00 to 17h00.</p> <p>Non-working days are Sundays.</p> <p>The special non-working days are All Public Holidays in terms of the Public Holidays Act (as amended), and the annual "Builder's Break" as defined by SAFCEC on an annual basis.</p>
5.11.1	Notwithstanding any other provision of this contract, the contractor agrees that there shall be no suspension of the works due to non-payment by the Client. The contractor shall continue to perform the works as scheduled, regardless of any delays or failures by the Client to make payments when due

Employer:		Contractor:	
Witness:		Witness:	



Contract: JW14406

CONSTRUCTION OF LINBRO PARK TOWER (With Associated works



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GCC Clause	Information
5.13.1	The penalty for failing to complete the Works is the greater of: An amount equal to daily Time Related P&G rate (as calculated from the Time Related P&G section in the Bill of Quantities) or R25 000.00 per day, whichever is greater.
5.14.1	The requirements for achieving Practical Completion are: <ul style="list-style-type: none"> <li>• Construction, testing &amp; commissioning of the new 3ML Linbro Park Tower and Pump station.</li> <li>• Construction, testing &amp; commissioning of all pipework including inlet, outlet, overflow, scour and drainage pipelines.</li> <li>• Installation, testing &amp; commissioning of all valves.</li> <li>• Installation, testing &amp; commissioning of all electrical and C&amp;I infrastructure.</li> <li>• Construction, testing &amp; commissioning of all stormwater infrastructure.</li> <li>• Construction of the guard house (including all civil and electrical infrastructure).</li> <li>• Construction of the telemetry hut (including all civil, electrical and telemetry infrastructure).</li> <li>• Construction of the valve building (including all pipework, valves, civil and electrical infrastructure).</li> <li>• Construction, Installation, testing &amp; commissioning of all security infrastructure (including fencing, gates, CCTV systems etc).</li> </ul>
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. The security to be provided by the Contractor shall be in the form of a Performance Guarantee and will comply with the requirements of Clause 6.2.3. The value of the Performance Guarantee shall be ten (10) % of the Contract Sum, which sum excludes VAT.
6.2.3	The performance Guarantee under shall be irrevocable, on -demand performance Guarantee, to be issued exactly in the form of the proforma document provided in favour of the client by a recognised financial institution or cash in lieu of bond will apply.
6.2.1	The liability of the guarantee shall be 10% of the tendered sum
6.8.2	<p><b>The Contract Price Adjustment is applicable for this contract.</b></p> <p>The contract rates shall be fixed for the first 12 months and thereafter the rates will be adjusted by the change in CPA (as published by Statistics SA and will be fixed for the next 12 months)</p> <p>The following formula will be applicable.</p> $(1-x) \left[ \frac{aLt}{Lo} + \frac{bPt}{Po} + \frac{cMt}{Mo} + \frac{dFt}{Fo} - 1 \right]$ <p>In which the symbols have the following meaning as per GCC 2015:</p> <p>"x" is the proportion of "Ac" which is not subject to adjustment.</p>

Employer:		Contractor:	
Witness:		Witness:	



Contract: JW14406

**CONSTRUCTION OF LINBRO PARK TOWER (With Associated works****Volume 1 Tender and Contract****Section C1 Agreement and Contract Data**

GCC Clause	Information
	<p>"a", "b", "c" and "d" are the coefficients contained in the Contract Data, which are deemed, irrespective of the actual constituents of the work, to represent the proportionate value of labour, contractors' equipment, material (other than "special materials" specified in the Contract Data) and fuel respectively.</p> <p>"L" is the "Labour Index"  "P" is the "Plant Index"  "M" is the "Materials Index"</p> <p>"F" is the "Fuel Index" The suffix "o" denotes the base indices applicable to the base month as stated in the Contract Data.  The suffix "t" denotes the current indices applicable to the month in which the last day of the period falls to which the relevant monthly statement relates.</p> <p>If any index relevant to any particular certificate is not known at the time when the certificate is prepared, the Engineer shall estimate the value of such index. Any correction which may be necessary when the correct indices become known, shall be made by the Engineer in subsequent payment certificates.</p> <p>The value of the payment certificates issued shall be adjusted in accordance with the Contract Price Adjustment Schedule, with the following values:</p> <p>The value of "x" is 0,10</p> <p>The values of the coefficients are:  a = 0,32 Labour  b = 0,25 Contractor's equipment  c = 0,33 Material  d = 0,10 Fuel</p> <p>The province where the Site is located is Gauteng and the urban area where the project is implemented is Johannesburg.</p> <p>The base month is the month prior to the month in which the tender closes.</p> <p>The Consumer Price Indices for Labour (L), Plant (P), Material (M) and Fuel (F) are as published by Statistics South Africa for the applicable time.</p>
6.8.3	Price adjustments for variations in the costs of special materials are <b>NOT</b> allowed.
6.10.1.5	The percentage advance on materials not yet built into the Permanent Works is 80%.
6.10.3	The percentage retention on the amounts due to the Contractor is 10%.
6.10.4	<p><b>Delivery, dissatisfaction with and payment of payment certificates</b></p> <p>Delete Clause 6.10.4 and replace with the following:</p> <p>Payment shall be made upon:</p> <ul style="list-style-type: none"> <li>After the payment certificate has been approved by Employer's Agent, the Contractor must issue an Original Tax Invoice compliant with SARS</li> </ul>

Employer:		Contractor:	
Witness:		Witness:	



Contract: JW14406

**CONSTRUCTION OF LINBRO PARK TOWER (With Associated works****Volume 1 Tender and Contract****Section C1 Agreement and Contract Data**

GCC Clause	Information
	<p>requirements for Valid Tax Invoice. The date of the Original Tax Invoice must be the date the Employer's Agent approved the payment Certificate. The payment certificate will then be ready for handing in to the Employer latest by the 25<sup>th</sup> of every month.</p> <ul style="list-style-type: none"> <li>• The payment certificate being submitted with an original tax invoice.</li> <li>• No payment certificate will be processed if correct labour returns are not submitted.</li> <li>• Any failure to submit the required, Employer's Agent-approved payment certificate by the agreed date will result in the assessment by the Employer's Agent being held over until the assessment interval following the correct submission of the required information.</li> </ul> <p>Payment will be made within 30 days of receipt of the Contractor's statement.</p> <p>Payment shall be subject to the Contractor submitting an Original Tax Invoice compliant with SARS requirements for a Valid Tax Invoice to the Employer for the amount due.</p> <p>Any dissatisfaction in respect of such payment certificate shall be dealt with in terms of Clause 10.2.</p>
6.10.5	<p>Payment of Retention Money Add to Clause 6.10.5 the following:</p> <p>When defects liability is specified, one half of the retention money shall be paid after the Employer's Agent has issued a Certificate of Completion in terms of Clause 5.14.4 as follows:</p> <ul style="list-style-type: none"> <li>• The Contractor will provide a statement for release of 5% retention to the Employer's Agent before or on the 20th of the month.</li> <li>• After the payment certificate has been approved by Employer's Agent, the Contractor must issue an Original Tax Invoice compliant with SARS requirements for Valid Tax Invoice. The date of the Original Tax Invoice must be the date the Employer's Agent approved the Payment Certificate. The certificate will then be ready for handing in to the Employer latest by the 25th of the month.</li> <li>• Payment will be on or before the last day of the month following the approval of the payment certificate by the Employer's Agent.</li> </ul> <p>The other half of the retention money shall be paid after the Employer's Agent has issued Final Approval Certificate at the end of the Defects Liability Period, which may be extended in term of Clauses 5.14.4 or 7.8.1, if necessary, as follows:</p> <ul style="list-style-type: none"> <li>• The Contractor will provide a statement for release of 5% retention to the Employer's Agent before or on the 20th of the month.</li> <li>• After the payment certificate has been approved by Employer's Agent, the Contractor must issue an Original Tax Invoice compliant with SARS requirements for Valid Tax Invoice. The date of the Original Tax Invoice must be</li> </ul>

Employer:		Contractor:	
Witness:		Witness:	



Contract: JW14406

## CONSTRUCTION OF LINBRO PARK TOWER (With Associated works



## Volume 1 Tender and Contract

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GCC Clause	Information
	<p>the date the Employer's Agent approved the Payment Certificate. The certificate will then be ready for handing in to the Employer latest by the 25th of the month.</p> <ul style="list-style-type: none"> <li>Payment will be on or before the last day of the month following the approval of the payment certificate by the Employer's Agent.</li> </ul> <p>Payment shall be subject to the Contractor submitting an Original Tax Invoice compliant with SARS requirements for Valid Tax Invoice to the Employer for the amount due.</p>
6.10.6	A Retention Money Guarantee is not permitted.
8.4.1.1	<p>Add to the end of Clause 8.4.1.1 the following text:</p> <p>"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).</p>
8.6.1.1.3	The amount to cover professional fees for repairing damage and loss to be included in the insurance sum is <b>15 % (fifteen percent)</b> of the value of the damage and/or loss.
8.6.1.3	The limit of indemnity for liability insurance is <b>R10 000 000 (Ten million Rand)</b> for any single claim – the number of claims to be unlimited during the construction and Defects Liability Periods.
8.6.1.5	<p>In addition to the insurances required in terms of General Conditions of Contract Clauses 8.6.1.1 to 8.6.1.4 the following insurance is also required:</p> <ol style="list-style-type: none"> <li>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 and brought on to the Site against all risks of physical loss or damage for the period that such Plant shall be on the Site to the full value thereof. In respect of a 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 if it has ensured 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, via the Employer's Agent, the policy or policies of insurance and receipts for payment of the current premiums.</li> <li>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)</li> <li>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 R2,5 million.</li> <li>Where the contract involves manufacturing and/or fabrication of the works or</li> </ol>

Employer:		Contractor:	
Witness:		Witness:	



Contract: JW14406

CONSTRUCTION OF LINBRO PARK TOWER (With Associated works



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GCC Clause	Information
	part thereof at premises other than the Site, the Contractor shall satisfy the Employer that all materials and equipment for incorporation in the works are adequately insured during manufacture and/or fabrication. In the event of the Employer having an insurable interest in such works during manufacture or fabrication then such interest shall be noted by endorsement to the Contractor's Policies of Insurance.
10.5.3	The number of Adjudication Board Members to be appointed is one (1).
7.8.2	The determination of disputes shall be by arbitration.

**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 the Contractor, should the latter fail to provide reporting Labor Stats and SMMEs Stats as required, 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 R10,000.00 if the Contractors not complying with Environmental scorecards above 85% but below 93% for 2 successive months then the scorecard below 85% will be R10,000.00 per occasion.
- The penalty value shall be R10 000 if the contractors fail to comply with health and safety requirements and scoring above 85% but below 93% for successive 2 months and then the score below 85% contractors will be penalised for each month R10 000.00 Per occasion.
- If the Contractor fails to complete the latter for 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

Employer:		Contractor:	
Witness:		Witness:	



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CONSTRUCTION OF LINBRO PARK TOWER (With Associated works



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Section C1 Agreement and Contract Data

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 of R100 000.00 Per occurrence on Contractor, should the latter fail to provide payment to the SMME as required in the specification highlighted in the Scope of Work and specified in the appointment agreements with the Contractor and the SMME.
- The penalty value shall be R 50,000.00 per report per occasion; and
- If the Contractor fails to pay any labourer or SMME for more than three incidents the Employer shall reserve the right to terminate the Contract in terms of GCC 2015 Clause 9.2

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 payment shall be delayed or become impossible for the above-mentioned reasons

c) 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 clause PS3.2.3, 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 PS3: Scope of Works, is 50% of the monetary value by which the achieved monetary value falls short of the target monetary value.

d) Penalties irreversible

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

Employer:		Contractor:	
Witness:		Witness:	



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**CONSTRUCTION OF LINBRO PARK TOWER (With Associated works**



**Volume 1 Tender and Contract**

**Section C1 Agreement and Contract Data**

**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.

**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

Employer:		Contractor:	
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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.

Employer:		Contractor:	
Witness:		Witness:	



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**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.

**C1.2.1.2.14 Continuation of Works During Dispute Resolution**

Notwithstanding any dispute or disagreement between the Client and Contractor, the Contractor shall continue to perform the Works as scheduled. Both parties agree that the resolution of any disputes shall proceed in parallel with the ongoing performance of the works, ensuring that the project timeline is maintained without interruption.

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Employer:		Contractor:	
Witness:		Witness:	




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**CONSTRUCTION OF LINBRO PARK TOWER (With Associated works****Volume 1 Tender and Contract****Section C1 Agreement and Contract Data****C1.2.2 PART 2: DATA PROVIDED BY THE CONTRACTOR**

<b>GCC Clause</b>	<b>Information</b>																		
Clause 1.1.1.9	The name of the Contractor is .....																		
Clause 1.2.1.2	The address of the Contractor is: <table border="0"> <tr> <td>Physical</td><td>Postal</td><td>Tel:</td></tr> <tr> <td>.....</td><td>.....</td><td>.....</td></tr> <tr> <td>.....</td><td>.....</td><td>Fax:</td></tr> <tr> <td>.....</td><td>.....</td><td>.....</td></tr> <tr> <td>.....</td><td>.....</td><td>Email:</td></tr> <tr> <td>.....</td><td>.....</td><td>.....</td></tr> </table>	Physical	Postal	Tel:	.....	.....	.....	.....	.....	Fax:	.....	.....	.....	.....	.....	Email:	.....	.....	.....
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Clause 6.5.1.2.3	The percentage allowance on the net cost of materials actually used in the completed work is .....(.....)% The percentage allowance on the gross remuneration of the workmen actually engaged is .....(.....)%																		
Clause 6.6.1.2.1	Provisional Sums and Subcontracting: The percentage allowance to cover overhead charges is .....%																		
Clause 6.8.3	The variation in cost of special materials is; <table border="0"> <tr> <td>Type of Special Material</td><td>Unit</td><td>Rate or Price</td></tr> <tr> <td>.....</td><td>.....</td><td>.....</td></tr> <tr> <td>.....</td><td>.....</td><td>.....</td></tr> <tr> <td>.....</td><td>.....</td><td>.....</td></tr> <tr> <td>.....</td><td>.....</td><td>.....</td></tr> <tr> <td>.....</td><td>.....</td><td>.....</td></tr> </table>	Type of Special Material	Unit	Rate or Price	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Type of Special Material	Unit	Rate or Price																	
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Employer:		Contractor:	
Witness:		Witness:	

<b>Volume</b>	<b>1</b>	2	3	4			
<b>Part</b>	T1	T2	<b>C1</b>	C2	C3	C4	C5

Contract JW14406 Page (1)  
Description: Linbro Park Tower (With  
Associated Works)  
**Forms and Securities**

# Johannesburg Water (SOC) Ltd



## VOLUME 1

### PART 1.3: FORMS AND SECURITIES



Employer:		Contractor:	
Witness:		Witness:	

<b>Volume</b>	<b>1</b>	2	3	4			
<b>Part</b>	T1	T2	<b>C1</b>	C2	C3	C4	C5



Contract JW14406 Page (2)  
Description: Linbro Park Tower (With Associated Works)

## Forms and Securities

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Employer:		Contractor:	
Witness:		Witness:	

<b>Volume</b>	<b>1</b>	2	3	4			
<b>Part</b>	T1	T2	<b>C1</b>	C2	C3	C4	C5



## 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 TENDERER**

- 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.



Employer:		Contractor:	
Witness:		Witness:	

Volume	1	2	3	4			
Part	T1	T2	C1	C2	C3	C4	C5



### C1.3.1 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

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
5. Our total liability hereunder shall not exceed the sum of \_\_\_\_\_

\_\_\_\_\_  
(R \_\_\_\_\_)



Employer:		Contractor:	
Witness:		Witness:	

<b>Volume</b>	<b>1</b>	2	3	4			
<b>Part</b>	T1	T2	<b>C1</b>	C2	C3	C4	C5



6. 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.
7. We hereby choose our address for the serving of all notices for all purposes arising herefrom as

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

As witnesses

1. \_\_\_\_\_

Signature

2. \_\_\_\_\_

Duly authorised to  
sign on behalf of

Address



Employer:		Contractor:	
Witness:		Witness:	

Volume	1	2	3	4			
Part	T1	T2	C1	C2	C3	C4	C5



### C1.3.2 Blasting Indemnity

Given by \_\_\_\_\_

\*Company Registration No. \_\_\_\_\_

Address \_\_\_\_\_

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 property 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

witnesses.

As witnesses

1. \_\_\_\_\_

Signature

2. \_\_\_\_\_

Duly authorised to  
sign on behalf of

Address



Employer:		Contractor:	
Witness:		Witness:	

Volume	1	2	3	4			
Part	T1	T2	C1	C2	C3	C4	C5



**C1.3.3 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 ((Proprietary) 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)



Employer:		Contractor:	
Witness:		Witness:	

<b>Volume</b>	<b>1</b>	2	3	4			
<b>Part</b>	T1	T2	<b>C1</b>	C2	C3	C4	C5



### C1.3.4 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 mandataries (contractors) save where a written agreement between the parties has been concluded containing arrangements and procedures to ensure compliance with the said Act by the mandatory.
4. All documents attached or referred to in the above agreement form an integral part of the agreement.
5. To perform in terms of this agreement mandataries must be familiar with the relevant provisions of the Act.
6. Mandataries who utilise the services of their own mandataries (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 \_\_\_\_\_
11. The area in which the work is to be conducted is \_\_\_\_\_
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.



Employer:		Contractor:	
Witness:		Witness:	

Volume	1	2	3	4			
Part	T1	T2	C1	C2	C3	C4	C5



#### C1.3.4.1 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.



Employer:		Contractor:	
Witness:		Witness:	

<b>Volume</b>	<b>1</b>	2	3	4			
<b>Part</b>	T1	T2	<b>C1</b>	C2	C3	C4	C5



Contract JW14406 Page (10)  
Description: Linbro Park Tower (With  
Associated Works)  
**Forms and Securities**

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 \_\_\_\_\_



Employer:		Contractor:	
Witness:		Witness:	

Volume	1	2	3	4				
Part	T1	T2	C1	C2	C3	C4	C5	



# Johannesburg Water SOC Ltd



## VOLUME 1

## PART 2: PRICING DATA

### TABLE OF CONTENTS



Employer:		Service Provider	
Witness:		Witness:	

Volume	1	2	3	4			
Part	T1	T2	C1	C2	C3	C4	C5



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Employer:		Service Provider	
Witness:		Witness:	

Volume	1	2	3	4			
Part	T1	T2	C1	C2	C3	C4	C5



## C2 PRICING DATA

### C2.1 PRICING INSTRUCTIONS

#### C2.1.1 GENERAL PREAMBLE TO THE BILL OF QUANTITIES

- a) **The Contract is to be constructed using labour intensive methods. In exceptional cases where the use of plant is required, the Contractor must motivate and obtain written permission before the work is undertaken with plant. Payment will not be made for unauthorized use of plant to carry out work.**
- b) 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.
- c) 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, Portion 1: Project Specification. Portion 2: comprises the Technical specifications for the works of each discipline in this contract.
- d) 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.
- e) 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. G for SANS 1200G.
- f) Unless otherwise stated, items are measured net in accordance with the drawings, and no allowance is made for waste.
- g) 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.
- h) 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.



Employer:		Service Provider	
Witness:		Witness:	

Volume	1	2	3	4			
Part	T1	T2	C1	C2	C3	C4	C5



- 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 (1000kg)
m <sup>2</sup>	=	square metre	No.	=	number
m <sup>2</sup> pass	=	square metre pass	sum	=	lump sum
ha	=	hectare	MN	=	meganeutron
m <sup>3</sup>	=	cubic metre	MN.m	=	meganeutron-metre
m <sup>3</sup> km	=	cubic metre-kilometre	P Csum=	=	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 Standard Specification for South African National Standards.

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 INK or TYPED. Tenderers are permitted to complete and submit the electronic Bill of Quantities (BOQ) instead of filling out the BOQ in the tender document. The original pages of the tender document should not be removed. The electronic version may be submitted as an annexure or inserted as additional pages within the tender document. Tenderers are not permitted to alter the document by amending the descriptions and/or quantities specified in the BOQ."

## 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:

- clearly state this in his qualifications; and
- 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.



Employer:		Service Provider	
Witness:		Witness:	

Volume	1	2	3	4			
Part	T1	T2	C1	C2	C3	C4	C5



#### C2.1.2.2 Security

The Contractor shall have been 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 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.

#### C2.1.3 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 Clause (30) of the Occupational Health and Safety Act 183 (1993), Construction Regulations (2014).

##### C2.1.3.1 Compilation of health and safety plan

Unit: Sum

The rate shall include the complete cost for the provision of resources (human and equipment), communication, transportation and travelling, documentation of activities and reporting activities required to compile a Health and Safety Plan as per the Health and Safety Specifications contained in Volume 2, and approval of such plan thereof. Remuneration shall be a lump sum.

##### C2.1.3.2 Implementation of health and safety plan

Unit: Sum

The rate shall include the complete cost for the provision of resources (human and equipment), communication, transportation and travelling, documentation of activities and reporting activities required



Employer:		Service Provider	
Witness:		Witness:	

Volume	1	2	3	4			
Part	T1	T2	C1	C2	C3	C4	C5



Contract JW14406 Page (6)  
Description: Linbro Park Tower (With  
Associated Works)  
**Pricing Data**

to fully comply with the implementation and maintenance of the Health and Safety Plan. Remuneration shall be on a monthly basis for services rendered, by dividing the total sum tendered by the construction duration.



Employer:		Service Provider	
Witness:		Witness:	

Volume	1	2	3	4			
Part	T1	T2	C1	C2	C3	C4	C5



### Safety officer

Unit: Sum

The rate shall include the wages and salary that is to be paid to the safety officer/s, whose responsibility it is to ensure that all activities required fully comply with the Health and Safety Plan as per the Health and Safety Specifications contained in Volume 2 for the duration of the Contract. The rate shall be on a monthly basis for services rendered, by dividing the total sum tendered by the construction duration.

**NOTE: The Contractor shall clearly state the number of Health and Safety officers in the provided space in the Bill of Quantities that he has allowed for in his price. Where no number is provided the Employer shall assume that adequate provision, minimum one (1) per site, has been made to implement the provided Health and Safety Plan successfully.**

### C2.1.4 EMP Implementation and Maintenance

Unit: Sum

The rate shall include the complete cost for the provision of resources (human and equipment), communication, transportation and travelling, documentation of activities and reporting activities required to fully comply with the implementation and maintenance of the EMP contained in Volume 2 for the duration of the Contract. Remuneration shall be on a monthly basis for services rendered, by dividing the total sum tendered by the construction duration.

No payment shall be applicable where equipment is not provided and services are not rendered in terms of the approved EMP.

### C2.1.5 Subcontracting

#### C2.1.5.1

The Contractor shall ensure that rates that are tendered (during Tender Stage) for work items that are likely to be Subcontracted, are market related rates. Provision is made in the Bill of Quantities (BoQ) for the Contractor to add a mark-up for the sourcing, handling, and management of Subcontractors, SMME's, and the like, for the duration of the Contract.

#### C2.1.5.2

The Contractor shall ensure that rates that are tendered (during Tender Stage) for work items that are likely to be Subcontracted, are market related rates. Provision is made in the Bill of Quantities (BoQ) for the Contractor to add a mark-up for the sourcing, handling, and management of Subcontractors, SMME's, and the like, for the duration of the Contract.

#### C2.1.5.3

On or during appointment of Subcontractors, should Subcontractors **prove** that rates, that have been tendered by the Contractor for BoQ work items that are being subcontracted, are not market related, the Contractor will be liable to cover the cost of the difference, i.e. the difference in rate tendered by the Contractor versus the rate that is being requested by the Subcontractor. This difference in cost will be for the Contractor's account, and no Variation Orders for additional costs will be entertained by the Employer.



Employer:		Service Provider	
Witness:		Witness:	

Volume	1	2	3	4			
Part	T1	T2	C1	C2	C3	C4	C5



The Contractor bears the full and complete risk for the rates that have been tendered by the Contractor during Tender Stage.

#### C2.1.5.4

In the event that a rate supplied by the Contractor for a specific BoQ work item is not sufficient to cover Subcontractor costs/rates for that specific item, the Contractor shall provide a detailed rate breakdown for that specific BoQ item (and each and every subsequent BoQ work item where the rate is not sufficient to cover Subcontractor cost); and shall indicate costs (amongst others) for labour, material, handling, mark-ups, etc. to prove that the rate that was submitted during tender stage was in fact market related; and in balance with other rates that were submitted for work items that will not be undertaken by Subcontractors.

#### C2.1.5.5

Should any delays be experienced during the period of the Contract due to the appointment of subcontractors by the Contractor, work stoppages by subcontractors, industrial action by subcontractors, etc. such delays shall be assigned to the Contractor, and no claims for Extension of Time will be entertained by the Employer

#### C2.1.6 RECOMMENDED LABOUR- INTENSIVE TASKS

ACTIVITY	TOOLS	TASK
Bush clearing	Axe, saw, rope	Medium dense bush (4 to 7 bushes per 100 m <sup>2</sup> ) 350 m <sup>2</sup> /md Dense bush (10 to 15 bushes per 100 m <sup>2</sup> ) 200 m <sup>2</sup> /md Very dense bush (20 to 30 bushes per 100 m <sup>2</sup> ) 100 m <sup>2</sup> /md
Grass clearing	Slasher, spade, hoe, fork, rake.	Dense grass 85 m <sup>2</sup> /md
Stripping ground cover and grubbing out roots, haul to nearby dump and spread	Pick, shovel, fork, rake	Light vegetation, dig to 50 mm deep 150 m <sup>2</sup> /md Medium vegetation, dig to 100 mm deep 75 m <sup>2</sup> /md Heavy vegetation, dig to 150 mm deep 40 m <sup>2</sup> /md
Grubbing out roots to 250 mm deep	Pick, shovel, fork, rake	Dig in soft ground to remove roots 42 m <sup>2</sup> /md
Destumping (removal of stumps and roots)	Pick, shovel, axe	Medium dense bush 60 m <sup>2</sup> /md
Removal of bush and tree cuttings	Bush hook, rope, axe, saw	Cut, bundle and load branches, tree trunk pieces, other vegetation 8 m <sup>3</sup> /md
Boulder removal	Crowbar	Daily paid



Employer:		Service Provider	
Witness:		Witness:	

Volume	1	2	3	4				
Part	T1	T2	C1	C2	C3	C4	C5	



Contract JW14406 Page (9)  
Description: Linbro Park Tower (With  
Associated Works)  
**Pricing Data**

Excavation (measured in place)		Throwing distance: up to 4 m	4 to 6 m
Loose soil	Shovel	5 to 6 m <sup>3</sup> /md	4.5 to 5 m <sup>3</sup> /md
Sticky soil	Spade, fork, forked hoe	2 to 3 m <sup>3</sup> /md	1.5 to 2 m <sup>3</sup> /md
Firm soil	Pick, shovel, spade, hoe	3 to 4.5 m <sup>3</sup> /md	2.5 to 4 m <sup>3</sup> /md
Hard stony gravel	Pick, shovel, crowbar	1.5 to 2 m <sup>3</sup> /md	1 to 1.5 m <sup>3</sup> /md
Loading (measured loose) into:	Shovel	Loose soil or gravel:	
Wheelbarrow		12 to 15 m <sup>3</sup> /md	
Trailer		7 to 10 m <sup>3</sup> /md	
Truck		4 to 6 m <sup>3</sup> /md	
Wheel-barrow haul (measured loose; haul and unload only)	Wheelbarrow  (Note production increases 30% for good haul route and decreases 30% for poor haul route)	Equivalent haul distance = length + 10(rise + fall)	Production in loose m <sup>3</sup> /md over average haul route
		20 m	4.44
		40	3.16
		60	2.44
		80	2.00
		100	1.70
		120	1.44
		140	1.28
		160	1.15
		180	1.02
		200	0.95
Levelling roadbed (measured loose)	Shovel, spreader 60 m <sup>2</sup> /md	60 m <sup>2</sup> /md	
Picking loose roadbed (bank m <sup>3</sup> )	Pick, shovel, fork	40 m <sup>2</sup> /md	
Spreading loose material (loose m <sup>3</sup> )	Shovel, spreader, hoe	Soil 12 loose m <sup>3</sup> /md Gravel 10 loose m <sup>3</sup> /md	
Watering, mixing, spreading and levelling	Shovel, spreader, hoe, string-lines, water bowser	Sandy soil 4.5 m <sup>3</sup> /md Gravel 3 m <sup>3</sup> /md (measured tight after compaction)	
Compaction and re-levelling	Roller, string lines, straightedge, shovel, spreader.	Depends upon chosen roller (see below)	
Compaction by pedestrian-controlled double drum vibro-roller	"Stampede" rollers: R75/50 S R90/55 S	Mass kg 980 1 350	Passes 5 4
		Layer 100 mm 100 mm	Output 8 m <sup>3</sup> /h 13 m <sup>3</sup> /h (tight)
Loosen material in trench with pneumatic tools	Compressor, pneumatic tools, team of 4 people	Intermediate 19 m <sup>3</sup> for team Rock 12 m <sup>3</sup> for team	
Screen bedding material	Sieve, shovel	7 m <sup>3</sup> loose /md	
Offload flat-bed truck or trailer	Shovel	15 m <sup>3</sup> loose /md	
Trench backfill, hand compaction	Shovel, spreader, hand- stamper, watering can	Backfill, compact, clean-up and load spoil 4.5 m <sup>3</sup> /md	
Collecting loose stone	Gloves, wheelbarrows	Up to 20 m	2.5 m <sup>3</sup> /md



Employer:		Service Provider	
Witness:		Witness:	

Volume	1	2	3	4			
Part	T1	T2	C1	C2	C3	C4	C5



		20 to 50 m	2.0 m <sup>3</sup> /md
Quarrying, prying out cracked rock	Crowbar, gloves, sledgehammer.	Up to 20 m	0.5 to 1 m <sup>3</sup> /md
Rock crushing	New Dawn Engineering hand-turned rock crusher, shovel	0.25 m <sup>3</sup> /md (depends on size of feed-stock and size of product)	
Backfill trench and compact	Shovel, watering can, hand stamper	3.0 m <sup>3</sup> /md	
Lay kerbing on level base	Shovel, rubber mallet, string-line, trowel, wheelbarrow	Straight	6.5 to 10.0 m/md
		Curved	2.0 to 5.0 m/md
Stone pitching: Plain stone pitching	Club hammer, gloves, string-line, shovel, wheelbarrow, stiff broom, pliers, short crowbar	10 to 15 m <sup>2</sup> /md, 200 mm thick	
Grouted stone pitching		6 to 10 m <sup>2</sup> /md, 200 mm thick	
Wired and grouted stone pitching		3 to 5 m <sup>2</sup> /md, 200 mm thick	
Block paving: placing bedding sand, laying blocks, compacting, joint filling, clean up	Shovel, screed rails and beam, rubber mallet, plate compactor, bass broom, wheelbarrow, gloves	16 to 20 m <sup>2</sup> /md	
Stormwater drainage pipes: trimming, bedding, laying, backfilling, compaction	Shovel, rake, boning rods, hand stamper, watering can, rope and ground anchors	450 mm dia concrete: 1.2 m/md (needs team of 10) 600 mm dia concrete: 1.0 m/md (needs team of 10) 450 mm dia plastic: 3.5 m/md (needs team of 5)	
Concrete base slab: batch, mix, transport, pour and finish off	Batching boxes, wheelbarrow, shovel, screed beam, wood float	0.8 m <sup>3</sup> /md (needs team of 5)	
Stone masonry walls	Wheelbarrow, shovel, trowel, club hammer, string line, spirit level, batching box.	1.0 m <sup>3</sup> /md	
Gabion work	Gloves, string-line, shovel, wheelbarrow, pliers, short crowbar	1.5 m <sup>3</sup> /md	

#### ABBREVIATIONS USED

md = man-day  
dia = diameter

Source :

Construction Education and Training Authority, Learning Material for Unity Standard 15165: "Use LIC



Employer:		Service Provider	
Witness:		Witness:	

<b>Volume</b>	<b>1</b>	2	3	4				
Part	T1	T2	C1	C2	C3	C4	C5	



Contract JW14406 Page (11)  
Description: Linbro Park Tower (With  
Associated Works)  
**Pricing Data**

## C2.2 BILL OF QUANTITIES

<b>C2.3 SUMMARY OF BILL OF QUANTITIES</b>			
<b>SCHEDULE</b>	<b>DESCRIPTION</b>	<b>AMOUNT</b>	
SCHEDULE No 1	PRELIMINARY AND GENERAL	R	
SCHEDULE No 2	DAYWORKS	R	
SCHEDULE No 3	SITE CLEARANCE (PIPELINE)	R	
SCHEDULE No 4	SITE CLEARANCE (ELEVATED TOWER ONLY)	R	
SCHEDULE No 5	SITE CLEARANCE (PUMPSTATION AND TOWER SITE)	R	
SCHEDULE No 6	EARTHWORKS (PIPELINE VALVE CHAMBERS)	R	
SCHEDULE No 7	EARTHWORKS (PIPELINE TRENCHES)	R	
SCHEDULE No 8	EARTHWORKS (ELEVATED TOWER)	R	
SCHEDULE No 9	EARTHWORKS (PUMPSTATION)	R	
SCHEDULE No 10	EARTHWORKS (PUMPSTATION PIPELINE TRENCHES)	R	
SCHEDULE No 11	CONCRETE (PIPELINE VALVE CHAMBERS)	R	
SCHEDULE No 12	CONCRETE (ELEVATED TOWER)	R	
SCHEDULE No 13	CONCRETE (PUMPSTATION)	R	
SCHEDULE No 14	PIPELINES (MAIN)	R	
SCHEDULE No 15	PIPELINES (BEDDING AND FILLING)	R	
SCHEDULE No 16	PIPELINES (PUMPSTATION)	R	
SCHEDULE No 17	PIPELINES (PUMPSTATION BEDDING AND FILLING)	R	
SCHEDULE No 18	PIPELINES (ELEVATED TOWER)	R	
SCHEDULE No 19	PIPE JACKING	R	
SCHEDULE No 20	STRUCTURAL STEEL (ELEVATED TOWER)	R	
SCHEDULE No 21	STRUCTURAL STEEL AND CORROSION PROTECTION (PUMPSTATION)	R	
SCHEDULE No 22	ELECTRICAL WORKS	R	



Employer:		Service Provider	
Witness:		Witness:	

Volume	1	2	3	4				
Part	T1	T2	C1	C2	C3	C4	C5	



Contract JW14406 Page (12)  
Description: Linbro Park Tower (With Associated Works)  
**Pricing Data**

SCHEDULE No 23	ELECTRONIC WORKS	R
SCHEDULE No 24	MECHANICAL WORKS	R
SCHEDULE No 25	PAVING	R
SCHEDULE No 26	KERBING AND CHANNELLING	R
SCHEDULE No 27	MISCELLANEOUS WORK FOR PUMP STATION AND VALVE HOUSE	R
<b>SUB TOTAL 1</b>	The above prices are Not Firm	<b>R</b>
PSA 8.10.1	<p>In respect of the total value of work done by approved SMME's at 30% of Sub Total 1 (This total shall include all amounts payable to SMME's, including P&amp;G's)</p> <p>= R.....<b>(A)</b></p> <p>Allowance as a percentage (maximum 15%) for appointing and handling work done by approved SMME's</p> <p>= .....%</p> <p><b>(B)</b></p>	
<b>SUB TOTAL 2</b>	Handling fees for subcontracting = <b>(A) x (B)</b>	<b>R</b>
<b>SUB TOTAL 3</b>	Sub-Total 3 = Sub Total 1 + Sub Total 2	<b>R</b>
Add	10 % for Contingencies	R
<b>SUB TOTAL 4</b>		<b>R</b>
Add	10 % for Escalation	R
<b>SUB TOTAL 5</b>		<b>R</b>
Add	15% for VAT	R
<b>TOTAL (INCLUSIVE OF VAT) CARRIED FORWARD TO FORM OF OFFER AND ACCEPTANCE</b>		<b>R</b>



Employer:		Service Provider	
Witness:		Witness:	

Volume	1	2	3	4			
Part	T1	T2	C1	C2	C3	C4	C5



Contract JW14406 Page (13)  
Description: Linbro Park Tower (With  
Associated Works)  
**Pricing Data**

This is a firm tender.

**Failure to adhere to this requirement will prejudice your tender**

Name of tenderer (in full): \_\_\_\_\_

Telephone number: \_\_\_\_\_

e-mail: \_\_\_\_\_

Name of person authorized to sign this tender: \_\_\_\_\_  
(BLOCK LETTERS)

Signature: \_\_\_\_\_ Date: \_\_\_\_\_ 202

## C2.3 SUMMARY OF BILL OF QUANTITIES



Employer:		Service Provider	
Witness:		Witness:	

Volume	1	2	3	4				
Part	T1	T2	C1	C2	C3	C4	C5	



Contract JW14406 Page (14)  
Description: Linbro Park Tower (With  
Associated Works)  
**Pricing Data**

SCHEDULE	DESCRIPTION	AMOUNT
SCHEDULE No 1	PRELIMINARY AND GENERAL	R
SCHEDULE No 2	DAYWORKS	R
SCHEDULE No 3	SITE CLEARANCE (PIPELINE)	R
SCHEDULE No 4	SITE CLEARANCE (ELEVATED TOWER ONLY)	R
SCHEDULE No 5	SITE CLEARANCE (PUMPSTATION AND TOWER SITE)	R
SCHEDULE No 6	EARTHWORKS (PIPELINE VALVE CHAMBERS)	R
SCHEDULE No 7	EARTHWORKS (PIPELINE TRENCHES)	R
SCHEDULE No 8	EARTHWORKS (ELEVATED TOWER)	R
SCHEDULE No 9	EARTHWORKS (PUMPSTATION)	R
SCHEDULE No 10	EARTHWORKS (PUMPSTATION PIPELINE TRENCHES)	R
SCHEDULE No 11	CONCRETE (PIPELINE VALVE CHAMBERS)	R
SCHEDULE No 12	CONCRETE (ELEVATED TOWER)	R
SCHEDULE No 13	CONCRETE (PUMPSTATION)	R
SCHEDULE No 14	PIPELINES (MAIN)	R
SCHEDULE No 15	PIPELINES (BEDDING AND FILLING)	R
SCHEDULE No 16	PIPELINES (PUMPSTATION)	R
SCHEDULE No 17	PIPELINES (PUMPSTATION BEDDING AND FILLING)	R
SCHEDULE No 18	PIPELINES (ELEVATED TOWER)	R
SCHEDULE No 19	PIPE JACKING	R



Employer:		Service Provider	
Witness:		Witness:	

Volume	1	2	3	4				
Part	T1	T2	C1	C2	C3	C4	C5	



Contract JW14406 Page (15)  
Description: Linbro Park Tower (With  
Associated Works)  
**Pricing Data**

<b>SCHEDULE No 20</b>	<b>STRUCTURAL STEEL (ELEVATED TOWER)</b>	R	
<b>SCHEDULE No 21</b>	<b>STRUCTURAL STEEL AND CORROSION PROTECTION (PUMPSTATION)</b>	R	
<b>SCHEDULE No 22</b>	<b>ELECTRICAL WORKS</b>	R	
<b>SCHEDULE No 23</b>	<b>ELECTRONIC WORKS</b>	R	
<b>SCHEDULE No 24</b>	<b>MECHANICAL WORKS</b>	R	
<b>SCHEDULE No 25</b>	<b>PAVING</b>	R	
<b>SCHEDULE No 26</b>	<b>KERBING AND CHANNELLING</b>	R	
<b>SCHEDULE No 27</b>	<b>MISCELLANEOUS WORK FOR PUMP STATION AND VALVE HOUSE</b>	R	
<b>SUB TOTAL</b>		R	
10% for Contingencies		R	
<b>SUB TOTAL</b>		R	
*10% for Escalation		R	
<b>SUB TOTAL</b>		R	
ADD 15% FOR VAT		R	
<b>TOTAL (INCLUSIVE OF VAT) CARRIED FORWARD TO FORM OF OFFER AND ACCEPTANCE</b>		R	

*\*The above escalation provision allows for any price adjustments that may be necessary during project implementation. This is an internal provision and the tender document will not make provision for bidders to include in their offers. The amount is the provision for escalation cost in accordance with the conditions under which the Contract Price Adjustment (Clause 6.8.2) applies to this contract.*

**Failure to adhere to this requirement will prejudice your tender**

Name of tenderer (in full): \_\_\_\_\_

Telephone number: \_\_\_\_\_



Employer:		Service Provider	
Witness:		Witness:	

Volume	1	2	3	4			
Part	T1	T2	C1	C2	C3	C4	C5



Contract JW14406 Page (16)  
Description: Linbro Park Tower (With  
Associated Works)  
**Pricing Data**

e-mail: \_\_\_\_\_

Name of person authorized  
to sign this tender: \_\_\_\_\_

(BLOCK LETTERS)

Signature: \_\_\_\_\_ Date: \_\_\_\_\_ 202



Employer:		Service Provider	
Witness:		Witness:	

<b>Volume</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>		
<b>Part</b>	<b>T1</b>	<b>T2</b>	<b>C1</b>	<b>C2</b>	<b>C3</b>	<b>C4</b>



Contract JW 14406 Page 1  
Description: Linbro Park Tower (With Associated Works)  
**Part 3: Scope of works**

# Johannesburg Water SOC Ltd



## Construction of Linbro Park Tower and Pump Station (With Associated Works)

### VOLUME 2

### PART 3: SCOPE OF WORK

Employer:		Contractor:	
Witness:		Witness:	

<b>Volume</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>		
<b>Part</b>	<b>T1</b>	<b>T2</b>	<b>C1</b>	<b>C2</b>	<b>C3</b>	<b>C4</b>



Contract JW 14406 Page 2  
Description: Linbro Park Tower (With  
Associated Works)

**Part 3: Scope of works**

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Employer:		Contractor:	
Witness:		Witness:	

<b>Volume</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>		
<b>Part</b>	<b>T1</b>	<b>T2</b>	<b>C1</b>	<b>C2</b>	<b>C3</b>	<b>C4</b>



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Description: Linbro Park Tower (With Associated Works)  
**Part 3: Scope of works**

## C3 SCOPE OF WORK

### PORTION 1: PROJECT SPECIFICATION

#### PS.1 DESCRIPTION OF THE WORKS

##### PS.1.1 Employer's Objectives

The proposed 3ML Linbro Park Tower will form part of Linbro Park / Alexandra Water District. The Linbro Park Tower distribution zone is currently partly supplied by the Linbro Park Reservoir and partly by the Linbro Park Direct - PRV 1 (PRV6 - Clifford Ave PRV1).

This project will provide the Linbro Park Area with its own storage capacity. The 3ML Linbro Park water tower and the associated infrastructure for the tower will also cater for the upcoming developments in Linbro Park. This will improve supply by eliminating deficiencies in the network as well as cater for future water demands within the sub-district. The project will provide the area within the Linbro Park direct feed with its own storage capacity.

##### PS.1.2 Overview of the Works

The project involves the construction of a new 3,0 MI Elevated Water Tower as well as a new Pump Station and Bulk Pipeline. These works will comprise Civil, Structural, Mechanical and Electrical Engineering elements.

##### PS.1.3 Extent of the Works

The above works includes the following:

- Construction of new elevated reinforced concrete water tower with a capacity of 3ML;
- Construction of all associated pipework and chambers in the reservoir complex;
- Construction of pump station to supply the new tower;
- Cathodic Protection and Telemetry requirements;
- Construction of bulk distribution pipeline;
- Construction of security features;
- Installation of an appropriate standby generator.

##### PS.1.4 Location of the Works

The Works are located in Linbro Park, corner of Clulee Road and Peace Street, Johannesburg, Gauteng Province. Refer to the locality plan included in Volume 3 of this Contract Document.

##### PS.1.5 Temporary Works

No temporary works are envisaged under this contract.

Employer:		Contractor:	
Witness:		Witness:	

<b>Volume</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>		
<b>Part</b>	<b>T1</b>	<b>T2</b>	<b>C1</b>	<b>C2</b>	<b>C3</b>	<b>C4</b>



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Description: Linbro Park Tower (With  
Associated Works)  
**Part 3: Scope of works**

## **PS.2 ENGINEERING**

### **PS.2.1 Employer's Design**

When and where specific reference is made or preference given to specified equipment, should the Contractor fail to comply with these requirements, this may lead to the disqualification of the tender submitted.

Contractors are free to propose alternative mechanical equipment (provided a main offer is submitted to specification) to that proposed by the Employer's Agent and, provided that drawings with details of each alternative proposal are submitted with the Tender, such alternative proposals will be considered in the adjudication of each Tender.

Any alternative mechanical equipment offered shall include all the necessary civil, mechanical, and electrical costs necessary for a complete working system.

The cost of any changes to the Engineer's design will be for the Contractor's account where full details of the changes were not submitted with the tender.

Contractors shall satisfy themselves that the layouts as proposed by the Employer's Agent suit in all respects the equipment proposed by the Employer's Agent or by the Contractor as the case may be. Where equipment other than that proposed by the Employer's Agent is accepted, it will be the sole responsibility of the Contractor to ensure that the associated equipment including pipe work is compatible with the accepted material and proposed structures.

In the case of the Employer's Agent's acceptance of an alternative proposal, the Contractor shall submit in triplicate to the Employer's Agent for his approval, detailed working drawings of the Contractor's alternative design proposal before any related work is executed.

An extension of Time for Completion of the Contract due to time spent on the alteration of the tender drawings to suit the Contractor's alternative proposals or, due to time spent in obtaining the Employer's Agent's approval of such alternatives, shall not be considered.

Acceptance of an alternative proposal or offer shall not relieve the Contractor of any of his obligations in terms of the Contract. The Contractor's cost of preparation and submission of an alternative proposal shall be deemed to be included in the rates tendered for the execution of the Work.

### **PS.2.2 Drawings**

#### **PS.2.2.1 Tender Drawings in Volume 4**

Drawings are included in Volume 4 of this Contract Document for Contractor's information. The drawings that are issued for tender purposes are listed below:

<b>DRAWING NUMBER</b>	<b>DESCRIPTION</b>	<b>REV</b>
<b>GENERAL (GL) DRAWINGS</b>		
C01486-GL01	Orthographic Map Layout Sheet 1 Of 2	T0
C01486-GL01	Site Map General Layout Sheet 2 Of 2	T0
C01486-GL02	Site Layout and Key Plan Sheet 1 Of 2	T0
C01486-GL02	Site Layout and Key Plan Sheet 2 Of 2	T0
C01486-GL03	Roads and Stormwater Layout Sheet 1 Of 2	T0
C01486-GL03	Roads and Stormwater Layout Sheet 2 Of 2	T0
<b>STRUCTURAL (SC) ENGINEERING DRAWINGS (LAYOUTS)</b>		
C01486-SC01	LINBRO PARK TOWER: 3.0ML Tower layouts and sections (1 of 9)	T0
C01486-SC02	LINBRO PARK TOWER: 3.0ML Tower layouts and sections (2 of 9)	T0

**Part 3: Scope of works**

DRAWING NUMBER	DESCRIPTION	REV
C01486-SC03	LINBRO PARK TOWER: 3.0ML Tower layouts and sections (3 of 9)	T0
C01486-SC04	LINBRO PARK TOWER: 3.0ML Tower layouts and sections (4 of 9)	T0
C01486-SC05	LINBRO PARK TOWER: 3.0ML Tower layouts (5 of 9)	T0
C01486-SC06	LINBRO PARK TOWER: 3.0ML Tower layouts (6 of 9)	T0
C01486-SC07	LINBRO PARK TOWER: 3.0ML Tower elevation and detail (7 of 9)	T0
C01486-SC08	LINBRO PARK TOWER: 3.0ML Tower elevation and detail (8 of 9)	T0
C01486-SC09	LINBRO PARK TOWER: 3.0ML Tower elevation and detail (9 of 9)	T0
<b>STRUCTURAL (SC) ENGINEERING DRAWINGS (REINFORCEMENT)</b>		
C01486-SR01	LINBRO PARK TOWER: 3.0ML Tower Pile caps and beams reinforcement layout	T0
C01486-SR01-BS01	LINBRO PARK TOWER: 3.0ML Tower Pile caps and beams reinforcement bending schedule	T0
C01486-SR01-BS02	LINBRO PARK TOWER: 3.0ML Tower Pile caps and beams reinforcement bending schedule	T0
C01486-SR01-BS03	LINBRO PARK TOWER: 3.0ML Tower Pile caps and beams reinforcement bending schedule	T0
C01486-SR02	LINBRO PARK TOWER: 3.0ML Tower Columns reinforcement layout	T0
C01486-SR02-BS01	LINBRO PARK TOWER: 3.0ML Tower Columns reinforcement bending schedule	T0
C01486-SR03	LINBRO PARK TOWER: 3.0ML Tower Central core reinforcement layout	T0
C01486-SR03-BS01	LINBRO PARK TOWER: 3.0ML Tower Central core reinforcement bending schedule	T0
C01486-SR04	LINBRO PARK TOWER: 3.0ML Tower Tank floor beams reinforcement layout	T0
C01486-SR04-BS01_02	LINBRO PARK TOWER: 3.0ML Tower Tank floor beams reinforcement bending schedule	T0
C01486-SR05	LINBRO PARK TOWER: 3.0ML Tower Floor slab reinforcement layout	T0
C01486-SR05-BS01	LINBRO PARK TOWER: 3.0ML Tower Floor slab reinforcement bending schedule	T0
C01486-SR05-BS02	LINBRO PARK TOWER: 3.0ML Tower Floor slab reinforcement bending schedule	T0
C01486-SR05-BS03	LINBRO PARK TOWER: 3.0ML Tower Floor slab reinforcement bending schedule	T0
C01486-SR05-BS04	LINBRO PARK TOWER: 3.0ML Tower Floor slab reinforcement bending schedule	T0
C01486-SR05-BS05	LINBRO PARK TOWER: 3.0ML Tower Floor slab reinforcement bending schedule	T0
C01486-SR06	LINBRO PARK TOWER: 3.0ML Tower Internal tank wall reinforcement layout	T0
C01486-SR06-BS01	LINBRO PARK TOWER: 3.0ML Tower Internal tank wall reinforcement bending schedule	T0
C01486-SR07	LINBRO PARK TOWER: 3.0ML Tower External tank wall reinforcement layout	T0
C01486-SR07-BS01	LINBRO PARK TOWER: 3.0ML Tower External tank wall reinforcement bending schedule	T0
C01486-SR08	LINBRO PARK TOWER: 3.0ML Tower Roof slab reinforcement layout	T0
C01486-SR08-BS01	LINBRO PARK TOWER: 3.0ML Tower Roof slab reinforcement bending schedule	T0

**Part 3: Scope of works**

DRAWING NUMBER	DESCRIPTION	REV
C01486-SR08-BS02	LINBRO PARK TOWER: 3.0ML Tower Roof slab reinforcement bending schedule	T0
<b>ELECTRO-MECHANICAL ENGINEERING (EM) DRAWINGS</b>		
C01486 - EM001	Pump Station Single Line Drawing	T0
C01486 - EM002	Pump Station General Arrangement Drawing	T0
C01486 - EM003	Pump Station Typical E-Stop Drawing	T0
C01486 - EM004	Pump Station -Small Power & Lighting Designs-Lights	T0
C01486 - EM005	Pump Station -Small Power & Lighting Designs-Plugs	T0
C01486 - EM006	Pump Station -Site Plan- Electrical Reticulation Layout	T0
C01486 - EM007	Pump Station -Piping & Instrumentation Diagram	T0
C01486 - EM008	Pump Station Typical Trench Low Voltage Cabling	T0
<b>PUMP STATION (PS) ENGINEERING DRAWINGS</b>		
C01486 - PS01	Pump Station Floor Plan Sheet 1 Of 1	T0
C01486 - PS02	Pump Station Elevations Sheet 1 Of 2	T0
C01486 - PS02	Pump Station Elevations Sheet 2 Of 2	T0
C01486 - PS03	Pump Station Outlet Pipeline Layout Sheet 1 Of 11	T0
C01486 - PS03	Pump Station Inlet Pipeline Layout Sheet 2 Of 11	T0
C01486 - PS03	Pump Station Inlet Pipeline Section A-A & Fittings Schedule Sheet 3 Of 11	T0
C01486 - PS03	Pump Station Outlet Pipeline Section B-B, C-C & Fittings Schedule Sheet 4 Of 11	T0
C01486 - PS03	Pump Station Basement Concrete Layout And Details Sheet 5 Of 11	T0
C01486 - PS03	Pump Station Roof Concrete And Sections Details Sheet 6 Of 11	T0
C01486 - PS03	Pump Station Ground Foundations, Landing Layout Details Sheet 7 Of 11	T0
C01486 - PS03	Pump Station Roof Slab And Beam Reinforcememnt And Details Sheet 8 Of 11	T0
C01486 - PS03	Pump Station Roof Slab Reinforcement Sheet 9 Of 11	T0
C01486 - PS03	Pump Station Retaining Wall Reinforcement & Bending Schedules Sheet 10 Of 11	T0
C01486 - PS03	Pump Station Retaining Wall Sheet 11 Of 11	T0
C01486 - PS04	Chamber 09 - Tower Outlet Chamber Sheet 1 Of 4	T0
C01486 - PS04	Chamber 09 - Valve Chamber #09 Concrete Layout And Sections Sheet 3 Of 4	T0
C01486 - PS04	Chamber 09 - Valve Chamber #09 Rebar Layout 4 Of 4	T0
C01486 - PS05	Chamber 10 - Pumpstation Inlet Chamber Sheet 1 Of 3	T0
C01486 - PS05	Chamber 10 - Valve Chamber #10 Concrete Layout Sections And Details Sheet 2 Of 3	T0
C01486 - PS05	Chamber 10 - Valve Chamber #10 Rebar Layout Sheet 3 Of 3	T0
C01486 - PS06	Chamber 11 - Pumpstation Outlet Chamber Plans And Sections Sheet 1 Of 3	T0
C01486 - PS06	Chamber 11 - Pumpstation Outlet Chamber Elevations Sheet 2 Of 3	T0
C01486 - PS06	Chamber 11 - Pumpstation Outlet Chamber Concrete And Rebar Sheet 3 Of 3	T0
C01486 - PS07	Chamber 12 - Prv Chamber Layout Plans And Sections Sheet 1 Of 6	T0
C01486 - PS07	Chamber 12 - Prv Chamber Layout Elevations Sheet 2 Of 6	T0
C01486 - PS07	Chamber 12 - Prv Chamber Retaining Wall Concrete Layout Sheet 3 Of 6	T0

**Part 3: Scope of works**

DRAWING NUMBER	DESCRIPTION	REV
C01486 - PS07	Chamber 12 - Prv Chamber Retaining Wall And Roof Rebar Layout Sheet 4 Of 6	T0
C01486 - PS07	Chamber 12 - Prv Chamber Roof Concrete Layout And Sections Sheet 5 Of 6	T0
C01486 - PS07	Chamber 12 - Prv Chamber Beams And Stairs Rebar Sheet 6 Of 6	T0
C01486 - PS08	Chamber 13 - Emergency Connection Chamber Sheet 1 Of 3	T0
C01486 - PS08	Chamber 13 - Emergency Connection Concrete Layout Chamber Sheet 2 Of 3	T0
C01486 - PS08	Chamber 13 - Emergency Connection Rebar Layout Chamber Sheet 3 Of 3	T0
C01486 - PS09	Longsection P3- Suction Pipeline From Exisitng Valve Chamber To Ps Sheet 1 Of 6	T0
C01486 - PS09	Longsection P4- Outlet From Pumpstation To Tower Layout Sheet 2 Of 6	T0
C01486 - PS09	Longsection P5- Connection From 1100mm Dia Pipeline Layout Sheet 3 Of 6	T0
C01486 - PS09	Longsection P6b- Tower Bypass Pipeline Layout Sheet 5 Of 6	T0
C01486 - PS09	Longsection P7- Outlet Pipeline From Tower Up To Network Layout Sheet 6 Of 6	T0
C01486 - PS09	Roads And Stormwater Layout Sheet 1 Of 2	T0
C01486 - PS21	Generator Room Roof Slab Layout And Details Sheet 2 Of 3	T0
C01486 - PS21	Generator Room Roof Slab Layout And Details Sheet 3 Of 3	T0
<b>STEEL PIPELINE (CP) ENGINEERING DRAWINGS</b>		
C01486-CP01	Details Of Air Valve Chamber	T0
C01486-CP02	Scour&Isolation Valve Chamber	T0
C01486-CP04	Padlock Pin & Ladder Details	T0
C01486-CP05	Pipe Support And Test Point	T0
C01486-CP07	Trench Excavation & Backfill For Steel Pipe	T0
C01486-CP08	Steel Pipe Tapers And Bends	T0
C01486-CP09	Protective Coating & Jointing	T0
C01486-CP10	Profile For Outlet Water Pipeline	T0
C01486-CP11	Longitudinal Section & Plan For Water Pipeline	T0
C01486-CP12	Pipe Jacking 1 Of 3	T0
C01486-CP13	Pipe Jacking 2 Of 3	T0
C01486-CP14	Pipe Jacking 3 Of 3	T0
C01486-CP15	Valves Along The Outlet Pipeline	T0
C01486-CP16	Isolation Valve Detail	T0
C01486-CP17	Air Valve Chamber Concrete Layout & Details	T0
C01486-CP18	Air Valve Chamber Rebar Layout & Details	T0
C01486-CP19	Scour & Isolation Valve Chamber Concrete Layout	T0
C01486-CP22	Scour & Isolation Valve Rebar Layout & Details	T0
C01486-CP23	Isolation Valve Concrete Layout & Details	T0
C01486-CP24	Isolation Valve Rebar Layout & Details	T0
C01486-CP25	Thrust Block C Concrete & Rebar	T0
C01486-CP25	Trust Block A Concrete & Rebar	T0

**Part 3: Scope of works**

DRAWING NUMBER	DESCRIPTION	REV
C01486-CP26	Trust Block B Concrete & Rebar	T0
C01486-CP27	Profile For Water Outlet Pipeline	T0
C01486-CP29	Details Of Air Valve Chamber	T0
<b>CATHODIC PROTECTION (CP) ENGINEERING DRAWINGS</b>		
PES-PEP0221-CP-001	Cathodic Protection - Mega Big Headed Test Post (Bhtp) Detail	T0
PES-PEP0221-CP-002	Cathodic Protection - Bunker Test Post Enclosure	T0
PES-PEP0221-CP-003	Cathodic Protection - Cp Coupon Detail	T0
PES-PEP0221-CP-004	Cathodic Protection - Big Headed Test Post Pre/Coupon Monitoring Test Post	T0
PES-PEP0221-CP-005	Cathodic Protection - Continuity Bonding At Pipeline Valve Chambers	T0
PES-PEP0221-CP-006	Cathodic Protection - Valve Chamber Test Post	T0
PES-PEP0221-CP-007	Cathodic Protection - Ir Free Card (Type B)	T0
PES-PEP0221-CP-008	Cathodic Protection - Pipe Joint Continuity Bonding	T0
PES-PEP0221-CP-009	Cathodic Protection - SACP Ground Bed Panel Cable Termination Detail	T0
PES-PEP0221-CP-010	Cathodic Protection - Cross Bond Link Panel Cable Termination Detail	T0
PES-PEP0221-CP-011	Cathodic Protection - Test Post Terminal Mounting Detail	T0
PES-PEP0221-CP-012	Cathodic Protection - SACP Groundbed Detail For Outlet And Inlet Pipelines	T0

Employer:		Contractor:	
Witness:		Witness:	

<b>Volume</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>		
<b>Part</b>	<b>T1</b>	<b>T2</b>	<b>C1</b>	<b>C2</b>	<b>C3</b>	<b>C4</b>



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### **PS.2.2.2 Construction drawings**

Upon receiving the instruction to commence with construction, the Contractor shall receive 4 sets of construction drawings, of which 1 set shall be designated for as-built records and updated by the Contractor on a daily basis. The drawings shall be submitted to the Employer's Agent with the Contractor's request for issue of the Practical Completion Certificate.

### **PS.2.2.3 Shop drawings**

Where an item to be supplied in conformance with this Contract Specification has not been designed by the Employer's Agent or Employer, the Contractor shall be required to supply the Employer's Agent with 3 copies of detailed shop drawings prior to delivery of materials, including an electronic copy in drawing format that is compatible with the software packages (AutoCAD or .dxf) used by the Employer's Agent and/or Employer. Only on approval of such shop drawings or an amended version thereof, shall the Contractor proceed with the manufacturing, supply and installation of the designed item.

## **PS.3 PROCUREMENT**

### **PS.3.1 Preferential Procurement Procedures**

The Contractor's attention is drawn to the following returnable schedules contained in Part T2:

- (a) Empowerment and Preferential Procurement (JW10); and
- (b) Enterprise Declaration Affidavit (to be endorsed by a Commissioner of Oaths) (JW11). These schedules contain all requirements with regard to preferential procurement.

### **PS.3.2 Sub-Contracting**

#### **PS.3.2.1 Definitions**

Unless inconsistent with the context in these specifications, the following terms, words or expressions shall have the meanings hereby assigned to them:

**1. Start-up Enterprises**

An enterprise that has been in existence and operating for less than two years.

**2. Small Enterprises**

An enterprise that has a CIDB grading designation of 1 or 2.

**3. Micro Enterprises**

An enterprise that has a CIDB grading designation of 3.

**4. Locally based SMMEs**

Enterprises that have their operational base in the ward in which the project is to be executed or, alternatively, the members of the enterprise are resident in the particular ward. Should a suitable locally based SMME as defined above not be available in the particular ward, then they shall be sourced from adjacent wards.

**5. Contract Participation**

Contract Participation in terms of this contract is a process by which the Employer implements Government's objectives by setting a target relating to small Contractor development which the Contractor shall achieve as a minimum.

Employer:		Contractor:	
Witness:		Witness:	

<b>Volume</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>		
<b>Part</b>	<b>T1</b>	<b>T2</b>	<b>C1</b>	<b>C2</b>	<b>C3</b>	<b>C4</b>



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#### **6. Contract Participation Goal (CPG)**

Contract Participation Goal is the monetary value of the target set by the Employer in the Contract Participation process.

#### **7. Contract Participation Performance (CPP)**

Contract Participation Performance is the measure of the Contractor's progress in achieving the CPG.

The commitment of the Employer to Government Policy concerning the empowerment of the SMMEs shall be noted and adhered to by the Contractor. It is against this background that Johannesburg Water has made provisions under this contract to ensure that the Contractor impart skills to the SMME within the project area during the project implementation.

The onus is upon the Contractor to handle and manage the procurement process of the Sub-Contractors and once appointed, should be dealt with in accordance with the provisions of Clause 4.4 of the General Conditions of Contract 2015.

The Contractor shall obtain the written approval of the Employer's Agent before appointing any Sub-Contractor. The Contractor shall be solely responsible for the supervision of and payments to such a Sub-Contractor(s) and the approval of a Sub-Contractor by the Employer's Agent shall not indemnify the Contractor from any of his liabilities in terms of the Contract.

#### **PS.3.2.2 Applicable Legislation**

The following Acts, as amended from time to time, are predominant amongst those which apply to the construction industry and are listed here for reference purposes only:

- The Constitution of South Africa;
- Preferential Procurement Policy Framework Act No. 5 of 2000;
- Construction Industry Development Board Act No. 38 of 2000;
- Broad-Based Black Economic Empowerment Act No. 53 of 2003.

#### **PS.3.2.3 Scope**

The City of Johannesburg has identified job creation and access to procurement opportunities by Start-ups, Small and Micro enterprises (SMMEs) as an essential requirement towards building an economically viable City.

This tender is subject to the sub-contracting condition as described in item T2.3.2.7 of the Tendering Procedures and must be adhered to by the main contractor. It is also the obligation of the main contractor to impart skills to the subcontractor/s on the project during implementation. Although a minimum of 20% of the contract value has been identified for this project, the contractor may increase this percentage at his discretion.

The identified scope of work to be subcontracted is listed in SMME BoQs number 1 to 14, however, the main contractor may identify additional works to allocate to SMMEs such as (example purposes):

1. Site clearance of the pipeline route
2. Pipe laying
3. hand excavation where applicable

Employer:		Contractor:	
Witness:		Witness:	54

<b>Volume</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>		
<b>Part</b>	<b>T1</b>	<b>T2</b>	<b>C1</b>	<b>C2</b>	<b>C3</b>	<b>C4</b>



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4. reinstatement

**NB: all sub-contractors appointed on this contract must comply with the Central Supplier Database (CSD) requirements, i.e. they must be registered on the CSD.**

It is a condition of this contract that the Contractor is required to sub-contract a minimum value of work to **SMME** equal to **30%** of the Contract Sum.

The Contractor is to allow for fortnightly certificates from the SMMEs and for payment to the SMMEs to be effected within 7 days of certification. In order to achieve the goals of this policy and to ensure that the SMMEs are treated fairly and given every opportunity to advance their business whilst delivering a successful project, the Contractor is to note the following and provide for any cost that may be associated therewith.

5. The Contractor shall subcontract the local SMME works at the Provisional Sum items allocated for the sections of work in Section 8 of the Bill of Quantities.
6. The Contractor will be expected to have clearly specified the programme dates to the SMME and these dates are to be included in the contractual agreement between the two parties. The Contractor is to monitor the SMME's progress against the programme and hold progress meetings with the SMME contractors where minutes are to be kept and signed off by both parties.
7. Before site establishment, the Contractor will provide each appointment letter and contractual agreement that the Contractor engages with for each SMME on this Project. The Agreement must include agreed work values agreed upon with the Contractor and SMME.
8. Before site establishment, the Contractor will provide the following for all SMMEs:
  - a) SMME company registration
  - b) SMME CIDB proof of registration.
9. The Contractor is to assess the skills of the SMME and provide the relevant support and training for the SMME to complete the works to programme, budget and specification. The Contractor will be expected to provide training to the SMME that will ensure that the SMME's staff is suitably trained to execute the works and that they receive sufficient relevant experience on the project.
10. The Contractor is responsible for safety compliance on the project and will assist the SMME Contractors in all aspects to achieve safety compliance, that will include:
  - a) Assisting the SMME with developing their safety files, legal appointments, etc.
  - b) Assisting the SMME with achieving safety on site.
  - c) Having tool box talks with the SMME Contractor's employees on a daily basis.
  - d) Providing all safety equipment and signage.
  - e) Providing safety training where necessary.
11. The Contractor is to provide all the necessary equipment for the timeous monitoring and the checking of the quality of works as carried out by the SMME. The Contractor will be expected to monitor the SMME's works for quality compliance and provide all the necessary support to the

Employer:		Contractor:	
Witness:		Witness:	

<b>Volume</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>		
<b>Part</b>	<b>T1</b>	<b>T2</b>	<b>C1</b>	<b>C2</b>	<b>C3</b>	<b>C4</b>



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SMME in order to achieve quality requirements. The Contractor is to ensure that if the SMME's quality of works does not achieve specification, the Contractor will assist the SMME to achieve specification and not allow the works to continue until the quality requirements are achieved.

12. The Contractor is to generate monthly reports for the Johannesburg Water SOC. which includes the following:
  - a) Per SMME: resources on the site, i.e. supervisors, labour, plant tools and equipment
  - b) Per SMME: progress of works on site.
  - c) Per SMME: quality control on site.
  - d) SMME expenditure on the project versus target expenditure including payment progress
  - e) Copies of minutes of the SMME and Contractor progress meetings.
  - f) Concerns and improvements to be made.
  - g) Items listed in PS 5.10
13. In the execution of the Subcontract Work, the Contractor shall ensure that the Sub-Contractor(s) comply with all relevant legislation and regulations including, but not confined to, the Occupational Health and Safety Act. The Contractor hereby indemnifies the Employer against any loss, damage, or claim for Subcontract Works set out for the construction of Linbro Park Tower as well as the new pump station arising out of the former's failure to comply with instructions issued to him in regard to these requirements.
14. The Contractor shall be required to adopt labour intense construction techniques through the allocated work in Section 8 of the Bill of Quantities with the proviso that the Employer's specific objectives regarding time and quality are not compromised. Maximisation of employment shall be the aim on this contract.
15. Together with their tenders, all Contractors are required to submit a comprehensive implementation plan clearly stating the labour content and number of jobs that shall be created. The employment of labour shall be reflected in a programme in sufficient details to enable the Project Manager to monitor and compare it with the implementation plan.
16. The Contractor shall be required to submit employment data on a monthly basis to the Employer's Agent.
17. Contractors are to also note that it is an explicit condition of this Contract that all unskilled labourers on the project are to be employed from the local community. The Contractor shall, in general, maximise the involvement of the local community.
18. **TRAINING OF SMMEs**  
The sum shall be in full compensation for the provision of training to SMMEs, to complete 8 the works as per specifications ..... Unit Sum

Employer:		Contractor:	
Witness:		Witness:	

<b>Volume</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>		
<b>Part</b>	<b>T1</b>	<b>T2</b>	<b>C1</b>	<b>C2</b>	<b>C3</b>	<b>C4</b>



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#### **PS.4 Completion of the Works**

The Time for Completion as stated in the Contract Data is 18 months. If the Contractor considers the completion time of 18 months inadequate, he must specify the completion period required in his covering letter to his Tender.

#### **PS.5 CONSTRUCTION**

##### **PS.5.1 Applicable Standards**

##### **PS.5.1.1 National standards**

The Standardised Specifications for all associated civil work applicable to this Contract shall be:

SANS 1200 A	General
SANS 1200 AB	Employer's Agent's office
SANS 1200 C	Site clearance
SANS 1200 D	Earthworks
SANS 1200 DB	Earthworks (pipe trenches)
SANS 1200 DM	Earthworks (roads, subgrade)
SANS 1200 G	Concrete (Structural)
SANS 1200 GA	Concrete (Small Works)
SANS 1200 H	Structural steel work
SANS 1200 L	Medium Pressure Pipelines
SANS 1200 LB	Bedding (Pipes)
SANS 1200 LE	Stormwater Drainage
SANS 1200 ME	Subbase
SANS 1200 MJ	Segmented Paving
SANS 1200 MK	Kerbing and channelling

These Specifications are not issued with this volume but are available at the Contractor's expense from: South African National Standards. The Contractor shall be in possession of these Technical Specifications and shall keep a hard copy of the specifications on site for reference by him and the Employer's Agent for the duration of the Contract.

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PRETORIA, 0001

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#### **Telefax:**

National: + 2712 428-6928  
International: + 27 12 428 6928

##### **PS.5.1.2 Other Standards**

Other Standard Specifications applicable water tank design, to this Contract shall be:

Employer:		Contractor:	
Witness:		Witness:	

<b>Volume</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>		
<b>Part</b>	<b>T1</b>	<b>T2</b>	<b>C1</b>	<b>C2</b>	<b>C3</b>	<b>C4</b>



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- a) BS8007:1987 Code of Practice for Water Retaining Structures
- b) BS5337:1976 Code of Practice for Water Retaining Structures
- c) BS8110:1997 Code of Practice for Reinforced Concrete design

#### **PS 5.1.2 Particular Generic Specifications**

The following Particular Generic Specifications forming part of the Contract have been written to cover phases or items of work involving a specialist type of operations or material to be encountered on this Contract and that are not adequately covered by the general specifications.

<b>Electrical Works</b>	
E01	Electrical Motors
E02	Electrical Cable Racks
E03	Electrical Isolator Pushbutton Station (Local Start/Stop) Equipment
E04	Electrical Low Voltage Switchboards and Motor Control Centres
E05	Electrical Low Voltage Power and Control Cable
E06	Electrical Medium and Low Voltage Cable Installation
E07	Electrical Industrial Plugs, couplers and socket outlets
E08	Electrical Wiring
E11	Earthing and Lightning Protection
E12	Electrical MV Cables

#### **PS.6 MANAGEMENT OF THE WORKS**

##### **PS.6.1 Applicable SANS 1921 Standards**

The Standards applicable to this Contract shall be: SANS 1921-1: 2004 first edition: Construction and Management Requirements for works Contracts: Part 1: General engineering and construction works

##### **PS.6.2 Planning and Programming**

No deviation from the approved sequence of construction shall be accepted without prior written approval.

The programme shall be in the form of a bar chart and shall show clearly the anticipated quantities of work to be performed each month, together with the manner in which the listed plant is to be used, as well as the cash flow for the various sections of work.

- Sequence of the works for the relevant works area.
- Target dates for the tasks identified in sequence of the works for the relevant works area
- Materials requirements.
- Construction Plant to be used.
- Services affecting construction

Employer:		Contractor:	
Witness:		Witness:	

<b>Volume</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>		
<b>Part</b>	<b>T1</b>	<b>T2</b>	<b>C1</b>	<b>C2</b>	<b>C3</b>	<b>C4</b>



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6. Any factors that could affect construction progress after commencement.

The method statement shall be approved by the Employer's Agent before commencement of construction. In order to minimize the impact on traffic, pedestrians and business the Contractor will be required to segment the works in such a manner that no portion of the works is more than one day ahead of the following position i.e. trenches cannot be excavated more than one day ahead of pipe laying, pipes more than one day in advance of manhole construction and finishing off etc. These segments of the works shall be clearly defined in the Contractor's method statement for each work area.

If, during the progress of the work, the quantities of work performed per month fall below those shown on the programme, or if the sequence of operations is altered, or if the program is deviated from in any other way, the Contractor shall, within one week after being notified by the Employer's Agent, submit a revised programme.

If the programme is to be revised by reason of the Contractor falling behind his programme, he shall produce a revised programme showing the modifications to the original programme that are necessary to ensure completion of the Works or any part thereof within the time for completion. Any proposal to increase the rate of work shall be accompanied by positive steps to increase production by providing more labour and plant on the Site, or by using the available labour and plant in a more efficient manner.

Failure on the part of the Contractor to submit or to work according to the programme or revised programme shall be sufficient reason for the Employer to take steps as provided for in the General Conditions of Contract.

The approval by the Employer's Agent of any programme shall have no contractual significance other than that the Employer's Agent would be satisfied if the work is carried out in accordance to such programme and that the Contractor undertakes to carry out the work in accordance with the programme. It shall not limit the right of the Employer's Agent to instruct the Contractor to vary the programme should circumstances make this necessary.

Where the Contractor's programme indicates completion beyond the official contract completion date, and the programme is accepted by the Employer's Agent, such acceptance shall in no way whatsoever indicate the Employer's Agent's acceptance of an extension to the contract period. Nor shall it be acceptable in terms of Clause 5.6.5 of the General Conditions of Contract as notification of an intention to claim. It shall, however, indicate that the Contractor has taken due cognizance of the completion date and of the consequent possible application of penalties.

#### **PS.6.2.1 Planning**

The Contractor shall ensure that he delivers good and services timeously, to not unnecessarily delay other contractors, service providers and suppliers.

#### **PS.6.2.2 Programming**

The Contractor shall provide and regularly (maximum monthly) update a Contract Programme. The programme shall at minimum contain:

##### **PS.6.2.2.1 Time Scale (minimum):**

- i. Days, where the period does not exceed three months.
- ii. Weeks, where the project period exceeds three months.
- iii. Months, where the period does not exceed one year.
- iv. Years, where the project period exceeds one year.

##### **PS.6.2.2.2 Tasks:**

Where phases or stages are anticipated, this shall be the highest level of division and all tasks related to the

Employer:		Contractor:	
Witness:		Witness:	

<b>Volume</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>		
<b>Part</b>	<b>T1</b>	<b>T2</b>	<b>C1</b>	<b>C2</b>	<b>C3</b>	<b>C4</b>



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successful accomplishment of that phase of the area shall be grouped. Resources allocation and task dependency shall be indicated.

#### **PS.6.2.2.3 Start and Finish Dates:**

All tasks shall have specific start and finish dates.

#### **PS.6.2.2.4 Critical Path:**

All tasks forming the programme line that will establish any delays in the overall Contract Period shall be clearly indicated and an indication of their sensitivity characteristics shall be provided.

#### **PS.6.2.2.5 Progress Tracking:**

The Contractor shall be required to periodically indicate progress per task graphically and on a percentage basis.

#### **PS.6.2.2.6 Non-working Time:**

South African public holidays, weekends and the local traditional annual builder's break shall be incorporated in the programme.

#### **PS.6.2.3 Sequence of the works**

The sequence of works to be executed shall be agreed between the Employer's Agent and the Contractor.

#### **PS.6.2.4 Software application for programming**

The construction programme shall be completed in Microsoft® Project Standard 2010 or compatible software. The construction programme and updated versions thereof shall be made electronically available to the Employer's Agent.

#### **PS.6.2.5 Methods and procedures**

The methods and procedures for the execution of the works shall be in accordance with the standard specifications and the variations and additions thereto.

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#### **PS.6.3 Quality plans and 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 experienced personnel, 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 will be deemed to be included in the rates tendered for the related items of work.

On completion and submission of every part of the Works to the Employer's Agent for examination, the Contractor shall furnish the Employer's Agent with proof of quality in the form of a data pack containing measurements and levels to indicate compliance with the scope of work.

Notwithstanding anything contained in this document, nor any examination of the Works by the Employer's Agent, nor any tests carried out, nor any approvals granted (verbally or in writing), nor any consent that may have been given, either directly or implied, nor anything that may be construed to the contrary, the Contractor shall remain fully and solely accountable for correctly setting out, founding and constructing the Works, and for compliance with the specifications and the drawings.

Employer:		Contractor:	
Witness:		Witness:	60

<b>Volume</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>		
<b>Part</b>	<b>T1</b>	<b>T2</b>	<b>C1</b>	<b>C2</b>	<b>C3</b>	<b>C4</b>



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#### **PS.6.4 Other contractors on site**

During the course of the contract, other contractors may be involved in construction projects within and in the vicinity of the site, which may be inter-related to the work being undertaken on this contract.

The Contractor shall cooperate with other such contractors and shall provide them with all reasonable access to enable them to carry out their work. Access may be required, from time to time, by these contractors and the Contractor shall take all reasonable steps to accommodate such requirements.

No claims, related to works being carried out by other contractors, will be entertained by the Employer.

#### **PS.6.5 Testing, completion, commissioning and correction of defects**

##### **PS 6.5.1 General**

The onus is on the Contractor to produce work that will conform in quality and in accuracy of detail to the requirements hereinafter specified. The Contractor shall clearly understand that it is not a duty of the Employer's Agent or his representative to act as foreman or surveyor on the Works.

The Contractor shall, at his own expense, provide an experienced Site Agent, foremen and surveyors together with all transport, instruments and equipment for supervising, checking and controlling the work.

The act of passing any completed work for payment by the Employer's Agent shall not be construed as signifying approval or acceptance thereof. Failure on the part of the Employer's Agent to reject any defective work or material shall not in any way relieve the Contractor of his obligations under the Contract, nor prevent later rejection when such work or material is discovered. In this regard, it is emphasised that notwithstanding anything contained in this document, any tests that may have been carried out, any consent that may have been given, either directly or implied, and anything that may be construed to the contrary, the Contractor shall remain fully and solely accountable for the Works and for compliance with the specifications and the drawings.

The Contractor shall, when submitting any work to the Employer's Agent for examination, satisfy himself by testing, measurement and otherwise as may be necessary that the work does in fact meet with the requirements of the Specifications. This information shall be submitted with the Contractor's request for examination and the Employer's Agent shall decide on the number and type of tests, measurements, etc. required to enable him to judge the quality of the work. The submission of this information shall in no way diminish the authority of the Employer's Agent to conduct such tests as he may consider necessary in order to determine the quality of the work performed by the Contractor, nor will he be bound to take account of the Contractor's tests, measurements, etc. should he consider these to be either incorrect or not representative.

Quality control and completion tests shall be in accordance with the relevant standard and amended specifications and additional specifications.

The tendered rates shall include the cost of all control testing, and no additional claims shall be entertained in this respect. This includes the supply of all necessary equipment required for these tests and/or inspections by the Employer's Agent.

Should the control testing performed or arranged by the Contractor not meet the requirements of the specification, the Employer's Agent shall have the right to conduct all such testing at the Contractor's expense.

In such a case, the Employer's Agent shall be given at least 72 hours' notice when testing is required. No

Employer:		Contractor:	
Witness:		Witness:	

<b>Volume</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>		
<b>Part</b>	<b>T1</b>	<b>T2</b>	<b>C1</b>	<b>C2</b>	<b>C3</b>	<b>C4</b>



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claims, however, shall be considered in respect of delays resulting from such testing.

Whenever the Employer's Agent conducts control testing on behalf of the Contractor, charges shall be levied. The Employer's Agent may, from time to time, carry out his own check tests on the work performed by the Contractor. Should such check tests show the Contractor's control testing to be such that the quality of the Contractor's work can be called into question, then the Employer's Agent may order further check tests to be carried out on work already completed by the Contractor.

All costs associated with such check tests shall be for the Contractor's account as shall the costs of any other check test whose results do not comply with the specification.

Where the Employer's Agent is required to witness certain control tests, such as the pressure testing of pipelines, and the results of such tests do not comply with the specifications, then charges will be levied against payments to the Contractor in order to recover the costs of the Employer's Agent's presence at the test.

The requirements of the Local Authority, insofar as their witnessing of tests, shall be adhered to.

#### **PS 6.5.2 Inspection of Works by Local Authority**

The Contractor shall afford inspectors from the Local Authority reasonable access to all parts of the site. The Employer's Agent in the presence of representatives of the Local Authority will generally undertake testing of the works. Accordingly the Contractor shall notify the Employer's Agent at least 24 hours in advance as to when the various sections of work will be available for testing. The Employer's Agent may require the Contractor to submit a weekly schedule of times, based on his programme, that he envisages work to be available for testing.

#### **PS 6.5.3 Completion, Commissioning and Correction of Defects**

The tendered rates shall include the cost of all activities and tests that may be required in ensuring proper completion and commissioning of the Works, and no additional claims shall be entertained in this respect. This includes the supply of all necessary equipment required for such and / or for inspections by the Employer's Agent and any other relevant authority.

Any defect in the Works shall be corrected to the satisfaction of the Employer's Agent.

#### **PS.6.6 Recording of Weather and Abnormal Rainfall**

If during the time for completion of the works or any extension thereof, abnormal rainfall or wet conditions shall occur, then an extension of time in accordance with Clause 5.12 in GCC 2015 hereof shall be granted by the Employer calculated in accordance with the formula given below for each calendar month or part thereof.

$$V = (Nw - Nn) + ((Rw - Rn)/X)$$

V	Extension of time in calendar days in respect of the calendar month under consideration.
Nw	Actual number of days during the calendar month on which a rainfall of Y mm or more has been recorded.
Nn	Average number of days, as derived from existing rainfall records, on which a rainfall of Y mm or more has been recorded for the calendar month.
Rw	Actual rainfall in mm recorded for the calendar month under consideration.
Rn	Average rainfall in mm for the calendar month as derived from existing rainfall records.

Employer:		Contractor:	
Witness:		Witness:	

<b>Volume</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>		
<b>Part</b>	<b>T1</b>	<b>T2</b>	<b>C1</b>	<b>C2</b>	<b>C3</b>	<b>C4</b>



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**Part 3: Scope of works**

For purposes of the contract Nn, Rn, X and Y shall have those values assigned to them in the Contract Data and/or the Specification.

The total extension of time shall be the algebraic sum of all monthly totals for the period under consideration, but if the total is negative the time for completion shall not be reduced due to subnormal rainfall. Extensions of time for part of a month to be calculated using pro rata values of Nn and Rn.

This formula does not take account of flood damage that could cause further or concurrent delays and will be treated separately as far as extension of time is concerned.

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

The following average rainfall figures are applicable:

INFORMATION SOURCE: South African Weather Service, Linbro Park, Tel.: 012 367 6014

Y = 10 mm/24-hour day  
X = 20 mm

<b>STATISTICAL INFORMATION: LINBRO PARK: LATEST</b>		
<b>Month</b>	<b>RAINFALL</b>	
	<b><u>Nn</u></b>	<b><u>Rn</u></b>
	<i>Actual number of days during the calendar months in which a rainfall of more than Y mm has been received</i>	<i>Average monthly rainfall</i>
January	2.4	140.7
February	1.3	69.4
March	0.9	45.4
April	0.2	32.6
May	0.3	15.9
June	0.0	6.0
July	0.0	0.8
August	0.0	3.2
September	0.1	5.4
October	1.3	48.9
November	1.2	63.7
December	1.9	107.1
<b>TOTAL</b>	<b>9.5</b>	<b>539.1</b>

The Contractor shall be permitted to take his own rainfall measurements on site subject to the Employer's Agent's approval, but access to the measuring gauge(s) shall be under the Employer's Agent's control. The Contractor is to provide and install all the necessary equipment for accurately measuring the rainfall as well as to provide, erect and maintain a security fence plus gate, padlock and keys at each measuring station, all at his own cost.

Employer:		Contractor:	
Witness:		Witness:	

<b>Volume</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>		
<b>Part</b>	<b>T1</b>	<b>T2</b>	<b>C1</b>	<b>C2</b>	<b>C3</b>	<b>C4</b>



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Description: Linbro Park Tower (With Associated Works)  
**Part 3: Scope of works**

#### PS.6.7 Format of communications

All communication shall be in writing and any verbal agreements shall only be binding once confirmed and agreed to in writing. Communication by registered post, email or facsimile is acceptable.

The Contractor and the Employer shall follow the correct communication protocol applicable to a normal civil engineering contract. The Contractor shall not put into effect any instructions received by him, other than through such protocol.

Should the Contractor be unclear in this regard, he shall obtain a ruling from the Employer's Agent.

Contractor to provide the following reporting on a monthly basis, Local resources reporting shall include but not be limited to;

- a) Number (labourers, SMMEs and suppliers),
- b) Labour:
  - Process of recruitment, selection and appointment
  - Name and surname
  - Gender and age
  - Certified copies of ID not validated older than three months.
  - Proof of Compliance with COIDA Act, which will be valid for the duration of the Construction period.
  - Contact details (address, telephone numbers and ward number)
  - Contract signed
  - Duration of appointment
  - Commencement date
  - Termination date
  - Activity performed
  - Classification (Skilled, semi-skilled or unskilled (labourer))
  - Time or task rate
  - Allocated Supervisor/foreman
  - Health and Safety induction undergone
  - Training provided
    - i. Trainer details
    - ii. Type of training
    - iii. Duration of training
    - iv. Cost of training
    - v. Attendance register
  - Performance rating (good, fair, poor)
    - i. For training
    - ii. Work execution
    - iii. Health and safety awareness
  - Additional training or supervision to be provided
  - Proof of Monthly and cumulative payments, including salaries or wages
  - UIF Returns
  - Certified copy of the contractual agreement not validated older than three months.
- c) SMMEs
  - Process of recruitment, selection and appointment

Employer:		Contractor:	
Witness:		Witness:	

<b>Volume</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>		
<b>Part</b>	<b>T1</b>	<b>T2</b>	<b>C1</b>	<b>C2</b>	<b>C3</b>	<b>C4</b>



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Description: Linbro Park Tower (With  
Associated Works)  
**Part 3: Scope of works**

- Company name
- Company contact details (address, telephone numbers and ward number)
- Company registration (also VAT and TAX)
- Company age (months or years)
- Type of company
- Company size (number of permanent employees)
- Name and surname of owner
- Owner contact details (address and telephone numbers and ward number)
- Gender, age and PDI status
- Contract signed
- Certified copies of ID
- Proof of Compliance with COID Act, which will be valid for the duration of the Construction period.
- Duration of appointment
  - i. Commencement date
  - ii. Termination date
- Resources provided (labour and/or plant and/or materials)
- Activity performed
- Classification
- Time or task rate
- Allocated Contractor Supervisor/foreman
- Health and Safety induction undergone
- Training provided
  - i. Trainer details
  - ii. Type of training
  - iii. Duration of training
  - iv. Cost of training
  - v. Attendance register
- Performance rating (good, fair, poor)
  - i. For training
  - ii. Work execution
  - iii. Health and safety awareness
- Additional training or supervision to be provided
- Proof of Monthly and cumulative payments , including salaries or wages
- UIF returns
- Certified copy of the contractual agreement not validated older than three months

d) Suppliers

- Process of recruitment, selection and appointment
- Company name
- Company contact details (address, telephone numbers and ward number)
- Company registration (also VAT and TAX)
- Company age (months or years)
- Type of company
- Company size (number of permanent employees)
- Name and surname of owner
- Owner contact details (address and telephone numbers and ward number)
- Gender, age and PDI status

Employer:		Contractor:	
Witness:		Witness:	

<b>Volume</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>		
<b>Part</b>	<b>T1</b>	<b>T2</b>	<b>C1</b>	<b>C2</b>	<b>C3</b>	<b>C4</b>



Contract JW 14406 Page 66  
Description: Linbro Park Tower (With Associated Works)  
**Part 3: Scope of works**

- Contract signed
- Duration of appointment
  - i. Commencement date
  - ii. Termination date
- Resources provided (plant and/or materials)
- Activity performed
- Allocated liaison
- Health and Safety induction undergone
- Performance rating (good, fair, poor)
- Monthly and cumulative payments

The report format may be amended from time to time by the Engineer. However the initial format shall be finalised by the Employer's Agent in association with the Contractor.

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#### **PS.6.8 Key personnel**

The Contractor is to provide the Curricula Vitae of key personnel to be employed on the project as well as the person's position and responsibilities within the project team. The Contractor shall provide the following minimum key staff:

- a) Contracts Manager
- b) Site Agent;
- c) Quality Manager/Auditor/Controller;
- d) Health and Safety Officer/s; and
- e) Foremen.
- f) SMME supervisor

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#### **PS.6.9 Management meetings**

The Employer's Agent shall hold regular site meetings with representatives of the Contractor, and the Employer. Minutes of such site meetings shall be kept and distributed by the Employer's Agent. Senior Contractor management staff attendance shall be compulsory.

The Contractor shall be required to provide reporting with regard to project progress, resources (human, plant and equipment), community issues, environmental and health and safety aspects.

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#### **PS.6.10 Forms for contract administration**

The Contractor shall maintain a file which shall contain project information related to project progress, resources (human, plant and equipment), community issues, environmental, health and safety aspects, penalties imposed, claims lodged and outcomes, disputes and resolutions, payment and variations.

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#### **PS.6.11 Daily records**

In addition to records on rainfall and weather, labour, plant, and materials, a site diary, site instruction book (both in triplicate) and safety documents are to be provided and maintained by the Contractor on site and updated daily.

These shall be submitted to the Employer's Agent on completion of the contract.

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#### **PS.6.12 Bonds and guarantees**

The Contractor shall within the period stated in the Contract Specific Data, of this document, provide the Employer with a Surety Bond in the form of a Bank Guarantee, Bank Transfer or a Guarantee from an approved Insurance Company to the satisfaction of the Employer in the form included in the Tender

Employer:		Contractor:	
Witness:		Witness:	

<b>Volume</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>		
<b>Part</b>	<b>T1</b>	<b>T2</b>	<b>C1</b>	<b>C2</b>	<b>C3</b>	<b>C4</b>



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Description: Linbro Park Tower (With Associated Works)  
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Documents. The Bank Guarantee shall be for an amount equal to ten per cent (10%) of the Tender Sum, for the due and punctual fulfilment and completion of all the Contractor's obligations under the Contract. No Extension of Time or any variation of the Contract nor the termination of the Contract by the Employer in terms of GCC 2015 hereof shall in any way impair or diminish or terminate any liability to the Employer under and by virtue of such Surety Bond. The cost of the Surety Bond to be so entered into, shall be at the expense in all respects of the Contractor; the Surety Bond to be released upon issue of the Employer's Agent's Certificate of Completion of the Works, unless otherwise stated in the Contract Data

Should the Contractor, when notified of the acceptance of his offer, fail to provide an approved Surety Bond within the stated period, then the Employer may, at his sole discretion:

- (a) Grant the Contractor a further reasonable period in which to provide the bond; or
- (b) Withdraw his acceptance of the tender, in which case the Contract shall be deemed to be void, but without prejudice to the Employer's rights to recover whatever damages he may have suffered by virtue of the Contractor's failure to fulfil his obligations.

#### **PS.6.13 Payment certificates**

Payment certificates shall be submitted to the Employer's Agent, in the format required, for approval and final submission to the Employer, on a monthly basis.

If any material on site is claimed, proof of ownership shall be provided, either by means of receipts, or by means of letters from the suppliers, stating that ownership has been transferred to the Contractor.

A VAT invoice shall be submitted to the Employer, by the Contractor, once each payment certificate has been finalised.

### **PS.7 FEATURES REQUIRING SPECIAL ATTENTION**

#### **PS.7.1 Security**

The Contractor shall be responsible to provide his own security on site, as he deems necessary. The Employer shall not be held responsible for any loss or damage suffered by the Contractor, his plant, equipment, materials, Sub-Contractor or employees as a result of a security incident of any nature.

#### **PS.7.2 Operation of Valves**

Only employees of the Johannesburg Water SOC. are permitted to operate water valves.

Requests for isolation of any section of such reticulation shall be made to the relevant section of the local authority at least 4 working days in advance of the requirement for isolation. The Employer's Agent shall be advised of the requirement and will monitor the implementation of the request.

#### **PS.7.3 Work outside normal working hours**

The Contractor is permitted to work outside of normal working hours (07:00 to 17:00) only upon obtaining written permission from the Employer's Agent.

Should the Contractor choose to work outside normal working hours without having been ordered to do so by the Employer's Agent, permission will not be unreasonably denied but all additional costs arising out of such work shall be entirely to the Contractor's account.

#### **PS.7.4 Additional Meetings**

The cost of all additional meetings or inspections over and above the normal that takes place because of the Contractor not keeping to his program or because of the quality of his work will be for the account of the Contractor and will be deducted from the following payment certificate. An amount of R 5 000.00 per meeting

Employer:		Contractor:	
Witness:		Witness:	

<b>Volume</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>		
<b>Part</b>	<b>T1</b>	<b>T2</b>	<b>C1</b>	<b>C2</b>	<b>C3</b>	<b>C4</b>



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**Part 3: Scope of works**

will be paid by the Contractor to compensate for the travelling cost, time, etc. of both the Employer's Agent and the Employer.

### **PS.7.5 Community liaison and community relations**

For the purpose of this project, community liaison officers will be required; who shall be required to inform the community with regards to Contractor's activities in particular to this project.

## **PS.8 HEALTH AND SAFETY SPECIFICATION FOR CONSTRUCTION WORK**

Contractors are to prepare Health and Safety Plans in accordance with Johannesburg Water's Health and Safety Specification (refer to Volume 2: Occupational Health and Safety Specification and Environmental Management Plan for Capital Investment Projects). The legal imperatives for this requirement stem from the Construction Regulations (2014), and more specifically the following:

- Regulation 4(1)(a): An Employer shall prepare a documented health and safety specification for the construction work, and provide any principal Contractor who is making a bid or appointed to perform construction work for the Employer with the same
- Regulation 4(1) (d): An Employer shall take reasonable steps to ensure that each principal contractor's health and safety plan is implemented and maintained on the construction site.
- Regulation 4(2): An Employer shall discuss and negotiate with the principal Contractor the contents of the health and safety plan and thereafter finally approve the health and safety plan for implementation.
- Regulation 5(1): A principal Contractor shall provide and demonstrate to the Employer a suitable and sufficiently documented health and safety plan, based on the Employer's documented health and safety specification

### **PS.8.1 Project-related Occupational Health and Safety Risks**

According to the Construction Regulations (2014), a Health and Safety Plan "means a documented plan which addresses hazards identified and includes safe work procedures to mitigate, reduce or control the hazards identified". Apart from complying with the Health and Safety Specification (Volume 2), specific attention is drawn to the identification and assessment of risks. The tendering Contractors are required to consider inter alia the following risks (where applicable):

#### Project- and site-specific risks:

- Excavation and safeguarding of pile casing and trenches;
- Working in elevated positions
- Scaffolding
- Traffic control;
- Plant and machinery operation;
- Existing services;
- Offloading of material;
- Electrical Distribution boards;
- Electrical Installation;
- Making of steel items

Employer:		Contractor:	
Witness:		Witness:	

<b>Volume</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>		
<b>Part</b>	<b>T1</b>	<b>T2</b>	<b>C1</b>	<b>C2</b>	<b>C3</b>	<b>C4</b>



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Description: Linbro Park Tower (With Associated Works)  
**Part 3: Scope of works**

- Laying of pipes;
- Placing concrete
- Machine operator;
- Third party exposures;
- Use of portable electrical tools;
- Location of site camp;
- Storage and handling of material;
- Fire prevention and protection;
- Refuelling vehicles/plant;
- Welding;
- Handling of compressed gas cylinders.

Safe work and emergency procedures need to be prepared to address the abovementioned risks.

## **PS.8.2 Guide to risk assessments**

### **PS.8.2.1 Nine steps to Effective Risk Assessments**

- Step 1 Identifying the current as well as emerging hazard, risks or exposures.
- Step 2 Aim to identify major hazards, don't waste time on the minor and detail except if such hazard has the potential to repeat itself on a frequent basis.
- Step 3 Involve as many people as possible in the ongoing risk assessment process especially those at risk.
- Step 4 Gather all the information and analyse it.
- Step 5 Look at what actually could or has occurred including non-routine operations.
- Step 6 Use a systematic approach to ensure all hazards are adequately addressed.
- Step 7 Assess the risks identified or the risk has occurred by taking into account the effectiveness of current as well as controls under consideration.
- Step 8 Ensure the process is practical, realistic, cost and business effective.
- Step 9 Always record the assessment in writing including i.e. assumptions, date and why a particular decision has been made.

### **PS.8.2.2 How serious is it?**

#### **Probability**

- A Common
- B Has Happened
- C Could Happen
- D Not Likely
- E Practically impossible

#### **Consequences**

- 1 Fatality or permanent disability.
- 2 Major injury.
- 3 Average Lost Time Injury.
- 4 Minor Injury.
- 5 Medical Treatment or less.

		<b>Probability</b>				
		<b>A</b>	<b>B</b>	<b>C</b>	<b>D</b>	<b>E</b>
<b>1</b>		1	2	3	4	5
<b>2</b>		2	3	4	5	6
<b>3</b>		3	4	5	6	7
<b>4</b>		4	5	6	7	8
<b>5</b>		5	6	7	8	9

Employer:		Contractor:	
Witness:		Witness:	

<b>Volume</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>		
<b>Part</b>	<b>T1</b>	<b>T2</b>	<b>C1</b>	<b>C2</b>	<b>C3</b>	<b>C4</b>



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Associated Works)  
**Part 3: Scope of works**

<b>Risk rating</b>	<b>Action</b>
1 - 3 = Serious	Immediate (within 1 week).
4 - 5 = High	Within 1 month.
6 - 7 = Moderate	> 4 weeks.
8 - 9 = Acceptable	No action but will consider from time to time.

Employer:		Contractor:	
Witness:		Witness:	

<b>Volume</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>		
<b>Part</b>	<b>T1</b>	<b>T2</b>	<b>C1</b>	<b>C2</b>	<b>C3</b>	<b>C4</b>



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**Part 3: Scope of works**

## **PS.9 ENVIRONMENTAL MANAGEMENT PLAN**

Contractors are to adhere to the mitigation measures listed in the Environmental Management Plan (EMP) (refer to Volume 2: Occupational Health and Safety Specification and Environmental Management Plan for Capital Investment Projects). Environmental mitigation measures are actions needed to align a project implementation phase with environmental control principles, where potential impacts to the natural and social environment are prevented, minimised or remediated. Environmental safeguarding is governed by various sets of legislation, with the most noteworthy for this project constituting the National Environmental Management Act (No. 107 of 1998) and the National Water Act (No. 36 of 1998).

## **PS.10 HEALTH AND SAFETY AGENT AND ENVIRONMENTAL CONSULTANT**

The contact details for the Health and Safety Agent and for the Environmental Consultant are:

Health and Safety Agent:

JW Health Safety Section

Environmental Consultant:

Contact Juliet Klaas for officer details

## **PS.11 GENERAL SECTION PAYMENT LIMITATION**

The gross sum of items 8.3 and 8.4, as per SANS 1200A, may not exceed 15% of the total contract amount excluding contingencies and VAT. If the amount tendered for these items exceeds the above, the tender will be altered to the reduced amount by reducing these specific items.

## **PS.12 EMPLOYMENT OF LABOUR**

### **PS.12.1 INTERPRETATIONS**

#### **PS.12.1.1 Supporting documents**

The Tendered Rules, Conditions of Contract, Standard, Supplementary and Specific Specifications and Construction Specifications and drawings shall inter alia be read in conjunction with this specification.

#### **PS.12.2 Application**

The provisions of this specification shall apply in respect of all workers and small, medium and micro enterprises other than the Contractor's key personnel, who are engaged on the execution of the works.

#### **PS.12.3 Community Liaison Officer**

The Project Steering Committee will identify a Community Liaison Officer (CLO) to facilitate liaison between the Contractor and the community and amongst other things to ensure that the employment of local labour proceeds smoothly.

All decisions regarding identification and hiring of labour, relieving labour of their duties, local problems and any other matter of local importance related to the Contract, will be made in consultation with the CLO.

#### **PS.12.4 Appointment, Office and Replacement of CLO**

The CLO will be appointed for the duration of the construction phase of this Contract. The CLO will occupy his own office in the Contractor's camp from where he will fulfil his duties to identify, screen and nominate labour from the community in accordance with the Contractor's requirements.

Employer:		Contractor:	
Witness:		Witness:	

<b>Volume</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>		
<b>Part</b>	<b>T1</b>	<b>T2</b>	<b>C1</b>	<b>C2</b>	<b>C3</b>	<b>C4</b>



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**Part 3: Scope of works**

The CLO will communicate with the Contractor daily regarding labour requirements.

Should it become apparent that the appointed CLO fails to meet his duties, he may be relieved from his duties and replaced by a new CLO in consultation and approval with the Employer's Agent.

#### **PS.12.5 Duties of the CLO**

- He will be available on site daily between the hours of 07:30 and 18:30, and at other times as the need arises.
- He will consult with the Contractor and the Employer's Agent daily to determine the labour requirements regarding number and skills, to identify possible labour disputes, and to inform local labourers timeously when they will be relieved.
- He will be responsible to screen candidates, to inform them of their conditions of temporary employment and to ensure their timeous availability.
- He will ensure that all workers who are involved in activities where productivity rates have been agreed, are fully informed regarding the expected level of productivity for the given tasks to be assigned as part of this Contract.
- He will attend disciplinary proceedings to ascertain that hearings are fair and reasonable.
- In consultation with the Contractor, he will determine the needs of the local labour for relevant technical training. And will be responsible for the identification of suitable trainees. He will also be required to attend some of the training sessions.
- He will keep a daily written record of his interviews and community liaison.
- He will attend the monthly Contractual site meetings to report about the local community labour involvement as well as any other relevant issues that need attention.
- He will act as a liaison officer between the Contractors on site and the local community through the project committee.
- He will be involved in all SMME related matters (Contracts, terminations etc.)
- 

#### **PS.12.6 Scheduled Item**

##### **PD.12.6.1a Community Liaison Officers - Salaries Unit: Provisional Sum**

The tendered sum shall include full compensation for the provisions of the CLO including salary (market related), provision of an office, transport costs, the cost of typing, printing and distributing notices, and for all other obligations to perform his job.

##### **PD12.6.1b Community Liaison Officers – Cellular phone Unit: Provisional Sum**

The Contractor must supply the CLO with a cellular phone for the duration of the CLO employment Contract and this rate must cover the cost of procuring and commissioning that phone.

##### **PD12.6.1c Community Liaison Officers – Cellular phone calls Unit: Provisional Sum**

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Employer:		Contractor:	
Witness:		Witness:	72

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## PORTION 2: VARIATIONS AND ADDITIONS TO THE STANDARDISED SPECIFICATIONS

### SANS 1200A: CIVIL ENGINEERING CONSTRUCTION: PRELIMINARY AND GENERAL

This portion of the specification covers variations and additions to the SANS 1200 Standardised Specifications. The clause numbers hereunder consist of a prefix, such as "PSA" indicating an amendment to SANS 1200 A and a number that represents the number of the clause in SANS 1200.

#### SECTION 1: CIVIL WORKS

##### 2.1 Applicable Standards

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###### 2.1.1 National standards

The standardised specifications for all associated civil work applicable to this Contract shall be:

SANS 1200 A	General
SANS 1200 AB	Employer's Agent's office
SANS 1200 C	Site clearance
SANS 1200 D	Earthworks
SANS 1200 DB	Earthworks (pipe trenches)
SANS 1200 DM	Earthworks (roads, subgrade)
SANS 1200 G	Concrete (Structural)
SANS 1200 GA	Concrete (Small Works)
SANS 1200 H	Structural steel work
SANS 1200 L	Medium Pressure Pipelines
SANS 1200 LB	Bedding (Pipes)
SANS 1200 LE	Stormwater Drainage
SANS 1200 ME	Subbase
SANS 1200 MJ	Segmented Paving
SANS 1200 MK	Kerbing and channelling
SANS 664	Isolation valves
SANS 1123	Jointing system for the steel pipeline
SANS 1200	All valves, fittings and chambers
SANS 966	Pipe fittings and couplings
SANS 135	Bolts and nuts
SANS 136	Bolts and nuts
SANS 1217	Internal lining
SANS 719	Steel specifications
API 1104	Welding

These Specifications are not issued with this volume but are available at the Contractor's expense from: South African National Standards. The Contractor shall be in possession of these Technical Specifications and shall keep a hard copy of the specifications on site for reference by him and the Employer's Agent for the duration of the Contract

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**PSA .4 PLANT****PSA 4.2 Contractor's offices, stores and services**

*Add the following to this sub-clause:*

**PSA4.2.1 Water, sanitation and electricity for construction purposes****a) Water**

Water is available on the site from an existing network. A water supply point will be made available within approximately 200 meters from the area available for the erection of site offices and stores. The availability of water is subject to the Employer's conditions and requirements and the Contractor shall make the necessary arrangements with Johannesburg Water in advance.

The Contractor shall be responsible for negotiating all costs and necessary connections which might be required during the execution of the works. All connections will conform to the requirements of Johannesburg Water and costs applicable will be paid by the Contractor

**b) Sewer**

The Contractor shall provide, maintain, move to positions as required and finally remove proper sanitary accommodation at each work front. Sanitary accommodation shall be properly screened and its use strictly enforced. The Contractor shall comply with the local authority's Sanitation General By-Laws Section 19(1) and 19(3).

The location of sanitary accommodation, prescribed in terms of the Sanitary General By-Laws, shall be approved by the Employer's Agent as being convenient for the person for whose use it is intended. The sanitary accommodation provided shall be adequately ventilated, properly disinfected and kept in a thoroughly clean condition at all times.

**c) Power**

Power is available on site. A power supply point will be made available within approximately 100 meters from the area available for the erection of site offices and stores. The availability of power is subject to Johannesburg Water's conditions and requirements and the Contractor shall make the necessary arrangements with Johannesburg Water or City Power in advance.

The responsibility lies with the Contractor to negotiate all costs and necessary connections which might be required during the execution of the works. All connections will conform to the requirements of Johannesburg Water and costs applicable will be paid by the Contractor.

*Add the following to this sub-clause:*

**PSA4.2.2 Site works**

- a) An area will be made available by the JHB Water Works Manager for the Contractor's site offices, workshops and stores.
- b) The Contractor shall make his own arrangements to secure the facilities provided.
- c) No employees, apart from a security guard, may be housed on the site of the works.
- d) Upon completion of the work in terms of this contract, the site shall be cleared of all structures, concrete slabs and waste and excavations shall be backfilled.
- e) The Contractor shall make the necessary arrangements with Johannesburg Water to obtain access for the vehicles and personnel he intends to employ on site.

### **PSA4.2.3 Telephone Facilities**

The Contractor will be responsible for arranging his own telephone facilities and will be responsible for all costs relating thereto.

### **PSA 4.3 Plant and Equipment**

*Add the following to this sub-clause:*

The Contractor is required to provide all plant and materials necessary to carry out the works as required. No additional allowances other than those already specified in the Bill of Quantities shall be allowed for with respect to plant and materials.

*Add the following to this sub-clause:*

The Contractor is required to provide all equipment necessary to carry out the works as required. No additional allowances other than those already specified in the Bill of Quantities shall be allowed for with respect to equipment.

Construction equipment shall be suited for the onsite intended use and shall comply with all relevant safety aspects required by the OHS Act.

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## **PSA .5 CONSTRUCTION**

### **PSA 5.1 SURVEY**

#### **PSA 5.1.1 Setting out of the works**

*Delete this sub-clause and replace with the following:*

The Contractor shall set out the works and maintain their correct position, not only according to the Contract Documents but also according to any drawings or orders that he may receive from time to time from the Employer's Agent. The Contractor shall:

- a) be held responsible for the accuracy of the setting out for the full period of the Contract;
- b) use equipment and instruments that can ensure the necessary accuracy;
- c) be held responsible for the correction of any error at his own expense; and
- d) update the plans, which are kept on site so that all the changes approved by the Employer's Agent are reflected on the drawings. These drawings will represent record drawings and must consequently reflect the Works as they are actually built. The cost for this shall be deemed to have been included in all works construction rates. The Contractor must check drawings periodically and after completion of the Contract they shall be handed over to the Employer's Agent.
- e) confirm the levels and coordinates of all benchmarks prior to commencing with construction

*Add the following to this sub-clause:*

#### **PSA 5.1.2 Preservation and replacement of beacons and pegs subject to the land survey act**

*Delete this sub-clause and replace with the following:*

The Contractor's attention is drawn to the provisions of Sections 35 and 36 of the Land Survey Act, 1927 (Act No 9 of 1927), in terms of which he will be deemed to be responsible for the safety of any survey beacons, survey bench marks and plot boundary pegs encountered on the Site. He shall further be responsible for all costs incurred in the replacement by a Registered Land Surveyor, in terms of the said Act, of any such marks or pegs that are moved or damaged.

### **PSA 5.1.3 Alterations, additions, extensions and modifications to existing works**

The Contractor is required to verify the accuracy of all drawings and levels provided by the Employer's Agent prior to commencing with any construction activities.

Where the Works require that alterations, additions, extensions and / or modifications be carried out to existing works or facilities, these shall be carried out strictly in accordance with the requirements of the relevant authorities.

### **PSA 5.2 WATCHING, BARRICADING, LIGHTING AND TRAFFIC CROSSINGS**

Replace the words "traffic crossings" in the heading and in text of this sub-clause with the words "accommodation of traffic"

*Add the following:*

#### **PSA 5.2.1 General Accommodation of Traffic**

The Contractor shall be responsible for the safe and easy passage of vehicular and pedestrian traffic over, past or alongside the works.

#### **PSA 5.2.2 Traffic control**

Wherever the contractor's activities on site affect or have the potential to affect the normal flow or safety of traffic during the construction, he shall be responsible for all aspects of traffic control, including flagmen, warning devices, signs, channelisation devices, layout of detours and by-passes, sign sequences and layouts, and all the requirements of the Chief Traffic Officer of the Local Authority.

Only warning devices, signs and channelisation devices included in the latest Road Traffic Ordinance of the province concerned (hereinafter referred to in this clause as the "Ordinance") shall be used. The standard patterns of the traffic control devices and signs, and the traffic -control procedures and methods prescribed in

the Ordinance shall be applied. The dimensions and other properties of all signs and devices and the sign and device sequences, layouts and spacing shall be in accordance with the provisions of the Ordinance unless otherwise specified. In addition, signs and devices shall be placed at the positions shown on the Drawings. In cases not covered by the Ordinance, the signs, speed limits, devices, sequences, layouts and spacing shall comply with the requirements of The South African Road Traffic Signs Manual, the Chief Traffic Officer of the relevant authority, and the Employer's Agent.

The Contractor shall ensure the safe accommodation of traffic at all areas where the Works may impact on traffic, and shall provide all drums, watching, lighting, signs and barricades required by the road authorities, and in accordance with the South African Road Traffic Signs Manual. In this regard, the following references have been extracted from the SARTSM Volume 2, Chapter 13:

<u>Item</u>	<u>Page No.</u>
<i>General</i>	13.10.1
<i>Urban Roadworks</i>	13.10.1
<i>Temporary Traffic Signals</i>	13.10.2
<i>Sidewalk Deviation</i>	13.10.4
<i>Localised Work Site – Good Visibility</i>	13.10.6
<i>Lane Closed Beyond a Junction</i>	13.10.8
<i>Work within a Junction</i>	13.10.10
<i>Work in a One-way Street</i>	13.10.12
<i>Road Closure - CBD</i>	13.10.14
<i>Road Closure – Dual Carriageway Street</i>	13.10.16
<i>Road Closure - Detour</i>	13.10.18
<i>Freeway/Dual Carriageway: Lane Closure</i>	13.11.3

Where applicable, the Contractor shall be responsible for traffic-control at night and adequate warning lights and flashing lights shall be provided.

## **PSA 5.3 PROTECTION OF STRUCTURES**

*Add the following:*

### **PSA 5.3.1 Inspection of adjoining properties**

The Contractor shall carry out inspections and evidence collection, as he deems appropriate, of properties adjoining the works to ensure that, in the event of a claim arising from any of the owners of the adjoining properties for damage to property and the like, the Contractor has substantial evidence to support or refute such claims. The Contractor accepts full liability and responsibility for damage that he causes to adjoining properties as well as any costs involved in refuting or processing of such claims.

*Add the following:*

### **PSA 5.3.2 Protection of Trees**

Where so directed by the Employer's Agent, adequate measures shall include double wrapping of sacking or similar material, around the bole up to 1,5m height. Compensation for the cost of such measures will be made under the relevant items in the Bill of Quantities.

## **PSA 5.4 PROTECTION OF OVERHEAD AND UNDERGROUND SERVICES**

*Add the following:*

Timely written notice shall be given by the Contractor to the Employer's Agent and to the authority or department concerned of the Contractor's intention to work across or near any existing works or services and such work shall not commence until the necessary permission has been received. The Contractor will not be entitled to claim for any delay in the construction programme caused by compliance with the requirements of this clause. Work across or near any existing works or services shall be carried out in compliance with the requirements of the relevant authority or department.

Whilst every effort will be made to ensure that any information relating to underground services is correct, the Employer and Employer's Agent takes no responsibility for the accuracy, or for the completeness of the information. The Contractor will be held responsible for any damage to services and shall be liable for the cost of making good the damage. All such costs incurred by the Employer will be deducted from monies due to the Contractor.

Manhole covers; valve boxes, hydrants, etc. shall not be covered over and shall be accessible at all times.

After an existing service has been passed in laying the service pipe, but before backfilling has been started, the Employer's Agent or relevant authority shall be informed in order that they may certify in writing that the service has not been damaged.

*Add the following:*

### **PSA 5.4.1 Permits and Way leaves**

The Contractor will be required to obtain permits from all the applicable service providers within the jurisdiction of the City of Johannesburg. It is the Contractor's responsibility to obtain final permit approval according to applicable procedures and specifications. Permits associated costs shall be deemed to have been included in the schedule rates for Way leaves and Permits.

*Add the following:*

### **PSA 5.4.2 Responsibilities**

#### **The Contractor:**

- a) Shall make provision for the possible existence of numerous services (e.g.: Stormwater, Water, Sewers, Eskom, City Power, Egoli Gas, Sasol Gas, Rand Water, Telkom, and the like) within and in close proximity to the work areas;
- b) Shall obtain way leaves indicating the location of existing services from all affected service providers prior to the commencement of construction. The Contractor is to comply with the conditions of the way leaves received from the various service providers;
- c) Shall ensure the protection and integrity of all existing services exposed and encountered through the course of construction activities. Adequacy in terms of protection of existing services shall be at the discretion of the Employer's Agent. The Contractor is to make good the protection of and any breakages to existing services. The Contractor is to record on the As-Built

drawings the location of existing services or services which have been relocated during the Contract Period;

- d) Shall inform the relevant service provider immediately (within 2 hours of the incident) such that procedures for the reinstatement of the service can be effected, should he damage or break an existing service (whether known or unknown);
- e) Is responsible to provide their own equipment in order to determine the location of existing services.

*Add the following:*

#### **PSA 5.4.3 Locating Existing Services**

Existing known services, both underground and overhead, are indicated on the sub surface detection drawings, but the positions of existing services on the drawings are not guaranteed nor does the Employer, nor the Employer's Agent, accept any liability in this regard. The Contractor shall liaise with all relevant local authorities to satisfy himself that all relevant services have been located.

At the commencement of the Contract, the Contractor shall hand excavate a distance 0.5 m on each side of the located service to expose it. The exposed service shall be identified and recorded on a drawing.

A copy of the drawing with all known services shall be submitted to the Employer's Agent before construction can commence in any road reserve.

Once the exposed service is identified and recorded the excavation shall immediately be backfilled. Re-excavation by hand at construction stage will not be measured in addition to normal trench excavation.

The Contractor shall retain full responsibility for establishing the exact positions of the various services in advance of any construction work. No allowance for delays or disruption shall be entertained unless the Contractor complies fully with the provisions of this clause regarding the establishment of the exact positions of the various services in advance of any construction work

#### **PSA 5.5 DEALING WITH WATER ON WORKS**

*Add the following paragraph:*

"The Contractor shall be deemed to have acquainted himself during tender stage with the groundwater and surface water conditions."

#### **PSA 5.6 POLLUTION**

*Add the following:*

##### **Precaution against Pollution and Nuisance**

The Contractor's attention is drawn to the fact that operations will be conducted in urban areas and in the presence of passing traffic. The Contractor shall take all necessary steps and precautions to prevent pollution of the surrounding area by his employees in any way.

Wherever excavated and/or loaded material is liable to form a dust nuisance, an effective method of spraying water over the cut area and loaded material shall be installed. Tarpaulins shall be provided to cover trucks

and prevent dust blowing from loads during transport.

Any material or debris falling from trucks on the roads in use by the public shall be immediately removed. Precautions shall be taken to prevent fouling of public roads or completed construction by trucks transporting muddy material. The Employer's Agent may order the Contractor to continuously broom off and clean where the mud tracking of vehicle or falling debris may constitute a danger to the public making use of roads.

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## **PSA .8 MEASUREMENT AND PAYMENT**

### **PSA 8.1.2.3 Contractor to Price all Items**

*Add the following paragraph;*

"The grouping of payment items under one all-inclusive rate is prohibited. Each payment item shall have its own rate. Where the Contractor elects not to insert a rate for any particular item, then it shall be deemed to be zero".

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## **PSA 8.2 PAYMENT**

### **PSA 8.2.2 Time-related Items**

Delete the last four lines of this sub-clause, i.e. the paragraph commencing with the word "Note..."

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## **PSA 8.3 SCHEDULED FIXED-CHARGED AND VALUE-RELATED ITEMS**

### **PSA 8.3.2.1 Facilities for Employer's Agent**

b) Delete 'Telephone' and insert 'Cellphone'.

*Add the following to this sub-clause:*

d)	Latrine facilities	Unit: Sum
e)	Board room to accommodate 15 personnel	Unit: Sum
f)	Computer facilities complete with printer, modem and telephone connection including 3G connection	Unit: Sum

### **PSA 8.3.2.2 (f) Tools and Equipment**

*Add the following new sub-clause:*

"The sum shall cover the cost of supplying all hand tools and equipment, as necessary for proper execution of the works. Unit: Sum

*Add the following new sub-clause:*

### **PSA 8.3.2.2 (k) Security of works**

"The sum shall cover the cost of supplying all security works, as deemed necessary by the Contractor, refer to clause PS7.1 Unit: Sum

## **PSA 8.3.3 OTHER FIXED CHARGE OBLIGATIONS**

i) **Notifications and warnings to consumers** Unit (Prov Sum)  
The Sum shall be in full compensation for all relevant, notification to consumers in any disruption, change in quality, quantity or stop to distribution of water, as may be required on this project, under the discretion and approval of the Employer's Agent.

- ii) **Permits and Wayleaves** sum (Sum)  
The Sum shall be in full compensation for obtaining all relevant information, permits and wayleaves from all service providers, as may be required on this contract

---

**PSA 8.4 SCHEDULED TIME RELATED ITEMS**

**PSA 8.4.2.1 Facilities for Employer's Agent**

- b) Delete 'Telephone' and insert 'Cell phone'.
- Add the following to this sub-clause:*
- d) Latrine facilities Unit: Sum
- e) Board room to accommodate 15 personnel Unit: Sum
- (f) Computer facilities complete with printer, modem and telephone connection including 3G connection. Unit: Sum

**PSA 8.4.2.2 (f) Tools and Equipment**

*Add the following new sub-clause:*

"The sum shall cover the cost of supplying all hand tools and equipment, as necessary for proper execution of the works. Unit: Sum

*Add the following new sub-clause:*

**PSA 8.4.2.2 (k) Security of works**

"The sum shall cover the cost of supplying all security works, as deemed necessary by the Contractor, refer to clause PS7.1 Unit: Sum

---

**PSA 8.5 SUMS STATED PROVISIONALLY BY ENGINEER**

Add the following sub-items:

- a) Provisional sum for control testing to be carried out as required by the Employer's Agent, including testing of structure Unit: Prov Sum
- b) Percentage adjustment to Item (a) for contractor's overheads, administration charges and profit Unit: percentage
- c) Additional tests ordered by Employer's Agent Unit: Prov Sum
- d) Handling cost and charges on (c) Unit: Percentage

The provisional sum shall cover the cost of control tests specifically ordered by the Employer's Agent. Tests shall be executed by an approved commercial laboratory.

**PSA 8.5.1 For work to be executed by the Contractor**

Provision sum is included hereunder in order to cover any contingencies that may arise. Its usage shall be under the strict control of the Employer's Agent.

**PSA 8.5 3 Training**

Add the following sub-clause:

The sum shall be in full compensation for the provision of training to targeted labour according to the specification of the Employer, and approved by the Employer's Agent Unit ProvSum

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**PSA 8.8 TEMPORARY WORKS****PSA 8.8.4 Relocation of services**

Excavation for exposing existing services in the following depth ranges below ground level:

- |            |   |                                |
|------------|---|--------------------------------|
| <b>(a)</b> | <b>0,0 m up to 2,0 m:</b>   |                                |
|            | (i) Soft material   | cubic metre (m <sup>3</sup> )  |
|            | (ii) Hard material  | cubic metre (m <sup>3</sup> )  |
|            |   |                                |
| <b>(b)</b> | <b>Exceeding 2,0 m up to 4,0 m:</b>   |                                |
|            | (i) Soft material   | cubic metre (m <sup>3</sup> )  |
|            | (ii) Hard material  | cubic metre (m <sup>3</sup> )  |
|            |   |                                |
| <b>(c)</b> | <b>Extra over sub-items (a) and (b) above for hand excavation by means of hand tools such as picks, crowbars and pneumatic tools in close vicinity of services or where no blasting or machine excavation is allowed:</b> |                                |
|            | (i) Soft material   | cubic metre (m <sup>3</sup> )  |
|            | (ii) Hard material  | cubic metre (m <sup>3</sup> )" |

The unit of measurement shall be in cubic metre of the material removed as specified:

The rates shall include full compensation for all cost to excavate and break down the various classes of materials, including the cost of all the necessary additional effort, plant, tools, materials, labour and supervision.

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**SANS 1200AB: ENGINEER'S OFFICE**

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**PSAB 3 MATERIALS****PSAB 3.1 Name boards**

The numbers of name boards noted in the Bill of Quantities are to be provided under this contract.

No other name boards other than stated above shall be allowed. On completion of the works, the Contractor shall obliterate all particulars on the name board and remove the board from the site, prior to the release of retention money.

**PSAB 3.2 Site Office**

*Add the following to this sub-clause:*

In addition to the standard requirements:

- a) The location of the office unit shall be selected in consultation with the Employer's Agent.
- b) The Employer's Agent must approve all internal furniture.
- c) Carport's shall be provided and shall cover not less than 24 m<sup>2</sup>, with the ground surface consisting of a layer of crushed gravel (no larger than 9 mm) to combat dust and mud. The

- carport shall be easily accessible, and be such that cars are protected from direct sunlight all times of day, and against inclement weather.
- d) Electrical power from the local authority that is adequate for operating a computer, an air conditioning unit, a heater and a refrigerator.
- e) The Contractor shall, in addition to his facilities, further provide at the site camp a meeting room for the Employer's Agent. The meeting room shall have adequate seating and table to hold site and other meetings, for 15 people.

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#### **PSAB 4 PLANT**

##### **PSAB 4.1. Telephone**

Add the following:

"A telephone will not be required for the sole use of the Employer's Agent. However, the Contractor shall be responsible for the payment of calls related to the contract made by the Employer's Agent's Representative, on his own mobile phone, during the course of the contract.

Add the following:

##### **PSAB 4.2 Computer Facilities**

The Contractor shall, for the duration of the Contract, provide the computer equipment complete with printer, telephone connection and internet connection (ADSL or 4G) together with the software specified hereunder, for the exclusive use of the Employer's Agent and his staff:

- a) 1 computer
- b) 1 printer

The computers shall comply with the following minimum specifications:

- Intel Core i3 3.30Ghz CPU
- 4Gb ddr3 memory module
- 500Gb hard drive
- Midi tower case + 550w powersupply
- Dvd/Rw drive - internal
- Usb keyboard
- Usb optical mouse
- 18.5" or 19" Led/Lcd wide monitor
- Internet connection (ADSL or 4G)

Printers shall, unless otherwise approved by the Employer's Agent, be Hewlett-Packard Desk Jet printers or equivalent compatible. Printer to be able to scan, and print both A4 and A3 documents , in monochrome and colour

All computer hardware shall be provided complete with the requisite connecting cables and all interfacing devices and software necessary for its efficient operation as an integral system.

The following software shall be properly installed on the computer, and the original license agreements and disks shall be provided to the Employer's Agent for safekeeping:

- MS Windows Latest Edition
- MS Office Home and Business Latest Edition
- MS Projects Latest Edition

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 of notification by the Employer's Agent's staff.

The Contractor shall further provide at his own cost, all paper, ink cartridges and other consumables reasonably required by the Employer's Agent."

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## **PSAB 5. CONSTRUCTION**

### **PSAB 5.4 Survey Assistants**

The Contractor is to make available two suitably, trained and experienced workmen to be used as survey assistants for the Employer's Agent or his representative during working hours as and when required.

### **PSAB 5.5 Survey Equipment**

The Contractor shall make available on the site the following survey equipment, all in good condition and adjustment.

- (a) 1 Automatic level and tripod
- (b) 5m Telescopic levelling staff
- (c) 100m Steel tape
- (d) 1m Spirit level
- (e) 6 Ranging rods

The equipment need not be for the sole use of the Employer's Agent, but it shall be available on request.

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## **SANS 1200 C: SITE CLEARANCE**

### **PSC 3 MATERIALS**

#### **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."

### **PSC 5 CONSTRUCTION**

#### **PSC 5.1 Areas to be cleared and grubbed**

Add the following:

"Pipeline routes shall be cleared on instruction of the Employer's Agent to a distance of 1, 5 m on both sides of the pipeline centre line. Route pegs or markers shall not be destroyed or damaged during clearing operations."

## **PSC 5.2     Cutting of trees**

### **PSC 5.2.3.2 Individual trees**

Replace the last sentence with the following:

"An amount of R1 000,00 will be deducted from moneys due to the Contractor as a penalty for every tree that is damaged or removed unnecessarily and without prior instruction from the Employer's Agent."

## **PSC 5.5 Reclearing of vegetation**

Add the following:

"When areas have to be recleared on the written instructions of the Employer's Agent, 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."

## **PSC 8       MEASUREMENT AND PAYMENT**

### **PSC 8.2     Payment**

#### **PSC 8.2.1 Clear and grub**

Replace the first line with the following:

"The area designated by the Employer's Agent to be cleared and grubbed will be measured in square metres to the nearest square metre or,"

"This item will be a provisional Sum to be approved by the Employer's Agent before work commences"

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## **SANS 1200 D: EARTHWORKS**

### **PSD 8.3.6 Overhaul**

Remove and replace with following

All haul shall be free haul

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## **SANS 1200 DB: EARTHWORKS**

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## **PSDB 5     CONSTRUCTION**

### **PSDB 5.1 Precautions**

#### **PSDB 5.1.1 General**

Add the following to this sub-clause:

The Contractor shall programme his activities in such a way that long sections of trenches do not lie open for undue periods of time, as this poses a safety risk. The pipes shall be laid as soon as possible after excavation of the trenches and the trenches then backfilled. Under no circumstances will trenches be left open for more than 1 week.

The Contractor shall inform the Johannesburg Road Agency (JRA) at least 2 days in advance of the actual date on which he proposes to excavate in any road or footway.

#### **PSDB 5.1.4 Existing services that intersect or adjoin trenches**

Add the following to this sub-clause:

Where it is necessary for a pipeline to pass under existing drains, the Contractor shall carefully excavate and backfill around them. During the course of the work, the drains shall be adequately supported to the satisfaction of the Engineer. Any damage shall be reported without delay and shall be made good by the Contractor before backfilling.

#### **PSDB 5.4 Excavation**

Add the following to this sub-clause:

Where the pipe trench crosses surfaced roads the Contractor shall neatly cut four parallel grooves into and through the "black top" before excavating between the inside 2 grooves. The outside 2 grooves should be 100 from the inside ones. The cost of this operation, where not scheduled separately, will be deemed to have been included in the general rates for excavation.

#### **PSDB 5.5 Trench Bottom**

Add the following to this sub-clause:

In waterlogged conditions and/or where so instructed by the Engineer, a 100mm thick layer of 20mm to 6mm graded stone shall be laid under the pipes.

#### **PSDB 5.6 Backfilling**

##### **PSDB 5.6.1 General**

Add the following to this sub-clause:

Notwithstanding the requirements of sub-clauses PSDB 5.6.1 and 5.6.6, no pipe joint or pipe-fitting shall be covered by either the blanket or the backfill prior to the successful completion of the visual inspection and the pressure testing of the relevant section of the pipeline and without the written permission of the Engineer.

##### **PSDB 5.6.2 Material for backfilling**

Add the following to this sub-clause:

No backfilling may be done unless it is authorised by the Engineer. Trenches must be backfilled and compacted to 90% modified AASHTO to at least 300mm above the pipe soffit in layers of 150mm around and above the pipe and care should be exercised to prevent damage to the pipe. Subsequent layers may be compacted in 175mm layers. Except where backfill material is in the opinion of the Engineer moist enough, water must be added to facilitate compaction.

In the event of no suitable material being available around the pipe for backfilling the trench in question, the Contractor must obtain suitable material from other excavations, transport it to the site and remove the unsuitable material to an approved dumping site. If no suitable material is thus obtainable, the Contractor must sift the material obtained from the trench through a sieve with a 10mm mesh, but, if above mentioned procedure is not practical, the Engineer may instruct the Contractor to import suitable material from approved sources and the Contractor will be under obligation to remove the unsuitable material to a dumping site.

If any settlement occurs during the Construction Period or before the end of the defects liability period, the Contractor must rectify such settlement to the satisfaction of the Engineer.

After all the excavations and backfilling have been completed, the surplus material and all additional material must be removed from the site to the satisfaction of the Engineer.

#### **PSDB 5.6.3 Disposal of soft excavation material**

Add the following to this sub-clause:

Surplus material or unsuitable material which is not disposed of within the trench servitude shall, on the instruction of the Engineer, be disposed of at approved tipping sites to be located by the Contractor.

The prior approval of the Engineer must be obtained before surplus material may be deposited, spread and levelled at agreed sites within the area of the works.

#### **PSDB 5.6.4 Disposal of intermediate and hard rock material**

Add the following to this sub-clause:

Surplus intermediate and hard rock material from trench excavations shall, on the instruction of the Engineer, be disposed of at approved tipping sites to be located by the Contractor.

The prior approval of the Engineer must be obtained before surplus material may be deposited, spread and levelled at agreed sites within the area of the works.

#### **PSDB 5.6.5 Deficiency of Backfill Material**

Add the following to this sub-clause:

All haul distances shall be freehaul distances.

### **PSDB 5.7 Compaction**

#### **PSDB 5.7.2 Areas subject to traffic loads**

Add the following to this sub-clause:

In areas subject to traffic loading and in constructed footways compaction shall be done as directed by the Engineer or JRA specifications.

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## **PSDB 8 MEASUREMENT AND PAYMENT**

### **PSDB 8.1 Basic Principles**

#### **PSDB 8.1.4 All haul shall be freehaul. PSDB 8.3 Scheduled Items**

#### **PSDB 8.3.3 Excavation ancillaries PSDB**

##### **8.3.3.4 Overhaul**

Delete this sub-clause and replace with the following:

Overhaul is not applicable. Hence all distances applicable are considered as free haul distances and no additional payment will be applicable.

### **PSDB 8.3.5 Existing services that intersect or adjoin a pipe trench**

Add the following to the end of the sub-clause:

- (v) notifying and attending upon the proprietor of the service,
- (vi) supporting and protecting the service while the pipeline is installed, inspected, tested and backfilled.

---

## **SANS 1200 F: PILING**

### **PSF 5.1.3.3 Add Additional Clause**

The Contractor shall take full responsibility for piling work and shall guarantee that piling work will support the calculated loads laid down by the Employer's Agent without injurious settlement. The actual lengths of piles shall be determined on site by the Contractor in consultation with the Employer's Agent who will give all assistance possible. This does not in any way relieve the Contractor of his responsibility or obligation to provide the specific guarantee.

The Contractor shall indemnify the employer against any injury to or death of any person and all loss or damage to all structures resulting from failure of any pile. In the event of the failure of any pile the Contractor shall make good such pile and all consequent damage at his own expense

The Contractor shall insure in a policy, approved by the Employer's Agent, against risks arising out of the responsibilities, guarantee and indemnities specified. The Contractor shall pay all premiums in respect of this insurance policy. The guarantee shall be for the amount of R 5 000 000.00 (Five Million Rand) and shall be effective for a period of 3 (Three) years from the date of completion of the contract

Add the following the clause:

### **PSF 7.9 Inspection of adjoining properties**

The Contractor shall carry out inspections and evidence collection of properties adjoining the works to ensure that in the event of a claim arising from any of the owners of the adjoining properties for damage to property and the like, the Contractor has substantial evidence to support or refute such claims. The Contractor accepts full liability and responsibility for damage which he causes to adjoining properties, as well as any costs involved in refuting or processing of such claims.

### **PSF 8.2.27 Inspection of surrounding structures by specialist appointed by the Contractor before and after construction of piles. Unit: Sum**

The tendered rate shall include full compensation for the cost the overhead and all related costs to appoint a specialist with proven similar experience, and for the specialist to complete a full inspection of surrounding structures before and after the construction of the piles.

---

**SABS 1200 GA : CONCRETE (Small Works)****PSGA 4.4.2 Finishes**

Add the following to this sub clause:

All surfaces regularly visible, including the internal walls and roofs of chambers, shall have a smooth finish with Degree of Accuracy II in terms of Clause 6.4

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**PSGA 3 MATERIALS****PSGA 3.4 Aggregates**

Use of "plumbs" will not be permitted.

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**PSGA 5 CONSTRUCTION****PSGA 5.1.2 Reinforcement Welding**

The Welding of reinforcement will not be permitted.

**PSGA 5.4.1.6 Ready Mixed Concrete**

The use of ready mixed concrete will be allowed subject to the Employer's Agent's approval of the supplier, which approval may be withdrawn should circumstances in the opinion of the Employer's Agent warrant such withdrawal.

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**SANS 1200 G : CONCRETE (STRUCTURAL)**

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**PSG 3 MATERIALS****PSG 3.2 CEMENT****PSG 3.2.1 Applicable specifications**

*Add the following:*

All references to 'Ordinary Portland Cement' shall be replaced with 'Portland composite cement (CEM II 32,5)'.

**PSG 3.2.2 Alternative types of cement**

*Replace the contents of this subclause with the following:*

"Only Portland composite cement (CEM II 32,5) shall be used.

If the Contractor wishes to use any other type of cement, he shall obtain the Employer's Agent's prior written approval (see 8.1.3.2 and 8.1.3.3). The tendered rates, however, shall be based on the use of Portland composite cement (CEM II 32,5) only."

**PSG 3.2.3 Storage of cement**

*Add the following:*

"Cement shall not be stored for longer than 12 weeks without the Employer's Agent's permission."

## **PSG 3.4 AGGREGATES**

### **PSG 3.4.3 Storage of aggregates**

*Add the following:*

When aggregates of different chloride content are stored on the site, their use in the various classes of concrete shall be strictly controlled."

## **PSG 3.5 ADMIXTURES**

### **PSG 3.5.1 Approval of admixtures required**

*Add the following:*

- a) Water proofing additive with tracing agent or similar approved.
- b) Minimum dosage 0,8% by weight of cementitious content, with 20 year warranty and all to manufacturers specifications. Concrete to be placed, protected and cured according to SANS 10100-2"

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## **PSG 4 PLANT**

### **PSG 4.1 General**

*Add the following subclause:*

#### **PSG 4.1.1 Minimum plant**

The Contractor shall have the following minimum plant available and in sound working order:

- (a) One concrete mixer of sufficient capacity to complete a section of the floor or road between construction joints within 4 hours and without interruption
- (b) Two concrete vibrators, at least one of which shall be powered by an internal combustion engine
- (c) One air compressor
- (d) Suitable and adequate plant to transport concrete and other material and equipment at all stages of construction
- (e) Storage tanks of adequate capacity to ensure that sufficient water will be available before commencement of every major concrete-placing operation.

If the Plant used for placing concrete is electrically or mechanically powered, the Contractor shall also provide some other approved, non-electrically-powered standby means for placing concrete at an adequate rate in the event of a power or mechanical failure of the main Plant."

## **PSG 4.5 Formwork**

### **PSG 4.5.1 Design**

*Add the following:*

"All formwork or scaffolding required for any part of the Works shall be designed by the Contractor, and before commencing with the erection of any formwork or scaffolding, the Contractor shall submit the methodshe proposes to use to the Employer's Agent for approval. The Employer's Agent has the authority to order alterations to the design or the sizes of any part of the formwork or scaffolding. The Contractor shall check the safety and suitability of all such alterations. The fact that the Employer's Agent has approved or altered any part of the formwork of scaffolding shall not be construed as relieving the Contractor of his responsibility with regard to the strength and stability of the formwork or scaffolding."

### **PSG 4.5.3 Ties**

Add the following: "No plugs, bolts, ties or clamps of any description used to hold the formwork will be allowed to project into or through the concrete unless expressly approved by the Employer's Agent.

Only approved tie-rods consisting of solid rods (that remain embedded in the concrete) and with removable ends shall be used to hold the formwork of the walls. The removable tie-rod ends shall facilitate removal without damage to the concrete, and no permanently embedded parts of such tie-rods shall have less than 50 mm of cover to the finished concrete surface.

The cavities left in the concrete when the tie-rod end cones are removed shall be soundly caulked with a cement mortar to which an approved shrinkage-reducing agent has been added, and shall be neatly finished to a smooth surface uniform with that of the surrounding concrete.

The cost of supplying special tie-rods as well as the filling of cavities left by the tie-rod cones shall be included in the rates tendered for formwork under the appropriate pay items.

On no account shall formwork be secured to reinforcing bars."

---

## **PSG 5 CONSTRUCTION**

### **PSG 5.1 Reinforcement**

#### **PSG 5.1.2 Fixing**

Add the following:

"The Employer's Agent will inspect the reinforcing after it has been fixed in place, the formwork has been cleaned, cover blocks have been positioned, and before concreting commences.

Welding of reinforcing steel will not be permitted."

#### **PSG 5.1.3 Cover**

Add the following:

"The distance between pipes in the concrete and the reinforcing steel shall nowhere be less than

- (a) 40 mm or
- (b) 5 mm plus the maximum size of the coarse aggregate, whichever is the largest."

### **PSG 5.2 Formwork**

#### **PSG 5.2.2 Preparation for formwork**

Add the following:

"Construction joints shall be positioned as shown on the Drawings."

#### **PSG 5.2.5 Removal of formwork**

Add the following subclause:

**"PSG 5.2.5.7 The Contractor shall make provision for the continued support of beams and slabs while the formwork is being removed and/or for back propping of beams and slabs."**

## **PSG 5.5 Concrete**

### **PSG 5.5.1 Quality**

#### **PSG 5.5.1.5 Durability**

The exposure conditions of the concrete are classified as "severe".

#### **PSG 5.5.1.6 Prescribed Mix Concrete**

The minimum cement content should be 325 kg/m<sup>3</sup>. A maximum water/cement ratio of 0.55 should be used except when Portland pulverized-fuel ash cement or a combination of ordinary Portland cement and P.F.A. is used, when the water/cement ratio should be 0.50. The 28-day characteristic cube strength should not be less than 35 N/mm<sup>2</sup>, and the concrete should be classed as grade C35A.

It should be noted that this classification is not in accordance with BS 8110, as higher 28-day strengths may, with some types and proportions of constituent materials, lead to undesirably high cement contents. A reduction in the water/cement ratio may be achieved by the use of plasticizers.

For reinforced concrete the cement content should not exceed either 400 kg/m<sup>3</sup> of ordinary Portland cement or cements containing G.G.B.S. or 450 kg/m<sup>3</sup> where cements containing P.F.A. are used. For prestressed concrete the maximum cement content may be increased to 500 kg/m<sup>3</sup> or 550 kg/m<sup>3</sup> respectively.

#### **PSG 5.5.1.7 Strength concrete**

Add the following:

"The concrete mixes shall be designed by the similar approved laboratory.

Mix designs to be submitted to the Employer's Agent for approval."

### **PSG 5.5.3 Mixing**

#### **PSG 5.5.3.2 Ready-mixed concrete**

Add the following:

"Ready-mixed concrete may be used on the Site. The Contractor shall take samples for testing from every load delivered to the Site."

### **PSG 5.5.5 Placing**

Add the following:

"Concreting of the floor between construction joints shall be carried out in both directions from a point on the floor in order to close the gap with fresh concrete."

### **PSG 5.5.7 Construction joints**

Add the following:

"Should the Contractor's method of construction necessitate the placing of a construction or other joint in a position not shown on the Drawings, such method of construction and position of the joint shall be approved by the Employer's Agent in writing. The cost of such joint shall be included in the tendered rates and shall include scabbling of the concrete where steel reinforcement is continuous."

PSG 5.5.7.1 b) Install a controlled expansion self-healing concrete waterstop (Size: 19 x 25 x 5mm), guaranteed as a system with the crystalline waterproofing additive with tracing agent, to primed joint surface between concrete pours by an approved applicator as per manufacturer's instructions.

Along all construction joints

#### **PSG 5.5.8 Curing and protection**

Add the following:

"The curing methods of retaining the formwork in place or covering with a waterproof membrane are strongly recommended. Concrete will not be paid for unless properly cured and proof of curing is continuously visible on site."

#### **PSG 5.5.11 Water Tight Concrete**

Add the following:

##### **PSG 5.5.11.1 Testing of Water Tank**

For a test of liquid retention, the structure should be cleaned and initially filled to the normal maximum level with the specified liquid (usually water) at a uniform rate of not greater than 2 m in 24 h.

When first filled, the liquid level should be maintained by the addition of further liquid for a stabilizing period while absorption and autogenous healing take place. The stabilizing period may

be 7 days for a maximum design crack width of 0.1 mm or 21 days for 0.2 mm or greater. After the stabilizing period the level of the liquid surface should be recorded at 24 h intervals for a test period of 7 days. During this 7-day test period the total permissible drop in level, after allowing for evaporation and rainfall, should not exceed 1/500th of the average water depth of the full tank, 10 mm or another specified amount.

Notwithstanding the satisfactory completion of the test, any evidence of seepage of the liquid to the outside faces of the liquid-retaining walls should be assessed against the requirements of the specification. Any necessary remedial treatment of the concrete, cracks, or joints should, where practicable, be carried out from the liquid face. When a remedial lining is applied to inhibit leakage at a crack it should have adequate flexibility and have no reaction with the stored liquid.

Should the structure not satisfy the 7-day test, then after the completion of the remedial work it should be refilled and if necessary left for a further stabilizing period; a further test of 7 days' duration should then be undertaken in accordance with this clause.

##### **PSG 5.5.11.2 Testing of roofs**

The roofs of liquid-retaining structures should be watertight and should, where practicable, be tested on completion by flooding the roof with water to a minimum depth of 25 mm for 24 h or longer if so specified. Where it is impracticable, because of roof falls or otherwise, to contain a 25 mm depth of water, the roof should have water applied by a continuous hose or sprinkler system to provide a sheet flow of water over the entire area of the roof for not less than 6 h. In either case the roof should be considered satisfactory if no leaks or damp patches show on the soffit. Should the structure not satisfy either of these tests,

then after the completion of the remedial work it should be retested in accordance with this clause. The roof insulation and covering should be completed as soon as possible after satisfactory testing.

### **PSG 5.5.13 Grouting**

Add the following:

Install a controlled expansion self-healing concrete waterstop (Size: 19 x 25 x 5mm), guaranteed as a system with the crystalline waterproofing additive with tracing agent, to primed joint surface between concrete pours by an approved applicator as per manufacturer's instructions.

Around all pipes/penetrations/full-bores etc."

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## **PSG 6 TOLERANCES**

### **PSG 6.2 Permissible Deviations**

#### **PSG 6.2.3 Specified permissible deviations**

Add the following:

"Degree-of-accuracy II is applicable.

Every specified permissible deviation is binding in itself. The cumulative effect of permissible deviations will not be considered. The maximum permissible vertical deviation is subject to the other permissible deviations."

Replace subclause 6.2.3(d)(5) with the following:

"Vertically, per metre of height .....  
subject to a maximum of ....."

Permissible deviation		
Degree of accuracy		
III	II	I
mm	mm	mm
5	3	2
50	30	10

---

## **PSG 7 TESTS**

### **PSG 7.1 facilities and frequency of sampling**

#### **PSG 7.1.1 Facilities**

Add the following:

"The Contractor shall provide sufficient storage capacity for the concrete cubes and shall arrange to have them tested by an approved laboratory.

The cost of all testing, including the cost of sampling, storage and transport of samples shall be included in the rates tendered for concrete work."

### **PSG 7.3 Acceptance Criteria For Strength Concrete**

Add the following:

"Test results obtained from the supplier of ready-mixed concrete will not be accepted for evaluation in terms of subclause 7.3, but samples for testing shall be taken of such concrete at the point of placing."

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## **PSG 8 MEASUREMENT AND PAYMENT**

### **PSG 8.1 Measurement And Rates**

#### **PSG 8.1.1 Formwork**

DELETE "or splays over 20 mm x 20 mm" FROM THE FIRST LINE OF PARAGRAPH 8.1.1.2.

Add the following to paragraph 8.1.1.2:

"Splays up to and including 25 mm x 25 mm will not be measured separately and will be deemed to be included in the formwork costs."

Add the following paragraphs:

- 8.1.1.7 For construction joints at kickers, all additional costs for formwork to edges up to 300 mm high will be deemed to be included in the rates tendered for vertical formwork to sides of walls and will not be measured separately in narrow widths.
- 8.1.1.8 No formwork will be measured to edges of blinding layers under structures, and the cost thereof (if needed) will be deemed to be included in the rates tendered for concrete in blinding layers.
- 8.1.1.9 Back-shuttering or formwork to top revealed surfaces of sloping or conical formwork will only be measured to surfaces of over 40° and up to 85° to the horizontal.
- 8.1.1.10 Formwork to horizontal surfaces in pump stations, valve chambers, manholes or sumps can either be removed through the manhole cover opening or the Contractor may use permanent formwork at his own cost as no claims in this regard will be considered."

#### **PSG 8.1.2 Reinforcement**

Replace the contents of this subclause with the following:

"The unit of measurement for steel bars shall be the ton of reinforcement in place, in accordance with the Drawings or as authorised by the Employer's Agent.

The unit of measurement for welded steel fabric shall be the ton of fabric reinforcement in place, and the quantity shall be calculated from the net area covered by the mesh, excluding overlaps.

Clips, ties, separators, stools and other steel used for positioning reinforcement will not be measured, unless these are shown on the bending schedules.

The tendered rate shall include full compensation for the supply, delivery, cutting, bending, welding, placing and fixing of the steel reinforcement, including all tying wire, stools, supports and waste."

Add the following clause:

#### **PSG 8.2.6 (c) Box out holes/forms voids**

Form opening 600mmx600mm for windblocks. Rate to include supply of all materials and labour to form complete walls. .Unit :m<sup>2</sup>

**PSG 8.2.6 (e)      Box out holes/forms voids**

Form opening of doors exceeding 2m, but not exceeding 3m. Rate to include supply of all materials and labour to form complete walls. Unit :m2

**PSG 8.4.3 Concrete**

Item to be priced as per SABS 1200 G 8.4.3 but to include admixture specified in PSG 3.5.1.

**PSG 8.4.7 Grouting**

Rate to cover supply and install all grouting for ferrol holes in concrete tank walls made up of material specified in BC 03.01.05

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**SANS 1200 H STRUCTURAL STEELWORK**

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**PSH 3. STRUCTURAL STEELWORK**

Replace the contents of this clause with the following:

All structural steelwork will be to SANS 1431: 2003, Grade S355JR.

---

**PSH 5 CONSTRUCTION**

**PSH 5.1.1 Shop Drawings**

The Contractor is to provide the Employer's Agent with shop drawings at least 4 weeks before the Contract Commencement date.

The drawings shall be compiled in the official language of the Contract. Approved drawings shall form an integral part of the Contract documents. Drawings not accepted and signed by a professional Employer's Agent, shall not be used by the Contractor on the site of Works for construction purposes or the manufacturing of any member.

The Contractor shall submit completed drawings in accordance with this specification and shall not be entitled to claim for delays resulting from incomplete submittals that may lead to the rejection thereof. The Employer's Agent shall require a period of at least 21 working days for the reviewing of the submittals.

The following submission items are considered to be essential and shall form part of the shop drawing submittals:

- A complete materials list clearly indicating the quantities of each member,
- Detail of each member showing the overall dimensions, drilling requirements and net weight, and
- Connection details for purlins fixing, bracing, sag rods and all members.

Add the following clause'

**PSH 5.5.6 Steel Structures**

Steel structures to be constructed as detailed on shop drawings. The unit of measurement will be tonnage and will include for the material, paint, plant and labour required for the erection of the structure.

## **PSH 5.7.1 Stainless Steel Handrailings**

### **PSH 5.7.1.1 Scope**

#### **PSH 5.7.1.2 General**

This specification covers the requirements for furnishing materials, labour, tools and equipment necessary to provide Handrail System for the Tower staircase and Handrails for Walkways in the Pump house.

#### **PSH 5.7.1.3 Applicable Requirements And Documents**

##### **PSH 5.7.2.1.3.1 Design Criteria**

The products shall be designed in accordance with governing building codes and standards as applicable.

The stainless steel handrails shall be designed to meet the requirements of SANS 10104:1991 Handrailing and Balustrading (Safety Aspects).

The height of handrail shall be a minimum of 1000mm above floor level when horizontal. The intermediate rail shall be located at mid-height. Spacing of posts shall not exceed 1.5m. The rails shall be terminated at a post.

Substitution of any component or modification of the system shall be made only when approved by the Employer's Agent.

##### **PSH 5.7.1.4 Submittals**

Shop drawings of all Stainless Steel handrails shall be submitted to the Employer's Agent for approval before manufacture commences.

Detail shop drawings shall show:

1. Dimensions of handrails;
2. Sectional assembly; and
3. Location and identification mark.

Manufacturer's catalogue data showing:

1. Dimensions, spacing and construction of handrail and
  2. Materials of construction
- shall be submitted together with the shop drawings.

Samples of each type of handrail system proposed shall be submitted for approval to the Employer's Agent prior to placement of purchase orders.

##### **PSH 5.7.1.5 Shipping And Storage Instructions**

All systems, sub-systems and structures shall be shop fabricated and assembled into the largest practical size suitable for transporting.

All materials and equipment necessary for the fabrication and installation of the handrails shall be stored before, during and after shipment in a manner to prevent cracking, twisting, bending, breaking, chipping or damage due to over exposure to the sun. Any material that, in the opinion of the Employer's Agent, has

become damaged as to be unfit for use, shall be promptly removed from the Works, and the Contractor shall receive no compensation for the damaged material or its removal.

All materials, items and fabrications shall be identified and marked up for installation and field assembly.

#### **PSH 5.7.1.6 Documents Drawings; and this specification.**

##### **PSH 5.7.1.7. Material**

Materials used in the manufacture of the products shall be new stock of the best quality and shall be free from all defects and imperfections that might affect the performance of the finished product.

All materials shall be of the kind and quality specified, and where the quality is not specified, it shall be the best of the respective kinds and suitable for the purpose intended.

The rails shall be 38 x 38 x 5mm round tube and the posts shall be 51 x 51 x 6mm square tube manufactured as per the manufacturer's specification. The parts shall be coated with an industrial grade polyurethane paint for additional UV protection and wear resistance.

The posts and round tube shall not have loose end caps but be sealed using the same material as the post or tube.

All exposed surfaces shall be smooth and true to form.

The handrails system in the pump house is to be hot dipped galvanised.

##### **PSH 5.7.1.8 Fabrication Qualifications**

The Contractor is to ensure that products will be manufactured in accordance with procedure manuals and quality inspection sheets.

##### **PSH 5.7.1.9 Construction**

The stainless steel handrail system shall be fabricated into finished sections by pushing the round tube through the predrilled square stanchions using epoxy adhesive and plastic rivets at the connections. All tubing shall end at a stanchion. No closures or other fittings shall be permitted.

The components used to join the fabricated sections together shall be shipped loose and joined using epoxy adhesive in the field by the Contractor, according to the manufacturer's requirements.

The fabricated handrail sections shall be installed as show on the Drawings. The handrail sections shall be accurately located, erected plumb and level. The stanchions shall be fastened to the structure using stainless steel base plates and stainless steel anchors.

The visible threads for the anchors at the base plates shall conform to SABS 1200 HA 5.2.7.

After fabrication, all cut ends; holes and abrasions shall be sealed with a compatible resin coating to prevent intrusion of moisture.

##### **PSH 5.7.1.10 Tolerances**

The tolerances for the handrailing and stanchions shall be in accordance with SABS 1200 HA Clause 6.

*Add the following clause*

#### **PSH 5.7.5 Walkways and Staircases**

All new walkways and gratings shall be supplied and installed as detailed on drawings. Rates shall include for all labour, plant and materials to render the work complete to the satisfaction of the Employer's Agent.

- All new handrails and walkways need to be painted with two coats of zinc based primer and final coat to Employer or manufacturers specification.
- The support beams to the walk way and gratings shall be installed as per drawings.
- The end connections will be inspected at the time of works.

#### **PSH 5.9 Ultra Sonic Housing Unit**

Ultra-sonic housing unit are to be installed as detailed in clause PSH 5.9 the unit of measurement will be a sum and will include for the material, plant and labour required for the erection of the structure, to render the work complete by the Employer's Agent.

The Contractor may submit an alternative design to the Employer's Agent approval, however if the total cost to the Contractor's design exceeds the rate given in the schedule, The Contractor will pay the additional cost.

Replace the contents of this clause with the following:

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#### **PSH 6 TOLERANCES**

The degree of accuracy II shall apply to all structural steelwork.

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#### **PSH 7.1 TESTING**

A manufacturer's certificate for the manufacture and installation will be required by the Contractor.

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#### **PSH 8 MEASUREMENT AND PAYMENT**

##### **PSH 8.2 Manhole Cover**

The measurement and payment for manhole covers as described in Clause PSH 5.8 will include for the provision of materials, plant and labour. This will be measured per number complete.

##### **PSH 8.3.7. HANDRAILS**

To supply and install all materials, such as horizontal and sloping rails including top mounted stanchions including base plate HD bolts, nuts and washers for each stanchion .Unit : m

The rates in PSH 5.7.1 above shall cover the cost of supplying the rails, stanchions (with base plates) and HD bolts complete with nuts and washers, assembling and installing complete with grouting and all other items necessary for a complete hand railing system including provision of all necessary bends. This rate will also include two coats of primer paint.

##### **PSH 8.3.8 STAINLESS STEEL CAT LADDERS**

Cat ladders for the Water Tower are to be installed as detailed on drawings. The unit of measurement will be a sum and will include for the material, plant and labour required for the erection of the structure. Unit: Sum

#### **PSH 8.3.14 ULTRA SONIC HOUSING UNIT**

Ultra-sonic housing unit are to be installed as detailed on drawings and clause PSH 5.9. The unit of measurement will be a sum and will include for the material, plant and labour required for the erection of the structure.

Unit: Sum

#### **PSH 8.3.15 Walkways and staircase**

The measurement and payment for walkways and staircase, including vastraps and supports, as described in Clause PSH 5.7.5, will include for the provision of materials, plant and labour. Walkways measured as tons. This rate will also include two coats of Zinc based primer paint, one at works and one on site after erection.

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#### **PSH 8.3.16 Steel sliding cover**

Tendered rate to include design, supply and install by the Contractor. Design to be approved by the Employer's Agent and, Employer before fabrication. This rate will also include two coats of Zinc based primer paint, one at works and one on site after erection.

No.

#### **PSH 8.3.17 Gantry**

Tendered rate to include supply of all materials, installation and labour, to ensure complete installation. Shop drawing to be approved by Employer's Agent before fabrication. This rate will also include two coats of Zinc based primer paint, one at works and one on site after erection.

Unit Tons.

#### **PSH 8.3.18 Security Desk Support structure**

Tendered rate to include supply of all materials, all connections, installation and labour, to ensure complete installation. Shop drawing to be approved by Employer's Agent before fabrication. This rate will also include two coats of Zinc based primer paint, one at works and one on site after steel erection.

Unit Tons.

#### **PSH 8.3.19 Equal Angles 40x40x5 (concrete edge protectors)**

Tendered rate to include supply of all materials, including cast in lugs, all connections, installation and labour, to ensure complete installation. Shop drawing to be approved by Employer's Agent before fabrication. This rate will also include two coats of Zinc based primer paint, one at works and one on site after erection.

Unit Tons.

#### **PSH 8.3.20 Mentis Grid**

Tendered rate to include supply of all materials, including cast in lugs, all connections, installation and labour, to ensure complete installation. Shop drawing to be approved by Employer's Agent before fabrication. This rate will also include two coats of Zinc based primer paint, one at works and one on site after erection.

Unit m

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### **SANS 1200L: MEDIUM PRESSURE PIPELINES (1983)**

#### **PSL 2 INTERPRETATIONS**

##### **PSL 2.3 Definitions**

Add the following to this sub-clause:

The steel pipes to be laid under this Contract shall be defined as being rigid pipes for bedding purposes.

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**PSL3 MATERIALS****PSL 3.1 General**

Add the following to this sub-clause:

Materials for this Contract should preferably be obtained from manufacturers who operate an effective quality management system such as that described in SANS 0157 or ISO 9000.

**PSL3.4 Steel Pipes, Fittings, And Specials****PSL3.4.5 Steel Pipe Specification**

Add the following new sub-clause:

8 mm thick wall to API 5L X 52 continuously welded steel pipe, RPU external coating

2000 microns (2mm) thickness, solvent free epoxy (SFE) internal lining with thickness of 600 microns. The steel specification is Grade X42 steel in accordance to SANS 719.

The coatings will be in accordance to SANS 1217.

**DIAMETERS OF STEEL PIPELINE**

700 diameter – 8mm thick

650 diameter - 8mm thick

500 diameter - 8mm thick

300 diameter - 8mm thick

**PSL3.8.3 Flanges and Accessories**

Add the following to this clause

The sizes and drilling of flanges shall comply with SANS 1123 Table 16/3 (as amended). Bolts and nuts to be hot dip galvanized and comply to SANS 135 & SANS 136.

It shall be the responsibility of the Contractor to ensure that flanges on pumps, valves, fittings, specials and pipes to be fitted together, are fully compatible.

**PSL3.10 Valves**

Delete the existing clause and replace with the following:

This specification does not necessarily cover every detail of the valves to be supplied under this Contract and the type or design of any detail not specifically mentioned is left to the discretion of the Contractor, provided that the complete equipment supplied complies with the specification.

All valves shall be to a standard acceptable to Johannesburg Water.

All valves and appurtenant fittings shall be at least Class 10 which is suitable for dealing with a maximum working pressure of 1 000kPa. Where higher working pressures are experienced, depending on circumstances, Class 16 or Class 25 valves shall be used. Valves shall be able to open and close under an unbalanced pressure equal to the specified maximum working pressure.

All valves must have designed useful life of 45 years under operating conditions and valves shall be guaranteed for a period of five years from date of delivery.

Where a valve is abnormally deep under the final finished ground level, an extension shall be fitted to the valve stem to ensure that a normal length valve key can be used to operate the valve.

All valves shall be supplied complete with bolts, nuts, and gaskets.

Valves shall be in accordance with SABS 664: 1989 and bare the SABS mark. Valves DN 200 and larger shall be coated on the inside and on the outside with 2 coats of epoxy paint (Sigmaguard EHB or similar) to a dry film thickness of 250micron.

All valves shall be capped and arranged for anti-clockwise closing.

All valves for this Contract shall be supplied with a full set of instruction manuals describing routine maintenance and repairs, as well as a complete parts list. All wearing parts for all valves used during this Contract shall be readily available in South Africa.

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## **PSL 5 CONSTRUCTION**

In addition to the existing clause the following shall apply:

### **PSL 5.1.3 Keeping pipelines clean**

Pipe laying operations and precautions taken during pipe laying shall be aimed at eliminating the necessity for cleaning of completed mains. However, should foreign matter have entered or remained in the pipelines, the Contractor shall arrange for the mains to be cleaned (at the Contractor's expense) to the satisfaction of the Engineer prior to testing.

### **PSL5.6 Valve And Meter Chambers**

Valve, scour valve and meter chambers shall be constructed as detailed on the drawings of the Employer or approved designed chambers by the Engineer. The rate tendered for the specific valve and meter chamber shall include step irons but exclude all pipes, valves, meters and fittings. Excavation, compacted backfill, concrete, formwork and steel reinforcing and precast concrete covers shall be measured and paid for separately.

### **PSL5.11 Connection To Existing Mains**

Add the following new sub-clause:

The new pipes to be laid under this Contract shall have to be connected to the existing network. All fittings used will be scheduled and paid for separately and an extra-over item will be scheduled for opening up the connection point, isolating the connection point and cutting into the existing pipe to effect the connection.

The Contractor shall confirm all measurements on site prior to ordering any pipe fittings and specials.

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## **PSL 8 MEASUREMENT AND PAYMENT**

Add the following new sub-clause:

### **PSL 8.2.16 Connect to Existing Mains . Unit: No**

The rate shall cover the cost of isolating, dewatering and exposing the existing main at the connection. The existing pipe should be cut just behind the thrust block and connected to the new pipe by means of pipe couplings as determined after measurement and inspection of the existing pipe.

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**SANS 1200 LB : BEDDING (PIPES)****PSLB 3 MATERIALS****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 19 mm."

**PSLB 3.2 Selected Fill Material**

Add the following:

"Selected fill material used for bedding shall be stabilized with 5% cement as specified under subclause PSDB 3.5(c)."

**PSLB 3.4 Selection****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)".*

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**PSLB 8 MEASUREMENT AND PAYMENT****PSLB 8.1 Principles****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."

**PSLB 8.1.6 Free-haul**

No separate payment for haul is applicable to this contract.

**PSLB 8.2 Scheduled Items**

Add the following item:

**PSLB 8.2.6 Extra over items 8.2.1 and 8.2.2 for bedding stabilized with 5% cement Unit: m<sup>3</sup>**

The tendered rate shall include full compensation for selecting, mixing, backfilling and compacting the stabilized material to 93% of modified AASHTO density."

## **SANS 1200 LE : STORMWATER DRAINAGE**

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### **PSLE 3 MATERIALS**

*Add the following clause:*

#### **PSLE 3.6 Polyethylene Sheeting**

Polyethylene sheeting shall comply with the requirements of SANS 952 and shall be at least 250 micron thick. All joints shall be mechanically sealed to provide a water tight surface."

#### **PSLE 5.5. Catchpits, Manholes, Inlets, And Outlet Structures**

##### **PSLE 5.5.8 Headwalls**

Add the following clause:

"The floor of excavations shall be compacted to 95% of modified AASHTO density to 150 mm deep before construction of the floor may proceed."

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### **PSLE 8 MEASUREMENT AND PAYMENT**

#### **PSLE 8.2 Scheduled Items**

Add the following items:

##### **PSLE 8.2.14 Polyethylene Sheeting**

The tendered sum shall include full compensation for procuring, transporting and installing sheeting and sealing of joints.

##### **PSLE 8.2.15 Compaction of excavation floors**

The tendered sum shall include full compensation for levelling the surface, adjusting the in-situ moisture content, compacting soil to 150mm thick to 95% of modified AASHTO density."

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## **BC WATERPROOFING OF CONCRETE ROOFS**

### **BC 01 SCOPE**

This specification covers new waterproofing of new concrete slabs and retaining walls including all sundries and the supply, delivery, installation of new cement screeds, waterproofing and sundries for various types of concrete roofs.

Waterproofing shall mean the work to be carried out to install new waterproofing materials and components

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### **BC 02 STANDARD SPECIFICATIONS**

#### **BC 02.01 GENERAL STANDARD SPECIFICATIONS**

The latest edition, including all amendments to date of the following specifications, publications and codes of practice, shall be read in conjunction with this specification and shall be deemed part to form part thereof:

OW 371- Specification of Materials and Methods to be used

(Fourth revision, October 1993)

SABS 021 SABS code of practice: Waterproofing of buildings.

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**BC 03 VARIATIONS AND ADDITIONS TO STANDARD SPECIFICATIONS****BC 03.01 MATERIALS**

The more commonly used waterproofing materials are listed below, as well as some general comments on these materials. It is suggested that the manufacturers be consulted with regard to specific products. The Employer's Agent's representative approval of the selected product shall be obtained prior to ordering.

**BC 03.01.01 Bituminous materials**

- (a) Polymer modified bitumen membranes
- (b) Reinforced bitumen emulsions.

**BC 03.01.02 Plastomeric membranes**

Plastics such as polyvinyl chloride (PVC) are applied as single-layer systems and are loose-laid or fully bonded. A high degree of skill is required for the laying of these membranes.

**BC 03.01.03 Reinforced liquid applied systems**

Membranes based on acrylic polymer (or modified acrylic polymers) binders, reinforced with woven polyester or polypropylene fabrics, perform well as waterproofing membranes and are durable. These fully bonded systems require detailed specifications and strict supervision during application to prevent malpractice.

**BC 03.01.04 Impermeable Ductile Slurry**

Tank walls internally to be coated with Penetron slurry or similar approved as per manufacturer's specification

**BC 03.01.05 Impermeable water stop**

Install a controlled expansion self healing concrete waterstop (Size: 19 x 25 x 5mm), guaranteed as a system with the crystalline waterproofing additive with tracing agent, to primed joint surface between concrete pours by an approved applicator as per manufacturer's instructions.

This will be utilised for all penetrations, pipes, etc.

**BC 03.02 Sterilization of water tank**

After completion and before commissioning, the reservoir shall be cleaned, washed and disinfected.

All areas inside of the structure shall be washed to the satisfaction of the Employer's Agent and thereafter it shall be brushed with a 15mg/l calcium hypochlorite solution. Upon completion of the disinfection process, the wash water shall be drained from the structure and discharge at a suitable location. Thereafter the water tightness test can be carried out.

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**BC 04 DETAILS OF NEW WORK**

The Bill of Quantities indicates approximate quantities of work. Detailed instructions will be issued during construction.

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**BC 05 MEASUREMENT AND PAYMENT****BC.05.01 Measurement And Rates****BC.05.01.01. General Inclusion of costs****Notes:**

New waterproofing material scheduled shall be deemed to include all preparation of existing concrete or waterproofed areas and jointing of new to existing material. Where new material is to join existing material, the new material shall be of the same type and system as the existing waterproofing system. All waterproofing shall come with a ten year written guarantee for water-tightness and the cost of such guarantee shall be deemed to be included in the applicable tendered rates.

**BC.05.02.S scheduled Items****BC.05.02.01 Installation of new waterproofing system Unit : m<sup>2</sup>**

As per specification BC03.01.01, the unit of measurement shall be the square metre of the horizontal and vertical surfaces of waterproofing as per the approval of the Employer's Agent/Johannesburg Water's representative. All turn-ups and turn-downs will be deemed to be included in the area measured for the waterproofing and will not be paid for separately.

The tendered rate shall include all costs for supplying, delivering, storing on site, handling, moving, installing and fixing the waterproofing system complete with all necessary sundry items, such as flashing strips, dressing waterproofing around pipes and into outlets and channels. Waterproofing around all pipes and protrusions will be completed as in accordance of specification BC 03.01.05. The tendered rate shall also cover the cost of cutting and waste and for scaffolding, hoisting facilities, etc.

**BC.05.02.02 Roof screeds Unit: m<sup>2</sup>**

The unit of measurement shall be the square metre of exposed surfaces to be screeded and installed as per the specifications of each drawing. Installation is strictly in accordance with the manufacturer's specification.

The tendered rate shall include all costs for supplying, delivering, storing on site, handling, etc. of the materials necessary for the screed, including mixing and laying of screeds to currents and falls and forming of sundry items such as fillets, etc. complete. The tendered rate shall also cover the cost for forming of screeds around outlets, waste, and of all scaffolding, temporary supports, hoisting facilities, etc.

**BC.05.02.03 Tank wall, floor and roof Unit : m<sup>2</sup>**

As per specification BC03.01.01, the unit of measurement shall be the square metre of the horizontal and vertical surfaces of waterproofing applied as per the manufacturers specification and approval of the Employer's Agent' representative. All turn-ups and turn-downs will be deemed to be included in the area measured for the waterproofing and will not be paid for separately.

The tendered rate shall include all costs for supplying, delivering, storing on site, handling, moving, installing and fixing the waterproofing system complete with all necessary sundry items, such as flashing strips, dressing waterproofing around pipes and into outlets and channels. Waterproofing around all pipes and protrusions will be completed as in accordance of specification BC 03.01.05. The tendered rate shall also cover the cost of cutting and waste and for scaffolding, hoisting facilities, etc.

**BC.05.02.04 One unpunctured layer 250 micron waterproof sheets sealed at laps Unit : m<sup>2</sup>**

As per specification BC03.01.04, the unit of measurement shall be the square metre of the horizontal and vertical surfaces underneath the surface bed. The waterproofing will not be punctured. The tendered rate shall include all costs for supplying, delivering, storing on site, handling, moving, installing and fixing the waterproofing system complete with all necessary sundry items, such as flashing strips, dressing waterproofing around pipes and into outlets and channels.

**BC.05.02.05    sterilisation of tank                      Unit : Sum**

As per specification, BC 03.02, the unit of measurement shall be Sum item. The tendered rate shall include all costs for supplying, delivering, storing on site, handling all materials, moving, cleaning, washing, labour to complete sterilisation.

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**BD      WALLS**

**BD 01 SCOPE**

This specification covers the new interior and exterior walls including all related building elements such as plastering, partitioning, wall tiling, windows, doors, etc., which form an integral part of a facility.

The complete scope of new work shall be in accordance with the section BD 04: Detail of new work.

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**BD 02. STANDARD SPECIFICATIONS**

**BD 02.01    General Standard Specifications**

The latest edition, including all amendments up to date of tender of the following specifications, publications and codes of practice shall be read in conjunction with this specification and shall be deemed to form part thereof. All other relevant and applicable SABS regulations are also to be considered as minimum requirements, and in particular SABS 0400: The Application of the National Building Regulations.

OW 371	-	Specification of materials and methods to be used (Fourth revision, October 1993)
SABS 022	-	Glazed ceramic wall tiles and fittings
SABS 227	-	Burnt clay masonry units
SABS 545	-	Wooden doors
SABS 622	-	Gypsum cove cornice
SABS 680	-	Glazing putty for wood and steel sashes
SABS 727	-	Windows and doors made from rolled mill steel sections
SABS 0107	-	The fixing of glazed wall tiles
SABS 1236	-	Silvered glass mirrors for general use
SABS 1263	-	Safety and security glazing materials for buildings

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**BD 03      VARIATIONS AND ADDITIONS TO STANDARD SPECIFICATIONS**

**BD 03.01    Face Bricks**

Face brickwork. - All other brickwork to be laid up with good hard-burned (the best merchantable) common bricks, acceptable to the Employer's Agent, in class II mortar.

All brick shall be well wet, except in freezing weather, before being laid.

All joints shall be thoroughly flushed with mortar of mix as specified in the Bill of Quantities, at every course. Care shall be taken to see that the bricks are bedded effectively and all joints completely filled to full depth

All partition walls to be tied to the existing walls by 30mm wide x 1.6mm thick galvanized steel straps/ anchors (furnished by this contractor), at every 4th course.

Include Brick force and wall ties as per the construction drawings

## **BD 03.02 Wall Tiling**

### **BD 03.02.01 General**

Tiling shall comply with the requirements of SABS 22 and section 15 of OW 371. The code of practice for the fixing of glazed wall tiles, SABS 0107 and the recommendations of the South African Ceramic Tile Manufacturer's Association (SACTMA) must be adhered to.

All tiled areas must be checked for damaged surfaces or to determine where tile adhesion to subsurface may turn out to be of non-satisfactory standard. In cases where tiled surfaces need to be redone, proper care shall be taken in removing all damaged tiles, as well as any adhesive remains on the subsurface.

Matching of existing size and colour should be pursued wherever possible.

### **BD 03.02.02 Glazed wall tiling**

White glazed tiles 150 x 150 x 5 mm thick, first grade, must be laid in a cement-based powder adhesive, strictly in accordance with the manufacturer's specification. Drying periods for backgrounds and substrates must be strictly adhered to. All tiles must be correctly bedded. This can be achieved by using a 6 mm square notched wall trowel to spread the fixative to the required thickness of 6 mm. Bed the tiles dry and move them firmly into position, ensuring that they are in proper overall contact with the bed and form an even surface.

A minimum of 2 mm grouting joints shall be allowed between tiles. Under no circumstances should the tiles be butt-jointed. Do not fill joints between tiles until at least 24 hours after the tiles have been bedded. Ensure that the joints are free of tile adhesive residue and any foreign matter. Fill joints with waterproof white cement. Existing joints must be cleaned and refilled with new white cement.

### **BD 03.02.03 Ceramic wall tiling**

Glazed ceramic wall tiles 230 x 115 x 11, 5 mm thick, with grade 1 acid resisting quality finish are to be used. Apply an approved epoxy grout into the tile joints and finish off with a wetted nosing tool to a smooth glazed finish. Ceramic tiles include special tiles, such as bull nose and corner tiles. Repairs include replacing damaged tiles and pointing between tiles with an approved epoxy grout.

### **BD 03.02.04 Corner protectors**

Install 75 x 75 x 5 mm thick aluminium angle corner protectors to external vertical wall corners for protection with 8 mm diameter impact nails x 80 mm long @ 300 mm c/c to a maximum height of 1,6 m. Seal the interface gap with approved silicone.

### **BD 03.02.05 Expansion joints**

Expansion joints for glazed wall tiling shall be provided at 3,5 m centres maximum (vertically and horizontally). The joints shall be 5 mm wide. Prepare the joints by cleaning them thoroughly. The joints shall be primed and sealed with an approved one component 5 x 5 mm white polyurethane jointsealant.

Expansion joints for ceramic wall tiling shall be provided at 4 m centres maximum (vertically and horizontally). The joints shall be 10 mm wide maximum. Prepare the joints by cleaning them thoroughly. The joints shall be primed and sealed with approved one component 10 x 10 mm white polyurethane joint sealant.

#### **BD 03.02.06 Tiling**

Rate for tiling to be accordance with BD 03.02, and include supply, all material, labour to complete installation  
Unit. m

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### **BD 03.03. WINDOWS**

#### **BD 03.03.01 General**

The Contractor shall take great care to make sure that the appropriate waterproofing details are applied strictly to ensure adequate protection against any water penetration.

#### **BD 03.03.03 Burglar bars to steel windows**

Where manganese bars are incorporated in the fixed mullions of the windows, this shall be done in such a way that the bars are not wider apart than 15 cm/centre. The bars shall have at least a section of 30 x 16 mm, penetrating at least 100 mm in the lintels and sills. Heavy duty burglar bars shall be 15 mm diameter or 12 mm square. Loose burglar bars shall be site welded to the window frames.

#### **BD 03.03.05 Aluminium windows**

When working with mortar or plaster great care shall be taken to protect all aluminium sections from staining by applying a film protector or motor oil on the aluminium surface.

#### **BD 03.03.06 Precast Concrete Windblock (600x600mm) with fitted Aluminium fitted frame to house aluminium fly mesh.**

Precast 600x600 concrete blocks will be fitted inside the tower shaft. These blocks will have an aluminium frame fitted into the block, and will hold the aluminium fly/mosquito mesh.

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### **BD 03.04. GLAZING**

#### **BD 03.04.01 Glass**

Glazing shall be installed in the new pump station windows. The glazing and fixing of glass in buildings shall be carried out strictly in accordance with SABS Code of Practice 0137.

#### **BD 03.04.02 Putty**

All new putty shall comply with the requirements of the SABS 680. The putty shall be delivered on the site in sealed containers marked with the SABS mark.

Type I putty as specified shall only be used for glazing in wood sashes and Type II only in steel sashes.

Paintwork on putty shall not commence until putty has properly dried out, which may necessitate the addition of an accelerating agent.

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**BD 03.05 DOORS****BD 03.05.01 General**

All new doors shall comply with the requirements of SABS 727 and 1129 and section 13 of OW 371. All new external doors are to be fitted with 1½ pair heavy duty hinges.

Door signage, such as door numbers, etc., shall be in accordance with Technical Specification BH: Fittings, and the Bill of Quantities.

Doors shall be painted to the requirements of Technical Specification BJ: Paintwork.

**BD 03.05.02 Doors, sidelights and fanlights**

All wooden stock doors shall comply with the requirements of SABS Standard Specification 545 and section 8, clauses 8.33 and 8.34 of OW 371.

**BD 03.05.03 External steel doors**

The Contractor shall supply and install 800x 2134 steel doors with the required hinges, frames and all materials to ensure the complete installation. The tendered rate will include, supply, all material and labour. This rate will also include two coats of Zinc based primer paint, one at works and one on site after erection.

**BD 03.05.04 Internal pump room doors**

Partition doors semi-solid core single door with masonite board Door size 1100 x 2400mm ( door and frame combination) The Contractor shall supply and install doors with the required hinges, frames and all materials to ensure the complete installation. The tendered rate will include, supply, all material and labour.

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**BD 03.06 IRONMONGERY****BD 03.06.01 General**

All ironmongery shall comply with the requirements of section 11 of OW 371. All ironmongery shall be approved by the agent/representative before fixing. Articles shall be fixed with screws of similar metal and shall be eased, oiled, adjusted and left in perfect working order on completion.

All ironmongery shall be inspected to assess the level of workability, paying special attention to door handles, locks, door closers, door stops, door catches, fixing of these fittings, etc. Should any of these fittings be found unsuitable due to damage, corrosion, etc., they shall be replaced. Where existing holes in wood are worn out, these holes must be plugged with wood to receive the screws.

Toilet doors in ablutions must be fitted with approved D-type natural anodised aluminium pull handles and 150 x 150 mm plate. Install 15 mm diameter concealed steel roller ball catch with chromium-plated striker plate with circular hole for roller ball catch. Fix this plate to door frame with two aluminium pop rivets.

**BD 03.06.02 Door locks**

Each lock shall be provided with two keys and no key shall pass a second lock. All mortice locks, mortice latches and night latches, rim and cylinder rim night latches, and escutcheon for locks shall comply with the requirements of the SABS. The Contractor shall supply all screws, etc., required for completion of the work.

**BD 03.06.03 Cupboard doors**

Where required according to the Bill of Quantities, built-in cupboard doors in sleeping quarters are to be provided with 2 x angle iron sections of 35 x 80 x 3 mm thick x 10 mm diameter hole for a padlock that must be fixed to the inside of the cupboard door.

Locker doors shall be provided with a 50 x 50 x 5 mm thick mild steel angle x 10 mm diameter hole for a padlock site welded to the locker.

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## **BD 04      Physical Perimeter Security Barriers**

### **1.1 Scope**

A. This specification covers material requirements and installation of security gates

### **1.2 Work Included**

A. Furnish and install gates, and accessories as required and shown.

### **1.3 References Codes and Standards**

A. CSIR, SABS, North Atlantic Treaty Organization (NATO) and International Aviation Authority Organization (ICAO).

CSIR Test 980289, 050036, 050056, T09998

SABS Test 2536/YM139

Nato Stock 5600/99-458-7474

ICAO ICAO Security Manual

### **1.4 Submittals**

- a. Certificate of compliance for materials and coatings
- b. Shop drawing for gates
- c. Submittal requirements are identified within the Specification.
- d. Quality control program shall be submitted to the Employer's Agent for review prior to commencement of any work.

### **1.5 General**

- a. All steel materials shall be of good commercial quality, galvanized steel..
- b. Zinc coating shall be smooth and essentially free from lumps, globs, or points.
- c. Miscellaneous material shall be galvanized.

## **2.0 Gates**

### **2.1 Swing Gates**

- a. All connections and joints shall be welded to form rigid frames or assembled with corner fittings.
- b. Hinges shall not twist or turn under the action of the gate, shall be so arranged that a closed gate cannot be lifted off the hinges to obtain entry.
- c. This rate will also include two coats of primer paint.

### **2.2 Sliding Gates**

- a. Gate frame fabrication and miscellaneous items shall be similar to Swing Gates.
- b. All fittings, brackets and rear wheel tracks shall be standard manufactured products for the intended application.

- c. Electric motor and remote control will be standard manufactured products for the intended application, and will be supplied and installed with all the components to deem the system functional
- d. This rate will also include two coats of primer paint.

### 2.3 Adjusting

- a. Gate: Adjust gate to operate smoothly, easily, and quietly, free from binding, warp, excessive deflection, distortion, nonalignment, misplacement, disruption, or malfunction, throughout entire operational range. Confirm that latches and locks engage accurately and securely without forcing or binding.
- b. Lubricate hardware and other moving parts.

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## BD 05 WATER CLOSET

### The installation will include the closet, pan, cistern, and flushing mechanism

#### Specification

Provide and install new pans of a standard type that is acceptable to the Employer. Pans shall conform to SANS 497, and be; pedestal type, robust and durable construction, siphonic and flush-down are acceptable but must flush all solids utilizing between 8.0 and 9.5-litres/flush.

Contractor will provided and installed cisterns shall comprise one shell (tank) and one lid, be of low-level type and white in colour, be of a robust and durable construction, have SANS 821 approval, flush volume shall not exceed 9.5 litres or be less than 8.0 litres per flush, and construction shall accommodate both Side-Inlet (SI) and Bottom-inlet (BI) arrangements.

In addition:

- a. float valves (Inlet Valve) shall conform to SANS 752 approval, and shall be of non-metallic construction to minimize any scrap metal value.
- b. ball float shall conform to SANS 1006 approval, must be supplied with a lever arm, and be non-metallic construction to minimize any scrap metal value.
- c. flush valve shall conform to SANS 1509, be robust construction with minimum moving parts, and must be Method I overflow.

Cistern peripherals shall include all fittings to connect the cistern to the water supply and to a WC pan and render the suite operational (it excludes the flush valve, inlet valve and ball float which are measured as part of the cistern item).

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## BD 06 WASH HAND BASIN AND SINK

	1. SANITARY WARE	BRASSWARE	TRAP
<b>WHBs</b>	Armitage Shanks or similar approved, white wall-mounted, white enamel CI,	Cobra 15 mm, CP star handle pillar taps OR similar approved	Flexi P-trap CP bottle trap lead P-trap

<b>Sinks</b>	cabinet-mounted	20 mm CP star handle taps, 20 mm Cobra taps, or similar approved CP sink mixer with overarm swivel outlet	Flexi P-trap , lead P-trap
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## **BD 08 MEASUREMENT AND PAYMENT**

### **BD 08.01 Measurement and Rates**

#### **BD 08.01.01 General inclusion of costs and specific specificationsNotes:**

Where applicable, standard SABS 1200 measurement and payment items shall be used for Earthworks (Small Works) (1200 DA), Site Clearance (1200 C) and Concrete (Structural) (1200 G).

All material scheduled to be removed shall be deemed to be existing damaged materials in small or large sections. All such redundant material shall become the property of the Contractor and must be removed from site immediately.

All new material shall be deemed to be in patchwork and shall be of approved equal quality, colours, profiles, thickness, etc. and shall in all cases match the existing materials and shall be fixed (internally or externally) to existing material, frames or surfaces.

All replacement, removal and repair work shall be done carefully as to not damage any adjacent or other material or work. Any damage to other or adjacent materials or areas caused by the negligence of the Contractor shall be repaired by him free of charge.

All work scheduled to be replaced shall be deemed to include for the careful removal of the damaged existing material as a whole or partly, as specified, for the cleaning and preparation of the remaining surface(s), frames, etc. as well as for the new material scheduled or specified to replace the damaged material.

All work scheduled to be removed, hacked off, or taken out shall be deemed to include the cleaning and preparation of the remaining surfaces, areas where material were removed, or remaining work to receive new material or work specified.

Repair and service work shall also include all removing, cutting, grinding, cutting into, welding, bending, strengthening, drilling, tightening, fastening, oiling, greasing, adjusting and providing missing or damaged screws or bolts, etc. to repair and service or to improve the items or areas as new and to match the existing. The servicing of windows will be measured in number irrespective of the type of window or the amount of opening sashes present in the overall window size. The rates tendered for this or similar items shall be deemed to include for servicing all opening sashes and the total overall frame.

Work scheduled to be realigned and refixed shall be deemed to include all necessary new additional materials, brackets, connector plates, bolts, pip rivets, nails, screws, spacer blocks, clamps, timber, and labour, etc. to leave the items as new and totally functional.

All new work is measured net and shall include all cutting, lapping, waste, bending, fixing, corners, mitres, fixing screws, pop rivets, nails, adhesive, grout, putty, etc., as well as cleaning and preparation of surfaces not already prepared as part of removed items, etc. The supply and installation of new window handles, pegs, stays, etc. as well as the service of windows shall include for sealing all bolts and screws of handles, stays, etc. with epoxy after fixing or tightening into positions.

The removal of doors, gates or windows shall include for the removal of all existing locks, handles, striking plates, etc. but exclude the hinges, etc., which shall be used for the new replaced items. All repair work (excluding paintwork) around and in the thresholds of new door frames, gates or windows build into existing brickwork in new or existing positions shall be deemed to be included in either the rates tendered for the new replacement item or the removal payment item of the frame, window, etc.

The new doors to toilets and wet areas as specified shall be fitted with rubber door stops, D-profiled pull handle and backplate sets, 15 mm roller ball catches with striking plates and all other ironmongery needed to install the doors complete. All new ironmongery shall be measured and paid for separately.

The new doors to offices, etc., as specified shall be fitted with rubber door stops, 4 lever mortice locksets with handle sets to match existing, striking plates and all other ironmongery needed to install the doors complete. All new ironmongery shall be measured and paid for separately.

All ironmongery installed on the project shall bear the SABS mark of compliance. Where requested, samples of ironmongery must be handed to the Employer's Agent for approval before ordering the material.

All brickwork shall include for damp proofing membranes, galvanized brickwork reinforcement to every third course, wire ties and wall anchors as needed.

Tilework to walls shall include all cutting, spacers, waste, jointing, mitres, corners, epoxy grout and joint filler.

Ordering of certain specified material ie NCI industrial type wall tiles needs special and urgent attendance and should be ordered timeously as to prevent any construction delays.

All new glass mirrors shall be silvered float glass copper backed mirrors with polished edges all round and shall, unless otherwise scheduled, be fixed to walls with chromium plated dome capped mirror screws with rubber buffers.

#### **BD 08.01.02                      Specific specification: Welding of thin steel plates**

Thin steel plates covering the external side of doors must be welded to the door frame members. The existing paint must be removed from the welding areas prior to site welding. A coded or experienced welder must submit the proposed welding procedure to the Employer's Agent/Department's representative for approval. The aim of the site welding is two fold, viz to fix the steel plate to the frame and secondly, to prevent water ingress into the inside of the door. The perimeter of the individual plate sections of the door must be sealed with continuous impervious welds.

#### **BD 08.02 Scheduled Items**

##### **BD.08.02.01a Doors :**

(a)                      (Type of doors, , locks, etc. and material indicated):

Description of item .....Unit : number  
The unit of measurement shall be the number of doors, , locks, etc. installed complete as specified.

The tendered rates shall include full compensation for the manufacturing and installation of the steel doors,, locks, frames, etc. complete with hinges, handles, locks, barrel bolts, retaining devices, door stops, stays and any other work necessary to complete the work as specified, scheduled or as shown on the Drawings. The tendered rates for windows shall also include full compensation for glazing, window sills and damp-proof sheeting as specified or to match existing. d. This rate will also include two coats of primer paint. Windows to be wired windows specified in BD.08.02.01.c

#### **BD.08.02.01 b Telemetry Room high security door and frame**

Description of item ..... Unit : Prov Sum

The tendered rates shall include full compensation for the manufacturing and installation of the steel doors, windows, locks, frames, etc. complete with hinges, handles, locks, barrel bolts, retaining devices, door stops, stays and any other work necessary to complete the work. This item will be utilised under the discretion of the Employer's Agent, and shall be approved by the Employer's Agent before fabrication d. This rate will also include two coats of primer paint.

#### **BD.08.02.01 c Wired windows**

Description of item ..... Unit : number  
The unit of measurement shall be the number of windows, locks, etc. installed complete as specified.

The tendered rates shall include full compensation for the manufacturing and installation of the steel windows, with a 0.6mm Georgian steel wired glass, locks, frames, burglar bars etc. complete with hinges, handles, locks, barrel bolts, retaining devices, door stops, stays and any other work necessary to complete the work as specified, scheduled or as shown on the Drawings. The tendered rates for windows shall also include full compensation for glazing, window sills and damp-proof sheeting as specified or to match existing.

#### **BD.08.02.01d Swing Gates**

Description of item ..... Unit : Prov Sum

The tendered rates shall include full compensation for the manufacturing and installation of the steel doors, locks, frames, etc. complete with hinges, handles, locks, barrel bolts, retaining devices, door stops, stays, rails and any other work necessary to complete the work. This item will be utilised under the discretion of the Employer's Agent, and shall be approved by the Employer's Agent before fabrication. d. This rate will also include two coats of primer paint.

#### **BD.08.02.01e Slide Gates and Motor**

Description of item ..... Unit : Prov Sum

The tendered rates shall include full compensation for the manufacturing and installation of the steel gate, locks, frames, etc. complete with hinges, handles, locks, barrel bolts, retaining devices, door stops, stays, rails and any other work necessary to complete the work. It will also include the supply and installation of an adequate motor and control system. This item will be utilised under the discretion of the Employer's Agent, and shall be approved by the Employer's Agent before fabrication. d. This rate will also include two coats of primer paint.

#### **BD 08.02.02 Precast Concrete Windblock ( 600x600mm) with fitted Aluminium fitted frame to house aluminium fly mesh.**

Precast 600x600 concrete blocks will be fitted inside the tower shaft. These blocks will have an aluminium frame fitted into the block, and will hold the aluminium fly/mosquito mesh. The rate will cover full

compensation for the manufacturing and supply, all material, and labour to ensure complete installation.

.....

.Unit No.

**BD.08.02.03 Face brick Wall:**

(a) Description of material to be used:

Description of item and/or position to be fixed..... Unit m, m<sup>2</sup>, number

The unit of measurement shall be the number, metre, etc. for each item as scheduled.

The tendered rates shall include full compensation for all costs of material, waste, labour, plant, transport, delivery, access, scaffolding, fuel, etc. to install the material as specified and to match the existing to the Employer's Agent/Department's representative approval. Brick work to have a compressive strength of 20MPa.

**BD.08.03 Ironmongery, steelwork, glass, wall finishings, etc.:**

- (a) Measured by number:  
(i) (Description of item)..... Unit: number  
(ii) Etc
- (b) Measured by linear metre:  
(i) (Description of item).....Unit: m  
(ii) Etc
- (c) Measured by area:  
(i)(Description of item) ..... Unit: m<sup>2</sup>  
(ii) Etc

The unit of measurement shall be the number, metre or square metre as applicable to each item.

The tendered rates shall include full compensation for manufacturing, providing and installing each item to new or existing steel, wood or plaster complete as per specifications, drawings, descriptions as scheduled or as the existing and shall include for all labour, material, waste, plant, transport, delivery, access, scaffolding, fuel, etc. to the Employer's Agent/Department's representative approval.

**BD.08.04 Tiling :**

Measurement..... Unit , m<sup>2</sup>, number

The unit of measurement shall be squared meters etc. for each item as scheduled.

The tendered rates shall include full compensation for all costs of material, waste, labour, plant, transport, delivery, access, scaffolding, fuel, etc. to install the material as specified, complete and to match the existing to the Employer's Agent/JHB Water representative approval.

**BD.08.05 Coring through Concrete walls**

Description of item .....Unit : Prov Sum

The tendered rates shall include full compensation for equipment and labour to core through Concrete under the discretion and approval of the Employer's Agent.....Unit Prov Sum.

**BD 08.07 Water closet (WC) . Unit: No.**

The rate shall include the cost to supply, transport, handle, installation and testing of pans, cisterns, cistern peripherals and cleaning of work area in accordance with clause  
Allowance is made for:

- a) cistern-pan connection; flush pipe,
- b) flexible cistern tank supply connection, and
- c) black rubber cone.

**BD 08.08 Wash Basin and Sink Unit: No.**

The rate shall include the cost to supply, transport, handle, installation and testing of wash hand basin or Sink and cleaning of work area in accordance with clause this will be of porcelain material

**BD.08.09 Meranti floor skirting's or similar approved**

Measurement

Unit m, , number

The unit of measurement shall be meters etc. for each item as scheduled.

The tendered rates shall include full compensation for all costs of material, waste, labour, plant, transport, delivery, access, , fuel, etc. to install the 120mm x,18mm meranti floor skirting's complete and to match the existing to the Employer's Agent/Department's representative approval.

**BD.08.10 HDPE 110mm OD perforated pipe to house submersible unit.**

The pipe will be strapped, with stainless steel 4.5 mm x 521 mm cable ties, at every 500mm interval, against the side of the cat ladder within the tank

Measurement

Unit , m, number

The unit of measurement shall be meters etc. for each item as scheduled.

The tendered rates shall include full compensation for all costs of material, including cable ties, waste, labour, plant, transport, delivery, access, scaffolding, fuel, etc. to install the material as specified, complete and to match the existing to the Employer's Agent/Department's representative approval.

## **SECTION 2: CONCRETE (STRUCTURAL)**

### **PSG CONCRETE (STRUCTURAL) (SANS 1200 G)**

#### **PSG 2: INTERPRETATIONS**

##### **PSG 2.4.2 Strength concrete**

###### **Add the following to this Sub-clause:**

With the exception of mixes weaker than 15 MPa, all concrete for the Works shall be considered to be strength concrete.

Unless otherwise specified on the drawings or in the Schedule of Quantities, all structural concrete shall be Grade 40 MPa/19.

#### **PSG 3: MATERIALS**

##### **PSG 3.2 Cement**

###### **Add the following to this Sub-clause:**

CEM1 52.5 as specified in SABS EN 197-1 common cements, a 75% CEM1 52.5 and 25% PFA blend or 50% slag cement and 50% CEM1 shall be used as specified in the relevant sections of SANS 1491 and SANS EN 197-1. Any variations to these are subject to the Engineer's approval.

For non-structural concrete CEM1 32.5 is acceptable.

##### **PSG 3.2.3 Storage**

###### **Add the following to this Sub-clause:**

Cement shall be used in the order in which it is received (first in, first out basis)

Cement kept in storage for longer than 6 weeks shall be removed from site and not used in the Works.

Any cement that shows signs of hydration, such as the formation of lumps, may not be used and is to be immediately removed from site.

##### **PSG 3.3 Water**

###### **Replace the contents of this clause with the following:**

Only potable quality water from an approved source may be used for mixing concrete. Water from a river or stream may only be used for curing.

##### **PSG 3.4 Aggregates**

###### **PSG 3.4.1 Applicable Specification**

###### **Add the following to this Sub-clause:**

The maximum aggregate size shall be 25 mm. Any aggregate may be used provided the free sodium alkali content in the concrete mix does not cause an alkali-aggregate reaction.

Coarse aggregate may be obtained from the nearest available commercial sources, and shall be subject to the Engineer's approval.

Fine aggregate may be obtained from local sources subject to testing of its suitability by an approved laboratory and approval by the Engineer.

Aggregates shall be tested periodically for reactivity, the costs of which shall be deemed included in the rate tendered for concrete. A design mix will have to be made and the results submitted to the Engineer for approval before construction begins.

Coarse and fine dolomitic aggregate shall be used where required in terms of PS LD3-2 Dolomitic aggregate. When tested in accordance with the method specified in Appendix C of SANS 677, not more than 25% by mass of the dolomitic aggregate shall be insoluble in hydrochloric acid.

At least one month before commencement of concrete work the Contractor shall supply at his own 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 specifications. Approximately 50 kg of each sample of aggregate shall be supplied.

After approval, these samples shall be taken as standard for the agreed aggregates to be used in the Works. If at any time during the course of the Contract the Engineer considers that there has been any deviation from the approved standard the Contractor shall submit further tested samples of material to the Engineer for approval.

### **Aggregates for grouting**

Notwithstanding the requirements of Sub-clause 3.4.1, the grading of the fine aggregate (sand) and coarse aggregate (stone or pea gravel) to be used for grouting shall conform to the grading given in Tables 1 and 2 respectively, below.

<b>TABLE 1 - SAND</b>		<b>TABLE 2 - STONE OR PEA GRAVEL</b>	
Test sieve nominal aperture size, mm	% Passing (by mass)	Test sieve nominal aperture size, mm	% Passing (by mass)
9,5	100	9,5	100
4,75	95 - 100	4,74	95 - 100
1,18	45 - 65	2,36	0 - 5
0,3	5 - 15		
0,15	0 - 5		

### **Dolomitic Aggregate**

Coarse and fine dolomitic aggregate shall be used where required in terms of PS LD 3.2.2 Dolomitic aggregate. When tested in accordance with the method specified in Appendix C of SANS 677, not more than 25% by mass of the dolomitic aggregate shall be insoluble in hydrochloric acid.

## **PSG 3.5 Admixtures**

**Add the following Sub-clause to clause 3.5:**

### **PSG 3.5.3 Pulverized fly ash (PFA)**

#### **PSG 3.5.3.1 General**

Concrete containing a percentage of FA shall be termed FA concrete. Pulverized fly ash (PFA) shall conform to the requirement of SANS 1491-2.

All concrete used shall consist of FA in the concrete unless otherwise shown on the drawings or ordered by the Engineer.

FA concrete shall conform to the requirements of SANS 1200 G for concrete and the additional requirements specified below.

#### **PSG 3.5.3.2 Source and quality**

Fly Ash shall be procured from an approved source and shall be of a consistent quality conforming to SANS 1491-2. In particular it shall be tested for and shall conform to the following:

- a) the loss on ignition shall not exceed 5%
- b) the percentage by mass retained on 45 micron screen shall not exceed 12.5%

#### **PSG 3.5.3.3 Cementitious material**

The cementitious material used for FA concrete shall consist of a mixture of between 75% and 80% by mass of ordinary Portland cement and of between 25% and 20% by mass of FA.

**Add the following Clauses:**

#### **PSG 3.9 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 5 mm sieve.

The cement/water ratio of the mix shall be at least 2,0.

#### **PSG 3.10 Bond breaker**

The bond breaker between the top of the blinding layer or dry packed mortar screed and the underside of the floor slab in the case of the clarifier, aeration tank, anaerobic ponds and chlorine contact tank shall be either a double coat of a spray grade bitumen emulsion complying with SANS 309 applied at a rate of 1,0 ℓ/m<sup>2</sup> of net bitumen or a 250 micrometre polythene sheet complying with SANS 952, Type D.

Where bitumen-impregnated resilient fibreboard is specified, it shall comply with American Federal Specification HH-F-341a for Type 1, Class B.

#### **PSG 3.11 Materials for movement joints**

##### **PSG 3.11.1 General**

The various jointing materials, the manufacturers of the materials and the methods of application shall be as approved by the Engineer. Materials shall be stored and protected to avoid damage, degradation, distortion or contamination.

The joint materials shall be resistant to ultraviolet light and to biological degradation.

##### **PSG 3.11.2 Waterstops**

Waterstops shall be of approved manufacture and of the pattern and the material and widths scheduled and specified and shown on the drawings. They shall comply with the tolerances specified in clause 6.1 of SANS 1200. They shall conform to Specifications CKS 388 or 389, for natural rubber or PVC respectively, and have the appropriate physical properties as set out below:

	<b>PVC</b>	<b>Rubber</b>
Tensile strength (@ 25°C)	12,2 MPa	20,7 MPa
Elongation at break (@ 25°C)	250%	500%

Hardness BS degrees (IRHD @ 25°C)	-	60 to 65°
Softness (BS)	28 to 52°	-

All intersections between waterstops shall be prepared by mitring and welding/vulcanising intersection pieces in the factory in accordance with the manufacturer's instructions and to approval of the Engineer. Only straight lengths of waterstop may be field welded using the appropriate jigs and tools.

Where required, waterstops shall have eyelets so that they may be tied securely to the adjacent reinforcement. "Rearguard"-type waterstops shall have flanges or cleats that grip effectively.

### PSG 3.11.3 Fillers

Closed cell expanded polyethylene fillers shall comply with the following:

Property	Unit	Value Test Method
Density	kg/m <sup>3</sup>	110 DIN 53420
Compression Stress at compression strains of 10% 25% 50%	kPa kPa kPa	175 210 340 DIN 53577 DIN 53577 DIN 53577
Compression set after 24 hours recovery	%	14
Tensile Strength	kPa	680 DIN 53571
Elongation at Break	%	49 DIN 53571
Max. water absorption after 24 hours by volume	%	0,1 ASTM C-177

Fillers shall be pre-cut to suit the application with a tear-out strip for forming the specified recess for the sealant. If so required the filler shall be glued into position with approved epoxy glue.

### PSG 3.11.4 Bond breakers, primers and sealants

The bond breaker (if specified) shall be self-adhesive PVC tape (or equal, approved material) with a width the same as the joint recess into which it is to be applied.

The primer, if required for the sealant, shall be fully compatible with the sealing compound that is to be used.

The elastomeric sealant shall be either a two-component polysulphide liquid polymer base complying with the requirements of SANS 110 or a polyethylene based polyurethane "pouring grade" for horizontal or near horizontal joints or "gun grade" for vertical/overhead joints and joints steeper than 1 in 10 to the horizontal. All elastomeric sealants shall comply with BS 4254 Type A1 and shall have a movement tolerance of 25%.

### PSG 3.12 Precast paving slabs

The paving slabs shall comply with the requirements of SANS 541, shall be as scheduled and with patterned surface, or equal approved. Samples of the types which the Contractor proposes to use shall be submitted for approval prior to construction.

## PSG 4: PLANT

### PSG 4.3 Mixing plant

#### PSG 4.3.1 General Requirement for Mixing Plant

**Add the following to this Sub-clause:**

Stand-by mixers of adequate capacity and with an independent power unit shall be maintained on site for immediate use in the event of breakdown of the regular mixers failure of the power supply.

**PSG 4.4     Vibrators**

**Add the following to this Sub-clause:**

Stand-by vibrators of adequate capacity and with an independent power unit shall be maintained on site for immediate use in the event of breakdown of the regular vibrator failure of the power supply.

Vibrators for in-situ concrete shall be of the internal or immersion type.

**PSG 4.5     Formwork**

**PSG 4.5.3 Ties**

**Add the following to this Sub-clause:**

The use of sleeves for formwork ties through the walls of water retaining structures will not be permitted. Ties, when cast in, shall have some form of positive anchorage to prevent any rotation when loosening formwork and some form of water bar to restrict seepage along the tie.

For Watertight concrete structures the shutters shall be fastened using an approved imbedded fastening system. Open ferrules will not be permitted in the reservoir.

**Add the following Clause:**

**PSG 4.6     Water-bath**

A temperature-controlled water-bath with a capacity to cure two hundred cubes shall be provided on site. The water-bath shall be located under cover.

**PSG 5       CONSTRUCTION**

**PSG 5.1     Reinforcing**

**PSG 5.1.2 Fixing**

**Add the following to this Sub-clause:**

Fixing of reinforcing bars by welding and heating of bars will not be permitted.

Fixing blocks for the attachment of fixtures may be embedded in concrete provided that the strength or any other desirable feature (such as appearance of the member) is not, in the opinion of the Engineer, impaired thereby.

Supports shall be of approved precast concrete blocks properly shaped to maintain position or proprietary supports of an approved type. Concrete blocks shall be adequately cured as specified. Wooden supports shall not be used nor shall bars be placed in succeeding layers of fresh concrete nor shall bars be adjusted during the placing of concrete. Tie-wire shall point away from the nearest formwork face.

Where clips, stools and other supports are not shown on the drawings and are structurally not required, the Contractor shall provide those supports he deems necessary to ensure the correct positioning of the reinforcement, to the satisfaction of the Engineer. The cost of such steel, labour, and other fixing materials shall be inclusive in the rate for the scheduled reinforcement and no additional payment shall be made.

## **PSG 5.2 Formwork**

### **PSG 5.2.1 Classification of finishes**

#### **Add the following to this Sub-clause:**

Rough formwork Degree of Accuracy III may be used on the outside faces where the concrete is more than 500 mm below the final ground level.

Smooth formwork Degree of Accuracy II will be used elsewhere.

Where specified special finishes shall be to Degree of Accuracy I

All honeycombing shall be repaired by cutting back to sound concrete and patching with a suitable epoxy mix to the approval of the Engineer.

Concrete for manholes shall be finished with a steel float or against a steel shutter which has been cleaned and oiled before use.

### **PSG 5.2.2 Preparation of formwork**

#### **Add the following to this Sub-clause:**

All exposed external angles in concrete work shall have 20 mm x 20 mm chamfers unless otherwise specified or ordered, but the top edge of a slab that is to receive an applied finish shall not be chamfered.

## **PSG 5.5 Concrete (Watertight)**

### **PSG 5.5.1 Concrete (Quality)**

#### **Add the following to this clause:**

35 MPa concrete with the minimum and maximum cement contents of 325 kg/m<sup>3</sup> and 450 kg/m<sup>3</sup> respectively shall be used. For concrete containing extenders the maximum cement content shall be 450 kg/m<sup>3</sup>. The water to cement ratio shall not exceed 0.50. All concrete mix designs shall be approved by the Engineer in advance.

The mix design and casting procedure shall be approved by the Engineer prior to casting.

All Water Retaining structures and all manholes shall be constructed using watertight concrete. The Contractor shall abide by all conditions set out in sub-clause 5.5.11 as amended of SABS 1200 G, and pay particular attention to this aspect of the works.

Cubes shall be taken on all pours in accordance with SABS 1200 G. Payment shall be included in the rate tendered for the supply of concrete. No payment shall be made for concrete pours on which no cube tests have been performed. A single cube test comprises the mean crushing strength of 3 cubes taken from the same batch of concrete and cubes must be taken at the frequency specified SANS 1200 G

The concrete shall be tested for water sorptivity, oxygen permeability, chloride conductivity, depth of cover and shrinkage; the details of the tests are given on the specification.

### **PSG 5.5.1.4 Chloride content**

#### **Add the following to this Sub-clause:**

Efflorescence will not be acceptable on any exposed concrete surface

### **PSG 5.5.1.5 Durability**

#### **Add to this Sub-clause the following:**

The water/cement ratio, as specified in Table 5, but shall not exceeding **0.5**.

#### **PSG 5.5.1.6 Prescribed mix concrete**

##### **Add the following to this Sub-clause:**

Notwithstanding the requirements of Sub-clause 5.5.1.6, samples of aggregates will not be made available by the Engineer. The Contractor shall supply aggregates from commercial sources located by him, complying with the requirements of Sub-clause 3.4.1, as amended, for the production of prescribed mix concrete.

##### **"No-fines" concrete:**

A nominal aggregate size of 19 mm shall be used in the manufacture of "no-fines" concrete.

No-fines concrete shall be laid under where specified and shall consist of coarse aggregate, cement and water only. No fine aggregate shall be used. Sandwiching or layering of pours will not be permitted. The Contractor shall cast to the profile depth in one pour.

The mixing of the cement and water paste shall have the consistency of paint capable of coating each coarse aggregate particle uniformly and sufficiently to form a small fillet at all the contact points of each stone in the aggregate.

Between 24 and 48 hours after the no-fines layer has been laid it shall be covered with 1:4 cement: sand mortar layer 20 mm 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 floated to form a plane surface.

The mortar skim shall be cured in the same manner as concrete for a period of not less than 2 days.

Payment shall be per cubic metre of no-fines concrete placed. The rate shall include compaction and skimming to the approval of the Engineer.

#### **PSG 5.5.1.7 Strength Concrete**

##### **Add the following to this Sub-clause:**

The concrete mix design for strength concrete must be prepared in an approved laboratory and the results of actual test mixes must be submitted for approval together with 7-day and 28-day strength test results. Special attention is drawn to the fact that the concrete mix must provide a very dense and impervious concrete.

The Contractor shall submit details of the proposed concrete aggregates and design mix to the Engineer for approval, after which he shall be required to make a trial mix and obtain cube test results to validate the proposed mix. Only after receipt of satisfactory cube test results, the Contractor shall be permitted to use the mix in the construction of water retaining structures. The cost of designing and proving the proposed concrete mix shall be deemed to be included in the tendered rates.

The Engineer may call for revised mix designs at any stage during the Contract.

Where blinding layers are specified, the concrete shall be grade 15 MPa/19 placed and finished off to the final level.

In order to facilitate or increase the workability of concrete in the fresh/plastic state, to ensure watertightness without increasing the water/cement ratio, the Engineer may approve the use of an additive.

The workability of concrete shall be assessed by means of the slump test. The slump shall be between 75 ± 25mm.

## **Curing**

Curing shall be done using a curing compound to the Engineer's approval and frequency or, in addition to water curing, well-secured plastic sheeting, shall be used. Water curing alone shall not be permitted. Where the Contractor fails to cure for a minimum of 7 days, no payment shall be made for the relevant pour of concrete.

### **PSG 5.5.2 Batching**

#### **Add the following to this Sub-clause:**

Batching of all strength concrete shall be by mass. Prescribed concrete may be batched by volume. Batching shall not be done by wheelbarrow.

All concrete shall be mechanically mixed.

Stand-by mixers of adequate capacity and with an independent power unit shall be maintained on site for immediate use in the event of breakdown of the regular mixers failure of the power supply.

### **PSG 5.5.3.2 Ready-mixed concrete**

#### **Replace the contents of this Sub-clause with the following:**

Concrete from a central concrete production facility other than on the construction site will be permitted if the facility is within a 40 km radius of the site and, apart from test results in terms of Sub-clauses 7.3.1, 7.3.2 and/or 7.3.3, test results obtained by such a production facility as part of its quality control system will be accepted for evaluation in terms of Sub-clause 7.3.4, provided the cubes are stored and cured on site.

### **PSG 5.5.5 Placing**

#### **Add the following Sub-clause:**

#### **PSG 5.5.5.10 Casting of concrete in excavation**

Structural concrete shall not be cast directly against the side of any excavation without the use of formwork unless prior approval has been obtained in writing from the Engineer.

Concrete used in pipe trenches for encasement and for the thrust / anchor blocks may be cast directly against the side of the excavation.

After vibration, the concrete shall be spaded in corners, in angles and against forms to release air bubbles which may have been trapped in these positions.

### **PSG 5.5.7 Construction joints**

#### **Add the following to these Sub-clauses:**

#### **PSG 5.5.7.1 General**

The edge of joints, exposed to view in the finished structure, shall be formed with suitable beads to provide a straight edge true to line and level.

All joints, other than expansion, contraction and other movement joints shall be treated as follows:

As soon as practical, but not before 15 hours after placing, the construction joint surface shall be prepared to receive fresh concrete. This preparation, as specified in Sub-clauses 5.5.7.3(a) to (d), shall be such as to remove all laitance or inert and strengthless material which may have formed and the specified chipping or sand blasting shall be such as to produce a roughened surface all over.

When concreting is interrupted concrete surfaces shall be protected from the sun as specified in Sub-clause 5.5.8(d) or by means of hessian kept damp until concreting is resumed.

All constructional joints shall be dealt with as specified in Sub-clause 5.5.7.3, as amended. Unless construction joints between designated joints shown on the drawings are authorized by the Engineer in writing, concrete in the floor and wall shall be cast continuously between the designated joints shown on the drawings.

**PSG 5.5.7.2      Formed joints (generally vertical or near vertical)**

Formed joints will be considered to be designated joints as defined in Sub-clause 2.4.3. (The forming of a straight edge to a construction joint as specified in PSG 5.5.7.1, as amended, General does not constitute a formed joint).

Each joint shall be formed as shown on the drawings, complete with shear key rebates, waffle formwork, V-feature, waterstops, "Flexcell" or equal, approved joint filler, dowel bars and their PVC tubes, etc. as indicated.

**PSG 5.5.7.3      Non-designated joints**

Any non-designated joints shall be identical to designated joints, as shown on the drawings, which would be used in similar positions and shall perform the same function.

**Add the following Sub-clauses:**

**PSG 5.5.7.4      Joints between footings or floors and walls or columns**

Construction joints between foundations, footings or floors and walls, columns or piers connected to them, shall not be made flush with the supporting surface, but shall be made at a distance above the footing or floor shown as on the drawings or approved by the Engineer. The "kicker" shall be cast as an integral part of the foundation, footing or floor.

**PSG 5.5.7.5 Construction Joints In Circular Reservoirs**

**(a) Construction Joints In Walls Or Footings**

Construction joints may only be placed where shown on the drawings or to the approval of the Engineer. Vertical joints in the walls of the reservoir are permitted only in the pre-stressed reservoir. These joints shall only be permitted radially on each side of stressing buttresses. No vertical joints shall be permitted in the reinforced concrete reservoir.

The entire contact surface along the joint in the concrete already cast shall be chipped or water jetted to expose the coarse aggregate to 5 mm beyond the surrounding matrix. Care shall be taken to ensure that the concrete structure is not damaged and that all loose material is removed. The surface must be thoroughly cleaned and wetted before casting against the joint.

All construction joints in the reservoir walls and footing shall be cast with water stops. Water stops shall be galvanised iron or 2 mm thick HDPE strips, as per detail drawings. No construction joints will be permitted in the floor.

Payment shall be per linear meter. The rate shall include supply and casting in of the water stop as per detail drawings.

**(b) Construction Joints In Roof Slabs**

Construction joints in the roof slab are permitted. The position of these joints shall be approved by the Engineer.

These joints shall be cast against a vertical shutter leaving a 15 mm deep by 20 mm wide recess which is sealed with a one part poly-sulphide sealer on completion. The sealer used and method of application shall be to the Engineer's approval.

No water stops are required; however, the completed roof shall be tested for water tightness in accordance with Sub-clause PSG 7.2.5(b), as amended. No additional payment shall be made for these joints.

### **(c) Expansion and Contraction Joints**

Expansion and contraction joints shall be constructed as detailed on drawings using PVC or rubber water stops.

Water stops extruded from recycled material shall not be permitted.

Prior to bandaging, concrete surfaces shall be scabbled with a mechanical scabbler and water jetted with a 200 bar water jet. All joints shall be butt jointed and patched over.

The waterproofing bandage shall comprise of two elements:

- (i) A 2 mm thick Hyperlon strip (350 mm wide for expansion joints and 250 mm wide for contraction joints)
- (ii) A 2 mm x 60 mm stainless steel strip with polythene backing bond breaker to the detail shown on the drawing.

The bandage shall be applied by coating the concrete and underside of the hyperlon bandage with an epoxy adhesive. The stainless steel strip is first positioned over the joint and the bandage with epoxy adhesive placed over the stainless steel strip. All trapped air shall be eliminated by hand rolling the bandage until the epoxy is fully cured.

Payment shall be per linear meter. The rate shall cover all costs for the supply and application of water stops and bandaging including the installation of the stainless steel strip.

### **PSG 5.5.7.6 Application of primers and adhesives**

The concrete to which the primer or adhesive is to be applied shall be dry and shall be cleaned of all dust, grit, grease, surface laitance and foreign matter by compressed air and/or water, solvents, or other suitable approved means. The Contractor shall provide on Site an approved moisture meter to measure the degree of dryness of the joint. This meter shall be made available to the Engineer for testing. The joint shall be approved for the application of the primer and adhesive if the moisture content of the concrete is less than or equal to 5%. It may be necessary to dry the concrete surfaces locally to reduce the moisture content to 5% or less.

### **PSG 5.5.7.7 Contraction and expansion joints**

Contraction and expansion joints shall be formed true to line in smooth formwork.

All surfaces shall be thoroughly cleaned of all accretions of concrete or other foreign matter by scraping or other approved means.

Particular care shall be taken to compact the concrete around waterstops, edges, etc.

Rebates for seals shall be formed to required dimensions and lines, or cut true to line and size after floating the surface and before the final set of the cement has taken place. All rebates, etc., shall be adequately protected against damage until the completion of the work; accidental damage which in the opinion of the Engineer will impair the performance or appearance of the joint shall be made good by reconstructing the work as directed by the Engineer. Rebates for seals 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.

### **PSG 5.5.7.8 Installation of waterstops in joints**

Waterstops shall be held in the formwork so as to prevent air pockets forming underneath them. 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.

#### **PSG 5.5.7.9          Installation of joint filler in expansion joints**

Joints in the filler shall be neatly butted so as to exclude mortar from the joint. Edges of 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) to the expansion movement for which the joint is designed.

Joint filler shall be fixed to the first cast of concrete with an approved adhesive and as directed by the Engineer.

#### **PSG 5.5.7.10          Application of joint seals**

Rebates shall be cleaned as required by PSG 5.5.7.6 Application of primers and adhesives and shall be inspected and approved by the Engineer's Representative before filling.

Joint 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 compound is applied the joint shall be protected against damage until completion of the Contract.

#### **PSG 5.5.8          Curing and protection**

**Add the following to this Sub-clause:**

##### **PSG 5.5.8.1          Horizontal surfaces**

Surfaces of the concrete shall be treated with a curing compound complying with Sub-clause PSG 5.5.8.3 Post-Crystallization (Concentrate & Modified) slurry coat and curing.

##### **PSG 5.5.8.2          Formed surfaces**

In order to improve the effectiveness of the crystallization treatment, the specified minimum time for the removal of the formwork shall be three days. All surfaces shall be pressure cleaned in accordance to the product manufacturer's requirement.

##### **PSG 5.5.8.3          Post-Crystallization (Concentrate & Modified) slurry coat and curing**

The Concrete surfaces to receive a concentrate slurry coat treatment shall have an open capillary system to provide 'tooth and suction', and shall be free from scale, excess form oil, laitance, curing compounds and foreign matter.

Surfaces shall be smooth and uncovered from excess form oil, laitance and foreign matter. The concrete should be lightly water blasted to remove such material for surface preparation.

Concrete surfaces must be thoroughly saturated with clean water prior to application in order to ensure the growth of the crystalline formation deep within the pores of the concrete. Wetting to be done must be at least 1hr before application. If concrete surface dries out before application, it must be re-wetted.

The concentrate slurry is applied at a coverage rate of 1kg/m<sup>2</sup> using a semi-stiff nylon bristle block brush – work slurry well into the surface, filling surface pores and hairline cracks. The coating must be uniformly applied at approximately 1.25 mm thickness. The second modified slurry coat with the same application rate must be applied within 48 hours of the first coat. Light pre-watering between coats may be required when drying out signs appear. Detail coating applications shall be confirmed by the manufacturing.

Cure by spray for minimum of 3 days must be established once the final coat has been applied. Protect from rainfall, puddling of water, wind & frost for at least 48 hours after application. When plastic sheeting is used as protection allowance must be made for the coating to breathe.

#### **PSG 5.5.8.4 Curing for normal concrete surfaces**

The use of membrane curing compounds will be allowed on vertical faces or steeply inclined faces (i.e. steeper than 45° to the horizontal) of cast in situ members of the structures subject to the Contractor producing sufficient, satisfactory cube crushing strength test results where the crushing strength of cubes which have been cured with the proposed curing membrane and left exposed to the elements are compared with those of an equal number of water cured cubes. The crushing strength of cubes cured with the proposed membrane shall be at least 85% of the crushing strength of the water cured cubes.

Before any membrane curing compound is used, each batch shall be tested on a trial surface to ensure that it forms a satisfactory membrane, and any compound which is unsatisfactory in the opinion of the Engineer, shall be rejected. Curing membranes will be disallowed if permanent discolouration of the concrete takes place. Surfaces where curing membranes are used shall be treated in such a manner that the final concrete texture and colour blends in with the rest of the concrete work. Furthermore, the Engineer shall, at his discretion, require the Contractor immediately to adopt an effective alternative means of curing any area of the structure to which a membrane has been applied which, in the opinion of the Engineer, is unsatisfactory. The curing compound 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. It shall preferably be applied by spraying and the rate of application shall be strictly in accordance with the manufacturer's recommendations. A method of monitoring the area to which curing compound has been applied and the application rate shall be as approved by the Engineer and rigidly applied 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.

#### **PSG 5.5.9 Adverse Weather Condition**

**Replace the contents of Sub-clause 5.5.9.2 with the following:**

No placing of concrete shall take place if the ambient temperature exceeds 32°C, or is likely to rise to above 32°C during the casting period or within eight hours after casting is completed.

If concrete is to be cast during times of high ambient temperature or hot drying winds, the Contractor shall be responsible for taking the necessary steps to keep the placement temperature as low as possible. Such steps include the spraying of the coarse aggregate with water, the painting of silos with a reflecting aluminium paint, the insulation of tanks and pipelines, and the protection of concrete ingredients against the direct rays of the sun. The area of the pour shall be shaded before and during concreting and the concrete shall be shaded from the time of mixing until eight hours after placing.

Windbreaks shall be erected if necessary.

#### **PSG 5.5.10 Concrete surfaces**

**Replace the contents of this Clause with the following:**

##### **PSG 5.5.10.1 Screeded finish**

After placing and compacting the concrete on a top (unformed) surface shall be struck off with a template to the designated grades and tamped with a tamping board to compact the surface thoroughly and to bring mortar to the surface, leaving the surface slightly ridged but generally at the required elevation. No mortar shall be added, and noticeable surface irregularities caused by the displacement of coarse aggregate shall be made good by re-screeding after the interfering aggregate has been removed or tamped.

#### **PSG 5.5.10.2 Wood-floated finish**

Where wood-floating is ordered or scheduled, the surface shall first be given a finish as specified in Sub-clause PSG 5.10.1, as amended, Screeded finish and, after the concrete has hardened sufficiently, it shall be wood-floated, either by hand or machine, only sufficiently to produce a uniform surface free from screeding marks.

#### **PSG 5.5.10.3 Steel-floated finish**

Where steel-floating is specified or scheduled, the surface shall be treated as specified in Sub-clause PSG 5.10.1, as amended, Screeded finish except that, when the moisture film has disappeared and the concrete has hardened sufficiently to prevent laitance from being worked to the surface, the screeded surface shall be steel-trowelled under firm pressure to produce a dense, smooth, uniform surface free from trowel marks.

#### **PSG 5.5.10.4 Granolithic screeds**

##### **PSG 5.5.10.4.1 General**

Before placing any granolithic screeds the base concrete shall be chipped to expose the aggregate over 100% of the area to be screeded and soaked with water for at least 24 hours.

The base concrete shall be thoroughly cleaned by scrubbing and all standing water removed after soaking. A 1:2 cement/sand grout shall then be brushed into the prepared surface followed by the granolithic screed before the grout sets. The granolithic screed shall be of the driest feasible consistency with a slump not exceeding 50 mm and shall be formed true to profile and shape as required and shown on drawings. Before placing granolithic screed against an adjacent band of granolithic screed the edge of the latter shall be prepared by chipping back to firm material, wire brushing and brushing with grout as for the base concrete.

Granolithic screed shall be compacted to remove all air and shall be screeded and finished with a steel trowel to Degree of Accuracy 1.

The trowelling shall be carried out in the following stages:

- a) First - as soon as the granolithic screed has been compacted and screeded.
- b) Second - after 2 hours to close the surface and remove laitance.
- c) Third - after a further 4 hours.

The time intervals are estimated as appropriate to normal temperature conditions and shall be varied by the Contractor to ensure a smooth dense finish.

Granolithic screed shall be cured as specified in Sub-clause 5.5.8(b), as amended, 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 in strict accordance with his instructions. It shall be commenced as soon as the equipment supplier gives notice on completion of erection and shall be finished expeditiously.

##### **PSG 5.5.10.4.2 Screed to floor (Where Specified)**

Where screed is specified it shall be approximately 50 mm thickness is required to each floor.

The screed shall be formed from granolithic concrete as specified in Sub-clause PSG 5.5.10.4 Granolithic screed. The screed shall be applied after the mechanical equipment has been erected by the mechanical plant contractor and shall be laid in alternate concentric rings not greater than 2,00 m in width. A period of 24 hours shall elapse before the intervening rings are laid.

The Contractor shall supply and fit a plywood template to the clarifier mechanism to act as a guide in determining the finished screed level. He shall not use the template to physically form the screed surface nor shall he place an excessive load on the scraper mechanism.

The Contractor shall only operate the scraper mechanism in strict accordance with the instructions of the manufacturer and the Engineer, and he shall make good any damage resulting from the use of the machinery.

Granolithic concrete shall be placed in position for a distance of approximately 3,0 m in front of the template and consolidated and roughly trimmed to level. The surface of the screed shall then be trimmed off to the level of the template which shall be moved as required by hand operation of the mechanism.

The trimmed surface shall be steel float finished and the edges of the ring left in a rough vertical condition to provide a key for the adjoining ring.

The preparation of the base concrete shall be done in accordance with Sub-clause PSG 5.5.10.1, as amended, Screeded finish. Before placing granolithic concrete against an adjacent band of granolithic concrete the edge of the latter shall be prepared by chipping back to firm material, wire brushing, and brushing with grout as for the base concrete.

Concrete to manholes shall be watertight concrete.

#### **PSG 5.5.11 Watertight Concrete**

##### **Add the following to this Sub-clause:**

The water-tightness of the reservoir and concrete chambers shall be tested as indicated below:

On completion of a water retaining structure it shall be cleaned and shall be filled with water at an approved rate. After allowing a period of absorption of 3 days, the depth of water shall be recorded and the water allowed to stand for a further 7 days during which the total permissible drop in water level after allowing for evaporation should not exceed 10 mm.

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 water-tightness to be unsatisfactory, the Contractor when ordered by the Engineer shall discontinue such filling or testing and shall, at his own expense, immediately take approved steps to rectify the leakage and to make the work thoroughly sound to the complete satisfaction of the Engineer. All such rectification work shall be continued assiduously until a satisfactory test is obtained, which shall prove to the Engineer that water-tightness has been obtained.

If required by the Engineer, the structure shall be retested before the expiry of the Defects Liability Period.

The floors, walls and roofs of all water retaining structures shall be considered to be watertight concrete structures.

The Works will not be certified complete until the structure has been proved by testing to be watertight to the satisfaction of the Engineer.

The cost of the above tests will be deemed to be included if the rates for the relative concrete to be provided by the contractor.

#### **PSG 5.5.14 Defects**

##### **Add the following to this Sub-clause:**

All defects shall be repaired as soon as possible after the formwork has been removed and the Engineer has inspected the concrete. A statement of the method 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 area concerned until he is satisfied that the repair has been satisfactorily executed.

**Add the following sub-clauses:**

**PSG 5.5.16 Casting pipes and specials in concrete**

Where the pipe or special is supplied by others the Contractor shall provide a box-out in the wall and cast the unit in at a later stage. When constructing such box-outs reinforcement shall not be cut but shall run through the opening. Reinforcement shall be cut and/or bent out at a later stage to suit the item being cast in. After installation of the item the remaining reinforcement shall be bent back in position.

Where entry holes for pipes/specials have been provided in the walls, the Contractor shall be responsible for the concreting in of such pipes/specials regardless of whether or not these have been supplied by himself.

Before commencing the positioning in holes of any pipes/specials the Contractor shall:

- a) remove all formwork and boxing remaining in the holes;
- b) make any alternations required to the position and shape of the holes and cut reinforcement to suit the item, as directed by the Engineer; and
- c) thoroughly scabble the sides of the holes so as to obtain a satisfactory bond surface for the new concrete and treat the surface as specified in Sub-clause 5.5.7.3, as amended.

Immediately prior to the placing of mortar and concrete around the pipes, the surface of the existing concrete shall be saturated with water. All surplus water shall be removed and the surface covered with a layer, approximately 12 mm thick, of mortar made of the same mix as the concrete in which the pipes/specials are to be placed.

The concrete ingredients shall be mixed and placed as dry as possible to obtain a dense, waterproof concrete. The concrete shall be carefully worked around the puddle flange, if any, and the pipe barrel or body of the special, and shall be vibrated in layers so as to obviate a falling away from pipe/special surfaces of the concrete already placed. The whole shall, when set, form a dense, homogeneous, and waterproof mass.

**PSG 5.5.17 Precast paving slabs**

The area to be paved shall be compacted to a minimum of 93% Mod AASSHTO density (100% for sand), trimmed and then treated with an approved weedkiller, with care being taken to avoid contaminating surrounding areas. The paving slabs shall be laid on a sand bed approximately 25 mm thick, which shall be graded to the required levels and slopes as approved by the Engineer. The joints between the slabs shall be 2 mm to 6 mm wide and shall be grouted with cement mortar. Gaps in the pattern of slabs shall be filled with Grade 15MPa/19 concrete and given a wood floated finish.

**PSG 5.5.18 Items to be cast in or grouted into concrete**

**PSG 5.5.18.1 Fixings for equipment supplied under separate contract**

- a) The Contractor will be responsible for the forming of pockets to the details shown on the drawings to accommodate holding down bolts for equipment supplied under a separate contract. Holding down bolts will be supplied by and positioned by others.
- b) After casting of the concrete all shuttering shall be removed and the sides of the bolt holes and surface on which the machine base is to be placed shall be scabbled to remove all defective concrete, laitance, dirt, oil, grease and loose material.
- c) Upon completion of the positioning and alignment of equipment and when instructed by the Engineer the Contractor shall in collaboration with the mechanical contractor, grout up pockets and baseplates by filling pockets and voids under the baseplates with an approved non-shrink grout.

### **PSG 5.5.18.2      Fixings for items supplied under this Contract**

Holding down bolts or other fixings required for the installation of items supplied under this Contract shall be provided by the Contractor. These fixings shall be cast in or grouted into pockets or installed by other means as approved by the Engineer.

Where anchor bolts are used which are installed into holes drilled into concrete or masonry these shall be of a type approved by the Engineer. All such bolts used shall be manufactured from stainless steel or a metal with a resistance to corrosion equal to that of grade 304 stainless steel. The metal used for bolts shall be compatible with galvanized mild steel.

Anchor bolts shall have minimum pull-out forces and minimum ultimate lateral loads at least equal to those specified below:

<b>Specified Anchor Size</b>	<b>Minimum Pull-out Force (kN)</b>	<b>Minimum Ultimate Lateral Load (kN)</b>
M6	10,35	7,60
M8	13,70	11,15
M10	19,44	15,95
M12	31,85	26,90
M16	50,45	45,80
M20	60,50	71,20

### **PSG 5.5.18.3      Plastic puddle pipe items supplied under this Contract**

Plastic puddle pipe cast-in fittings as indicated per drawing required for the installation of items supplied under this Contract shall be provided by the Contractor. These fittings shall be cast in or grouted into pockets or installed by other means as approved by the Engineer.

All such fittings shall be manufactured from uPVC CLASS 16 according to the drawings in accordance with SANS 966. The welded puddle shall be governed in accordance with standards DVS 2207 and SANS 10268. All welded items shall be issued with an accredited quality certificate from an accredited manufacturer.

### **PSG 5.5.18.3      Supervision**

The Contractor shall be responsible for ensuring that the erection of the concrete work is carried out under the supervision of a person with adequate knowledge of the mixing, transporting, placing and curing of concrete.

Programme and Plant

Prior to carrying out any concrete work, the Contractor shall obtain the approval of the Engineer in respect of:

- a) Structural programme,
- b) Concrete plant details,
- c) Materials to be used in concrete,
- d) Details of concrete,
- e) Construction joints

### **PSG7      TESTS**

#### **PSG 7.1.2 Frequency of sampling**

**Add the following to this clause:**

One sample shall consist of three concrete test cubes.

For each sample taken the position in the structure shall be recorded where the batch represented by that sample is placed as also the date sampled.

Sampling of concrete of a particular grade shall be as specified in Sub-clause 7.1.2 with the following frequency of sampling referred to in Sub-clause 7.1.2.2 being amended to read as follows:

"A minimum of 4 samples per day of each grade of concrete placed or 6 samples for pours in excess of 10 m<sup>3</sup> shall be taken."

## **PSG 7.2 Testing**

**Add the following Sub-clauses:**

### **PSG 7.2.5 Testing Watertight Concrete**

The Clear/potable water retaining structures shall be disinfected before testing. Any re-testing that may be required shall be at the Contractor's expense.

The entire inside surface of the reservoir including columns and roof shall be thoroughly hosed down with water and brushed until properly cleaned off all dirt and other foreign matter.

The floor of the structure shall then be flooded to a depth of 150 mm with chlorinated water and dosed at the rate of 150 grams of chloride or lime to every cubic meter of water. The entire inside surface shall again be scrubbed using this water. The workers engaged in this operation shall wear clean rubber boots. On completion the floor of the structure shall be swept clean.

The chlorinated water shall be stored until the free chlorine level has dropped to an acceptable level. Excess dirt swept from the floor into the sump may be discharged subject to written approval being obtained from the Local Authority.

Payment shall be a lump sum. The rate shall cover the costs of all materials and water used.

The reservoir shall be tested for water tightness in accordance with BS 8007 1987 Section 9.

#### **(a) Testing of the Structure:**

For testing the liquid retention, the structure shall be cleaned and initially filled to the normal maximum level with the water at a uniform rate of not greater than 2 m in 24 hours.

When first filled, the water level should be maintained by the addition of further water for a stabilising period while absorption and autogenous healing take place. After a stabilization period of 21 days, refill (top up) and record the water level 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 and rainfall, should not exceed 10 mm.

Notwithstanding the satisfactory completion of the test, any evidence of seepage of the liquid to the outside faces of the liquid-retaining walls shall be assessed by the Engineer against the requirements of the specification. Any necessary remedial treatment of the concrete, cracks, or joints shall be carried out from the liquid face where practicable. If a lining is used for this purpose, it shall be sufficiently flexible and not be in any way detrimental to the water quality.

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 water-tightness to be unsatisfactory, the Contractor when ordered by the Engineer shall discontinue such filling or testing and shall, at his own expense, immediately take approved steps to rectify the leakage and to make the work thoroughly sound to the complete satisfaction of the Engineer. All such rectification work shall be continued assiduously until a satisfactory test is obtained, which shall prove to the Engineer that water-tightness has been obtained.

If required by the Engineer, the structure shall be retested before the expiry of the Defects Liability Period.

The Works will not be certified complete until the structure has been proved by testing to be watertight to the satisfaction of the Engineer.

**(b) Testing of the Roof of water retaining structures**

The roof shall be tested on completion by using a hose or sprinkler system to obtain a sheet flow over the whole area of the roof for a period of not less than 6 hours.

The roof shall be considered satisfactory if no leaks or damp patches appear on the soffit.

**PSG7.2.6 Durability Testing:**

Concrete shall comply with the durability parameters defined below:

**(a) Water Sorptivity:**

Sorptivity is sensitive to surface effects and may be used to assess the effectiveness of initial curing.

**(b) Oxygen Permeability:**

Permeability is sensitive to changes in the coarse pore fraction and is thus a means of assessing the degree of compaction of concrete. It may be used to quantify the microstructure of the concrete and is sensitive to macro-defects such as voids and cracks.

**(c) Chloride Conductivity:**

Chloride conductivity provides a method of characterisation of concrete in the marine environment and may be used to assess the chloride resistance of concrete.

Unlike oxygen permeability and water sorptivity, chloride conductivity is not really a measure of construction quality, but it shall be used for materials selection and design of mixes in aggressive chloride conditions. It will therefore only be used as a check on mix designs during the initial stages of construction.

**(d) Concrete Cover:**

Concrete cover is a dimensional indicator of cover concrete depth. Cover concrete is the outer concrete layer which protects the internal reinforcing steel, and its depth varies according to the requirements of the different environmental exposure classes.

Test for cover shall be conducted using an approved calibrated electromagnetic cover meter.

This test shall be conducted when instructed by the Engineer to confirm that the specified depth of concrete cover has been achieved. The cover meter tests shall cover at least 1 m<sup>2</sup> for every 10 m<sup>2</sup> exposed. The average cover of the 1 m<sup>2</sup> subjected to the test shall be used to determine the payment as per Table PSG 7.3.10.3 unless the Contractor chooses to carry out additional tests as detailed under clause PSG 7.3.8. The cover meter must be calibrated for each project by drilling and measuring actual cover in at least 3 locations to validate the readings.

**(e) General:**

Durability predictions will be based on the following tests that shall be arranged by the contractor. The durability testing shall be carried out by a laboratory approved by the Engineer.

For testing, water sorptivity, oxygen permeability and chlorine conductivity, cores of 68 mm diameter shall be extracted from the structure when the concrete reaches the age of at least 28 days and tested for the durability criteria set out in PSG 7.3.7. The frequency

of the testing at the start of the contract shall be such that there is at least one test (consisting of 2 cores) per discrete concrete element, or per 15 m<sup>3</sup> poured (whichever is the lesser), until such time that the Engineer is satisfied that the specified criteria are consistently achievable. Hereafter testing shall be limited to one test per discrete concrete element or maximum concrete pour of 40 m<sup>3</sup> (whichever is the lesser), or as directed by the Engineer. Depending on access requirements, the frequency and locations of the tests may be changed to suit site requirements as directed by the Engineer. Note that for decks and walls, the cores shall be taken on the exposed faces of the concrete i.e. the soffit and side wall face, taking care not to cut the reinforcing bars. Where the cores do contain pieces of reinforcing steel, they shall not be used for the tests, particularly in the chloride conductivity test or where bleeding cavities may have formed.

The cores shall be extracted through the cover concrete from the constructed concrete element and a slice (25 mm thick) shall then be cut from the outer surface of this core such that the slice is representative of the middle layer of the cover concrete, i.e. the middle layer being a 25 mm thick slice of concrete, 5 mm from the exposed outer surface extending in towards the reinforcement, and tested. The positions at which the cores shall be extracted shall be as indicated by the Engineer.

Filling of the holes left by the drilling of the cores shall be the responsibility of the contractor and shall be carried out using an approved proprietary non-shrink repair mortar so as to restore structural integrity and durability of the structural element tested. The cost of drilling and filling of the holes shall be included in the rate make-up of pay items for durability testing.

#### **PSG 7.2.7 Depth Of Concrete Cover**

The procedure for testing for depth of reinforcement from concrete surface shall be in accordance with the manufacturer's requirements for the relevant electromagnetic cover meter. The number of readings taken to each 1 m<sup>2</sup> to be tested shall be such that an accurate average cover can be determined for the tested area.

#### **PSG 7.2.8 Shrinkage**

The dry shrinkage tests shall be conducted in accordance with SABS 1085. The drying shrinkage shall not exceed 0.04%.

### **PSG 7.3 Acceptance Criteria for Strength Concrete**

**Add the following Sub-clauses:**

#### **PSG 7.3.6 Durability Parameters Acceptance Ranges**

When tested in accordance with the test procedures described below for each potential durability parameter, the concrete shall meet the limits given in the tables below:

##### **PSG 7.3.6.1 Water Sorptivity And Oxygen Permeability**

<b>Table PSG 7.3.6.1 Water Sorptivity and Oxygen Permeability</b>		
<b>Acceptance Category</b>	<b>Test No. / Description / Unit</b>	
	<b>Water Sorptivity (mm/h)</b>	<b>Oxygen Permeability (log scale)</b>
Concrete made, cured and tested in laboratory	6	> 10.0
Full acceptance of in-situ cast concrete	< 8	> 9.15
Conditional acceptance of in-situ cast concrete (with remedial measures)	8 - 15	8.75 – 9.15
Rejection	> 15	< 8.75

### PSG 7.3.6.2 Chloride Conductivity

Table PSG 7.3.6.2 Chloride Conductivity (severe to very severe conditions)								
Concrete	100% PC		10% CSF		30% FA		50% GGBS	
Curing Period	28d	90d	28d	90d	28d	90d	28d	90d
Full wet cured	1.25	1.00	0.50	0.45	1.50	0.40	1.25	1.00
Moist cured (3 – 7d)	1.75	1.60	0.60	0.55	2.25	1.25	2.25	2.00

### PSG 7.3.6.3 Concrete Cover

Table PSG 7.3.6.3 Concrete Cover			
Test Description	Specified Cover (mm)	Acceptance Range	
		Minimum	Maximum
Concrete cover to reinforcement	20 – 30	As specified	As specified + 5 mm
	30 - 80	As specified	As specified + 10 mm

### PSG 7.3.7 Criteria For The Compliance With The Requirements

No extra payment shall be made for cube strength testing. The cost of cube strength testing shall be included in the rates tendered for concrete.

Water used for testing shall be free of charge except for failed tests when water will be charged at standard municipal rates.

In the event that the actual achieved average cube strengths of an element are less than 85% of the target mean strength, the Engineer may instruct the taking of cores for additional strength testing. The cost of taking the cores and repairing the holes in the structures shall be for the Contractor's account.

The Engineer will conduct routine tests for the durability parameters on cores taken from the completed elements during the construction, the costs for which shall be to the Employer's account unless the parameters are not met.

The test results shall be accepted or rejected based on the criteria as set out in Tables PSG 7.3.6.1, PSG 7.3.6.2 and PSG 7.3.6.3 based on the following categories:

- Full Acceptance: Concrete shall be accepted unconditionally and full payment shall be made.
- Conditional Acceptance: Concrete may be accepted at the Engineer's discretion with a warning that construction methods be examined to improve the durability criteria. A reduced payment shall be applied to all the relevant pay items under SABS 1200 G for the non-conforming element or concrete pour as set out in Tables PSG 7.3.10.1, PSG 7.3.10.2 and PSG 7.3.10.3. Alternatively, the Contractor may elect to carry out remedial work to improve the durability of the concrete to the criterion of "Full Acceptance" to the satisfaction of the Engineer, and receive full payment. All proposed remedial measures shall be subject to the approval of the Engineer. The cost of all such remedial work shall be for the Contractor's account.
- Rejection: The concrete shall be removed and replaced with fresh concrete at the expense of the Contractor, as directed by the Engineer.

Should the test result(s) indicate conditional acceptance or rejection of the item tested, the Contractor shall have the option of carrying out additional tests on that item, at his own expense, to confirm or disapprove the original test result(s). Not more than two such additional tests shall be carried out. Should one additional test confirm the original test result, then the original result shall serve to determine payment in accordance with Tables PSG 7.3.10.1, PSG 7.3.10.2 and PSG 7.3.10.3. If two additional tests are carried out and both such tests contradict the original

test result(s) then the effective penalty as per Tables PSG 7.3.10.1, PSG 7.3.10.2 and PSG 7.3.10.3, based on the original test result(s), shall be halved.

### PSG 7.3.8 Procedure In The Event Of Non-Compliance With The Requirements

Structural concrete elements or concrete pours shall be represented by test cubes and extracted cores, which shall be tested for strengths and the appropriate durability parameters.

If the durability parameters have been proved acceptable, the costs for such testing shall be borne by the Employer. However, where non-compliance to the specified parameters has been identified, the assessed element shall be rejected and at the Engineer's sole discretion any of the following measures may be considered at the Contractor's expense:

- (a) Coating with an approved product specifically designed to improve the non-conforming parameter depending on the severity of the test results.
- (b) Acceptance at reduced payment.
- (c) Demolition and rebuilding.

Where the Engineer allows conditional acceptance, reduced payment shall be applied to all the relevant pay items under SABS 1200 G for the non-conforming element or concrete pour according to Tables PSG 7.3.10.1, PSG 7.3.10.2 and PSG 7.3.10.3.

### PSG 7.3.9 Tests Ordered By The Engineer

One concrete cube strength test shall comprise the results of tests carried out on three standard test cubes made from concrete sampled from one batch of concrete in accordance with these specifications.

### PSG 7.3.10 Determination Of Reduced Payment

Payments for all durability concrete shall be based on the test results. The durability parameters are calculated according to Tables PSG 7.3.10.1, PSG 7.3.10.2 and PSG 7.3.10.3 below.

**Table PSG 7.3.10.1 Water Sorptivity**

TEST	Coastal ( $\leq 5$ km from coast and up to 15 km up river valleys/estuaries)		Inland ( $> 1$ km from coast)	
Water sorptivity (mm/h)	TEST RESULT	% PAYMENT	TEST RESULT	% PAYMENT
	$< 8$	100%	$< 8$	100%
	$8 < 12$	90%	$\geq 8 < 12$	90%
	$12 < 15$	85%	$\geq 12 < 15$	85%
	$\geq 15$	0%	$\geq 15$	0%

**Table PSG 7.3.10.2 Oxygen Permeability**

TEST	Coastal ( $\leq 5$ km from coast and up to 15 km up river valleys/estuaries)		Inland ( $> 1$ km from coast)	
Oxygen Permeability Index (log scale)	TEST RESULT	% PAYMENT	TEST RESULT	% PAYMENT
	$> 9.15$	100%	$> 9.5$	100%
	$> 9.0 \leq 9.15$	90%	$> 9.25 \leq 9.5$	90%
	$> 8.75 \leq 9.0$	85%	$> 9.0 \leq 9.25$	85%
	$\leq 8.75$	0%	$\leq 9.0$	0%

**Table PSG 7.3.10.3 Concrete Cover**

TEST	Coastal ( $\leq 5$ km from coast and up to 15 km up river valleys/estuaries)		Inland ( $> 1$ km from coast)	
	TEST RESULT	% PAYMENT	TEST RESULT	% PAYMENT
30 mm specified	$\geq 30 \leq 40$	100 %	$\geq 30 \leq 40$	100 %
	$\geq 25 < 30$	40 %	$\geq 20 < 30$	40 %
	$< 25$ or $> 40$	0 %	$< 20$ or $> 40$	0 %
40 mm specified	$\geq 40 \leq 50$	100 %	$\geq 40 \leq 50$	100 %
	$\geq 35 < 40$	40 %	$\geq 30 < 40$	40 %
	$< 35$ or $> 50$	0 %	$< 30$ or $> 50$	0 %
50 mm specified	$\geq 50 \leq 60$	100 %	$\geq 50 \leq 60$	100 %
	$\geq 45 < 50$	40 %	$\geq 40 < 50$	40 %
	$< 45$ or $> 60$	0 %	$< 40$ or $> 60$	0 %
60 mm specified	$\geq 60 \leq 70$	100 %	$\geq 60 \leq 70$	100 %
	$\geq 55 < 60$	40 %	$\geq 50 < 60$	40 %
	$< 55$ or $> 70$	0 %	$< 50$ or $> 70$	0 %
65 mm specified	$\geq 65 \leq 75$	100 %	$\geq 65 \leq 75$	100 %
	$\geq 60 < 65$	40 %	$\geq 55 < 65$	40 %
	$< 60$ or $> 75$	0 %	$< 55$ or $> 75$	0 %
75 mm specified	$\geq 75 \leq 85$	100 %	$\geq 75 \leq 85$	100 %
	$\geq 70 < 75$	40 %	$\geq 65 < 75$	40 %
	$< 70$ or $> 85$	0 %	$< 65$ or $> 85$	0 %
80 mm specified	$\geq 80 \leq 90$	100 %	$\geq 80 \leq 90$	100 %
	$\geq 75 < 80$	40 %	$\geq 70 < 80$	40 %
	$< 75$ or $> 90$	0 %	$< 70$ or $> 90$	0 %

Percentage payment for concrete cover shall be based on the average result of the total number of cover meter tests performed on a particular concrete element.

The overall percentage payment applied to a concrete member shall be based on the average of the percentage payments applicable to each durability parameter, together with the percentage payment based on the strength requirements described in the project specifications.

The reduced payments shall apply to the relevant payment items scheduled in the Schedule of Quantities.

### PSG 7.3.11 Grouting

The Contractor shall, where so ordered, carry out a site test for each grouting procedure. The tests shall be carried out on a dummy bedplate similar in configuration to that which is to be grouted, but not exceeding 1 m<sup>2</sup> in area unless otherwise ordered. When the dummy bedplate is dismantled, the underside shall show a minimum grout contact area of 80% with reasonably even distribution of the grout over the surface grouted except that, in the case of expanding grout, the minimum grout contact area shall be 95%. The test shall show evidence of good workmanship and materials and the results shall be to the satisfaction of the Engineer.

The Contractor shall, when so ordered, make standard test cubes from various grout mixtures and also subject them to compression tests to determine whether the specified strength has been achieved. Test procedures shall comply with the relevant requirements of Sub-clauses 7.2.1 to 7.2.3.

## **PSG 8 MEASUREMENT AND PAYMENT**

### **PSG 8.1.1 Formwork**

**Add the following Sub-clause:**

#### **PSG 8.1.1.7 Edges of blinding layer**

No separate payment will be made for formwork to the edge of the blinding layer. The rates tendered for concrete to the blinding layer shall cover the cost of such formwork.

#### **PSG 8.1.1.8 Chamfers and fillets**

No additional payment will be made for chamfers and fillets up to 40 mm wide. Larger fillets and chamfers will be measured by length in accordance with Sub-clause 8.2.5.

### **PSG 8.1.2 Reinforcement**

**Add the following to Sub-clauses 8.1.2.2 and 8.1.2.3:**

Notwithstanding the method of measuring and paying for reinforcement specified in Sub-clauses 8.1.2.2 and 8.1.2.3, reinforcement will be measured and paid for as scheduled.

### **PSG 8.1.3 Concrete**

**Add the following to Sub-clauses 8.1.3.3:**

The rates for concrete shall also cover:

- a) the use of dolomitic aggregate where prescribed,
- b) the cost of the preparation of design mixes by an approved laboratory and submission for approval by the Engineer,
- c) screeded finish of unformed surface as specified in PSG 5.5.10.1, as amended, Screeded finish, and
- d) inclusion of admixtures where specified.

## **PSG 8.2 Scheduled Formwork Items**

**Add the following payment item to this clause:**

### **PSG 8.2.7 Kickers .....Unit: m<sup>2</sup>**

Formwork to the edges of kickers will be measured as plane (or circular) vertical (not as narrow widths).

### **PSG 8.2.8 Edges of blinding layer**

No separate payment will be made for formwork to the edge of the blinding layer. The rates tendered for concrete to the blinding layer shall cover the cost of such formwork.

### **PSG 8.2.9 Chamfers and fillets..... Unit: m<sup>2</sup>**

No additional payment will be made for chamfers and fillets up to 40 mm wide. Larger fillets and chamfers will be measured by length in accordance with Sub clause 8.2.5.

## **PSG 8.4 Concrete**

### **PSG 8.4.4 Unformed surface finishes..... Unit: m<sup>2</sup>**

**Add the following to this Sub-clause:**

The rates for unformed surface finishes shall cover the cost of providing the respective surface finish as specified in PSG 5.5.10, as amended, Concrete Surfaces.

## **PSG 8.5 Joints**

### **Add the following to this clause:**

Only designated joints as shown on the drawings will be measured for payment according to the length of each type of joint constructed. The rate shall cover the cost of all materials, labour and plant required to construct each type of joint specified on the drawings, including the cost of all shuttering, treatment of the joint as specified in Sub-clause 5.5.7.3, as amended, the provision of chamfers as specified where concrete is exposed, as well as testing and repairing where necessary.

Non-designated joints will not be measured for payment.

### **Add the following Sub-clause to this payment clause:**

#### **PSG 8.5.1 Formed joints ..... Unit: m**

Formed joints will be measured by the length of the joint.

The rates shall cover the cost of all operations and materials specified in Sub-clause 5.5.7, as amended, and Sub-clause PSG 5.5.7.2, as amended, Formed joints (generally vertical or near vertical), and detailed on the drawings such as joint filler, dowel bars and tubes, bitumen coats, etc., but excluding waterstops or waterbars.

Waterstops and waterbars will be measured by length separately for each type.

#### **PSG 8.7 Grouting.....Unit: m<sup>2</sup>**

### **Add the following to this payment clause:**

Grouting of base plates and equipment bases will be measured by the volume of grout used.

The rate shall cover the cost of the supply and floating in of grout under the plates to ensure solid and complete filling of the gap.

#### **PSG 8.8 HD Bolts and miscellaneous Metal Work ..... Unit: t**

### **Add the following to this payment clause:**

Fixing of holding down bolts will be measured by number. The rate shall cover the cost of all things necessary to ensure that the bolts are effectively and rigidly held in position during casting, complete with sleeved pockets, all as detailed on the drawings.

### **Add the following payment items:**

#### **PSG 8.9 Impervious membrane..... Unit: m<sup>2</sup>**

The impervious membrane will be measured by the surface area covered excluding laps and wastage. The rate shall cover the cost of the supply, laying, jointing of sheets as recommended by the supplier and final trimming of outer edges.

#### **PSG 8.10 No-fines concrete..... Unit: m<sup>2</sup>**

No-fines concrete will be measured by area.

The rate shall cover the cost of supplying materials, constructing and placing in position the no-fines concrete, and shall include for the steel floated 20 mm mortar skim.

**PSG 8.11 Items cast in concrete ..... Unit: No.**

Items cast in concrete will be measured by number separately for each type of item.

Notwithstanding Sub-clause 8.2.6, the rate shall cover the cost of fixing in position and casting in the item as construction proceeds, irrespective of whether the Contractor chooses to fix the item in the formwork and cast it in directly or to box out a hole and grout the item in subsequently.

The item will be measured and paid separately.

The rate for the puddle pipes shall cover the cost of all things necessary to ensure that the fitting are effectively and rigidly held in position during casting including the certification and all as detailed on the drawings. Repairs for leaking cast in items will not be paid for.

**PSG 8.12 Granolithic screeds ..... Unit: m<sup>2</sup>**

Special floor finish will be measured by area. The rate shall cover the cost of the supply and application of the specified material, complete as specified by the manufacturer and to the approval of the Engineer. Repairs to unsatisfactory work will not be paid for. Measurement of granolithic screeds will be by the surface area covered.

The unit rate or lump sum shall cover the cost of all materials, labour and equipment required to provide the screed as specified in Sub-clause PSG 5.5.10.4, as amended, Granolithic screeds. The rate shall include the steel float finish.

**PSG 8.13 Precast paving slabs. .... Unit: m<sup>2</sup>**

Precast paving slabs will be measured by the area paved.

The rate shall cover the cost of compacting the area, application of weed-killer, supplying, laying and bedding the slabs, grouting the joints and filling any gaps, all as specified.

**PSG 8.14 PFA concrete.....Unit: m<sup>3</sup>**

Measurement and payment for PFA concrete shall be as specified in Sub-clause 8.1.3 as amended.

The tendered rate shall cover all costs in connection with the supply, storage, handling on site and mixing in of PFA.

**PSG 8.15 Watertightness test..... Unit: No.**

The watertightness test will be paid by a lump sum separately for each structure.

The sum shall cover the cost of all labour, equipment and materials to carry out the tests, as specified in Sub-clause PSG 5.5.11, as amended, Watertightness test, to rectify faults and to achieve a test result to the satisfaction of the Engineer.

The sum shall include for all water required over and above that required for one filling of the water retaining structure based on the assumption that water will be available in time through the potable water pipeline that shall be laid alongside the main sewer as part of this Contract.

A provisional item is provided for an extra payment to the above to allow for the water not being available through the pipeline in time and the Contractor has to make his own other arrangements for providing water for testing. Such an arrangement shall only come into effect on the Engineer's instruction.

**PSG 8.16 Slurry coat and curing.....Unit: m<sup>2</sup>**

Supply & apply waterproof treatment with Xypex Concentrate and Xypex modified to all areas inside tank.

The rate shall cover for the supply and surface treatment of specified concrete surfaces according to Sub-clause PSG 5.5.8.3, as amended.

**PSG 8.16 Miscellaneous Metalwork.....Unit: No.**

Payment shall be by number. Separate items shall be scheduled for the following where required:

(a) Manhole covers

The manhole cover in the reservoir roof shall be installed to the details shown on the drawings. The rate shall include supply, bitumen coating, installation and casting of the frame into the supporting concrete.

(b) Reservoir ventilators

The reservoir ventilators in the reservoir roof shall be installed to the details shown on the drawings. The rate shall include fabrication, galvanising, shuttering, grouting and installation.

(c) Step irons

Cast iron step irons shall be cast into the side of the reservoir wall, sump and manholes as detailed. The rate shall include for the supply and installation of the step irons.

**PSG 8.17 Black Plastic Bond Breaker ..... Unit: m<sup>2</sup>**

A 500 micron black plastic continuous layer is to be laid over the no-fines concrete under the reservoir floor. The side and end laps shall not be less than 100mm. Just before casting the sheeting shall be perforated in a grid pattern at 1 m centres.

Payment shall be by the square meter laid. Care shall be taken not to rip or tear the sheeting. All repairs shall be at the Contractor's expense.

**PSG 8.18 Teflon Sliding Bearings.....Unit: m**

Neoprene (Kilcher or similarly approved) Teflon sliding bearings shall be placed on the top of the reservoir wall prior to casting the roof slab. A 3T50/50 bearing shall be used for the reinforced concrete reservoir, while a 3T50/100 bearing shall be used for the prestressed concrete reservoir. The top of the wall shall be cast to a smooth steel float finish.

Payment shall be per linear metre for the preparing and placing of the bearings. The rate shall include the supply, laying, jointing and masking of the bearings to the polystyrene strip.

**PSG 8.19 Poly-urethane sealants .....Unit: m**

A one part polyurethane sealant shall be used in the outside joint between the reservoir roof and walls to the details shown and shall be finished off neatly leaving a smooth regular finish.

Payment shall be per linear metre. The rate shall include the supply, preparation, sealing and finishing.

**PSG 8.20 Commercial Laboratory. ....Unit: Prov Sum**

A Provisional Sum for the services of a commercial laboratory has been included in the Bill of Quantities for the Engineer's Acceptance Testing. The use of this laboratory is for additional testing required over and above the testing specified in SANS 1200 G and the variations to SANS 1200 G specified above. Testing shall only be paid on written instruction for additional testing from the Engineer.

The procedure for sampling and manufacturing, storing, curing and testing test cubes shall be in accordance with SABS 863.

## **SECTION PSHA: STRUCTURAL STEELWORK (SUNDRY ITEMS) (Applicable to SABS 1200 HA 1990)**

### **PSHA 3 MATERIALS**

#### **PSHA 3.1 Structural Steel**

Delete the Sub-Clause and substitute:

Except where scheduled to the contrary or shown on the drawings, the grade of steel to be used in the manufacture of the following shall be that grade normally supplied by reputable manufacturers approved by the Engineer:

All structural steelwork which shall include ladders, safety cages and platforms, shall be manufactured from 300W grade steel in conformity with SABS 1431, except where shown to the contrary on the drawings or in the schedule of quantities.

All stainless steel shall be grade 304, except where shown to the contrary on the drawings or in the schedule of quantities.

Grade 3Cr12 steel shall be used where scheduled or shown on the drawings and shall be fully pickled and passivated prior to installation.

### **PSHA 5 CONSTRUCTION**

#### **PSHA 5.1.2 Contractor to Provide Shop Details**

Add to the Sub-Clause:

The Contractor shall prepare his own shop details based on the dimensions and details given on the drawings and will be required to submit his shop details to the Engineer at least 3 weeks prior to fabrication. Written consent must be obtained from the Engineer, prior to commencing fabrication. The Contractor is still responsible for ensuring that the shop details are dimensionally correct.

#### **PSHA 5.2.6 Handrails**

Add to the Sub-Clause:

Handrailing shall be of tubular construction in Grade 304L stainless steel of an approved proprietary make.

Hand and knee rails shall be not less than 32 mm O.D. (wall thickness not less than 1,6 mm) and the height of the handrails (centre) shall be 1 000 mm above walk-way level, with knee rails located approximately midway between.

Stanchions shall be not less than 44 mm O.D. (wall thickness not less than 1,6mm) and shall have ball type or spun and flared connectors to suit horizontal or angled handrailing as required. The base plates shall not be less than 8mm thick.

In general all bends in the hand and knee railing shall be 140 mm radius. Handrails shall be either side or top mounted and shall be fastened with stainless steel nuts, bolts and washers.

Spacing between stanchions shall be determined by site conditions but in no case shall it exceed 1 800 mm c/c. At bends, stanchions shall be provided on either side at a distance of 300 mm from mid-bend.

Finished handrailing shall be true to line and level and connections shall be securely fixed by means of 2 No. stainless steel pins, finished flush on each side of the joints (to the approval of the Engineer).

All ends shall have closures joining the hand and knee railing.

The rate quoted per metre is to include for the supply and installation of the handrail, knee rail, portion of a stanchion, footing, holding down bolts and nuts and is to be inclusive of all cutting, mitring, welding, grinding and waste.

## **PSHA 5.2.7 Ladders**

Add to the Sub-Clause:

Stairs and ladders are to be provided in accordance with the details shown on the drawings.

## **PSHA 5.2.8 Open Grid Floors**

Add to the Sub-Clause:

Open grid steel flooring is to be cut and framed to the required panel shapes and sizes all in accordance with the details shown on the drawings.

## **PSHA 5.2.10 Protective Treatment**

Add to the Sub-Clause:

All mild steel shall be hot-dip galvanised except where shown to the contrary on the drawings or in the schedule of quantities. Hot-dip galvanising shall conform to SABS 121;2000 for heavy duty coatings or equivalent. Screwed and socketed tubing shall be galvanised in compliance with BS 1387. Galvanised malleable cast iron fittings shall comply with SABS 509.

## **PSHA 5.2.11 Pipe Clamps and Brackets and/or Supports (New Sub-Clause)**

Clamps and brackets around pipes and supports under pipes and valves are to be constructed to the details shown on the drawings and are to be provided with all necessary bolts for fixing to concrete.

Where pipes and valves are supported inside concrete chambers on fabricated steel pipe supports, a layer of 6 mm thick GP rubber sheet (Shore hardness 65) shall be attached to the top surface of the steel support by contact adhesive prior to receiving the pipe or valve to be supported. The rubber is to extend 20mm beyond the edges of the plate.

## **PSHA 5.3.6 Grouting**

Add to the Sub-Clause:

The Contractor will be fully responsible for all grouting work under this Contract.

## **PSHA 6 TOLERANCES**

### **PSHA 6.1.3 Accuracy of Erection**

Add to the Sub-Clause:

The accuracy of erection shall be the degree of accuracy II as tabulated but amended as follows:

In items d)1) and d)2) of the table the Degree of Accuracy given as " $\pm 5$ " shall be read as " $\pm 3$ ".

## **PSHA 7 TESTING**

### **PSHA 7.1 Test Certificates**

Delete the part sentence "in terms of the project specification" from the wording of the Sub-Clause and add the words "when so requested by the former" at the end of the sentence.

## **PSHA 8 MEASUREMENT AND PAYMENT**

### **PSHA 8.3 Scheduled Items**

Add the following introduction to the subsequent Sub-Clauses:

The tendered rates shall cover the cost of preparing shop details (where applicable), the supply of all materials, fabrication, process control, loading, transporting to Site, off-loading, erection (unless separately included), setting into concrete or brickwork and grouting in. They shall also include for the supply of all nuts, bolts, holding down bolts, washers, rivets, cutting to waste, all temporary bracing, templates and shuttering necessary for installing, transporting and erecting.

Where the scheduled items for steelwork include corrosion protection, then the price stated shall also include for such protection as specified in SABS 1200 HC as amended by PSHC. Similarly the materials and corrosion protection for nuts, bolts, washers etc shall match the steelwork ordered.

Where the requirements of the above introduction conflict with the requirements of Sub-Clauses 8.3.1 to 8.3.6 inclusive the requirements of the introduction shall take precedence.

## **SECTION PSHC: CORROSION PROTECTION OF STRUCTURAL STEEL (Applicable to SABS 1200 HC: 1988)**

### **PSHC CONSTRUCTION**

**Add the following Clause:**

#### **PSHC 5.1 Structural steel**

All structural steel members shall be hot dip galvanized.

#### **PSHC 5.3 Dressing and Repairs During Fabrication**

Add to the Sub-Clause:

Edges shall be ground to a smooth radius of at least 1 mm unless otherwise indicated

#### **PSHC 5.4.1 Preparation for Coating-General**

Add to the Sub-Clause:

The work of surface preparation prior to painting shall be carried out at the manufacturer's works.

The work of surface preparation prior to galvanising shall be carried out at the galvaniser's works.

##### **PSHC 5.4.3.1 Abrasive Blast Cleaning**

Add to (a) General:

The standard of blast cleaning required in terms of Swedish Standard SIS-05-59-00 is Sa 2 1/2.

The surface profile after blasting shall be in accordance with the paint manufacturer's requirements for the particular paint system being used.

Add to (b) Dry Abrasive Blast Cleaning

The blast cleaning media shall not be recycled.

##### **PSHC 5.4.3.2 Cleaning by Hand or with Power Tools**

Add to the Sub-Clause:

Cleaning by hand or power tools, where permitted or ordered by the Engineer, shall be to standard St 3 of SIS-05-59-00.

## PSHC 5.7 Coating system for New Steelwork

Add to the Sub-Clause:

All structural steel members shall be hot dip galvanized

The coating system to be applied under this Contract shall be carried out strictly in accordance with the manufacturers instructions which written instructions shall be obtained by the Contractor and a copy handed to the Engineer's Representative prior to commencing painting operations.

The paint system to be used shall be selected by the Contractor from the following alternative systems:

### PSHC 5.7.1 Painting System No. 1

For structural steelwork coastal regions - exterior work

<b>AECI Dulux</b>	<b>DFT (µm)</b>	<b>Plascon</b>	<b>DFT (µm)</b>
Zinc galv 6 <sup>(2)</sup>	75	Zinc rich primer M1 233	70
Zinc galv 1	touch up	Chemcote High Build CHC 101 – light grey	70
Chlorinated Rubber – Kemrist	<u>90</u> <u>165</u>	Chemcote enamel CHC 3000 series	<u>30</u> <u>170</u>

### PSHC 5.7.2 Painting System No.2

For structural steelwork coastal regions - interior work

<b>AECI Dulux</b>	<b>DFT (µm)</b>	<b>Plascon</b>	<b>DFT (µm)</b>
Zinc galv 6 <sup>(2)</sup>	60	Degrease with Aquasolv GR	-
Zinc galv 1	touch up	Zinc phosphate Primer UC 182	55
Chlorinated Rubber Kemrist	<u>60</u> <u>120</u>	Alkyd undercoat UC 189	35

### PSHC 5.7.3 Painting System No.3

For overcoating galvanised work

<b>AECI Dulux</b>	<b>DFT (µm)</b>	<b>Plascon</b>	<b>DFT (µm)</b>
Prepare surface Galvkleen	-	Prepare surface cleaner GIC	-
Corrocote 2(2)	10	Galvogrip metal primer	30
Chlorinated Rubber – Kemrist	<u>70</u> <u>80</u>	Universal undercoat UCI	30
		Supergloss Enamel Code G	<u>25</u> <u>85</u>

## **PSHC 5.8 Application of Painting Coatings**

Add to the Sub-Clause:

No application of paint shall be carried out before the paint manufacturer has approved the firm of applicators and the plant to be used, except where instructed to the contrary by the Engineer.

Where applicable, the range of temperature, outside the range of +5° to 35°C, within which paint may be applied, shall be that range which the Contractor shall obtain in writing from the manufacturer of the paint.

The embedded lengths of irremovable fasteners which penetrate deeper than 75mm from the concrete face may be left as base metal. The remaining portion shall comply with the paint system specified for the adjacent steelwork.

Surfaces which will become inaccessible for coating after fabrication or erection shall be given the full paint treatment specified plus one further top coat prior to the surfaces becoming inaccessible.

## **PSHC 5.9 Application of Metal Coatings**

Add to the Sub-Clause:

The grade of HDG (hot dipped galvanising) required shall be carried out in accordance with SABS 121:2000, and shall be that for heavy duty coatings. This shall be applicable to all metalwork where HDG is called for either on the drawings or in the Schedule of Quantities.

## **PSHC 7 TESTING**

### **PSHC 7.1d) Testing by the Contractor**

Tests are not required to be carried out after the application of each intermediate coat.

#### **PSHC 7.3.8 Dry Film Thickness**

The frequency of DFT test readings required is to be in accordance with SABS Method 141.

## **SECTION 3: ELECTRICAL**

SECTION 3.1	ELECTRICAL & ELECTRONIC SPECIFICATIONS
SECTION 3.2	CONTROL PHILOSOPHY
SECTION 3.3	INPUT OUTPUT (I/O) LIST

### **SECTION 3.1 ELECTRICAL AND ELECTRONIC SPECIFICATIONS**

#### **E100 ELECTRICAL INSTALLATION PROJECT SPECIFICATION**

E100.1	SCOPE OF WORK
E100.2	GENERAL INFORMATION
E100.3	STANDARDS AND REGULATIONS
E100.4	ELECTRICITY SUPPLY
E100.5	DRAWINGS, MANUALS, TRAINING, SPARES AND TOOLS
E100.6	INSPECTIONS, TESTS AND COMMISSIONING
E100.7	FIRE EXTINGUISHERS, FIRST AID KITS, DANGER SIGNS AND NOTICES
E100.8	MATERIALS, FINISHING AND PAINTING OF MATERIALS AND EQUIPMENT
E100.9	LV MOTOR CONTROL CENTRES
E100.10	LV MOTOR STARTERS
E100.11	FIELD CONTROL STATIONS
E100.12	LOW VOLTAGE POWER
CABLES	
E100.13	LOW VOLTAGE DISTRIBUTION
BOARDS	
E100.14	EARTHING AND LIGHTNING
PROTECTION	
E100.15	INTERIOR AND EXTERIOR LIGHTING
E100.16	POWER OUTLETS
E100.17	LOW VOLTAGE MOTORS
E100.18	CONNECTIONS TO MECHANICAL
EQUIPMENT	
E100.19	ENGINE DRIVEN ELECTRICITY GENERATING SET

#### **E200 ELECTRICAL INSTALLATION STANDARD SPECIFICATIONS**

E200.1	SCOPE OF WORK
E200.2	ELECTRICITY SUPPLY
E200.3	GENERAL
E200.4	COMPLIANCE WITH REGULATIONS AND STANDARDS
E200.5	STANDARD SPECIFICATIONS
E200.6	BUILDER'S WORK
E200.7	DRAWINGS, MANUALS, LITERATURE, TUITION, SPARES AND TOOLS
E200.8	INSPECTION, TESTS AND COMMISSIONING
E200.9	FIRE EXTINGUISHERS. FIRST AID KITS DANGER AND INSTRUCTION SIGNS FOR SUBSTATIONS
E200.10	NAMEBOARDS
E201	MATERIALS
E202	FINISHING AND PAINTING OF MATERIALS AND EQUIPMENT
E203	FIXING OF MATERIALS
E204	ENCLOSURES FOR DISTRIBUTION BOARDS, MOTOR CONTROL CENTRES AND OTHER BUILDING SERVICES PANELS
E205	LOW VOLTAGE SWITCHGEAR AND CONTROLGEAR FOR DISTRIBUTION BOARDS, MOTOR CONTROL CENTRES, CUBICLES AND PANELS
E206	BUSBARS
E207	CURRENT TRANSFORMERS
E208	LOW VOLTAGE MOTOR PROTECTION AND RELAYS
E209	WIRING IN DBS, MCCS AND PANELS
E210	WIRING- AND CABLE TERMINATIONS AND TEST TERMINAL BLOCKS

E211	GLANDS AND GLAND PLATES FOR PVC AND PILOT CABLES
E212	CABLE TERMINATIONS, JOINTS, CABLE END BOXES, ENCLOSURES AND CLAMPS
FOR CABLES RATED 3,3 KV AND ABOVE	
E213	SWITCHBOARD ACCESSORIES
E214	NAME PLATES AND LABELS
E215	METERING AND INDICATION EQUIPMENT
E216	EARTHING
E217	WIREWAYS
E218	CIRCUITRY
E219	WIRING IN WIREWAYS
E220	CABLE TRAYS AND LADDERS
E221	ACCESSORIES: LIGHT SWITCHES AND SOCKET
OUTLETS	
E222	LUMINAIRES
E223	LIGHTNING PROTECTION
E231	MEDIUM VOLTAGE (UP TO 33 KV), LOW VOLTAGE AND PILOT
CABLES	
E234	VARIABLE SPEED DRIVES (VSDS)
E237	STREET- AND SECURITY LIGHTING
E238	MASTS: MANUFACTURING AND
INSTALLATION	
E239	STANDBY DIESEL GENERATOR
E241	LOW VOLTAGE ELECTRIC MOTORS

This section is comprised of:

- A project specification which details the electrical scope of works under this Contract.
- Standard electrical specifications

### **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 from the existing Linbro Park Reservoir into the new Linbro Park 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 powercables.
- 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

#### **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.

### **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).

### **E100.4 ELECTRICITY SUPPLY**

The Contractor is responsible for the 400V, 500kVA electricity supply from the local electricity supply authority from City Power for the new pump station at Linbro Park.

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 Linbro Park 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%

### **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.

### **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

### **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).

### **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.

#### **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.

#### **E100.6 INSPECTIONS, TESTS AND COMMISSIONING**

In addition to the requirements of Standard Specification E200.8, the following requirements shall be complied with:

##### **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.

##### **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 Speed Drives (VFDs):**

- 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.

### **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 Linbro Park 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.

### **E100.8 MATERIALS, FINISHING AND PAINTING OF MATERIALS AND EQUIPMENT**

#### **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.

#### **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.

### **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.

### **E100.9    LV MOTOR CONTROL CENTRES**

#### **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.

#### **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

#### **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.

#### **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.

#### **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).

#### **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.

#### **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)

### **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.

### **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.

### **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:

<b>Indication</b>	<b>Colour</b>	<b>Example / Comment</b>
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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.

### 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.

### 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.

### **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.

### **E100.10 LV MOTOR STARTERS**

#### **E100.10.1 GENERAL**

Three 400V low voltage Variable Speed Drives (VSDs) shall be provided for the booster pump motors at Linbro pump station. The VSDs 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 VSDs shall be fed from dedicated motor feeder circuit breakers in the LV switchboard. These VSDs shall be connected as shown on the LV single-line diagrams.

#### **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 three (3) 400V, 160kW variable Speed Drives (VSDs) for the new pump motors at the new Linbro Park Pump station.

The VSDs 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 VSD 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 VSD 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 VSD installation.

### **E100.10.3 ACCEPTABLE MANUFACTURERS**

The variable frequency convertors shall either be Mitsubishi, ABB, Schneider, or equally approved.

### **E100.10.4 CONSTRUCTION AND PERFORMANCE**

The VSDs will be rated for use with standard squirrel cage induction motors driving centrifugal water pumps. The Contractor shall be responsible for the system (VSD / 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 VSD 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 VSD 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 VSD shall be supplied as cabinet units equipped with an active supply unit and low harmonic line filter.

### **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 VSDs with active front ends or a combination of VSDs with high-pulse diode front ends and associated harmonic filters shall be provided.

Should DFE VSDs be provided, tuned harmonic filters shall be provided for each VSD individually.

#### **E100.10.6 MOTOR PROTECTION**

The VSD shall provide protection for the motor against the following:

- Thermal overload;
- Locked rotor;
- Under-voltage;
- Short circuit; and
- Earth Fault.

#### **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 VSD panels shall be equipped with fans for drawing air in through filtered louvres and discharging the air out the top of the panel.

#### **E100.10.8 DIP RIDE-THROUGH**

The VSDs 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 VSD 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 VSDs.

The VSDs shall also be capable of riding through a loss of auxiliary power for up to 1s.

#### **E100.10.9 AUTOMATIC RESTART**

Should the VSD be subjected to a voltage dip or power interruption of a magnitude and / or duration that causes the VSD to shut down, the VSD shall not automatically restart itself. However, the VSD shall be available to be restarted by the pump station's control system.

#### **E100.10.10 MOTOR COMPATIBILITY**

The VSDs 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 VSDs 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 VSD supplier shall ensure that the maximum allowable increase in the floating neutral voltage does not exceed the following conditions:

Peak Voltage  $= 1.9 \times V_n$

(rms); and  $dv/dt = 7-15 \text{ kV}/\mu\text{s}$ .

Where  $V_n$  is the rated RMS voltage of the motor.

These values must not be exceeded at any condition of VSD 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.

## **E100.10.11 CONTROL AND MONITORING**

VSDs 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 VSD 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.

### **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.

### **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.

### **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.

### **E100.12 LOW VOLTAGE POWER CABLES**

#### **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.

#### **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 Linbro Park 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.

#### **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.

#### **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.

#### **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.

#### **E100.13 LOW VOLTAGE DISTRIBUTION BOARDS**

##### **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.

##### **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 mm<sup>2</sup> insulated earth wire.

Detachable gland plates suitable for receiving the cable shall be provided at the bottom side of Distribution board with glands.

### **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.

### **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.

### **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.

### **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.

## **E100.14 EARTHING AND LIGHTNING PROTECTION**

### **E100.14.1 GENERAL**

The earthing system which shall be provided at the Linbro Park Pump station shall comprise the following:

- An earth electrode and associated main earth bar.
- Earthing conductors
- Earth continuity conductors
- Bonding

### **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 70mm<sup>2</sup> 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.

### **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.

### **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.

### **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.

## **E100.15 INTERIOR AND EXTERIOR LIGHTING**

### **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.

#### **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.

#### **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 cable.

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.

#### **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.

#### **E100.16 POWER OUTLETS**

##### **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.

### **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 linediagrams.

Samples shall be submitted to the engineer for approval.

### **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.

### **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.

### **E100.18 CONNECTIONS TO MECHANICAL EQUIPMENT**

Where the single-line diagrams indicate a local disconnecter 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 disconnecter alongside the mechanical equipment, and the final connection from the disconnecter to the equipment shall be made by the installer of the mechanical equipment.

### **E100.19 ENGINE DRIVEN ELECTRICITY GENERATING SET**

#### **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:

<b>SPEC NO.</b>	<b>TITLE</b>
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

### **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.

### **E100.19.3 GENERAL**

This specification specifies the standby power requirements for the Linbro Park pump station.

The standby power system comprises a stationary diesel alternator set to provide standby power for the purpose of running:

- 3 x 160 kW electric motor driven pump sets – Method of starting: VSD 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 sound attenuated generator room 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: 0-50°C.
- Relative humidity: 80% non-condensive
- Altitude: 1782m above sea level
- Environment: Regular

### **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 attenuation 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.

#### **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

Item 14.

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.

#### **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.

#### **E100.19.7 EQUIPMENT**

##### **A.D iesel 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.

#### **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.

#### **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.

#### **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.

#### **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

#### **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.

#### **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.

#### **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.

#### **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.

#### **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.

### **E200 ELECTRICAL INSTALLATION PROJECT SPECIFICATION**

#### **E200.1 SCOPE OF WORK**

**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.

**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.

#### **E200.2 ELECTRICITY SUPPLY**

**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.

### **E200.3 GENERAL**

#### **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.

#### **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.

#### **E200.3.3 DEFINITIONS**

**E200.3.3.1** "Main Contractor", "Building Contractor", or "Builder" shall mean the Principal Contractor, if such exists as stated in the Project Specification.

**E200.3.3.2** "Contractor" shall mean the Contractor or Subcontractor, as applicable, appointed in terms of this document.

**E200.3.3.3** "Contract" shall mean the contract or subcontract as applicable in terms of this document.

**E200.3.3.4** "Extra low voltage" shall mean voltages of 50V or less.

**E200.3.3.5** "Low voltage" shall mean voltages not exceeding 1 000V.

**E200.3.3.6** "Medium voltage" shall mean voltages exceeding 1 000V.

**E200.3.3.7** "Isolator" shall mean "switch-disconnector".

**E200.3.3.8** "Main Switch" shall mean "main disconnect" or "local disconnect", as applicable.

**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.

**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.

**E200.3.3.11** "Provide" shall mean supply and install.

**E200.3.3.12** "Installation" shall mean the electrical installation covered by this document.

**E200.3.3.13** "Approved" shall mean acceptable to the Employer in the sole opinion of the Engineer.

**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.

**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.

**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.

#### **E200.4 COMPLIANCE WITH REGULATIONS AND STANDARDS**

**E200.4.1** The electrical installation shall comply with the latest revisions and amendments of the following:

**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".

**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.

**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.

**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.

**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.

**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.

**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.

**E200.4.1.8** The Municipal By-laws and Regulations and any regulations of the Supplier of Electricity.

**E200.4.1.9** The Local Fire Office Regulations.

**E200.4.1.10** Regulations of Telkom.

**E200.4.1.11** The relevant codes and specifications as defined under Clause 3.3.16.

**E200.4.1.12** The regulations of the local gas supplier where applicable.

**E200.4.1.13** The standard Regulations of any Government Department or other statutory body where applicable.

**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.

**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.

**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.

## **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
<b>SWITCHGEAR AND CONTROL GEAR</b>			
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		
<b>TRANSFORMERS AND MINI-SUBS</b>			
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		

Converter 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		
<b>CABLES</b>			
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
<b>CURRENT AND VOLTAGE TRANSFORMERS</b>			
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		
<b>EARTHING AND LIGHTNING / SURGE PROTECTION</b>			
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		
<b>METERS, INSTRUMENTS AND RELAYS</b>			
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		
<b>CAPACITORS</b>			
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	

## **E200.6 BUILDER'S WORK**

### **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.

### **E200.6.2 CHASING**

**E200.6.2.1** The Contractor shall chase only where it is impossible to build-, or cast-in.

**E200.6.2.2** No face-brick or finished surface may be chased without the permission of the Engineer and the Builder.

**E200.6.2.3** No structural concrete may be chased without the permission of the Engineer and Builder.

**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.

**E200.6.2.5** The Contractor will be held responsible for any damage caused by him to the building work or any other service.

### **E200.6.3 DUCTS, SLEEVES AND OPENINGS**

**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.

**E200.6.3.2** Do not cut any structural concrete without prior permission of the Builder and Engineer.

**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.

## **E200.7 DRAWINGS, MANUALS, LITERATURE, TUITION, SPARES AND TOOLS**

**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:

**E200.7.1.1** The Engineer's drawings;

**E200.7.1.2** The Architect's drawings;

**E200.7.1.3** The Structural Engineer's drawings;

**E200.7.1.4** The Engineer's drawings of the other disciplines, as applicable.

**E200.7.1.5** The drawings of other services installations that are relevant for co-ordination and installation.

**E200.7.1.6** The installation drawings of other Contractors and Subcontractors where applicable.

**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.

**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.

**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.

**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.

**E200.7.6** Drawings to be entitled "Record" shall bear the signature of the Contractor, or his authorised representative, and the date.

**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.

**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.

**E200.7.9** The Contractor shall submit to the Engineer two sets of approved microfilm of each of the record drawings, if specified\*\*\*.

**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: -

**E200.7.10.1** Dimensioned drawings of the layout of the equipment and systems.

**E200.7.10.2** Wiring diagrams cross referred to the drawings described above, and to the Engineer's layout and schematic drawings.

**E200.7.10.3** All Test Certificates for tests done at the factories and on the site.

**E200.7.10.4** System and equipment descriptions.

**E200.7.10.5** Operating instructions.

**E200.7.10.6** Maintenance, adjustment and calibration instructions with preventive maintenance schedule and fault-finding procedures.

**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.

**E200.7.11** The Contractor shall provide thorough tuition of the Employer's staff in the operating and maintenance of the contract works.

**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.

**E200.7.13** The Contractor shall provide a complete set of tools associated with equipment offered per substation.

**E200.7.14** The installation shall not be accepted until the manuals have been approved by the Engineer and handed over to the Employer.

## **E200.8 INSPECTION, TESTS AND COMMISSIONING**

**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.

**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.

**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.

**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.

**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.

**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.

**E200.8.7** Carry out additional special tests as required by the Engineer and provide the required test equipment.

**E200.8.8** Timeously advise the Engineer of all inspections and tests as the Engineer reserves the right

to witness such inspections and tests.

**E200.8.9** Provide access, tools, instruments and attendance, to assist the Engineer who may perform verification tests at any time.

**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.

**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).

**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.

**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.

#### **E200.8.14 INSPECTIONS, TESTS AND COMMISSIONING WITH REFERENCE TO MATERIAL AND EQUIPMENT**

##### **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.

##### **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.

### **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.

### **E200.9 FIRE EXTINGUISHERS. FIRST AID KITS DANGER AND INSTRUCTION SIGNS FOR SUBSTATIONS**

#### **E200.9.1 FIRE EXTINGUISHERS**

**E200.9.1.1** Unless otherwise specified, 5kg type fire extinguishers or nearest standard sizes offered by manufacturers, shall be supplied for substation building.

**E200.9.1.2** Fire extinguishers shall be of the CO<sub>2</sub> type or of a type approved for the fighting of fires where electrical apparatus and oil fires are involved.

**E200.9.1.3** Unless otherwise specified, fire extinguishers shall be provided as follows:

- 1) Medium voltage switchrooms: One extinguisher per 30m<sup>2</sup> of floor area.
- 2) Low voltage rooms One per room.
- 3) Transformer rooms One per transformer.

**E200.9.1.4** Fire extinguishers shall be mounted on suitable wall mounted brackets.

**E200.9.1.5** Fire extinguishers shall be installed next to exit doors wherever possible.

#### **E200.9.2 FIRST AID KITS**

**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.

**E200.9.2.2** The first aid kit shall be housed in a suitable metal box with internal trays and a metal lid.

**E200.9.2.3** The first aid kit shall be mounted on a suitable wall mounted shelf next to the substation main exit door.

**E200.9.2.4** One first aid kit shall be provided for every substation building.

#### **E200.9.3 DANGER SIGNS AND NOTICES**

**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.

**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.

**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.

**E200.9.3.4** One set of notices called for above shall be provided and installed for each substation building

**E200.9.3.5** The notices shall be displayed at a prominent position inside the building.

**E200.9.3.6** The notices shall be made from suitable plastic with engraved lettering.

## **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.

## **E201 MATERIALS**

**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.

**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.

**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

**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.

**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.

**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.

**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.

## **E202 FINISHING AND PAINTING OF MATERIALS AND EQUIPMENT**

### **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.

### **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).

### **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.

### **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).

## **E203 FIXING OF MATERIALS**

**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:

**E203.1.1** Concrete (in situ) - expanding cast-in, or gun-bolted, metal screw-fasteners.

**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.

**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.

**E203.1.6** Woodwork - woodscrews, not nails.

**E203.1.7** Hollow tiles - spring toggles of not less than 6 mm diameter, but only with permission from the Engineer.

**E203.1.8** Exposed to weather - solid brass or stainless-steel screw-fasteners.

**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.

**E203.3** Where sizes of fasteners etc. are not specified, submit samples and proposals to the Engineer for approval.

**E203.4** Do not gun-bolt into ash bricks, brickwork, gas-beton or precast concrete, except as permitted by the Engineer in writing.

**E203.5** The Contractor will be held responsible for any damage to Builder's work due to unauthorised inadmissible gun-bolting.

**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.

**E203.7** Provide suitable washers under screw heads and nuts.

**E203.8** Install materials in accordance with manufacturer's instructions and recommendations in all respects including type, size and spacing of fixings.

## **E204 ENCLOSURES FOR DISTRIBUTION BOARDS, MOTOR CONTROL CENTRES AND OTHER BUILDING SERVICES PANELS**

### **E204.1 GENERAL**

**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.

**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

**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

**E204.1.4** The Project Specification sets out which DBs, MCCs and panels shall be provided under the contract.

**E204.1.5** Unless otherwise stated in the Project Specification, MCCs and floor-standing distribution boards shall be Form 4a to SANS IEC 60439.

**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.

**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.

**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).

**E204.1.9** Sufficient space shall be provided in enclosures for internal wiring, incoming and outgoing cabling, and cabling for any future circuits.

**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.

**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.

## **E204.2 CONSTRUCTION OF FLOOR-MOUNTED ENCLOSURES**

### **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.

### **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.

#### **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.

#### **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.

### **E204.3 CONSTRUCTION OF WALL-MOUNTED ENCLOSURES**

#### **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.

#### **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 disconnect or local disconnect 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.

#### **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.

## **E205 LOW VOLTAGE SWITCHGEAR AND CONTROLGEAR FOR DISTRIBUTION BOARDS, MOTOR CONTROL CENTRES, CUBICLES AND PANELS**

### **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.

### **E205.2 SURGE ARRESTERS**

**E205.2.1** Surge arresters shall be provided for each phase in all boards, connected to each phase of the incoming cables.

**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.

### **E205.3 AIR CIRCUIT BREAKERS (ACBs)**

**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.

**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.

**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.

**E205.3.4** Interlocking shall be provided to ensure that an ACB is fully isolated before access to any live terminals can be obtained.

**E205.3.5** ACBs shall be horizontally withdrawable allowing full maintenance and tests without the breaker having to be removed from the withdrawal mechanism.

**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.

**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.

**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.

**E205.3.9** A mechanically operated "ON/OFF" or ("I/O") position indicator shall be incorporated.

**E205.3.10** Facilities for padlocking in the "off" position shall be provided.

**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.

**E205.3.12** Where noted on the drawings special purpose interlocking (key/mechanical/electrical) shall be provided between ACBs.

**E205.3.13** Unless otherwise stated in the Project Specification, the ACBs shall have a one second fault withstand rating.

#### **E205.4 MOULDED CASE CIRCUIT BREAKERS (MCCB's)**

**E205.4.1** Moulded case circuit breakers shall comply with the relevant codes and specifications. MCCB's shall be of flush panel mounting type.

**E205.4.2** MCCB's with ratings of 100A and less shall be suitable for mounting on a DIN rail.

**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.

**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.

**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.

**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.

**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.

**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.

**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.

**E205.4.10** Where called for, MCCB's shall be capable of remote closing using the specified control voltage.

**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.

**E205.4.12** Current limiting MCCB's will not be allowed unless otherwise stated in the Project Specification.

**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.

**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.

## **E205.5 DISCONNECTORS**

**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.

**E205.5.2** The disconnectors shall have the ratings specified on the drawings.

**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.

**E205.5.4** Disconnector handles shall have an integral key lock or padlocking facility.

**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.

## **E205.6 SWITCHES AND SELECTOR SWITCHES**

**E205.6.1** Switches and selector switches shall be switch disconnectors complying with the relevant SANS specification.

**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.

**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.

**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.

**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.

**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.

**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.

**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.

**E205.6.9** Switches shall be provided with a clear "ON/OFF" or "I/O" position indicator.

## **E205.7 BUS-SECTION SWITCHES**

**E205.7.1** Bus-section switches shall be interlocked with the incoming switchgear by means of special-purpose key interlocking facility when specified.

**E205.7.2** Bus-section switches of rating less than 1 000A shall comprise isolators.

**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.

**E205.7.4** Busbar selector or change-over switches shall be provided with suitable position indicators.

## **E205.8 TIME SWITCHES**

**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.

**E205.8.2** Time switches shall be fitted with a manual overriding switch.

**E205.8.3** An external bypass switch shall be provided in each time switch circuit.

**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;

**E205.8.5** The whole mechanism shall be totally enclosed in a dust-proof enclosure.

## **E205.9 PHOTO SWITCHES**

**E205.9.1** Photo switches shall comply with the relevant codes and specifications.

**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.

**E205.9.3** An external bypass switch shall be provided in each photo switch circuit.

**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.

**E205.9.5** The photo-electric cells shall have a time delay of not less than 30 seconds.

**E205.9.6** Photo-electric cells shall be completely waterproof and shall be of robust construction.

**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.

**E205.9.8** The photo-electric cells shall be provided with built-in lightning arresters.

**E205.9.9** Samples of photo-electric cells shall be submitted to the Engineer for approval prior to the ordering thereof.

**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-sub.

## **E205.10 COMBINATION FUSE-SWITCH (CFS) UNITS**

**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.

**E205.10.2** Fuse-switches shall be capable of breaking 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.

**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.

**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.

**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.

**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.

**E205.10.7** All components shall be capable of continuously carrying rated current without excessive temperature rise.

**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.

**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.

**E205.10.10** Provide facilities for padlocking in the "off" position.

**E205.10.11** In all cases, the top terminal of fuses shall be the live terminal.

**E205.10.12** Six spare fuses shall be provided for each rating fitted.

## **E205.11 FUSE LINKS AND HOLDERS**

**E205.11.1** Fuse links shall be high-rupturing capacity (HRC) cartridge type fuse links conforming to the relevant codes and specifications.

**E205.11.2** HRC fuse link holders shall be of the withdrawable bakelite type and shall conform to the relevant codes and specifications.

**E205.11.3** Each fuse link and holder shall incorporate a visual inspection eye for fault location.

**E205.11.4** Fuses protecting a specific instrument shall be mounted as a group in close proximity to the relevant instrument.

**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.

**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.

**E205.11.7** Six spare fuses shall be provided for each rating fitted.

**E205.11.8** The spare fuses shall not be used by the Contractor during erection, commissioning, or maintenance.

## **E205.12 EARTH LEAKAGE PROTECTION UNITS**

**E205.12.1** Earth leakage protection units shall conform to the relevant codes and specifications.

**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.

**E205.12.3** All units shall have test push buttons and, unless otherwise specified the sensitivity shall be 30 mA.

**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.

## **E205.13 CONTACTORS**

**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.

**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.

**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.

**E205.13.4** Each contactor shall be provided with at least two normally open and two normally closed auxiliary contacts, unless otherwise specified.

**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.

**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.

### **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.

**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.

## **E206 BUSBARS**

**E206.1** Busbars, metal-enclosed busbar trunking systems and connections shall comply with the relevant codes and specifications.

**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.

**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.

**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.

**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.

**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.

**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.

**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.

**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.

**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	-

**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.

**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.

**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.

**E206.14** Unless fully tested in accordance with SANS IEC 60439-1, the current density of copper busbars shall not exceed 2A/mm<sup>2</sup> for currents up to 1600A, or 1.6A/mm<sup>2</sup> for currents above 1600A.

**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.

**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.

**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.

#### **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  $S = 0,006 \times I$  mm<sup>2</sup> where "S" is the area in mm<sup>2</sup>, 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.

#### **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 busbar trunking shall be subject to the Engineer's 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.

#### **E207 CURRENT TRANSFORMERS**

**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.

**E207.2** Each panel shall be equipped with the current transformers as specified in the Project Specification and or drawings.

**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.

**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.

**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

**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.

**E207.7** The rated primary currents of current transformers shall be 10, 15, 20, 30, 50 and 75 Amperes or their decimal multiples.

**E207.8** The current transformers secondary ratings shall be 5A unless otherwise specified.

**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.

**E207.10** The class of insulation of current transformers shall be Type A (maximum temperature rises 60°C) unless otherwise specified.

**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.

**E207.12** The error in turns ratio on any tapping of a Class X current transformer shall not exceed  $\pm 0,25\%$ .

**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.

**E207.14** The VA ratings shall be sufficient to operate the various metering equipment and relays but shall not be less than 10 VA.

**E207.15** The accuracy limit factor of the protection current transformers shall be 15 unless otherwise specified.

**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

**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.

**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.

**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.

**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.

**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.

## **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.

### **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.

### **E207.22.2 Routine Tests: General**

**E207.22.2.1** Verification of terminal markings and polarity tests.

**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.

### **E207.22.3 Additional Routine Tests for Measuring Current Transformers**

- Tests shall be performed to verify limits of current error and phase displacement.

### **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.

#### **E207.22.5 Additional Routine Tests for Special Purpose Current Transformers: Class X**

Routine tests shall be performed to verify 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.

#### **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.

#### **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.

#### **E208 LOW VOLTAGE MOTOR PROTECTION AND RELAYS**

##### **E208.1 MOTORS UP TO AND INCLUDING 55KW**

**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.

**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.

**E208.1.3** The overload thermal relays shall be phase loss sensitive and shall be provided with a manual reset button.

**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.

**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.

**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.

## **E208.2 MOTORS LARGER THAN 55KW**

**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.

**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}.

**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  $\Omega$  (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.

## **E209 WIRING IN DBS, MCCS AND PANELS**

**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.

**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.

**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.

**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.

**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.

**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.

**E209.7** Additional red cable markers marked "T" in white shall also be fitted on wires associated with trip circuits.

**E209.8** When the board main disconnect or local disconnect 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.

**E209.9** All control terminals shall be accessible from the rear, except in the case of front access boards.

**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.

**E209.11** The supply end connections to all equipment shall always be at the top and the load end connections at the bottom.

**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.

**E209.13** A maximum of two conductors shall be used per equipment terminal.

**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.

**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

**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.

**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.

**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.

## **E210 WIRING- AND CABLE TERMINATIONS AND TEST TERMINAL BLOCKS**

### **C3.3.3.11.1 E210.1 GENERAL**

**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.

**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.

**E210.1.3** The terminal blocks shall have a temperature rating of at least T40 for indoor and T55 for outdoor switchgear.

### **E210.2 RAIL-MOUNTED WIRING TERMINAL BLOCKS**

**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.

**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.

**E210.2.3** Terminals shall be sized and rated to match the conductors that are connected to them.

**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.

**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.

**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.

**E210.2.7** Full details and samples of terminal strips shall be submitted to the Engineer for prior approval.

**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.

### **E210.3 POWER CABLE TERMINALS**

**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 10mm<sup>2</sup>, clamp type terminals

may be provided, but the type where the clamp screws are in direct contact with the conductor will not be acceptable.

**E210.3.2** The terminals for power cables shall be large enough for the terminating lugs of the cable sizes specified.

**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.

**E210.3.4** Diagonal or vertical arrangement of terminals for power circuits will not be accepted.

**E210.3.5** Where aluminium core cables are used, suitable tinned, copper or aluminium lugs with Densal paste shall be used for the termination.

**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.

**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.

**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.

**E210.3.9** The terminals of each individual circuit shall be clearly labelled with the circuit name and number.

## **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.

## **E211 GLANDS AND GLAND PLATES FOR PVC AND PILOT CABLES**

### **E211.1 GLANDS**

**E211.1.1** Mechanical cable glands and flameproof glands shall comply with the relevant codes and specifications.

**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.

**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.

**E211.1.4** Glands and components shall be manufactured of non-corrosive material such as nickel-plated brass.

**E211.1.5** Adjustable cable glands of the correct size designation shall be provided in switchboards for all cable types as specified.

**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.

**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.

**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.

**E211.1.9** Glands for outdoor use shall be equipped with a waterproofing shroud and an inner seal kit.

**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.

## **E211.2 GLAND PLATES**

**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.

**E211.2.2** Gland plates shall be at least 200mm above the normal floor level.

**E211.2.3** Gland plates shall be from non-magnetizing material where single core cables are terminated to the boards

## **E212 CABLE TERMINATIONS, JOINTS, CABLE END BOXES, ENCLOSURES AND CLAMPS FOR CABLES RATED 3,3 KV AND ABOVE**

**E212.1** Cable terminations and enclosures shall comply with the relevant codes and specifications.

**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.

**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.

**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.

**E212.5** If approved by the Engineer, heat shrink type cable terminations and joints may be provided.

**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.

**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.

**E212.8** Heat shrink terminations shall be completely non-tracking and U.V. stabilized to ensure long life.

**E212.9** Outdoor heat shrink terminations shall be equipped with sheds to increase flashover distances as recommended by the supplier for the specific voltage.

**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.

**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.

**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 120mm<sup>2</sup>.

**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.

**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.

**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.

**E212.16** 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.

**E212.17** 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.

**E212.18** 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.

**E212.19** 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.

**E212.20** 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.

**E212.21** 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.

**E212.22** 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.

**E212.23** 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.

**E212.24** 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		

**E212.25** 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 70mm<sup>2</sup> 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.

**E212.26** Compound shall conform to the relevant codes and specifications. Oil filling compounds shall not be acceptable.

**E212.27** 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.

**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. : 185mm<sup>2</sup> 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.

**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.

#### **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.

## **E213 SWITCHBOARD ACCESSORIES**

### **E213.1 CONTROL PUSHBUTTONS**

#### **E213.1.1 GENERAL**

**E213.1.1.1** Push buttons shall comply with the relevant codes and specifications.

**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.

**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.

**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.

**E213.1.1.5** Contacts shall be silver-tipped or be constructed of an approved high-quality material.

**E213.1.1.6** Push buttons shall be labelled by means of removable legend plates clearly indicating its function. Legend plates shall be interchangeable.

**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.

**E213.1.1.8** Illuminated push buttons shall comply with the specification for indicator lamps and lights.

#### **E213.1.2 MOTOR CONTROL CENTRES**

**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

**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                  |

**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.

### **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

### **E213.2 SIGNAL LIGHTS E213.2.1**

#### **GENERAL**

**E213.2.1.1** Indicator lights shall comply with the relevant codes and specifications.

**E213.2.1.2** Indicator lights shall be provided as specified in the Project Specification and indicated on drawings.

**E213.2.1.3** Similar cluster multi-led (8 chip) long life signal lamps shall be provided for all indications.

**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. Equivalentents shall be submitted for approval by the Engineer.

**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.

**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.

**E213.2.1.7** Two spare lamps shall be provided for each type and colour lamp used on the boards unless otherwise specified.

**E213.2.1.8** The spare lamps shall not be used by the Contractor during erection, commissioning, or maintenance.

#### **E213.2.2 MOTOR CONTROL CENTRES**

**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

### **E213.2.3 SWITCHGEAR**

**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.

**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.

### **E213.2.3 SEMAPHORES**

**E213.2.3.1** Semaphores shall be provided if specified in the project specification.

**E213.2.3.2** Semaphores shall be of the electrically operated, totally enclosed type, suitable for the operation with the specified control voltage.

**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.

## **E214 NAME PLATES AND LABELS**

### **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.

**E214.1.1** The manufacturer's name or trademark.

**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.

**E214.1.3** SANS or IEC Designation.

**E214.1.4** Rated operational voltage.

**E214.1.5** Short circuit strength in kA.

**E214.1.6** Degree of protection IP rating.

**E214.1.7** Maximum current carrying capacity of busbars.

**E214.1.8** Maximum current carrying capacity of equipment.

**E214.1.9** Voltage transformer ratio (where applicable).

**E214.1.10** Current transformer ratio, burden, class and knee point voltage (where applicable).

**E214.1.11** Current transformer connection instructions for various CT ratios (where applicable provide separate nameplate close to the relevant terminal blocks).

### **E214.2 LABELLING**

**E214.2.1** Labels shall generally have black lettering on a white background. Danger and safety notices shall have red lettering on a white background and be in both official languages.

**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.

**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.

**E214.2.4** Each cubicle shall also be provided with labels of similar wording at the back of the cubicle.

**E214.2.5** Where possible labels shall not be fixed to removable panels or doors.

**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.

**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.

**E214.2.8** Typical labels are as follows:

**E214.2.8.1** Cabinet: cabinet description.

Incoming cables/busbar: size and origin.

**E214.2.8.3** Main disconnect: "main switch" and danger notice.

**E214.2.8.4** Local disconnect: "local switch" and danger notice.

**E214.2.8.5** Fuses and combination fuse switches: circuit designation and fuse rating.

**E214.2.8.6** Circuit breakers: circuit designation and overcurrent adjustment where applicable.

**E214.2.8.7** Earth leakage protection units: circuit designations.

**E214.2.8.8** Contactors, relays, time-switches, timers, control fuses, etc: designation of control circuit and circuits controlled, function and fuse ratings.

**E214.2.8.9** Push buttons: circuit designation and function.

**E214.2.8.10** Indicating lamps: circuit designation and condition.

**E214.2.8.11** Instruments and selector switches: circuit designation and phase colour.

**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.

**E214.2.8.13** Terminal blocks: terminal designations and function.

**E214.2.8.14** Current transformers: ratios and terminal designations.

### **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.

## **E215 METERING AND INDICATION EQUIPMENT**

### **E215.1 GENERAL**

**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.

**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.

**E215.1.3** All meters shall be protected with suitable fuses.

### **E215.2 AMMETERS**

**E215.2.1** Ammeters shall be of the flush mounted, 96 mm square, quadratic scale type unless otherwise approved by the Engineer.

**E215.2.2** Ammeters shall comply with the relevant codes and specifications.

**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%.

**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.

**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.

**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.

**E215.2.7** Ammeters shall be fitted with zero adjustment screws.

**E215.2.8** Each ammeter shall be clearly marked with the appropriate colour of the phase to which it is connected.

**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.

**E215.2.10** Ammeters shall be mounted in a horizontal line on cabinets and cubicles.

### **E215.3 VOLTMETERS**

**E215.3.1** Voltmeters shall be of the suppressed zero, 96mm square, quadratic scale, flush mounted type, unless otherwise specified.

**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.

**E215.3.3** Voltmeters shall comply with the relevant codes and specifications and shall be of Accuracy Class 2,5.

**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.

**E215.3.5** All voltmeters shall be fitted with zero adjustment screws.

**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.

#### **E215.4 kWh, kW MAXIMUM DEMAND, kVA MAXIMUM DEMAND AND COMBINED kWh / kVA MAXIMUM DEMAND METERS**

**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.

**E215.4.2** kW and kVA Maximum demand meters and combined kVA/kWh meters shall be operated through current transformers.

**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.

**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.

**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.

**E215.4.6** All meters shall be fitted with security seal fitting facilities.

**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.

**E215.4.8** The integrating period on all maximum demand meters shall be 30 minutes, unless otherwise specified.

**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.

**E215.4.10** Meters shall comply with the relevant codes and specifications. with Class 2,0 accuracy, unless otherwise specified.

#### **E215.5 POWER FACTOR INDICATORS**

**E215.5.1** Power factor meters shall comply with the relevant codes and specifications.

**E215.5.2** The meter shall be suitable for use on 3-phase, 3 or 4 wire system. Unbalanced conditions shall be allowed for.

**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.

**E215.5.4** The meter shall be suitable for operation with the current and voltage transformers specified.

**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.

**E215.5.6** Power factor indicators shall be of the 96mm square, or larger, flush mounted type.

## **E216 EARTHING**

### **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.

### **E216.2 EARTH ELECTRODE**

#### **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 70mm<sup>2</sup> 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.

#### **E216.2.2 TRENCH EARTHS**

Trench earths shall comprise 70mm<sup>2</sup> bare, stranded copper conductors buried underground at a depth of at 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.

#### **E216.2.3 EARTH MAT**

An earth mat shall comprise 70mm<sup>2</sup> 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.

### **E216.3 EARTH BAR**

**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.

**E216.3.2** The earth conductors to the earth bar from the main distribution board, earth electrode, water mains, and transformer tank shall comprise 70mm<sup>2</sup> bare stranded copper conductor. The earth conductor to any transformer's neutral terminal shall comprise a 70mm<sup>2</sup> PVC- insulated copper conductor.

#### **E216.4 EARTH CONTINUITY**

**E216.4.1** Provide earth continuity conductors to earth outlet and each metallic appliance and luminaire.

**E216.4.2** The earth continuity conductors shall be separate bare or green PVC-insulated copper conductors when associated with wiring in wireways.

**E216.4.3** 2.5mm<sup>2</sup> Earth continuity conductors shall be green/yellow PVC-insulated.

**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.

**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.

#### **E216.5 BONDING**

**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.

**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.

**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.

**E216.5.4** Do not use self-tapping screws for any earthing or bonding functions.

**E216.5.5** Complete bonding work before painting.

**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.

#### **E216.6 TESTING**

**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.

**E216.6.2** Test the earth and bonding continuity in accordance with the Wiring Code.

**E216.6.3** Submit all test results to the Engineer in a written report before any permanent paving is provided over the earth electrode.

#### **E216.7 EARTHING OF FENCES**

Earth the fence of outdoor transformer and/or switchgear installations by means of a 70mm<sup>2</sup> 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 1.8 m earth rod by means of a 70mm<sup>2</sup> bare, stranded copper conductor.

Bond the perimeter conductor to the main earth bar by means of a 70mm<sup>2</sup> bare, stranded copper conductor.

## **E217 WIREWAYS**

### **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.

### **E217.2 CONDUIT**

#### **E217.2.1 GENERAL**

No conduit shall be smaller than 20mm diameter.

#### **E217.2.2 TYPES OF CONDUIT AND APPLICATIONS**

##### **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.

##### **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.

### **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 50°C,
- c) not exposed to mechanical damage, and
- d) not used to support any loads.

### **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.

## **E217.2.3 INSTALLATION OF CONDUIT**

### **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.

### **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.

### **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.

### **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.

#### **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.

#### **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.

#### **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.

### **E217.3 CONDUIT BOXES**

#### **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.

### **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.

### **E217.3.3 DRAW BOXES**

Provide draw boxes to facilitate the drawing in of cables and particularly: -

- 1) after 180° 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.

### **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.

### **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.

## **E217.4 TRUNKING**

### **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.

#### **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.

#### **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.

#### **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  $\pm 12\text{mm}$  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.

## **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.

## **E218 CIRCUITRY**

### **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 – 2.5mm<sup>2</sup>
- ii) PVC-insulated wiring and cabling for signal, control, alarm, and communication – 1.5mm<sup>2</sup>
- iii) PVC/PVC/SWA/PVC cabling for three-phase circuits – 1.5 mm<sup>2</sup>

### **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.

### **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

### **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.

## **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.

## **E220 CABLE TRAYS AND LADDERS**

### **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.

### **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.

### **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.

### **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 300mm. 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°.

## **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.

## **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.

## **E221 ACCESSORIES: LIGHT SWITCHES AND SOCKET OUTLETS**

### **E221.1 LIGHT SWITCHES**

#### **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.

#### **E221.1.2 Flush Wall Switches**

Where conduit is routed flush, install flush wall switches built into conduit boxes.

#### **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.

#### **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.

### **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.

### **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.

## **E221.2 SOCKET OUTLETS**

### **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.

### **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.

### **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.

### **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.

### **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-IO or approved alternative.

### **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.

### **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.

### **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.

### **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.

### **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.

### **E221.2.11 13A Single-phase Socket Outlets**

13A single-phase socket outlets shall comply with SANS 1363.

## **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.

## **E222 LUMINAIRES**

### **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 0,5mm<sup>2</sup>, 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%.

### **E222.2 INSTALLATION**

**E222.2.1** Refer to Section: "Fixing of Materials" of this Specification.

**E222.2.2** Install luminaires in accordance with the manufacturer's recommendations.

**E222.2.3** Mount luminaires after the first coat of paint has been applied. Await final coat of paint, before completing installation of luminaires.

**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.

**E222.2.5** Where luminaires butt, fix them together with brass bushes and lock nuts.

**E222.2.6** Screw conduits directly to exterior luminaires and to luminaires with a degree of protection in excess of IP44.

Provide gasketing 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.

**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.

### **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.

### **E222.4 SHEET METAL WORK AND PAINTING**

**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.

**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.

**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.

**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.

**E222.4.5** Paint finish shall be smooth, glossy and free from imperfections.

### **E222.5 EMERGENCY AND STANDBY LUMINAIRES**

#### **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.

## **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.

## **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.

## **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.

## **E222.6 FLUORESCENT LUMINAIRES**

### **E222.6.1 GENERAL**

Interior fluorescent luminaires shall comply with SANS 1119:1976.

### **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.

### **E222.6.3 CHANNEL LUMINAIRES**

Fluorescent channel luminaires shall consist of a ventilated rectangular wiring channel.

### **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.

### **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.

#### **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.

#### **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.

#### **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.

### **E223 LIGHTNING PROTECTION**

#### **E223.1 SCOPE OF WORK**

The following sections of work are included in the lightning protection installation:

**E223.1.1** Air terminations (other than metallic roofs).

**E223.1.2** Down conductors (other than reinforcing steel and metallic columns).

**E223.1.3** Earth terminals.

**E223.1.4** Earth conductors and associated excavations and backfilling.

**E223.1.5** Bonding.

#### **E223.2 GENERAL**

##### **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.

### **E223.3 COMPLIANCE WITH REGULATIONS AND STANDARDS**

The lightning protection installation shall comply with SANS Code of Practice 03 and 03A.

### **E223.4 DRAWINGS**

**E223.4.2** Submit shop drawings of the following:

**E223.4.2.1** Details of reinforcing steel bonding terminals.

### **E223.5 MATERIALS**

#### **E223.5.1 CONDUCTORS**

**E223.5.1.1** Conductors above ground may be of copper or of a suitable corrosion resistant aluminium alloy.

**E223.5.1.2** Aluminium conductors may not be installed in direct contact with concrete or plaster but shall be installed with suitable insulating sleeves and stand-off brackets.

**E223.5.1.3** Aluminium conductors may only be connected to copper with cadmium-plated or heavily tinned connectors.

**E223.5.1.4** Copper conductors may only be connected to galvanised steel via a heavily tinned connector above ground.

**E223.5.5** Underground connections shall only be made between similar metals.

**E223.5.6** Avoid copper conductors in the vicinity of underground galvanised steel services.

**E223.5.7** Avoid galvanised steel conductors in the vicinity of underground copper services.

**E223.5.8** Stainless steel components shall be Type 304 or approved alternative.

**E223.5.9** Aluminium may not be installed underground except in short lengths completely protected by a plastic sleeve with both ends above ground and facing downwards.

**E223.5.1.10** Any steel components shall be hot dip galvanised to SANS 763.

### **E223.6 FIXING OF MATERIALS**

#### **E223.6.1 CONDUCTOR FASTENINGS**

**E223.6.1.1** Conductors shall be securely fastened at spacings of not less than 1.5m.

**E223.6.1.2** The fastenings shall allow for thermal expansion and contraction and prevent direct contact between aluminium and concrete or plaster.

**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.

### **E223.7 TESTING**

**E223.7.1** Provide permanent testing joints between each down conductor and its associated earth conductor.

**E223.7.2** Test and submit test record to Engineer, as follows:

**E223.7.2.1** Earth resistance of earth conductor.

**E223.7.2.2** Continuity of any trench earth.

**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.

#### **E223.8 ROOF CONDUCTORS, FINIALS AND DOWN CONDUCTORS**

**E223.8.1** These shall comprise strip, rod, tube or stranded conductor of at least 50mm<sup>2</sup> cross-sectional area, of copper, brass, phosphor-bronze, aluminium, stainless steel or galvanised steel.

**E223.8.2** Galvanised steel, however, may not be used within 50km of the coast.

#### **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.

#### **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.

#### **E223.11 EARTH RODS**

**E223.11.1** Single earth rods shall be installed at a depth of at least 1,5m below final ground level.

**E223.11.2** An array of earth rods shall be installed at a depth of at least 0,9m below final ground level.

#### **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.

#### **E223.13 ANTENNAE EARTHING**

Bond antennae via a down conductor to an earth terminal and to any metallic water main.

## **E231 MEDIUM VOLTAGE (UP TO 33 KV), LOW VOLTAGE AND PILOT CABLES**

### **E231.1 GENERAL**

**E231.1.1** The Contractor shall supply and install cables as specified in the Project Specification and indicated on the drawings.

### **E231.2 CABLE CONSTRUCTION**

#### **E231.2.1 MEDIUM VOLTAGE CABLES**

##### **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.

##### **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

## **E231.2.2 LOW VOLTAGE CABLES (1000V)**

### **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.

### **E231.2.3 PILOT CABLES**

#### **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.

#### **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.

#### **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 between any core and any metal work that may be earthed | : | 5kV between any two cores; 10kV   |
| 7) | General  | : | Pilot cables shall be designed to ensure the minimum crosstalk level and maximum immunity against induced effects |

#### **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.

#### **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.

#### **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.

### **E231.3 EXCAVATIONS AND LAYING OF CABLES**

#### **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.

### **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:

#### **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.

#### **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.

#### **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.

### **E231.3.3 ROAD AND RAILWAY CROSSINGS**

#### **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.

#### **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.

#### **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.

#### **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.

#### **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.

#### **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.  |

## **E231.3.4 CLASSIFICATION OF EXCAVATIONS**

**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 0,03m<sup>3</sup> to 2,0m<sup>3</sup> 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 0,03m<sup>3</sup> to 2,0m<sup>3</sup> in a matrix of soft material, will be classified as boulder excavations, Class "B". The rates shall include the removal of rock from site.

**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"

**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.

### **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.

## **E231.3.5 CABLE TRENCH LAYOUT**

The standard minimum cable trench depths are as follows unless otherwise specified:

- |   |  |
|---|--|
| 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.

#### **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.

#### **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.

#### **E231.4 LAND SURVEYOR PEGS**

**E231.4.1** Stand boundary pegs which were installed by the Land Surveyor shall under no circumstances be removed or shifted.

**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.

**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.

**E231.4.4** The pegs will be reinstated by a Land Surveyor at the cost of the Contractor.

**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.

## **E231.5 BUSH CLEARING**

The absolute minimum number of bushes and trees shall be cleared by the Contractor for the purpose of laying cables.

## **E231.6 CABLE MARKERS**

### **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.

### **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.

## **E231.7 DAMAGES TO FENCES, WALLS, STREET SURFACES, KERB STONES AND PROPERTIES**

**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.

**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.

**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.

## **E234 VARIABLE SPEED DRIVE (VSDs)**

### **E234.1 GENERAL**

**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.

**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.

**E234.1.3** Unless otherwise specified the VSDs shall be suitable for centrifugal pumps with a squared torque characteristic.

**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.

**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.

**E234.1.6** Components which are standard for number of product ranges of the manufacturer shall be used.

**E234.1.7** The colour of the VSD shall be specified in the project specification.

**E234.1.8** The availability of spares shall be guaranteed for 10 years after the contract is accepted.

## **E234.2 PULSE WIDTH MODULATED DRIVES (PWM DRIVES) FOR INDUCTION MOTORS**

**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.

**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.

**E234.2.3** The rectifier and converter shall be 6 or 12 pulse as specified.

## **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,  $\pm 2\frac{1}{2}\%$
- Phase rotation : R-Y-B-R anti clockwise
- System fault level : Specified in the project specification.

## **E234.4 SUPPLY INTERRUPTIONS AND DISTORTIONS**

**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  $2\frac{1}{2}$  per cent (continuous).
- Supply voltage total harmonic distortion of 3 (three) per cent with individual voltage harmonic distortion of one per cent.

## **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.

## **E234.6 RATINGS**

**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.

**E234.6.2** Each VSD shall be capable of continuous duty at full rating (24hrs/day, 365days/annually) under the specified power supply conditions.

## **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 10 present 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.

## **E234.8 VSD ELECTRONIC EQUIPMENT AND COMPONENTS**

**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.

**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.

**E234.8.3** The material used for the printed circuit boards shall be of the best quality.

**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.

**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).

**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.

**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.

**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.

**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.

**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.

**E234.8.11** Solid state electronic components shall be used.

## **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.

### **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.

### **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.

### **E234.12 HARDWARE TRIP INTERLOCKS**

**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.

**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.

### **E234.13 MAIN POWER EQUIPMENT**

The main power equipment unit shall comprise the following:

**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.

**E234.13.2** The contactor unit.

**E234.13.3** Rectifying transistors and inverting thyristors.

**E234.13.4** A choke in series with the rectifying transistors (input) shall be installed to limit the

**E234.13.5** By-pass switch if specified in the project specification.

**E234.13.6** Auxiliary power supply equipment.

**E234.13.7** Step down transformers if required.

### **E234.14 CUBICLE ARRANGEMENT**

**E234.14.1** Smaller VSD's shall be mounted into a free-standing MCC panel suitable for floor fixing.

**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.

**E234.14.3** The VSD equipment e.g. fused isolator, contactor, thyristor stock, control circuitry, etc., shall be housed in separate compartments or cubicles.

**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.

**E234.14.5** The equipment shall be arranged so that the various parts of the drive are easily accessible.

**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.

**E234.14.7** The main isolator handle shall be mounted on the front of the cubicle and shall be door inter-locked.

**E234.14.8** IP54 enclosure protection shall be provided unless otherwise specified in the project specification.

**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.

**E234.14.10** The cable entry shall be below unless otherwise specified.

## **E234.15 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.

**E234.15.1** The transistors/thyristors shall be forced air cooled by means of fans.

**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.

**E234.15.3** Replaceable air filters shall be provided at the air-intake of the cubicle.

**E234.15.4** The hot air shall be exhausted into the room.

## **E234.16 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.

### **E234.16.1 THERMAL OVERLOAD**

The relay shall have current time characteristics matched to the thermal damage curve of the drive motor.

### **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.

### **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%.

### **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

### **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.

### **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.

### **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.

### **E234.16.8 LOSS OF PHASE**

Loss of a supply phase shall cause the drive to be disconnected sufficient rapidly to prevent damage.

### **E234.16.9 INCORRECT PHASE ROTATION**

The drive controls shall be capable of detecting this condition and preventing start-up.

**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

**E234.16.11** Audible and visible indication shall be provided for all trip and alarm functions.

#### **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 overtemperature 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.

#### **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.

#### **E234.17 CONTROL INDICATION AND INSTRUMENTATION**

The following minimum controls and instrumentation shall be provided on the front panel of the electronic compartment:

##### **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 tripreset push buttons.

f) Indication test push button to test lamps.

g) Speed control.

#### **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	

#### **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 hourmeter.

#### **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

## **E234.18 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.

## **E237 STREET- AND SECURITY LIGHTING**

### **E237.1 GENERAL**

Street and security lighting shall in general conform to SANS 098, unless otherwise specified.

### **E237.2 STEEL POLES FOR STREETLIGHTING**

#### **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.

#### **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.

#### **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.

#### **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.

#### **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.

#### **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.

#### **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 25mm<sup>2</sup>, 4-core PVC insulated steel wire armoured cables can be easily installed. The project specification will state whether ECC cables shall be used.

#### **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.

#### **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.

### **E237.3 WOODEN POLES FOR STREETLIGHTING**

**E237.3.1** Wooden poles shall be suitably treated and shall comply with SANS 753 or 754.

**E237.3.2** The dimensions and classes of wooden poles required shall be as specified in the Project Specification.

**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.

**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.

**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.

**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 25mm<sup>2</sup>, 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.

**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 25mm<sup>2</sup>, 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.

#### **E237.4 MIDHINGE TYPE MASTS**

##### **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.

##### **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.

#### **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.

#### **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.

#### **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.

#### **E237.5 HIGH MASTS**

##### **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.

##### **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 boltholes 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.

#### **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.

#### **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.

#### **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.

#### **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.

#### **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.

#### **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.

#### **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.

#### **E237.6 LUMINAIRES**

**E237.6.1** High masts and poles shall be fitted with luminaires as specified further herein and in the Project Specification.

**E237.6.2** The final adjustment of the luminaires shall be done on site to provide area lighting to the Engineer's satisfaction.

**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.

**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.

**E237.6.5** The luminaires shall be fully gasketed to eliminate the ingress of dirt and moisture.

**E237.6.6** All luminaires offered shall be of high quality and of a type approved by the Engineer.

**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.

**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.

#### **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:

**E237.7.1** The photocell shall be mounted on the pole nearest to the mini-sub, substation or low voltage distribution cubicle.

**E237.7.2** All photo-electric cells shall be provided with suitable mounting brackets to mount these on the streetlight pole.

**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.

#### **E237.8 STREETLIGHTING ARMS**

**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.

**E237.8.2** The brackets shall be galvanised and, if called for, painted as specified in the Standard Specification E202.

**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.

**E237.8.4** The dimensions of the spigot shall be suitable for the type of luminaires offered.

**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.

**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.

#### **E237.9 INSTALLATION OF STREETLIGHTING**

**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 4mm<sup>2</sup> 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 4mm<sup>2</sup>, 3-core PVC insulated cable on wooden poles.
- 9) Supply, installation, and termination of three 4 mm<sup>2</sup> 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.

**E237.9.2** All luminaires shall be installed complete with the types of lamps specified.

**E237.9.3** All luminaires, steel brackets and poles shall be properly earthed.

**E237.9.4** Where painting of streetlighting poles are called for, a final coat shall be applied after erection.

## **E238 MASTS: MANUFACTURING AND INSTALLATION**

### **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.

### **E238.2 INTERPRETATIONS**

**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.

#### **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.

### **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.

### **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.

### **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.

### **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:

**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.

**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.

**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<sup>2</sup> copper conductor and shall provide a maximum resistance of 20 Ohms unless otherwise stated in the project specification.

**E238.7      TESTING**

Test certificates shall be submitted for all tests as specified in SANS 0225.

## **E239 STANDBY DIESEL GENERATOR**

### **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 160kW 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.

### **E239.2 INSTALLATION**

Except for those items specifically excluded, tenderers must include for the complete installation and wiring of the plant in running order.

### **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.

### **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.

### **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.

### **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.

## **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.

## **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.

### **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.

### **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.

### **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.

### **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.

### **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.

### **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.

#### **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.

#### **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.

#### **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.

##### **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.

##### **E239.9.2 REGULATION**

The steady state voltage regulation must not exceed  $\pm 1\%$  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%.

##### **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.

##### **E239.9.4 OUTPUT VOLTAGE**

The set shall have a site output as set out in the detail specification.

#### **E239.10 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.

#### **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.

#### **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.

#### **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.

#### **E239.14 MAINS FAIL SIMULATION KEYSWITCH**

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.

#### **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.

#### **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.

#### **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.

#### **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.

##### **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.

##### **E239.18.2 THE FOLLOWING EQUIPMENT IS REQUIRED IN THE BOARD**

- a) One flush 96 mm square dial voltmeter, scaled, reading the alternator voltage.
- a) One flush voltmeter selector switch with 6 metering and one-off position, connecting the voltmeter to phase and neutral.

- b) One flush 96 mm square dial indicating type frequency meter, indicating the alternator frequency.
- c) 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.
- d) One set of fuses or cb's for potential circuits of the meters.
- e) Flush 96mm square dial maximum demand ammeters for measuring the alternator current, scaled to suit complete with necessary current transformer with resettable pointer.
- f) One isolator for the mains isolation (check detailed specification for requirement).
- g) Automatic – change over control equipment. (check detailed specification).
- h) One circuit breaker for alternator protection against overload and short circuit conditions (check detailed specification for requirement).
- i) One four-position operation selector switch.
- j) Two push buttons or one switch marked “Start” and “Stop” for manual starting and stopping the set.
- k) Battery charging equipment as specified, complete with flush ammeter and voltmeter.
- l) Relays with re-set pushes as specified, for engine protection and warning.
- m) Fault indicating lights.
- n) Mains fail simulation key switch.
- o) Switch for fuel pump.
- p) Warning hooter.
- q) Bypass switch.
- r) Test pushbutton to test all indicator lamps.
- s) Suitable terminals for incoming main and alternator cables, for the outgoing feeder and for the earth connection.
- t) Any other equipment necessary for the correct and safe operation of the installation.

### **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.

## **E239.19 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.

## **E241 LOW VOLTAGE ELECTRIC MOTORS**

### **E241.1 GENERAL**

**E241.1.1** This specification covers low voltage (below 1000V), 3-phase a.c. squirrel cage induction motors.

**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.

**E241.1.3** Motors of the same manufacture shall be used throughout the Contract unless otherwise approved by the Engineer.

**E241.1.4** Motors shall be designed for fixed speed or variable speed operation as specified in the Project Specification.

### **E241.2 QUALITY OF MATERIALS**

**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.

**E241.2.2** Quality control shall be in accordance with ISO 9001.

**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.

### **E241.3 INTERCHANGEABILITY**

**E241.3.1** Motors of the same rating shall be interchangeable without them having to be modified.

**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.

### **E241.4 DRAWINGS AND INFORMATION FOR APPROVAL**

The following drawings and information shall be submitted for approval before manufacture commences:

**E241.4.1** Dimensioned outline and required foundation drawings of the motors. (Shaft diameter, shaft height and motor mass to be clearly shown).

**E241.4.2** Cross-sectional dimensioned drawings of the terminal boxes.

**E241.4.3** Detailed drawings of the motor base plate showing full constructional details with dimensions.

## **E241.5 INSPECTION OF MANUFACTURED EQUIPMENT**

**E241.5.1** The Engineer, or his appointed representative, reserves the right to inspect the motors or associated parts at any stage of manufacture.

**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.

## **E241.6 GUARANTEE AND MAINTENANCE**

**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.

**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.

## **E241.7 MOTOR RATINGS**

**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.

**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.

**E241.7.3** Motors shall be designed to allow 6 starts per hour, of which two shall be consecutive.

**E241.7.4** Rated voltage shall be 400 / 525 / 690V as specified in the Project Specification.

**E241.7.5** Rated frequency shall be 50Hz.

**E241.7.6** The motors shall be capable of operating with Zone A combined voltage and frequency variations as defined in SANS 60034-1.

**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.

**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.

## **E241.8 MOUNTING**

**E241.8.1** The motors shall be mounted to suit the driven equipment. The mounting arrangement shall be as stated in the Project Specification\*\*\*.

**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.

**E241.8.3** Motor feet shall be fitted with Grade 316 stainless steel jacking screws for both horizontal and vertical adjustment.

**E241.8.4** Mounting bolts shall be included in the motor's price, unless otherwise stated in the Project Specification.

## **E241.9 ENCLOSURES AND COOLING**

**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.

**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.

**E241.9.3** Ambient and cooling temperatures shall be in accordance with SANS 60034-1, unless otherwise stated in the Project Specification.

**E241.9.4** Noise levels shall not exceed the levels permitted in SANS 60034-9.

## **E241.10 WINDINGS**

**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).

**E241.10.2** With self-ventilated cooling systems, allowance shall be made for the speed dependency of heat transfer.

**E241.10.3** Converter-fed motors (variable speed drives) shall be rated to allow for additional harmonic losses in accordance with SANS 60034-17.

**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.

**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.

## **E241.11 BEARINGS**

### **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.

### **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.

### **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.

## **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).

**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.

**E241.12.2** The wires of all detectors must be wired to a terminal strip in a suitable terminal box on the motor.

**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.

## **E241.13 ANTI-CONDENSATION HEATERS IN MOTORS**

**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.

**E241.13.2** The terminals of the heaters shall be wired to a heater terminal box.

## **E241.14 TERMINAL BOXES AND TERMINATIONS**

**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.

**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.

**E241.14.3** All terminals must be properly and permanently marked for easy identification.

**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.

**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.

**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.

**E241.14.7** The terminal box shall be suitable for the cable termination method specified in the Project Specification.

## **E241.15 INFORMATION PLATES FOR MOTORS**

**E241.15.1** In addition to the information required by SANS 60034-1, the following shall also be marked on the name plates:

**E241.15.1.1** Year of manufacture

**E241.15.1.2** The order number

**E241.15.1.3** Total mass of motor in kg

**E241.15.1.4** Diagram indicating the number, type and positions of heaters and temperature detectors if applicable.

**E241.15.1.5** Bearing types and sizes

**E241.15.1.6** Bearing grease interval or bearing replacement interval where pre-packed bearings are used.

## **E241.16 COUPLINGS AND DIRECTION OF ROTATION**

**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.

**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.

## **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.

## **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.

### **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.

### **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.

#### **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.

#### **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  $2 VR + 1 \text{ kV}$ ).

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**

#### **CI100 CONTROL AND INSTRUMENTATION PROJECT SPECIFICATIONS**

CI100.1	GENERAL
CI100.2	SCOPE
CI100.3	GENERAL
CI100.4	ELECTRICAL SUPPLY
CI100.5	DRAWINGS
CI100.6	MATERIAL, FINISHING AND PAINTING OF MATERIALS AND
EQUIPMENT CI100.7	CABLE SUPPORTS
CI100.8	CONTROL AND INSTRUMENTATION
CABLES CI100.9	JUNCTION BOXES
CI100.10	FIELD INSTRUMENTATION
CI100.11	TELEMETRY
CI100.12	UNINTERRUPTIBLE POWER SUPPLIES (UPS)

#### **CI101 SUBMITTAL PROCEDURES**

CI101.1	GENERAL
CI101.2	PRODUCTS
CI101.3	EXECUTION

#### **CI102 OPERATIONS AND MAINTENANCE DATA**

CI102.1	GENERAL
CI102.2	PRODUCTS
CI102.3	EXECUTION

#### **CI103 DEMONSTRATION AND TRAINING**

CI103.1	GENERAL
CI103.2	PRODUCTS
CI103.3	EXECUTION

#### **CI104 GENERAL COMMISSIONING REQUIREMENTS**

CI103.1	GENERAL
CI103.2	PRODUCTS
CI103.3	EXECUTION

#### **CI200 GENERAL SPECIFICATION FOR AN ELECTRONICS INSTALLATION**

CI200.1	GENERAL
CI200.2	PRODUCTS
CI200.3	EXECUTION

#### **CI201 COMMISSIONING OF CONTROL SYSTEM**

CI201.1	GENERAL
CI201.2	PRODUCTS
CI201.3	EXECUTION

#### **CI202 FLOW MEASUREMENT**

CI202.1	GENERAL
CI202.2	PRODUCTS
CI202.3	EXECUTION

<b>CI203</b>	<b>LEVEL MEASUREMENT</b>
CI203.1	GENERAL
CI203.2	PRODUCTS
CI203.3	EXECUTION
<b>CI204</b>	<b>PRESSURE MEASUREMENT</b>
CI204.1	GENERAL
CI204.2	PRODUCTS
CI204.3	EXECUTION
<b>CI205</b>	<b>PROCESS SWITCHES</b>
CI205.1	GENERAL
CI205.2	PRODUCTS
CI205.3	EXECUTION
<b>CI206</b>	<b>TEMPERATURE MEASUREMENT</b>
CI206.1	GENERAL
CI206.2	PRODUCTS
CI206.3	EXECUTION
<b>CI207</b>	<b>VIBRATION MEASUREMENT</b>
CI207.1	GENERAL
CI207.2	PRODUCTS
CI207.3	EXECUTION

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.

## **CI100 CONTROL AND INSTRUMENTATION PROJECT SPECIFICATION**

### **CI100.1 GENERAL**

The Linbro Park 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.

## **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 Linbro Park Tower pump station and Reservoir
- Surge protection
- The instrumentation and cabling
- A communication system linking all electrical equipment to telemetry

## **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.

### **CI100.3.1 PUMP 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.

#### **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.

#### **CI100.3.2 VALVE 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.

### **CI100.3.3 FILLING OF THE TOWER**

The Linbro Park tower will be equipped with three level switches namely:

- High Level
- Control Low, and
- Low Low Level

Control Low will start the duty pumps, starting of the pumps will alternate between the pumps. Should the water in the tower reach a low low level the duty pumps will be started. High level in the tower will stop the pump.

The duty pumps 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.

### **CI100.3.4 POWER 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.

### **CI100.4 ELECTRICAL SUPPLY**

Electrical supply for this project is covered in the Electrical Project Specification

### **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.

### **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.

### **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.

## 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	Galvanized Steel Wire
Serving	Laminated 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.

## 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.

## 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.

### 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.

### 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.

### **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.

#### **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.

### **CI100.10.4 ELECTROMAGNETIC FLOW METERS**

One Electromagnetic flow meter shall be supplied in accordance with Standard Specification for Instrumentation and the relevant datasheet.

### **CI100.10.5 THERMAL FLOWSWITCHES**

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.

### **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.

### **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.

### **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.

#### **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.

#### **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.

### CI100.11.3 SCADA PROGRAMMING

All telemetry signals shall be displayed and historized via the existing 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.

### 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.

### 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.

#### CI100.12.1 UPS SPECIFICATION

Type of configuration	:	Single UPS with
bypass Bypass to	:	Primary power
Standby power generator	:	No
Nominal input voltage	:	230V $\pm$ 10%
No of phases	:	Single
Nominal input frequency	:	50Hz
$\pm$ 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.

## **CI101 SUBMITTAL PROCEDURES**

### **CI101.1 GENERAL**

#### **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.

#### **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.

- a) 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.
- b) 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
- c) 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.
- d) 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.

- 1) Trash removal and control.
- 2) Space arrangement for workshops, storage, offices, mock-ups, laboratories, parking, etc.
- 3) Other items as required by the engineer and/or the Contract Documents.

#### **CI101.1.3 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.

#### **CI101.1.4 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 identify 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.

## **CI101.2 PRODUCTS**

### **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 for 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 A1 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 CI101.2.2 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.

- a) Goods Certificates: Prepare written statements on manufacturer's letterhead certifying that Goods comply with requirements.
- b) 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.
- c) 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.
- d) 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 for adhesion.
- e) 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.
- f) 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.
- g) Maintenance Data: Prepare written and graphic instructions and procedures for operation and normal maintenance of products and equipment. Comply with all stipulated requirements.
- h) 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.
- i) 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.

- j) **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.
  - 1) Statement on condition of substrates and their acceptability for installation of product.
  - 2) Statement that products at Project Site comply with requirements.
  - 3) Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
  - 4) Results of operational and other tests and a statement of whether observed performance complies with requirements.
  - 5) Statement whether conditions, products, and installation will affect warranty.
  - 6) Other required items indicated in individual Specification Sections.
- g) **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.

### **CI101.3 EXECUTION**

#### **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.

#### **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.
- 1) 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.
- 2) 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.

## **CI102 OPERATIONS AND MAINTENANCE DATA**

### **CI102.1 GENERAL**

#### **CI102.1.1 SECTION INCLUDES**

- a) Format
- b) Maintenance Data
- c) Manual for Equipment and System
- d) Instruction of Owner Personnel

#### **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.

### **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, addresses, 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.

### **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.

#### **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.

#### **CI102.2 PRODUCTS**

##### **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

### **CI102.3 EXECUTION**

#### **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.

### **CI103 DEMONSTRATION AND TRAINING**

#### **CI103.1 GENERAL**

##### **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.

##### **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.

##### **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.

##### **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.

#### **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.

#### **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.

## **CI103.2 PRODUCTS**

### **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.

### **CI103.2.1 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.

### **CI103.3 EXECUTION**

#### **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.

#### **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.

## **CI104 GENERAL COMMISSIONING REQUIREMENTS**

### **CI104.1 GENERAL**

#### **CI104.1.1 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.

#### **CI104.1.2 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.

#### **CI104.1.3 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.

#### **CI104.1.4 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.

#### **CI104.1.5 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.

#### **CI104.1.6 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.
- 
- a) Review commissioning related specifications, submittals, and construction documents. Communicate noted deficiencies and concerns to the Owner, Architect and Engineer.
  - b) Develop detailed and specific Functional Testing procedures for equipment and systems to be commissioned.
  - c) Develop testing, adjusting and balancing (TAB) specifications. Oversee the TAB process.
  - d) Perform site inspections and verify Construction Manager's subcontractor readiness for the Functional Testing process. Document deficiencies for future resolution.
  - e) 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.
  - f) 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.
  - g) Verify that CMR O&M documentation is complete.
  - h) 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-38k-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.

- 2) Other documentation will be retained by the CxA.

#### **CI104.1.7 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.

#### **CI104.1.8 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.

#### **CI104.1.9 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.

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.

#### **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.

#### **CI104.2 PRODUCTS (NOT APPLICABLE)**

#### **CI104.3 EXECUTION (NOT APPLICABLE)**

### **CI200 GENERAL SPECIFICATION FOR AN ELECTRONICS INSTALLATION**

#### **CI200.1 GENERAL**

##### **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.

##### **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.

### **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.

#### **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.

#### **CI200.2 PRODUCTS**

##### **CI200.2.1 CABLES AND WIRES**

- a) All general wiring shall be multi-stranded of minimum thickness of 0,5 mm<sup>2</sup> 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.

##### **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.

### **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.

### **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.

### **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.

### **CI200.3 EXECUTION**

#### **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.

### **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.

### **CI200.3.3 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.

#### **CI200.3.4 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.

#### **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.

#### **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.

#### **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.

#### **200.3.8 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.

#### **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.

## **CI201 COMMISSIONING OF CONTROL SYSTEM**

### **CI201.1 GENERAL**

#### **CI201.1.1 DESCRIPTION**

- a) Commission all systems and equipment of this instrumentation and control system.

#### **CI201.1.2 RELATED WORK AND DOCUMENTS**

- a) Division 25 Integrated Automation

#### **CI201.1.3 SUBMITTALS**

- a) Submit commissioning documents for all equipment and systems including checklists and test procedures that will be used.

### **CI201.2 PRODUCTS**

#### **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.

### **CI201.3 EXECUTION**

#### **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.

#### **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.

### **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)

### **CI201.3.4 FUNCTIONAL PERFORMANCE TESTS**

Performance testing shall demonstrate that the system functions according to the specifications.

## **CI202 FLOW MEASUREMENT**

### **CI202.1 GENERAL**

#### **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.

#### **CI202.1.2 DESCRIPTION**

- a) This part of the standard gives detailed technical specifications which apply to the installation of flow instruments.

#### **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

#### **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.

#### **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.

#### **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

#### **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.

#### **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.

## **CI202.2 PRODUCTS**

### **CI202.2.1 FLOW ELEMENTS**

- a) Specification for Orifice Plates (DP Element)
- 1) General Flange tapings 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:
    - $\pm 0.75\%$  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 cell (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:
    - $\pm 1\%$  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:
  - $\pm 1\%$  of full scale
- 5) Preferred:
  - Proflow
  - Kent
  - Engineer approved equivalent

## 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: connection as appropriate to application	Pipe stand or direct process
Output:	4-20mA into 250Ω load
Supply:	24 V DC nominal Loop powered

Calibration Adjustments:	Independent
Zero span Element Temperature Limitation:	100°C
Electronics:	70°C
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: span / 10°C change	Effect not to exceed 0,5% of maximum

- 4) Preferred Type:
- Honeywell Smart
  - Endress + Hauser
  - Engineer approved equivalent

### 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: application	Carbon Steel or Ni Steel - depending on
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 or valve chamber) depending on application	IP65 (indoor) or IP 68 (in meter
Ambient Temperature Range:	-10 to
+50°C 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: 10m/s	0.5% of span over a velocity range of 0,05 -
Repeatability:	0.2% of span
Ambient temperature: 10°C	effect not to exceed 0.5% of maximum span per
change	
Minimum sensitivity:	5 µS/cm

### 4) Preferred:

- Krohne
- Endress+Hauser
- SAFMAG
- Engineer approved equivalent

b) Specification for Vortex FlowMeters

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
- rotating 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

( $\theta=20^\circ$  to  $100^\circ$ ): 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:	60°C

### 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 10°C 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
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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 10°C 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 +50°C

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 10°C change

4) Preferred

- Krohne
- Engineer approved equivalent

## CI202.2.4 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

## 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  $\pm 0.2\%$  of reading

Repeatability: 0.005% fsd, 0.1% of reading

### d) Preferred

- Endress + Hauser
- Krohne
- Engineer approved equivalent

## CI202.3 EXECUTION

### 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.

## **CI203 LEVEL MEASUREMENT**

### **CI203.1 GENERAL**

#### **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.

#### **CI203.1.2 DESCRIPTION**

- a) This part of the standard gives detailed technical specifications which apply to the installation of level instruments.

#### **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

#### **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.

#### **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.

#### **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

#### **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.

#### **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.

## CI203.2 PRODUCTS

### 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.

### 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
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Membrane:	Stainless Steel
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Electrical Connection:	20mm ISO conduit
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Max Operating Temp: 60°C

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 into 250Ω 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 10°C

- 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 150°C
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 10°C 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 connection as appropriate to application	Pipe stand or direct process
Output	4-20mA into 250Ω load
Supply	24 V DC nominal
Calibration Adjustments	Independent Zero Span
Element Temperature Limitation	100°C

Electronics	70°C
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/ 10°C 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.

### CI203.2.3 SPECIFICATION FOR HYDROSTATIC LEVEL TRANSMITTERS

a) General

Transmitter shall be non-indicating, electronic type based on piezo-resistive 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 length as appropriate to application	Suspended on cable of suitable
Output	4-20mA into 250Ω load
Supply	24 V DC nominal
Calibration Adjustments	Fixed range
Element Temperature Limitation	1 - 100°C Electronics -
10 - 70°C 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 valve	Direct on process pipe via ½" NPT shut off
Output	4-20mA into 250 Ω load
Supply	24 V DC nominal
Calibration Adjustments	Zero and span
Element Temperature Limitation	1 - 100°C Electronics -
10 - 70°C 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/10°C change

## d) Preferred

- 1) Vega
- 2) Endress & Hauser
- 3) Engineer approved equivalent

### **CI203.3 EXECUTION**

#### **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.

### **CI204 PRESSURE MEASUREMENT**

#### **CI204.1 GENERAL**

##### **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.

##### **CI204.1.2 DESCRIPTION**

- a) This part of the standard gives detailed technical specifications which apply to the installation of pressure instruments.

##### **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

##### **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.

### **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.

### **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

### **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.

### 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.

### CI204.2 PRODUCTS

#### CI204.2.1 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" or 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 for static pressure 75% fsd	1,3 x full scale Upper limit of range
Upper limit of range for fluctuating pressure	66% fsd

##### d) Preferred type

- 1) Control Instruments
- 2) Wika.

## CI204.2.2 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.

## 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 StainlessSteel
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: appropriate to application	Pipestand or direct process connection as
Output:	4-20 mA into 250Ω load
Supply:	24 V DC nominal
Calibration Adjustments:	Independent Zero and span
Element Temperature Limitation:	100°C Electronics: 70°C
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: change	not to exceed 0.5% of maximum span / 10°C

d) Preferred type:

- 1) Endress + Hauser
- 2) Honeywell Smart

#### **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: appropriate to application	Pipestand or direct process connection as
Output:	4-20 mA into 250Ω load

Supply:	24 V DC nominal
Calibration Adjustment:	Independent Zero and span
Element Temperature Limitation:	100°C Electronics: 70°C
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 change	not to exceed 0.5% of maximum span/10°C
d) Preferred type	
1) Endress + Hauser	
2) Honeywell Smart	

### **CI204.3 EXECUTION**

#### **CI204.3.1 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.

### **CI205 PROCESS SWITCHES**

#### **C3.3.4.11.1 CI205.1 GENERAL**

##### **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.

##### **CI205.1.2 DESCRIPTION**

- a) This part of the standard gives detailed technical specifications which apply to the installation of process switches.

##### **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

#### **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.

#### **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.

#### **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

#### **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.

#### **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.

#### **CI205.2 PRODUCTS**

##### **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.

##### **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:	100°C

- b) Preferred:

- Asco

##### **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:	100°C

- d) Preferred:
- Asco,
  - Fenwal

#### **CI205.2.4 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 parts:	Stainless Steel
Process Connection:	1" N.P.T. or to suit
Electrical Connection:	20 mm ISO conduit
Max Process Pressure:	1000 kPa Maxprocess
Temperature:	100°C

##### 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 parts:	Stainless Steel
Process Connection:	1" N.P.T. or to suit
Electrical Connection:	20 mm ISO conduit
Max Process Pressure:	1000 kPa Maxprocess
Temperature:	100°C

##### 2) Preferred:

- Effector;
- FCI

## CI205.2.5 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 safe maintenance when required.
- 4) Mounting brackets shall be secure and corrosion resistant.



### **CI205.2.6 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

### **CI205.2.7 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.
- a) Preferred:
  - Turck

## **CI205.3 EXECUTION**

### **CI205.3.1 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.

## **CI206 TEMPERATURE MEASUREMENT**

### **CI206.1 GENERAL**

#### **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.

#### **CI206.1.2 DESCRIPTION**

- a) This part of the standard gives detailed technical specifications which apply to the installation of temperature measurement equipment.

#### **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

#### **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.

#### **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.

#### **CI206.1.6 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

#### **CI206.1.7 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.

#### **CI206.1.8 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.

## CI206.2 PRODUCTS

### CI206.2.1 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: mineral insulated	Type "J" (Iron Constantan),
Diameter:	6mm nominal OD
Performance: 300°C to 1300°C	±2°C up to 300°C ±¾% from
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: insulated	PT 100 3 wire simplex mineral
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: 10°C change	Not to exceed 0.5% of span per

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

## 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

### 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 250Ω load
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

### **CI206.3 EXECUTION**

#### **CI206.3.1 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.

### **CI207 VIBRATION MEASUREMENT**

#### **CI207.1 GENERAL**

##### **CI207.1.1 RELATED DOCUMENTS**

- Drawings and General Provisions of the Contract, including General Conditions, Conditions of Particular Application, and Specification Sections, apply to work of this Section.

##### **CI207.1.2 DESCRIPTION**

- This part of the standard gives detailed technical specifications which apply to the installation of vibration measurement equipment.

##### **CI207.1.3 APPLICABLE CODES AND STANDARDS**

- 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:
  - SANS 10142. "The Standard Regulations for the Wiring of Premises".
  - SANS 10313 "Lightning Protection of Equipment".
  - The Occupational Health and Safety Act 85/93.
  - EN 60204 Electrical
  - IEC 60529 /BS EN 60529 Enclosure non- Hazardous
  - ATEX II 2GD Enclosure Hazardous
  - ATEX II 1G Enclosure Intrinsic Safety

##### **CI207.1.4 RELATED SECTIONS**

- The following sections include requirements which relate to this section.
  - Other division 25 sections.
  - Division 26 Electrical sections.

### **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.

### **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

### **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.

## 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.

## CI207.2 PRODUCTS

### CI207.2.1 SEISMIC 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:	Shar Element
Temperature Limitation:	-10 to 100°C
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

## **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

## **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

### **CI207.3 EXECUTION**

#### **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.

## SECTION 3.2 - CONTROL PHILOSOPHY

### JOHANNESBURG WATER LINBRO PARK PUMP STATION ELECTRONIC WORKS CONTROL PHILOSOPHY

#### System Operation Philosophy

The basic control and operating philosophy of the Linbro Pump Station will be as described below, it being noted that the actual controls, trip interlocks, alarms and detailed operating philosophy will only be finalized after award of the Contract and will be further expanded in the Functional Description Specification.

The Linbro Pump Station consists of three 160kW centrifugal pumps configured in a two duty/ one stand-by operating arrangement. The motors are powered via Variable Speed Drives (VSDs) and controlled by the level transmitter in the pump station intermediate tank. The level transmitter will produce a discrete analogue output of 4-20mA externally powered by the electrical distribution with a power source from the Motor Control Centre (MCC) located at the Linbro Pumpstation, with an operational voltage of 230V 1 $\phi$  50Hz. The pump station intermediate tank shall be used as a process interlock to inhibit operation of the Linbro Pump Station when the water level is below a set threshold e.g. 20% (Actual value will be determined during commissioning)

Another level transmitter located in the Linbro elevated tower shall be used to maintain the tower level as close as possible to 100%. The tower level transmitter will produce a discrete analogue output of 4-20mA that will be used to control the start and stop levels of the Linbro Pump station. The operational range of the VSD pumps shall be programmed to allow the tower level to be between 60-100% always. The tower level transmitter shall also be externally powered by the electrical distribution with a power source from the Motor Control Centre (MCC) located at the Linbro Pumpstation, with an operational voltage of 230V 1 $\phi$  50Hz.

A process interlock is created by the two-pressure indicating transmitters on the suction and discharge end of the Linbro pump station line. The VSDs are interlocked with the pressure indicating transmitter to detect blockage of the pipeline. The respective suction or delivery pressure indicating transmitter will produce a discrete analogue output of 4-20mA externally powered by the electrical distribution with a power source from the MCC located at the MCC, with an operational voltage of 230V 1 $\phi$  50Hz. The output of the pressure indicating transmitter will be connected to the PLC analog input card. For the suction pressure the pumps will inhibit the pumps from starting if the pressure is below a set value. As for the discharge pressure the interlock will trip the VSD should the pressure in the discharge pipeline exceed the pre-set value in the PLC as defined in the RAT List. This trip is a process trip and will be a soft trip.

A safety interlock is created by the magnetic flow meter located on each pump discharge line between potable water pumps and the elevated tower. The VSDs are interlocked with the magnetic flow meter to prevent the cavitation of the pumps or blockage of the pipeline. The magnetic flow meter will produce a discrete analogue output of 4-20mA externally powered by the electrical distribution with a power source from the MCC located in the Pumpstation, with an operational voltage of 230V 1 $\phi$  50Hz. The output of the magnetic flow meter will be connected to the Pump station PLC. A flow profile will be established and created in the PLC during commissioning which will estimate the flow proportional to the speed of the variable speed drive. Should the flow between the potable water pumps and the elevated tanks fall outside the operational range as determined by the PLC, the VSD will trip on low flow in the process protecting the pumps. The operational mean will be determined by the PLC with an operational band of  $\pm 10\%$  and a predefined time limit 20 seconds. This will be finalised during commissioning. Should the flow profile fall outside this band, this will be communicated to the HMI. This safety trip will be a hard trip and will require physical reset on the pump station panel for system to return to operability state.

The other Magflow meter located on the common discharge line will just be used to compute the total flow out of the pump station. The value shall be processed and depicted on the HMI. An ultrasonic meter installed close to the tower will be used as a check meter to confirm there is no water loss along the

pipeline between the pump station and the elevated tower. The ultrasonic flow meter reading will be compared to the common discharge Magflow meter and any deviations greater than 5% shall be alarmed to allowed operations team to investigate further however, this will not have any influence on the operation of the pump station.

Hard wired electrical interlocks will be provided to prevent more than two pumps from starting or running at the same time. This restriction will also be programmed into the PLC.

### ***Pump Operational Philosophy***

- a) The suction valve shall have proximity sensors and the proximity sensor position shall be active to show if suction fully opened. The pump will not be available as duty if the respective suction valve is not fully opened.
- b) The discharge valve shall have proximity sensors and the proximity sensor position shall be active to show if discharge valve is fully opened. The pump will not be available to start if the respective delivery valve is not fully opened.
- c) The pumps shall have three control modes:
  - I. Duty Pumps can be run on “Local -HMI” (meaning locally inside the pump station) from the Human Machine Interface (HMI).
  - II. Duty Pumps can be run on “Local -Manual” (meaning locally inside the pump station) from the Motor Control Centre (MCC panel).
  - III. Duty Pumps can be run on “Auto” (meaning fully Automatic) from the tower level sensor and PLC functionality.
- d) Two of the three pumps shall be selected as the duty pumps, and this function will be based on running hours and computed and determined in the PLC.
- e) A remote/Local selector switch shall be provided on the MCC panel to select the desired mode.
- f) A start command signal will be received from the elevated tower calling on the selected duty pumps to start when the water level in the tower drops to a predetermined level and then to either maintain or increase speed, and ultimately to reduce speed and stop when the elevated tower is full.

Upon the recipient of the start signal from the low-level point usually 75%, the system shall check the pump suction manifold pressure if it's above the acceptable level as per the RAT list. The actual pressure ranges will be optimised during the commissioning period. If the pressure range is ok the pump will start and ramp up to full speed. If the tower level continues to drop and demand from users out strips the inflow, the second pump will start to augment to inflow into the elevated tower. The two pumps will continue to pump until the tower is at 98% where the first stop point and then eventually ramp down and shutdowns when the tower reaches 100%.

- g) If the duty pump fails to start when called upon to do so by the elevated tower level transmitter, the standby pump shall start, and an alarm signal will be generated. The alarm should latch and shall only be cleared via acknowledgement by an operator to allow further investigation on the cause of the alarm. The fault pump will be taken out of operation and the standby pump becomes the duty pump. At any given time at least two pumps shall be duty and only on exceptional cases where only one duty pump is available.
- h) A pump will be prevented from starting if the suction pressure is below a certain value or, if it is running, it will stop if the suction pressure drops below a certain value for a predetermined period. A maximum of 3 starts shall be permissible within an hour on a running time basis.

- i) The duty pump will stop if there is no flow registered on the magnetic flow meter after a predetermined period after starting – there will be an indication of the condition and it will have to be manually re-set before that pump can re-start. The reset from HMI can only be allowed for 3 consecutive times within 1 hour. After 3 consecutive attempts within 1 hr the system shall lock out and only be reset at the pump station.
- j) Alarms and trips will be provided for all temperatures namely pump bearings, motor bearings, pump volute casing, and motor windings. The alarm limits and trip settings will be hardcoded into the PLC and can be optimised during commissioning.
- k) Alarms and trips will be provided for all vibration readings namely pump NDE and DE (XYZ) and ,Motor NDE and DE (XYZ). The alarm limits and trip settings will be hardcoded into the PLC and can be optimised during commissioning.
- l) In order to mitigate the surge pressures in the pipe system, a “trip” is to result in a 30 second speed reduction (ramp to stop) from the then current operating speed to zero.
- m) In the instance of the system is operated on “Local-HMI” the operator shall input a preset reference speed to write the value into the PLC so the pumps can ramp up to that speed
- n) In the event of the system running on Local Manual, a preset reference speed shall be programmed into the PLC so that the pumps can run. It is not expected to run the pump station for extended periods in manual mode.
- o) On receipt of a start signal from the elevated Tower Level Transmitter the PLC will:
  - i. Check that the selected pump’s suction and delivery valves are full open.
  - ii. Check that a healthy signal state is being received from the respective pump mag-flow meter.
  - iii. Check if all process instruments are healthy, pressure transmitter etc.
  - iv. Start the pump and run up to a speed that results in a predetermined and pre-set flow rate which will be at least 10% greater than the minimum requirement of the pump (Qmin) and less than the maximum allowable pumping rate. This value will be optimised during the commissioning stage.
  - v. If, the reservoir level continues to drop below a level set point the pump will ramp up by the corresponding percentage of the pre-set speed, thus demand The second duty pump is called in to augment in the flow and subsequently increase the water level in the elevated tower.
  - vi. If, the reservoir level reaches the maximum level 100% ramp down the first duty pump and when the first duty pump is off subsequently ramp down the remaining duty pump shutting down the pump station until the next command signal is received.
  - vii. Ensure that there is a minimum period of 10 minutes between consecutive starts (mainly to allow attenuation of hydraulic surge conditions in the pipelines but also to assist with motor heating conditions).
  - viii. In the event of there being no signal from the Linbro elevated tower level transmitter for a predetermined period (15 minutes) and if the duty pump is running, the pump is to stop. The shutdown sequence shall be initiated, and the pump will ramp down to stop
- p) A number of starts counter is to be provided for each pump which will limit the number of starts per hour to three (3) obtained from the VSD.

- q) A non-resettable running hour meter is to be provided for each pump and programmed in the PLC.
- r) A digital speed indicator (RPM) is to be provided for each pump with the maximum allowable speed clearly marked.
- s) A digital rate of flow indicator will be provided for the respective duty pump mag-flow meter with the maximum permissible pumping rate being marked on each indicator.
- t) Another digital rate of flow indicator will be provided for both the common discharge mag-flow and the ultrasonic ("check") flow meter. Any deviation greater than 5% on the total volumetric flow shall be alarmed only.
- u) The VSD will communicate with the PLC to keep the drive motors within the operational band of the motor and will communicate the following parameters to the PLC:
  - i. Speed
  - ii. Current
  - iii. Operational Voltage
  - iv. Overcurrent Trip
  - v. Short Circuit Trip
  - vi. Earth Fault Trip
  - vii. Local Control
  - viii. Auto Control

The PLC will interpret the signals received from the VSD, transmitting the signal to the HMI or to the VSD itself. These levels are detailed in the RAT list. Should the VSD fall outside of the operational levels of the pump station, the PLC will compute and send the appropriate response to the event.

- v) Safety interlocks will be hard trips and process interlocks shall be soft trips.
- w) The following interlocks are to be implemented to protect the pumps and the system:
  - I. Level in pump station intermediate tank is lower than a set value (to be defined at commissioning stages) for longer than 5 seconds. Action- Start interlock , this alarm condition can self-correct and no need for operator reset.
  - II. No flow detected on Magflow meter for longer than 60 seconds while pump is running. Action- Initiate trip interlock- Operators need reset alarm on HMI.
  - III. Discharge pressure is lower than a set value (to be defined at commissioning stages) for longer than 5 seconds while pump is running under normal circumstances – burst pipe detection / pump failure. Action – Initiate trip interlock- Operators need reset alarm on HMI.
  - IV. 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. Action- Initiate trip interlock -operators need reset alarm on HMI.
  - V. Motor winding temperature higher than a set value (to be defined at commissioning stage from the RAT list). Action- Initiate trip interlock operators need reset alarm on HMI.

- VI. Motor bearing temperature higher than a set value (to be defined at commissioning stage from RAT list). Action- Initiate trip interlock operators need reset alarm on HMI.
  - VII. Motor bearing vibration reading (XYZ) higher than a set value (to be defined at commissioning stage from RAT list). Action- Initiate shutdown sequence interlock operators need reset alarm on HMI.
  - VIII. Pump bearing vibration reading (XYZ) higher than a set value (to be defined at commissioning stage from RAT list). Action- Initiate shutdown sequence interlock operators need reset alarm on HMI.
- x) Process and electrical alarms, ranges and process related variables will be displayed and logged in the HMI for trending and reporting purposes. Trending and logging is described as per Johannesburg Water Standards.

### ***Telemetry Interface Philosophy***

- a) The specialist nominated Johannesburg Water approved Telemetry sub-Contractor shall be appointed to undertake the integration and interfacing of the telemetry signals to the Main operation head office.
- b) Separate dedicated hardwired signals and instrumentation shall be wired/configured directly to the telemetry RTU panel.
- c) A separate dedicated level transmitter shall be provided for the elevated tower to be connected directly to the telemetry RTU.
- d) The following hardwired signals shall be mandatory on all pumpsets, and to be linked to the Telemetry RTU
  - I. Auto
  - II. Run
  - III. Trip
- e) The SCADA system at the Johannesburg Water Control Room shall be capable of viewing the flowing statuses via the telemetry system. The list of signals is not exhaustive and shall be finalised in consultation with Johannesburg water technical personnel.

1	Pump Duty selection	2	Pump available
3	Pump running	4	Suction valve opened/closed
5	Pump stopped	6	Discharge Valve opened/closed
7	Pump Tripped	8	Suction pressure
9	Motor Current	10	Delivery pump pressure
11	Motor Voltage	12	Reservoir level
13	Intermediate tank level	14	

- f) The SCADA system at the Johannesburg Water Control Room shall be capable of viewing the power meter statues. The final list of power meter signals shall be finalised in consultation with Johannesburg water technical personnel during commissioning
- g) The SCADA system at the Johannesburg Water Control Room shall be capable of viewing the Standby Generator statues. The final list of power meter signals shall be finalised in consultation with Johannesburg water technical personnel during commissioning

## SECTION 3.3 – INPUT OUTPUT (IO) LIST

PLC I/O List							
P&ID Tag	EQUIPMENT	AI	DI	AO	DO	COMMS	COMMENT
	<b>Linbro Park Pump Station</b>						
TBD	ESKOM Mains Closed		1				
TBD	GENERATOR Mains Closed		1				
TBD	ATS Changeover Switch Mains ON Feedback		1				
TBD	ATS Changeover Switch Generator ON Feedback		1				
TBD	PUMPSTATION_Common Discharge Magnetic Flowmeter	1				1	
TBD	PUMPSTATION_Common Discharge Ultrasonic flowmeter	1				1	
TBD	PUMPSTATION_Tower Level Transmeter	1					
TBD	PUMPSTATION_Reservoir Level Transmeter	1					
TBD	GENERATOR_Start Command				1		
TBD	GENERATOR_Battery Voltage					1	
TBD	GENERATOR_Battery Amps					1	
TBD	GENERATOR_Oil Pressure					1	
TBD	GENERATOR_Oil Temperature					1	
TBD	GENERATOR_Coolant Temperature					1	
TBD	GENERATOR_Engine Speed					1	
TBD	GENERATOR_Fuel Level					1	
TBD	GENERATOR_Common Alarm		1				
TBD	GENERATOR Status					1	
TBD	GENERATOR Mains Frequency					1	
TBD	GENERATOR L1-N Voltage					1	
TBD	GENERATOR L2-N Voltage					1	
TBD	GENERATOR L3-N Voltage					1	
TBD	GENERATOR L1-L2 Voltage					1	
TBD	GENERATOR L2-L3 Voltage					1	
TBD	GENERATOR L-L1 Voltage					1	
TBD	GENERATOR L1 Current					1	
TBD	GENERATOR L2 Current					1	
TBD	GENERATOR L3 Current					1	
TBD	GENERATOR Power - kW					1	
TBD	GENERATOR Power - kVA					1	
TBD	GENERATOR Power - kWh					1	
	GENERATOR Power - kVAr					1	
TBD	PUMPSET_1_CB - Open		1				New
TBD	PUMPSET_1_CB - Closed		1				New
TBD	PUMPSET_1_CB - Tripped		1				New
TBD	PUMP 1 Automatic Mode		1				New
TBD	PUMP 1 Control_CB ON/OFF		1				New
TBD	PUMP 1 Run Feedback		1				New
TBD	PUMP 1 Stop Feedback		1				New
TBD	PUMP 1 EStop Feedback		1				New
TBD	PUMP 1 VSD Fault Feedback		1				New
TBD	PUMP 1 Reset		1				New
TBD	PUMPSET_1 -VSD_Healthy		1				New
TBD	PUMPSET_1 -Start_Command				1		New
TBD	PUMPSET_1 -Stop_Command				1		New
TBD	PUMPSET_1 -Reset_Command				1		New
TBD	PUMPSET_1 -Suction_Valve_Closed		1				New
TBD	PUMPSET_1 -Suction_Valve_Opened		1				New
TBD	PUMPSET_1 -Discharge_Valve_Closed		1				New
TBD	PUMPSET_1 -Discharge_Valve_Opened		1				New
TBD	PUMPSET_1 -Suction_Pressure_Transmitter	1					New
TBD	PUMPSET_1 -Discharge_Pressure_Transmitter	1					New
TBD	PUMPSET_1 -Discharge_Flow Meter	1					New
TBD	PUMPSET_1 Power_Meter -kWh					1	New
TBD	PUMPSET_1 Power_Meter -kW					1	New
TBD	PUMPSET_1 Power_Meter -kVA					1	New
TBD	PUMPSET_1 Power_Meter -kVAr					1	New
TBD	PUMPSET_1 Power_Meter -pf					1	New
TBD	PUMPSET_1 Power_Meter -Frequency					1	New
TBD	PUMPSET_1 Power_Meter -Voltage L1-L2					1	New
TBD	PUMPSET_1 Power_Meter -Voltage L2-L3					1	New
TBD	PUMPSET_1 Power_Meter -Voltage L1-L3					1	New
TBD	PUMPSET_1 Power_Meter -Voltage L1-N					1	New
TBD	PUMPSET_1 Power_Meter -Voltage L2-N					1	New
TBD	PUMPSET_1 Power_Meter -Voltage L3- N					1	New

TBD	PUMPSET_1 Power_Meter -Current Red Phase					1	New
TBD	PUMPSET_1 Power_Meter -Current Blue Phase					1	New
TBD	PUMPSET_1 Power_Meter -Current White Phase					1	New
P&ID Tag	EQUIPMENT	AI	DI	AO	DO	COMMS	COMMENT
TBD	PUMPSET_1_DE_Vertical_Vibration	1					New
TBD	PUMPSET_1_DE_Horizontal_Vibration	1					New
TBD	PUMPSET_1_DE_Axial_Vibration	1					New
TBD	PUMPSET_1_NDE_Vertical_Vibration	1					New
TBD	PUMPSET_1_NDE_Horizontal_Vibration	1					New
TBD	PUMPSET_1_NDE_Axial_Vibration	1					New
TBD	PUMPSET_1_DE_Bearing_Temperature	1					New
TBD	PUMPSET_1_NDE_Bearing_Temperature	1					New
TBD	PUMPSET_1_Motor_Red_Phase_Temperature_1	1					New
TBD	PUMPSET_1_Motor_Red_Phase_Temperature_2	1					New
TBD	PUMPSET_1_Motor_Blue_Phase_Temperature_1	1					New
TBD	PUMPSET_1_Motor_Blue_Phase_Temperature_2	1					New
TBD	PUMPSET_1_Motor_White_Phase_Temperature_1	1					New
TBD	PUMPSET_1_Motor_White_Phase_Temperature_2	1					New
TBD	PUMPSET 2_CB - Open		1				New
TBD	PUMPSET 2_CB - Closed		1				New
TBD	PUMPSET 2_CB - Tripped		1				New
TBD	PUMPSET 2 Automatic Mode		1				New
TBD	PUMPSET 2 Control_CB ON/OFF		1				New
TBD	PUMPSET 2 Run Feedback		1				New
TBD	PUMPSET 2 Stop Feedback		1				New
TBD	PUMPSET 2 EStop Feedback		1				New
TBD	PUMPSET 2 VSD Fault Feedback		1				New
TBD	PUMPSET 2 Reset		1				New
TBD	PUMPSET_2 -VSD_Healthy		1				New
TBD	PUMPSET_2 -Start_Command				1		New
TBD	PUMPSET_2 -Stop_Command				1		New
TBD	PUMPSET_2 -Reset_Command				1		New
TBD	PUMPSET_2 -Suction_Valve_Closed		1				New
TBD	PUMPSET_2 -Suction_Valve_Opened		1				New
TBD	PUMPSET_2 -Discharge_Valve_Closed		1				New
TBD	PUMPSET_2 -Discharge_Valve_Opened		1				New
TBD	PUMPSET_2 -Suction_Pressure_Transmitter	1					New
TBD	PUMPSET_2 -Discharge_Pressure_Transmitter	1					New
TBD	PUMPSET_2 -Discharge_Flow Meter	1					New
TBD	PUMPSET_2 Power_Meter -kWh					1	New
TBD	PUMPSET_2 Power_Meter -kW					1	New
TBD	PUMPSET_2 Power_Meter -kVA					1	New
TBD	PUMPSET_2 Power_Meter -kVar					1	New
TBD	PUMPSET_2 Power_Meter -pf					1	New
TBD	PUMPSET_2 Power_Meter -Frequency					1	New
TBD	PUMPSET_2 Power_Meter -Voltage L1-L2					1	New
TBD	PUMPSET_2 Power_Meter -Voltage L2-L3					1	New
TBD	PUMPSET_2 Power_Meter -Voltage L1-L3					1	New
TBD	PUMPSET_2 Power_Meter -Voltage L1-N					1	New
TBD	PUMPSET_2 Power_Meter -Voltage L2-N					1	New
TBD	PUMPSET_2 Power_Meter -Voltage L3- N					1	New
TBD	PUMPSET_2 Power_Meter -Current Red Phase					1	New
TBD	PUMPSET_2 Power_Meter -Current Blue Phase					1	New
TBD	PUMPSET_2 Power_Meter -Current White Phase					1	New
TBD	PUMPSET_2_DE_Vertical_Vibration	1					New
TBD	PUMPSET_2_DE_Horizontal_Vibration	1					New
TBD	PUMPSET_2_DE_Axial_Vibration	1					New
TBD	PUMPSET_2_NDE_Vertical_Vibration	1					New
TBD	PUMPSET_2_NDE_Horizontal_Vibration	1					New
TBD	PUMPSET_2_NDE_Axial_Vibration	1					New
TBD	PUMPSET_2_DE_Bearing_Temperature	1					New
TBD	PUMPSET_2_NDE_Bearing_Temperature	1					New
TBD	PUMPSET_2_Motor_Red_Phase_Temperature_1	1					New
TBD	PUMPSET_2_Motor_Red_Phase_Temperature_2	1					New
TBD	PUMPSET_2_Motor_Blue_Phase_Temperature_1	1					New
TBD	PUMPSET_2_Motor_Blue_Phase_Temperature_2	1					New
TBD	PUMPSET_2_Motor_White_Phase_Temperature_1	1					New
TBD	PUMPSET_2_Motor_White_Phase_Temperature_2	1					New
TBD	PUMPSET 3_CB - Open		1				New

TBD	PUMPSET 3_CB - Closed		1				New
TBD	PUMPSET 3_CB - Tripped		1				New
TBD	PUMPSET 3 Automatic Mode		1				New
TBD	PUMPSET 3 Control_CB ON/OFF		1				New

P&ID Tag	EQUIPMENT	AI	DI	AO	DO	COMMS	COMMENT
TBD	PUMPSET 3 Run Feedback		1				New
TBD	PUMPSET 3 Stop Feedback		1				New
TBD	PUMPSET 3 EStop Feedback		1				New
TBD	PUMPSET 3 VSD Fault Feedback		1				New
TBD	PUMPSET 3 Reset		1				New
TBD	PUMPSET_3 -VSD_Healthy		1				New
TBD	PUMPSET_3 -Start_Command				1		New
TBD	PUMPSET_3 -Stop_Command				1		New
TBD	PUMPSET_3 -Reset_Command				1		New
TBD	PUMPSET_3 -Suction_Valve_Closed		1				New
TBD	PUMPSET_3 -Suction_Valve_Opened		1				New
TBD	PUMPSET_3 -Discharge_Valve_Closed		1				New
TBD	PUMPSET_3 -Discharge_Valve_Opened		1				New
TBD	PUMPSET_3 -Suction_Pressure_Transmitter	1					New
TBD	PUMPSET_3 -Discharge_Pressure_Transmitter	1					New
TBD	PUMPSET_3 -Discharge_Flow Meter	1					New
TBD	PUMPSET_3 Power_Meter -kWh					1	New
TBD	PUMPSET_3 Power_Meter -kW					1	New
TBD	PUMPSET_3 Power_Meter -kVA					1	New
TBD	PUMPSET_3 Power_Meter -kVAr					1	New
TBD	PUMPSET_3 Power_Meter -pf					1	New
TBD	PUMPSET_3 Power_Meter -Frequency					1	New
TBD	PUMPSET_3 Power_Meter -Voltage L1-L3					1	New
TBD	PUMPSET_3 Power_Meter -Voltage L3-L3					1	New
TBD	PUMPSET_3 Power_Meter -Voltage L1-L3					1	New
TBD	PUMPSET_3 Power_Meter -Voltage L1-N					1	New
TBD	PUMPSET_3 Power_Meter -Voltage L3-N					1	New
TBD	PUMPSET_3 Power_Meter -Voltage L3- N					1	New
TBD	PUMPSET_3 Power_Meter -Current Red Phase					1	New
TBD	PUMPSET_3 Power_Meter -Current Blue Phase					1	New
TBD	PUMPSET_3 Power_Meter -Current White Phase					1	New
TBD	PUMPSET_3_DE_Vertical_Vibration	1					New
TBD	PUMPSET_3_DE_Horizontal_Vibration	1					New
TBD	PUMPSET_3_DE_Axial_Vibration	1					New
TBD	PUMPSET_3_NDE_Vertical_Vibration	1					New
TBD	PUMPSET_3_NDE_Horizontal_Vibration	1					New
TBD	PUMPSET_3_NDE_Axial_Vibration	1					New
TBD	PUMPSET_3_DE_Bearing_Temperature	1					New
TBD	PUMPSET_3_NDE_Bearing_Temperature	1					New
TBD	PUMPSET_3_Motor_Red_Phase_Temperature_1	1					New
TBD	PUMPSET_3_Motor_Red_Phase_Temperature_3	1					New
TBD	PUMPSET_3_Motor_Blue_Phase_Temperature_1	1					New
TBD	PUMPSET_3_Motor_Blue_Phase_Temperature_3	1					New
TBD	PUMPSET_3_Motor_White_Phase_Temperature_1	1					New
TBD	PUMPSET_3_Motor_White_Phase_Temperature_3	1					New
	<b>Totals</b>	55	50	0	10	69	
	<b>20% Spare Capacity</b>	66	60	0	12	83	

## **SECTION 4 : MECHANICAL SPECIFICATIONS (PUMPS)**

### **MECHANICAL**

#### **0000 SCOPE OF WORKS FOR MECHANICAL PORTION**

- 0000.1 SCOPE
- 0000.2 THE SITE
- 0000.3 NORMATIVE REFERENCES
- 0000.4 MINIMUM STANDARDS 0000.5
- SCOPE OF MECHANICAL WORKS
- 0000.6 COMMISSIONING
- 0000.7 MEASUREMENT AND PAYMENT

#### **0001 GENERAL MECHANICAL REQUIREMENTS**

- 0001.1 SCOPE
- 0001.2 NORMATIVE REFERENCES
- 0001.3 MATERIALS
- 0001.4 CASTINGS
- 0001.5 FABRICATION OF STEELS
- 0001.6 WELDING
- 0001.7 INSTALLATION
- 0001.11 ELECTRIC MOTORS
- 0001.12 BASEFRAMES

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<b>3.3.2.1</b>	<b>0000</b>	<b>SCOPE OF WORKS FOR MECHANICAL PORTION</b>
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<b>C3.3.2.1.1</b>	<b>0000.1</b>	<b>SCOPE</b>
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0000 specifies the project specific requirements for the construction of the new proposed Linbro Tower.

The Plant described hereunder is for the pumps 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 pumps 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 pumps 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 0000.2 THE SITE**

The site is situated in Linbro Park.

**C3.3.2.1.3 0000.3 NORMATIVE REFERENCES**

The following documents shall form part of the Contract Document:

- Data Sheets.
- 0001: General Mechanical Requirements.
- 0002: Operating and Maintenance Manuals.
- 5019: Horizontally Split Case Centrifugal Pump.
- 7023: Couplings and Flange Adapters.
- 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 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 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.

##### **C3.3.2.1.5. 0000.5.1 NEW LINBRO PUMP HOUSE**

###### **C3.3.2.1.5.1 0000.5.1.1 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 Linbro Pump House as shown on Tender Drawing C01486 PS03 GL03 associated Data sheets and as detailed below.

###### **C3.3.2.1.5.1.2 0000.5.1.2 Horizontally Split Case Centrifugal Pump sets**

This part of the specification shall fully comply with the requirements of Particular Specification 5019 for Horizontally Split Case Centrifugal Pump.

Three (3) horizontally split case centrifugal pumps shall be supplied, delivered and installed as indicated on the associated drawings. The pumps shall operate on a 2 duty and 1 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: 280 l/s (single pump)
- Duty head: 45 m
- Efficiency: 88 % (estimate)
- Installed motor size: 160 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 Drawings stated earlier.

### **C3.3.2.1.5.3 0000.5.3 PRESSURE GAUGES AND INSTRUMENTATION**

#### **C3.3.2.1.5.3.1 0000.5.3.1 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 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.

#### **C3.3.2.1.5.3.2 0000.5.3.2 Pressure Gauges**

All gauges shall fully comply with 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:

<b>Location</b>	<b>Suction (kPa)</b>	<b>Discharge (kPa)</b>
Linbro Pump Station	0 to 500	0 to 1000

#### **3.3.2.1.5.3.3 0000.5.3.3 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.

**C3.3.2.1.5.3.4      0000.5.3.4      SPARES**

The Contractor shall submit a list of recommended spares for approval as part of the tender offer.

**C3.3.2.1.6 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      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      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 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 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 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.

<b>C3.3.2.2</b>	<b>0001</b>	<b>GENERAL MECHANICAL</b>
<b>C3.3.2.2.1</b>	<b>0001.1</b>	<b>SCOPE</b>

0001 specifies general technical requirements for mechanical engineering projects in which the contractor is responsible for the detailed design.

#### **C3.3.2.2.2 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 0001.3 MATERIALS**

#### **C3.3.2.2.3.1 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 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 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 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 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 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; BS1452
S. G. Iron	SANS 936/7; BS 2789
Steel (General Purpose)	SANS 1465; BS 3100
Aluminium	SANS 989/992; BS1490
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 0001.5 INSTALLATION**

##### **C3.3.2.2.5.1 0001.5.1 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 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 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.

#### **C3.3.2.2.8.1 0001.8.1 BASEFRAMES, PIPE SUPPORTS, ETC.**

The design requirements for base frames and pipework supports are specified elsewhere in 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.

#### **C3.3.2.2.9.1 0001.9.1 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.

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".

#### **C3.3.2.2.10.1 0001.10.11 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.

#### **C3.3.2.2.11 0001.11 ELECTRIC MOTORS**

##### **C3.3.2.2.11.1 0001.11.1 ELECTRIC MOTORS BELOW 30 KW**

###### **C3.3.2.2.11.1.1 0001.11.1.1 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.

#### **C3.3.2.2.11.1.2 0001.11.1.2 Performance Requirements**

Motors shall provide rated power output at an ambient temperature of up to 40 °C 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.

#### **C3.3.2.2.11.1.3 0001.11.1.3 Operation and Control**

Protection against both starting overload and running overload shall be designed and provided so that it is specific to the application.

#### **C3.3.2.2.11.1.4 0001.11.1.4 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.

#### **C3.3.2.2.11.1.5 0001.11.1.5 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.

#### **C3.3.2.2.11.1.6 0001.11.1.6 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 0001.14.1.7 Safety**

Rotating parts shall be guarded as required by legislation.

### **C3.3.2.2.11.2 0001.11.2 ELECTRIC MOTORS OF 30 kW AND ABOVE**

#### **C3.3.2.2.11.2.1 0001.11.2.1 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 °C rise capability) with Class B temperature rise (80 °C). 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.

#### **C3.3.2.2.11.2.2 0001.11.2.2 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 °C 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.

#### **C3.3.2.2.11.2.3 0001.11.2.3 400 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.

#### **C3.3.2.2.11.2.4 0001.11.2.4 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.

#### **C3.3.2.2.11.2.5 0001.11.2.5 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.

#### **C3.3.2.2.11.2.6 0001.11.2.6 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.

#### **C3.3.2.2.11.2.7 0001.11.2.7 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.

#### **C3.3.2.2.11.2.8 0001.11.2.8 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.

#### **C3.3.2.2.11.2.9 0001.11.2.9 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.

#### **C3.3.2.2.11.2.10 0001.11.2.10 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.

#### **C3.3.2.2.11.2.11 0001.11.2.11 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.

#### **C3.3.2.2.11.2.12 0001.11.2.12 Safety**

Rotating parts shall be guarded as required by legislation.

#### **C3.3.2.2.12 0001.12 BASEFRAMES**

##### **C3.3.2.2.12.1 0001.12.1 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.

#### **C3.3.2.2.12.2      0001.12.2 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 be made for reaching the nut with a suitable spanner. In the period between machining and installation of the equipment, the machined surface shall be protected against corrosion by a removable coating. After installation, a non-hardening compound, Tectyl or equivalent, shall be applied to exposed machined surfaces and to the crevice formed at the foot of the equipment. 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.

#### **C3.3.2.2.12.3      0001.12.3 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.

#### **C3.3.2.2.12.4      0001.12.4 MATERIALS**

Base frames shall be fabricated from steels complying with SANS 50025 for grade S 355 JR or for grade S 355 JO.

#### **C3.3.2.2.12.5      0001.12.5 CORROSION PROTECTION**

Steel base frames shall be hot-dip galvanized in accordance with 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.

#### **C3.3.2.2.12.6      0001.12.6 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.

<b>Pump Inlet</b>	<b>Fastener Size (Minimum)</b>
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.

#### **C3.3.2.2.12.7      0001.12.7 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      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 0002 OPERATING AND MAINTENANCE MANUALS**  
**C3.3.2.3.1 0002.1 SCOPE**

0002 specifies the standard requirements for the Operating and Maintenance Manual for the Contract.

**C3.3.2.3.2 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 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 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
<b>1</b>	<b>General</b>	
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.
<b>2</b>	<b>Operation</b>	
2.1	Operating System	Description of the operating system containing: <b>Start-up</b> , adjustment, operating and shut-down procedures for manual and automatic operation - <b>Emergency</b> operating procedures - <b>Process</b> verification - <b>Settings</b> , setpoints, protection, alarms and trips. This document shall be suitable for using as a Training Manual.
2.2	Commissioning	Commissioning results.
<b>3</b>	<b>Maintenance Schedule</b>	
	Maintenance and Lubrication	Schedule of routine maintenance for all <b>mechanical, electrical, instrumentation and control</b> 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 <b>all</b> lubrication periods, lubricants and capacities.
<b>4</b>	<b>Mechanical Equipment</b>	
4.1	Mechanical Equipment Item 1 (e.g. Pumps)	<ul style="list-style-type: none"> <li>- The make, model, serial number, description, size, design range, performance data, motor and drive details and supplier's details of the item.</li> <li>- Dimensioned drawing.</li> <li>- A photograph of the nameplate.</li> <li>- Manufacturer's operating and maintenance manual.</li> <li>- Operating curves, test results, etc.</li> </ul>
4.2	Equipment Item 2 (e.g. Mixers)	Ditto
4.3	etc.	Ditto
<b>5</b>	<b>Electrical Equipment</b>	
5.1	Elec. Equip. Item 1 (e.g. MCC Panels)	As for 4.1 above; <b>PLUS:</b> <b>Control</b> and electrical details, including logic sequence, circuit diagrams and software, as applicable - <b>Electrical</b> reticulation drawings - <b>Equipment</b> overall dimensions - <b>Wiring</b> diagrams - <b>Switchboard</b> layout drawings - <b>SLDs</b> .
5.2	Elec. Equip. (e.g. VFCs)	ditto
5.3	etc.	ditto
<b>6</b>	<b>Instrumentation Equipment</b>	
6.1	Instrumentation Equip. Item 1 (e.g. Magflo)	As for 4.1 above; <b>PLUS:</b> <b>Circuit</b> diagrams of instrumentation systems and of individual instruments - <b>Installation</b> arrangement - <b>Normal</b> operating range - <b>Calibration</b> procedures.
6.2	Equip. Item 2 (e.g. level)	ditto
<b>7</b>	<b>Control</b>	
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.
<b>8</b>	<b>Documents</b>	
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	List of spares provided in terms of this Contract - Certificate of electrical compliance - Corrosion protection systems used - Coating supplier's data sheets and coating repair procedures.

#### **C3.3.2.3.5 0002.5 MEASUREMENT AND PAYMENT**

##### **C3.3.2.3.5.1 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.

**C3.3.2.7 5019 HORIZONTAL SPLIT CASE CENTRIFUGAL PUMP**

**C3.3.2.7.1 5019.1 SCOPE**

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 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 0001: General Mechanical Requirements.
- d) Specification 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 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 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 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.
- Vibration monitors shall be installed for monitoring only and shall not lead to the motor tripping.

#### **C3.3.2.7.6 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 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 5019.8 SHAFT SEALS**

##### **C3.3.2.7.8.1 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 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 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 5019.9 BEARINGS**

##### **C3.3.2.7.9.1 5019.9.1 GENERAL**

Bearings shall comply with the clause "Bearings" in 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 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 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 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 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 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 0001.

#### **C3.3.2.7.12 5019.12 FABRICATION**

The baseplate and any other fabricated item shall comply with the clauses "Fabrication of Steels" and "Welding" in 0001.

Fabrications will generally be inspected by the Engineer after fabrication is complete.

#### **C3.3.2.7.13 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 5019.14 CORROSION PROTECTION**

##### **C3.3.2.7.14.1 5019.14.1 GENERAL**

All components shall be suitably designed for corrosion resistance. Corrosion Protection shall comply generally with 0003.

##### **C3.3.2.7.14.2 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 5019.15 FASTENERS**

Fasteners shall comply with the clause "Fasteners" in 0001. Anchor

fasteners shall have a minimum diameter of M16.

##### **C3.3.2.7.16 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:  $T_{trip} = T_{equilibrium} + (40^{\circ}\text{C} - T_{ambient}) + 10^{\circ}\text{C}$ .

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 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 0001.

#### **C3.3.2.7.17 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 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 0001.

#### **C3.3.2.7.19 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 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 5019.21 TESTING REQUIREMENTS**

#### **C3.3.2.7.21.1 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 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 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 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.

<b>Volume</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>		
<b>Part</b>	<b>T1</b>	<b>T2</b>	<b>C1</b>	<b>C2</b>	<b>C3</b>	<b>C4</b>



#### **C3.3.2.7.22.1**

#### **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**

#### **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.

<b>Volume</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	
<b>Part</b>	<b>T1</b>	<b>T2</b>	<b>C1</b>	<b>C2</b>	<b>C3</b>	<b>C4</b>



Contract JW14406 Page 1  
Description: Linbro Park Tower (With  
Associated Works)  
**SITE INFORMATION**

# Johannesburg Water SOC Ltd



## VOLUME 1

### PART 4: SITE INFORMATION

<b>Volume</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	
<b>Part</b>	<b>T1</b>	<b>T2</b>	<b>C1</b>	<b>C2</b>	<b>C3</b>	<b>C4</b>



Contract JW 14406 Page 2  
Description: Linbro Park Tower (With  
Associated Works)  
**SITE INFORMATION**

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Employer:		Contractor:	
Witness:		Witness:	

<b>Volume</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	
<b>Part</b>	<b>T1</b>	<b>T2</b>	<b>C1</b>	<b>C2</b>	<b>C3</b>	<b>C4</b>



## C4 SITE INFORMATION

### C4.1.1 GENERAL

This section describes the site at the time of tender to enable the Contractor to price his tender and to decide upon his method of working and programming and risks.

### C4.1.2 Site Location

The site is situated at Corner of Clulee Road and Peace Street, Linbro Park in Johannesburg

### C4.1.3 Access To Site And Restrictions

Although the works are located on sites within the Employer's property and/or reserve, the contractor may have to obtain permission from JRA to excavate road surfaces in order to execute the works required as part of this Contract. Any other 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.

### C4.1.4 Existing Services, Servitudes And Wayleaves

A number of existing services have been located through a subsurface detection drawings and others have been marked out on site. Existing services identified are electrical servitude, water pipes and some unidentified anomalies bordering the proposed location of the tower and pump station. For detailed specification the Contractor shall refer to clauses PS1.5 (Temporary Works), PS4.5 (Existing services), and PS4.8 (Permits and wayleaves).

### C4.1.5 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.

Employer:		Contractor:	
Witness:		Witness:	

<b>Volume</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	
<b>Part</b>	<b>T1</b>	<b>T2</b>	<b>C1</b>	<b>C2</b>	<b>C3</b>	<b>C4</b>



Contract JW14406 Page 4  
Description: Linbro Park Tower (With Associated Works)  
**SITE INFORMATION**

Refer to clause PS7.1 (Security)

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#### **C4.1.6 Nature Of Ground And Subsoil Conditions**

Geotechnical investigation has been done; the ground and subsoil conditions are highlighted as part of this tender document. It shall be the Contractor's responsibility to acquaint himself with the conditions of the site.

A Topographical survey of the existing site has been included.

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#### **C4.1.7 Geotechnical Report And Borehole Cores**

The Geotechnical report is attached to this document.

Employer:		Contractor:	
Witness:		Witness:	



ITEM NO	PAYMENT REFERS	SHORT DESCRIPTION	UNIT	QUANTITY	RATE (R)	AMOUNT (R)
	<b>SANS 1200 A</b>	<b>SECTION 1 : GENERAL</b>				
1,1	8,3	<u>Contractual Requirements</u>				
1.1.1	PSA 8.3.1	Contractual requirements including but not limited to providing surites, insurance of the works and plant; third party or public liability; insurance for compliance with Workmans Compensation Act and any other contractual obligations.	Sum	1		0,00
1.1.2		Fixed preliminary and general charges	Sum	1		0,00
	8.3.2	<b>Establishment of facilities on site:</b>				
	8.3.2.1	<u>Facilities for Employers Agent</u>				
1.1.3	8.3.2.1(a)	Provision of a furnished meeting room and office for the Employers Agent's Representative (including all furnishings, facilities and equipment including toilet facilities)	Sum	1		0,00
1.1.4		Provision of survey equipment (PSAB 4.2)	Sum	1		0,00
1.1.5	PSAB 8.1	Contract Nameboard (2 No.) and Identity Boards (2 No.) with supports erected & moved complete. (Refer to PSAB 3.1)	No.	2		0,00
1.1.6		Provision of survey assistants (Refer PSAB 5.5)	Sum	1		0,00
1.1.7		Covered Parking (2 bays) (Refer PSAB 3.3)	Sum	1		0,00
1.1.8		PPE for Engineer, assistants and students	Sum	1		0,00
1.1.9		Security of works	Sum	1		0,00
1.1.10		All other specified facilities (incl wifi internet connection and printer)	Sum	1		0,00
1.1.11	8.3.2.2, 8.3.2.3	<u>Facilities for Contractor</u>				
1.1.11.1		a) Offices and storage sheds	Sum	1		0,00
1.1.11.2		b) Workshops	Sum	1		0,00
1.1.11.3		c) Laboratories	Sum	1		0,00
1.1.11.4		d) Living Accommodation	Sum	1		0,00
1.1.11.5		e) Ablution and latrine facilities	Sum	1		0,00
1.1.11.6		f) Tools and equipment	Sum	1		0,00
1.1.11.7		g) Water supplies, electric power and communications	Sum	1		0,00
1.1.11.8		h) Dealing with water	Sum	1		0,00
1.1.11.9		i) Access	Sum	1		0,00
1.1.11.10		j) Construction Plant and Transport	Sum	1		0,00
1.1.11.11	8.3.4	Remove all site establishment on completion	Sum	1		0,00
1.1.11.12	PSA8.17	Dealing with conditions of permits, Wayleave Agreements, EIA, RoD. (Refer to C3.4.4.8)	Sum	1		0,00
1.1.11.13		Notices and warnings to consumers	Sum	1		0,00
<b>TOTAL CARRIED FORWARD</b>						<b>0,00</b>

ITEM NO	PAYMENT REFERS	SHORT DESCRIPTION	UNIT	QUANTITY	RATE (R)	AMOUNT (R)
TOTAL BROUGHT FORWARD						0,00
1.1.12	PSA 8.8 a	<b><u>OH&amp;S Requirements (Fixed charges)</u></b>  The sum shall cover all preparation of risk assessments (Annexure D), safe work procedures, the project H&S File, the H&S Plan, medicals for all workers, the provision of PPE and protective clothing, including hazards and potential hazard identification, Standard Working Procedures, and Method Statements and all other costs necessary in complying generally with the Occupational Health and Safety Act 85 of 1993, (as amended), the Construction Regulations 2014 and the Particular Safety Specification (Annexure C)	Sum	1		0,00
1.1.13		Completing and checking the Project H&S File and handing over to Client on completion of the works and exit medicals for all workers.	Sum	1		0,00
1.1.14		<b><u>HIV / AIDS Awareness</u></b> Refer to SANS 1921-6 and Annexure F  Conduct HIV/AIDS awareness programme workshops on site for not less than 90% of the workers inclusive of all direct and indirect costs (at least once every 4 months)	No.	3		0,00
1.1.15		Provide and maintain condom dispenser	No.	1		0,00
1.1.15		Provide and maintain HIV/AIDS awareness posters	No.	1		0,00
1.1.16		Provide information regarding the voluntary testing of construction workers, counselling, support and care in a monthly report	Sum	1		0,00
1.1.17	PSA 8.15	<b><u>Environmental Management and EMP</u></b>  The sum shall cover the cost of all activities necessary to comply with section C3.5 and Annexure M of the Environmental Management Particular Specification, and Environmental Management Plan, which incorporates the ROD requirements for the Project, which have not been included in the tendered rates for the scheduled items allowed elsewhere in the bill of quantities	Sum	1		0,00
1.1.18		Extra over Item 1.1.26 for the appointment of a Specialist selected Sub-Contractor, to carry out at least 25% of the environmental rehabilitation work.	Sum	1		0,00
		Appointment of Safety Officer	Sum	1		0,00
		Appointment of Environmental Officer	Sum	1		0,00
1.2	<b>SANS 1200A</b>	<b>TIME RELATED ITEMS</b>				
1.2.1	PSA 8.4.1	Contractual requirements (including, EPWP, QA and Project Reporting)	Months	18		0,00
TOTAL CARRIED FORWARD						R 0,00

ITEM NO	PAYMENT REFERS	SHORT DESCRIPTION	UNIT	QUANTITY	RATE (R)	AMOUNT (R)
	TOTAL BROUGHT FORWARD					R 0,00
	PSA 8.4.2	<b>Operate and maintain facilities on Site</b>				
	8.4.2.1	<b><u>Facilities for Engineer for duration of contract (SANS 1200AB)</u></b>				
1.2.2	8.4.2.1 (a)	Provision of meeting room and office for the Engineer's Representative including toilet facilities as per PSAB 5.2 & PSAB 3.2	Months	18		0,00
1.2.3		Provision of survey equipment (Refer to PSAB 4.2)	Months	18		-
1.2.4		Provision of 2 No survey assistants (Refer to PSAB 5.5)	Months	18		-
1.2.5		Nameboards (2No.)	Months	18		-
1.2.6		PPE for Engineer and assistants	Months	18		-
1.2.7		Engineer's Office and parking facilities	Months	18		-
1.2.7		Security of works	Months	18		-
1.2.8	8.4.2.2 8.4.2.3	<b><u>Facilities for Contractor</u></b>				
1.2.8.1		a) Offices and storage sheds	Months	18		0,00
1.2.8.2		b) Workshops	Months	18		0,00
1.2.8.3		c) Laboratories	Months	18		0,00
1.2.8.4		d) Living Accommodation	Months	18		-
1.2.8.5		e) Ablution and latrine facilities	Months	18		0,00
1.2.8.6		f) Tools and equipment	Months	18		0,00
1.2.8.7		g) Water supplies, electric power and communications	Months	18		0,00
1.2.8.8		h) Dealing with water	Months	18		0,00
1.2.8.9		i) Access	Months	18		0,00
1.2.8.10		j) Construction Plant and Transport	Months	18		0,00
1.2.9	PSA 8.4.3	Supervision for duration of the contract (all supervisory staff not considered labour)	Months	18		0,00
1.2.10	8.4.4	Company and Head Office overhead costs	Months	18		0,00
1.2.11	PSAB 8.20	General responsibilities and other time related obligations	Months	18		0,00
	PSA 8.17	<b><u>Permits and Wayleaves</u></b>				
1.2.12		Dealing with conditions of permits, Wayleave Agreements, EIA, RoD (Refer to C3.4.4.8)	Months	18		0,00
	TOTAL CARRIED FORWARD					R 0,00

ITEM NO	PAYMENT REFERS	SHORT DESCRIPTION	UNIT	QUANTITY	RATE (R)	AMOUNT (R)
TOTAL BROUGHT FORWARD						R 0,00
1.2.13	PSA 8.8 a	<b><u>OH&amp;S Requirements (Time charges)</u></b> Updating and amending the risk assessments, safe work procedures, the project H&S File, the H&S Plan, medicals for all workers, the provision of PPE and protective clothing, including hazards and potential hazard identification, Standard Working Procedures, and Method Statements and all other costs necessary in complying generally with the Occupational Health and Safety Act 85 of 1993, (as amended), the Construction Regulations 2014 and the Particular Safety Specification (Annexure C)	Months	18		0,00
1.2.14		Full compliance and checking the Project H&S File during construction of the works under the Contract.	Months	18		0,00
1.2.15		The sum shall cover all activities necessary in complying with the requirements of the Health and Safety Specification in terms of Training as the Work proceeds	Months	18		0,00
1.2.16		The sum shall cover all activities necessary in complying with the requirements of the Health and Safety Specification in terms of Monitoring and Review as the Work	Months	18		0,00
1.2.17		The sum shall cover the cost of all activities necessary to comply with section C3.5 and Annexure M of the Environmental Management Particular Specification, and Environmental Management Plan, which incorporates the ROD requirements for the Project, which have not been included in the tendered rates for the scheduled items allowed elsewhere in the bill of quantities	Months	18		0,00
1.2.18	PSA 8.4.5	Security in accordance with C3.4.4.6	Months	18		0,00
1.2.19		Any other time related obligations	Months	18		0,00
1.2.20	PSA 8.5.4	<b><u>EME's or QSE's</u></b> Contractor to provide manager for dealing with EME's or QSE's for duration of contract to meet local employment and local enterprise targets (Refer to C1.8, C1.9 and C3.4.10 & PSA 5.10)	Months	18		0,00
1.2.21		Dealing with conditions of EME's or QSE's sub-contractors and local/target labour (Refer to C1.9, C3.4.10 & C3.3.2).The tendered rate shall cover all costs including but not limited to procurement, management, administration, overheads, finance costs, transportation, training, risk and profit and any other costs associated on work allocated to EME's or QSE's and targeted labour in order to achieve the required participation goals. (Contractor to allocate packages)	Months	18		0,00
TOTAL CARRIED FORWARD						R 0,00

ITEM NO	PAYMENT REFERS	SHORT DESCRIPTION	UNIT	QUANTITY	RATE (R)	AMOUNT (R)
TOTAL BROUGHT FORWARD						R 0,00
1.3	8,5	<b>SUMS STATED PROVISIONALLY BY ENGINEER</b>				
1.3.1		Quality assurance and management plan	Sum	1,0		0,00
1.3.2		Provisional sum for Independent OHS, EMP and Electrical practitioners	Prov. Sum	1,0	300 000,00	300 000,00
1.3.3		Provisional sum for Cathodic Protection	Prov. Sum	1,0	1 500 000,00	1 500 000,00
1,4	8,8	<b>TEMPORARY WORKS</b>				
	C3.1.5					
	PSA 8.7.2	Dealing with traffic or accommodation of traffic and erecting signage (also refer to SANS 1921-2)	Sum	1		0,00
1.4.1						
	8.8.1	Access to works including all temporary roads, excavations and ramps, etc.	Sum	1		0,00
1.4.2	PSA 5.8					
1.4.3	PSA 8.7.6	Dealing with water	Sum	1		0,00
1.4.4	PSA 8.8.4	Dealing with existing infrastructure	Sum	1		0,00
1.4.5	PSA 8.22	Dealing with Public	Sum	1		0,00
1.4.6	PSA 8.18	Barricading of Trenches	Sum	1		0,00
1.4.7	PSA 8.19	Fencing	Sum	1		-
	PSLD 8.2.2	Equipment supplied for testing and disinfection of structures and pipelines from existing infrastructure, including transportation costs (Prov.).	Sum	1		0,00
1.4.8	PSL 5.10					
1.4.9	PSA 8.22	Allow for the attendance of other Contractors, JW staff and public within the parameters of the site.	Sum	1		0,00
TOTAL FOR SECTION 1 CARRIED FORWARD TO SUMMARY						R 1 800 000,00

ITEM NO	PAYMENT REFERS	SHORT DESCRIPTION	UNIT	QUANTITY	RATE (R)	AMOUNT (R)
2	SANS 1200A	SECTION 2: DAYWORKS, PROVISIONAL SUMS AND PRIME COST ITEMS				
2,1	8,7 PSA 8.6	DAYWORKS				
		<u>Labour</u>				
2.1.1	8.5 (b.1)	Allow for total remuneration paid to workers	Prov Sum	1	500 000,00	500 000,00
2.1.2	PSA 8.5	Overheads, charges and profit on 2.1.1 above	%	500 000,00		0,00
2.1.3		Team Leader / charge hand	hr	120		0,00
2.1.4		Artisan	hr	150		0,00
2.1.5		Skilled	hr	150		0,00
2.1.6		Semi-skilled	hr	250		0,00
2.1.7		Unskilled	hr	500		0,00
2.1.8		Engineer	hr.	5,0		
2.1.9		Technician	hr.	5,0		
2.1.10		Foreman	hr.	10,0		
2.1.11		Driver (LDV,machine, trucks, etc.)	hr.	10,0		
2.1.12		Certified Blaster	hr.	10,0		
2.1.13		Steel fixer	hr.	10,0		
2.1.14		Concretor	hr.	10,0		
2.1.15		Charge hand	hr.	10,0		
2.1.16		Security guard	hr.	10,0		
		<u>Plant and equipment</u>				
2.1.17		(a) Tractor loader backhoe (TLB) (i) Tractor Loader Backhoe (Bigger than 45kW but smaller than 70kW)	hr.	10,0		
2.1.18		(b) Crawler Excavators (i) Smaller than 93kW (small)	hr.	10,0		
2.1.19		(ii) Bigger than 93kW but smaller than 200kW ( Medium)	hr.	10,0		
2.1.20		(c) Tipper Trucks (i) Tipper trucks (3m³) Small	hr.	10,0		
2.1.21		(ii) Tipper trucks (5m³) Medium	hr.	10,0		
2.1.22		(iii) Tipper trucks (10m³) Large	hr.	10,0		
2.1.23		(d) Flat Bed Trucks (i) Flat bed 5t capacity	hr.	8,0		
2.1.24		(ii) Flat bed 7t capacity	hr.	8,0		
2.1.25		(e) LDV (i) 1t Pick-up	hr.	10,0		
2.1.26		(f) Mobile Crane 5t at 3m radius	hr.	10,0		
2.1.27		(g) Walk behind vibrating rollers (i) Model - Bomag 60 or similar (small)	hr.	10,0		
2.1.28		(ii) Model - Bomag 76 or similar (medium)	hr.	10,0		
2.1.29		(iii) Model - Bomag 90 or similar	hr.	10,0		
TOTAL CARRIED FORWARD					R	500 000,00

ITEM NO	PAYMENT REFERS	SHORT DESCRIPTION	UNIT	QUANTITY	RATE (R)	AMOUNT (R)
TOTAL BROUGHT FORWARD						R 500 000,00
2.1.30		(h) Plate compactors (i) Vipac or similar	hr.	10,0		
2.1.31		(i) Rammers (i) Model - Wacker or similar	hr.	10,0		
2.1.32		(j) Concrete mixers				
2.1.33		(i) Volume 100 litre wet (small, towable)	hr.	8,0		
2.1.34		(ii) Volume 175 litre wet (medium)	hr.	8,0		
2.1.35		(iii) Volume 250 litre wet (large)	hr.	8,0		
		(k) Diesel compressors including hoses and tools	hr	10,0		
2.1.36		(i) Capacity smaller than 200 cfm (small)	hr.	10,0		
2.1.37		(ii) Capacity bigger than 200 cfm smaller than 400 cfm (medium)	hr.	10,0		
2.1.38		(iii) Capacity bigger than 400 cfm (large)	hr.	10,0		
2.1.39		(l) Waterpump				
2.1.40		(i) Capacity smaller than 400 litre/min	hr	10,0		
2.1.41		(ii) Capacity bigger than 400 but smaller than 600 litre/min (medium)	hr	10,0		
2.1.42		(iii) Capacity bigger than 600 but smaller than 1 100 litre/sec (large)	hr	10,0		
		<b><u>Materials</u></b>				
2.1.43	8.5 (a, b1)	Net cost of goods or materials	Prov Sum	1	500 000,00	500 000,00
2.1.44	PSA 8.5	Overheads, charges and profit on 2.1.8 above	%	500 000,00		0,00
		<b><u>Contractors own Plant</u></b>				
2.1.45	8.5 (a)	Allow for all-inclusive cost of using Contractor's own plant on site.	Prov Sum	1	800 000,00	800 000,00
		<b><u>Plant hired by the Contractor</u></b>				
2.1.46	8.5 (b.1)	Net cost of hired plant	Prov Sum	1	250 000,00	250 000,00
2.1.47	PSA 8.5	Overheads, charges and profit on 2.1.11 above	%	250 000,00		0,00
		<b><u>Survey Beacons/Pegs</u></b>				
2.1.48	8.5 (a)	Search for, record, reference and protect survey stations, bench marks, erf boundary pegs and other reference pegs and expose on completion of works	Sum	1		0,00
2,2	8,5	<b>SUMS STATED PROVISIONALLY BY THE ENGINEER</b>				
2.2.1	PSA 8.5	Cellphone allowance for the Employers Agent Representative and their assistant for the duration of the contract (R1000 pm)	Prov Sum	1	18 000,00	18 000,00
2.2.2		Overheads, charges and profit on 2.2.1 above	%	18 000,00		0,00
TOTAL CARRIED FORWARD						R 2 068 000,00

ITEM NO	PAYMENT REFERS	SHORT DESCRIPTION	UNIT	QUANTITY	RATE (R)	AMOUNT (R)
TOTAL BROUGHT FORWARD						R 2 068 000,00
2.2.7		Equipment for the Employers Agent Representative and their assistant for the duration of the contract	Prov Sum	1	80 000,00	80 000,00
2.2.8		Overheads, charges and profit on 2.2.7 above	%	80 000,00		0,00
		<b><u>Survey</u></b>				
2.2.9		Ad-hoc topographical survey as requested by the Engineer during the contract	Prov Sum	1	30 000,00	30 000,00
2.2.10		Overheads, charges and profit on 2.2.9 above	%	30 000,00		0,00
	PSA 8.5.3	<b><u>Community Liason Officer and Consultant</u></b>				
2.2.11	a)	Employment of the CLO for duration of contract who shall be appointed by the Contractor and shall report to the Engineer and the Client (R8500 pm plus R500 pm cellphone allowance) (refer C3.4.7)	Prov Sum	1	162 000,00	162 000,00
2.2.12	b)	Overheads, charges and profit on 2.2.11	%			0,00
2.2.13		Employment of a social consultant for duration of contract	Prov Sum	1	550 000,00	550 000,00
2.2.14	PSA 8.5	Overheads, charges and profit on 2.2.13	%	550 000,00		0,00
	PSA 8.12 PSA 8.13	<b><u>Training</u></b>				
2.2.15		Allowance for training of local unskilled labour	Prov Sum	1	200 000,00	200 000,00
2.2.16	PSA 8.5	Overheads, charges and profit on 2.2.15	%	200 000,00		-
2.2.17	PSA 8.14	Allowance for transport	Prov Sum	1	100 000,00	100 000,00
2.2.18		Overheads, charges and profit on 2.2.17	%	100 000,00		0,00
	Spec PC	<b><u>Re-vegetation</u></b>				
2.2.19		Re-vegetation of the site	Prov Sum	1	100 000,00	100 000,00
2.2.20	PSA 8.5	Overheads, charges and profit on 2.2.19	%	100 000,00		-
		<b><u>Pipework</u></b>				
2.2.21		Connection to existing / proposed pipework	Prov Sum	1	200 000,00	200 000,00
2.2.22		Overheads, charges and profit on 2.2.21	%	200 000,00		0,00
		<b><u>Control Testing</u></b>				
2.2.23	PSA 8.5.1	Acceptance Control Testing	Prov Sum	1	200 000,00	200 000,00
2.2.24	8.5 (b)	Overheads, charges and profit on 2.2.23	%	200 000,00		0,00
TOTAL CARRIED FORWARD						R 3 690 000,00

ITEM NO	PAYMENT REFERS	SHORT DESCRIPTION	UNIT	QUANTITY	RATE (R)	AMOUNT (R)
TOTAL BROUGHT FORWARD						R 3 690 000,00
	PSA 8.5	<b><u>Students</u></b>				
2.2.25		Provisional Sum for employing students on the Contract	Prov Sum	1	360 000,00	360 000,00
2.2.26		Overheads, charges and profit on 2.2.25 above	%	360 000,00		0,00
2,3	PSA 8.4.7	<b>MISCELLANEOUS</b>				
2.3.1		General Signage, as per the Engineer's instructions (Prov)	Prov Sum	1	20 000,00	20 000,00
2.3.2		Overheads, charges and profit on 2.3.1	%	20 000,00		0,00
2.3.3	PSA 8.22	Allow for the attendance of EME's or QSE's and other Contractors within the parameters of the site (refer C3.5.26)	Sum	1		0,00
TOTAL FOR SECTION 2 CARRIED FORWARD TO SUMMARY						R 4 070 000,00

ITEM NO	PAYMENT REFERS	SHORT DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
3	SABS 1200 C	<b>SECTION 3: SITE CLEARANCE (PIPELINE)</b>				
3.1	8.2.1	CLEAR SITE <b>Clear and grub site and remove any obstruction that may occur and spoil to designated site. Only areas indicated in writing by Engineer must be cleared:</b>				
3.1.1	PSC 5.1	Clear and grub including all vegetation for pipe route 3m wide.	m	560		0,00
3.1.2	PSC 3.1	Transport spoil material to unspecified sites and dump (provisional)	m³.km	560		rate only
<b>TOTAL FOR SECTION 3 CARRIED FORWARD TO SUMMARY</b>						<b>R 0,00</b>

ITEM NO	PAYMENT REFERS	SHORT DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
4	SABS 1200 C	SECTION 4: SITE CLEARANCE (TOWER ONLY)				
4.1	8.2.1	CLEAR SITE Clear and grub site and remove any obstruction that may occur and spoil to designated site. Only areas indicated in writing by Engineer must be cleared:				
4.1.1		Clear and grub including all vegetation for Elevated Tower	m <sup>2</sup>	468		0,00
4.1.2	PSC 3.1	Transport spoil material to unspecified sites and dump (provisional)	m <sup>3</sup> .km	1 400		Rate Only
4.1.3	8.2.10	SITE PREPARATION Remove top soil to nominal depth 75 mm, stockpile and maintain	m <sup>3</sup>	35		0,00
TOTAL FOR SECTION 4 CARRIED FORWARD TO SUMMARY						R 0,00

ITEM NO	PAYMENT REFERS	SHORT DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
5	SABS 1200 C	SECTION 5: SITE CLEARANCE (PUMPSTATION AND TOWER SITE)				
5.1	8.2.1	CLEAR SITE Clear and grub site and remove any obstruction that may occur and spoil to designated site. Only areas indicated in writing by Engineer must be cleared:				
5.1.1		Clear and grub including all vegetation for Site footprint (Pump Station and Valve Chambers)	m <sup>2</sup>	450		0,00
5.1.2	PSC 5.1	Clear and grub including all vegetation for inlet-pipe route 3m wide.	m	120		0,00
5.1.3	PSC 3.1	Transport spoil material to unspecified sites and dump (provisional)	m <sup>3</sup> .km	2 500		Rate only
5.1.4	8.2.10	SITE PREPARATION Remove top soil to nominal depth 75 mm, stockpile and maintain	m <sup>3</sup>	80		0,00
TOTAL FOR SECTION 5 CARRIED FORWARD TO SUMMARY						R 0,00

ITEM NO	PAYMENT REFERS	SHORT DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
6	<b>SABS 1200 D</b>	<b>SECTION 6: EARTHWORKS (PIPELINES)</b>				
6.1	PSD 8.3.2 8.3.2a	EXCAVATION <b>Excavate in all materials and use for backfill, or dispose as ordered: Refer to drawing CO1486-CP10 &amp; 11, 18, 19, 22,</b>				
6.1.1		<b>(a) Air-Valve Chamber L.P.C 1</b>	m <sup>3</sup>	120		0,00
		<b>Extra over items D1.1</b>				
6.1.1.1		(i) Intermediate material	m <sup>3</sup>	12		0,00
6.1.1.2		(ii) Hard rock material	m <sup>3</sup>	6		0,00
6.1.3		<b>(b) Air-Valve Chamber L.P.C 2</b>	m <sup>3</sup>	120		0,00
		<b>Extra over items D1.4</b>				
6.1.3.1		(i) Intermediate material	m <sup>3</sup>	12		0,00
6.1.3.2		(i) Hard rock material	m <sup>3</sup>	6		0,00
6.1.4		<b>(c) Air-Valve Chamber L.P.C 3</b>	m <sup>3</sup>	120		0,00
		<b>Extra over items D1.7</b>				
6.1.4.1		(i) Intermediate material	m <sup>3</sup>	120		0,00
6.1.4.2		(ii) Hard rock material	m <sup>3</sup>	6		0,00
6.1.5		<b>(d) Air-Valve Chamber L.P.C 4</b>	m <sup>3</sup>	120		0,00
		<b>Extra over items D1.10</b>				
6.1.5.1		(i) Intermediate material	m <sup>3</sup>	12		0,00
6.1.5.2		(ii) Hard rock material	m <sup>3</sup>	6		0,00
6.1.6		<b>(e) Scour&amp;Isolation Valve Chamber L.P.C 5</b>	m <sup>3</sup>	150		0,00
		<b>Extra over items D1.13</b>				
6.1.6.1		(i) Intermediate material	m <sup>3</sup>	15		0,00
6.1.6.2		(ii) Hard rock material	m <sup>3</sup>	6		0,00
6.1.7		<b>(f) Air-Valve Chamber L.P.C 6</b>	m <sup>3</sup>	120		0,00
		<b>Extra over items D1.16</b>				
6.1.7.1		(i) Intermediate material	m <sup>3</sup>	12		0,00
6.1.7.2		(ii) Hard rock material	m <sup>3</sup>	12		0,00
6.1.8		<b>(h) Air-Valve Chamber L.P.C 7</b>	m <sup>3</sup>	120		0,00
		<b>Extra over items D1.19</b>				
6.1.8.1		(i) Intermediate material	m <sup>3</sup>	12		0,00
6.1.8.2		(ii) Hard rock material	m <sup>3</sup>	6		0,00
6.1.9		<b>(i) Isolation Valve Chamber L.P.C 8</b>	m <sup>3</sup>	150		0,00
		<b>Extra over items D1.1</b>				
6.1.9.1		(i) Intermediate material	m <sup>3</sup>	15		0,00
6.1.9.2		(ii) Hard rock material	m <sup>3</sup>	6		0,00
6.1.10		<b>(i) Isolation Valve Chamber L.P.C 9</b>	m <sup>3</sup>	150		0,00
		<b>Extra over items D1.1</b>				
6.1.10.1		(i) Intermediate material	m <sup>3</sup>	15		0,00
6.1.10.2		(ii) Hard rock material	m <sup>3</sup>	6		0,00
<b>TOTAL CARRIED FORWARD</b>						<b>0,00</b>

ITEM NO	PAYMENT REFERS	SHORT DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
TOTAL BROUGHT FORWARD						R 0,00
6.2		EXISTING SERVICES				
	PSD8.3.8.1	<b>Hand excavation for locatiiong and exposing existing services in:</b>				
6.2.1		(a) All other areas	m³	250		
		<b>Topsoiling from stockpile 75 mm layer:</b>				
6.2.2	PSD 8.3.10	Level on Site	m³	51		
		<b>Extra over items PSD 8.3.2. for</b>				
6.2.3	PSD 8.3.14	(a) Temporary stockpiling	m³	970		
6.2.4	PSD 8.3.15	(b) Disposing of spoil material on a site provided by The Contractor	m³	1 020		
TOTAL FOR SECTION 6 CARRIED FORWARD TO SUMMARY						R 0,00

ITEM NO	PAYMENT REFERS	SHORT DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
7	SABS 1200 DB	SECTION 7:EARTHWORKS (PIPE TRENCHES)				
7.1	PSDB8.3.2a	EXCAVATION <b>Excavate by machine in all materials for trenches, backfill, compact and dispose of surplus or unsuitable material for pipes up to 700 mm diameter for depths:</b>				
		<b>Over and up to</b>				
7.1.1		(a) 0,0 m 1,0 m	m³	0		
7.1.2		(b) 1,0 m 2,0 m	m³	0		
7.1.3		(c) 2,0 m 3,0 m	m³	2 520		0,00
7.2	8.3.2b	<b>Extra-over items DB1.1 to DB1.3 for excavation in (provisional):</b>				
7.2.1		(a) Intermediate material	m³	1 000		0,00
7.2.2		(b) Hard rock material	m³	10		0,00
7.2.3	8.3.2c	Excavate unsuitable material from trench bottom and dispose of it	m³	13		0,00
7.3	8.3.3	EXCAVATION ANCILLARIES				
	8.3.3.1a	<b>Imported backfill materials from trench excavation or stockpiles on site:</b>				
7.3.1		Acquire, deliver, place and compact imported selected backfill to fill over-excavation under pipe bedding where unsuitable material under item DB1.5 is removed	m³	13		0,00
7.3.2	PSDB8.3.2(4)	Backfill stabilized with 5% cement where directed by the Engineer	m³			Rate only
7.3.3	PSDB8.3.2(5)	Soilcrete backfill where directed by the Engineer	m³			Rate only
TOTAL FOR SECTION 7 CARRIED FORWARD TO SUMMARY						R 0,00

ITEM NO	PAYMENT REFERS	SHORT DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
8	SABS 1200 D	SECTION 8: EARTHWORKS (ELEVATED TOWER)				
8.1	PSD 8.3.2	EXCAVATION				
	PSD 8.3.2	Excavate to level in all materials and stockpile and maintain suitable material for future use for backfill or dispose as specified. Rate to include for selective removal of unsuitable material and compaction of base to 93% MOD AASHTO and allow at least 1000mm working space around structure:				
8.1.1		Pile Caps	m³	520		0,00
8.1.2		Pile Cap Ring	m³	128		0,00
8.1.3		Straight RC Ground Beams	m³	161		0,00
8.1.4		Circular RC Ground Beams (Ring Beam)	m³	102		0,00
8.1.5		Trimming down of Piles	m³	335		0,00
8.1.6	8.3.2b	Extra over Items 8.1.1 to 8.1.4 for excavation in hard rock material.	m³	274		0,00
8.1.7	8.3.2d	Extra over items 8.1.1 to 8.1.4 for excavation in:				
8.1.7.1		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	m³	182		0,00
8.1.7.2	8.3.9	Backfill to structures from existing stockpile in 200mm compacted layers to 95% MOD ASSHTO using material from stockpile on site as directed by the Engineer	m³	575		0,00
8.1.8		Exsting Services				
	PSD8.3.8.1	Hand excavation for locating and exposing existing services in:				
8.1.8.1		(a) Roadways	m³	50		0,00
8.1.8.2		(b) All other areas	m³	50		0,00
8.1.9	PSA 8.4.7	Disposal of material from stockpile to designated municipal disposal sites	m³	900		0,00
TOTAL FOR SECTION 8 CARRIED FORWARD TO SUMMARY						R 0,00

ITEM NO	PAYMENT REFERS	SHORT DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
9	<b>SABS 1200 D</b>	<b>SECTION 9: EARTHWORKS (PUMPSTATION)</b>				
9.1	PSD 8.3.2	EXCAVATION				
9.1.1	8.3.2a	<b>Excavate in all materials and use for backfill, or dispose as ordered:</b>				
9.1.1.1		(a) Pump Station	m <sup>3</sup>	1 200		0,00
9.1.1.2		(b) Valve Chambers No. 9, 10, 11, 12, 13, 14) - Ref Draw No. C01486-PS01	m <sup>3</sup>	950		0,00
9.1.2	8.3.2b	<b>Excavate in all materials to spoil:</b>				
9.1.2.1		(a) Pump Station Foundation	m <sup>3</sup>	400		0,00
9.1.2.2		(b) Valve Chamber	m <sup>3</sup>	300		0,00
9.1.3	8.3.2c	<b>Extra over items D1.1 to D1.4 for excavation in:</b>				
9.1.3.1		(a) Intermediate material	m <sup>3</sup>	300		0,00
9.1.3.2		(b) Hard rock material	m <sup>3</sup>	100		0,00
	8.3.2d	<b>Extra over items D1.1 to D1.4 for excavation in:</b>				
9.1.4		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)	m <sup>3</sup>	300		0,00
		<b>FILLINGS ETC</b>				
9.1.5		Compaction of ground beam, etc including scarifying for a depth of 150mm, breakdown oversize material, adding suitable material where necessary and compacting to 93% Mod AASHTO density.	m <sup>2</sup>			
9.1.6		Pump House	m <sup>2</sup>	350		0,00
9.1.7		Chambers	m <sup>2</sup>	60		0,00
9.2	PSD8.3.8.1	EXISTING SERVICES				
9.2.1		<b>Hand excavation for locationg and</b>				
9.2.1.1		(a) Roadways	m <sup>3</sup>	0		0,00
9.2.1.2		(b) All other areas	m <sup>3</sup>	20		0,00
9.2.2	PSD 8.3.10	<b>Topsoiling from stockpile 75 mm layer:</b> Level on Site	m <sup>3</sup>	50		0,00
9.2.3		<b>Extra over items PSD 8.3.2. for</b>				
9.2.3.1	PSD 8.3.14	(a) Temporary stockpiling	m <sup>3</sup>	950		0,00
9.2.3.2	PSD 8.3.15	(b) Disposing of spoil material on a site	m <sup>3</sup>	700		0,00
9.2.4	PGENRD 8	<b>Grassing</b> Grassing (Kikuyu instant lawn)	m <sup>2</sup>	100		0,00
<b>TOTAL FOR SECTION 9 CARRIED FORWARD TO SUMMARY</b>					<b>R</b>	<b>0,00</b>

ITEM NO	PAYMENT REFERS	SHORT DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
10	<b>SABS 1200 DB</b>	<b>SECTION 10: EARTHWORKS (PIPE TRENCHES)</b>				
10.1		EXCAVATION				
10.1.1	PSDB8.3.2a	<b>Excavate by machine in all materials for trenches, backfill, compact and dispose of surplus or unsuitable material for pipes up to 700 mm diameter for depths:</b>				
		<b>Over and up to</b>				
10.1.1.1		(a) 0,0 m 1,0 m	m	20		0,00
10.1.1.2		(b) 1,0 m 2,0 m	m	10		0,00
10.1.1.3		(c) 2,0 m 3,0 m	m	15		0,00
10.1.1.4		(d) Over 3,0 m	m	120		0,00
10.1.2	8.3.2b	<b>Extra-over items DB1.1 to DB1.3 for excavation in (provisional):</b>				
10.1.2.1		(a) Intermediate material	m³	500		0,00
10.1.2.2		(b) Hard rock material	m³	200		0,00
10.1.3	8.3.2c	Excavate unsuitable material from trench bottom and dispose of it	m³	200		0,00
10.2	8.3.3	EXCAVATION ANCILLARIES				
	8.3.3.1a	<b>Imported backfill materials from trench excavation or stockpiles on site:</b>				
10.2.1		Acquire, deliver, place and compact imported selected backfill to fill over-excavation under pipe bedding where unsuitable material under item DB1.5 is removed	m³	200		0,00
10.2.2	PSDB8.3.2(4)	Backfill stabilized with 5% cement where directed by the Engineer	m³	0		Rate only
10.2.3	PSDB8.3.2(5)	Soilcrete backfill where directed by the Engineer	m³	0		Rate only
<b>TOTAL FOR SECTION 10 CARRIED FORWARD TO SUMMARY</b>						<b>0,00</b>

ITEM NO	PAYMENT REFERS	SHORT DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
11	<b>SABS</b>  <b>1200 G</b>	<b>SECTION 11: CONCRETE (PIPELINE CHAMBERS)</b>				
11.1		<b>CHAMBER L.P.C 1 - AIR VALVE</b> <b>Refer to drawing CO1486-CP18 &amp; 19</b> <b>Formwork</b>				
11.1.1		Smooth vertical plane to air-valve chamber	m <sup>2</sup>	90		0,00
		<b>BOX OUT HOLES/FORM VOIDS</b>				
		Small circular holes of diameter 0.35m up to 0.65m sealed with a bentonite strip when grouted.				
11.1.2		Inflow and Outflow pipes	No	2		0,00
		<b>High-tensile steel bars reinforcement</b>				
11.1.3		Diameters 10 mm to 40 mm: average price as indicated on schedules	t	3		0,00
11.2		<b>CONCRETE</b> <b>Blinding layer in 15 MPa/19 mm concrete:</b>				
11.2.1		50 mm minimum thickness	m <sup>2</sup>	20		0,00
		<b>Strength concrete: 20 MPa/19 mm:</b>				
11.2.2		Concrete for Air-valve chamber base	m <sup>3</sup>	6		0,00
		<b>Strength concrete: 35 MPa/19 mm:</b>				
11.2.3		Air-Valve chamber walls	m <sup>3</sup>	15		0,00
		<b>Strength concrete: 35 MPa/19 mm:</b>				
11.2.4		Air-Valve chamber roof cover	m <sup>3</sup>	3		0,00
11.3		<b>UNFORMED SURFACE FINISHINGS</b>				
		<b>Wood floated finishings:</b>				
11.3.1		Air-Valve chamber base	m <sup>2</sup>	20		0,00
11.3.2		Air-Valve chamber roof	m <sup>2</sup>	20		0,00
		<b>CHAMBER L.P.C 2 - AIR VALVE</b> <b>Refer to drawing CO1486-CP18 &amp; 19</b> <b>Formwork</b>				
11.3.3		Smooth vertical plane to air-valve chamber	m <sup>2</sup>	90		0,00
		<b>BOX OUT HOLES/FORM VOIDS</b>				
		Small circular holes of diameter 0.35m up to 0.65m sealed with a bentonite strip when grouted.				
11.3.4		Inflow and Outflow pipes	No	2		0,00
		<b>High-tensile steel bars reinforcement</b>				
11.3.5		Diameters 10 mm to 40 mm: average price as indicated on schedules	t	3		0,00
<b>TOTAL CARRIED FORWARD</b>						<b>R 0,00</b>

ITEM NO	PAYMENT REFERS	SHORT DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
TOTAL BROUGHT FORWARD						R 0,00
11.4		CONCRETE <b>Blinding layer in 15 MPa/19 mm concrete:</b>				
11.4.1		50 mm minimum thickness	m <sup>2</sup>	20		0,00
11.4.2		<b>Strength concrete: 20 MPa/19 mm:</b> Concrete for Air-valve chamber base	m <sup>3</sup>	6		0,00
11.4.3		<b>Strength concrete: 35 MPa/19 mm:</b> Air-Valve chamber walls	m <sup>3</sup>	15		0,00
11.4.4		<b>Strength concrete: 35 MPa/19 mm:</b> Air-Valve chamber roof cover	m <sup>3</sup>	3		0,00
11.5		UNFORMED SURFACE FINISHINGS				
11.5.1		<b>Wood floated finishings:</b> Air-Valve chamber base	m <sup>2</sup>	20		0,00
11.5.2		Air-Valve chamber roof	m <sup>2</sup>	20		0,00
11.5.3		<b>CHAMBER L.P.C 3 - AIR VALVE</b> <b>Refer to drawing CO1486-CP18 &amp; 19</b> <b>Formwork</b> Smooth vertical plane to air-valve chamber	m <sup>2</sup>	90		0,00
11.5.4		<b>BOX OUT HOLES/FORM VOIDS</b>  Small circular holes of diameter 0.35m up to 0.65m sealed with a bentonite strip when grouted. Inflow and Outflow pipes	No	2		0,00
11.5.5		<b>High-tensile steel bars reinforcement</b>  Diameters 10 mm to 40 mm: average price as indicated on schedules	t	3		0,00
11.5		CONCRETE <b>Blinding layer in 15 MPa/19 mm concrete:</b>				
11.5.1		50 mm minimum thickness	m <sup>2</sup>	20		0,00
11.5.2		<b>Strength concrete: 20 MPa/19 mm:</b> Concrete for Air-valve chamber base	m <sup>3</sup>	6		0,00
11.5.3		<b>Strength concrete: 35 MPa/19 mm:</b> Air-Valve chamber walls	m <sup>3</sup>	15		0,00
11.5.4		<b>Strength concrete: 35 MPa/19 mm:</b> Air-Valve chamber roof cover	m <sup>3</sup>	3		0,00
11.6		UNFORMED SURFACE FINISHINGS				
11.6.1		<b>Wood floated finishings:</b> Air-Valve chamber base	m <sup>2</sup>	20		0,00
11.6.2		Air-Valve chamber roof	m <sup>2</sup>	20		0,00
TOTAL CARRIED FORWARD						R 0,00

ITEM NO	PAYMENT REFERS	SHORT DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
TOTAL BROUGHT FORWARD						R 0,00
11.6.3		<b>CHAMBER L.P.C 4 - AIR VALVE CHAMBER</b> <b>Refer to drawing CO1486-CP18,19</b> <b>Formwork</b> Smoth vertical plane to Air valve chamber	m²	90		0,00
11.6.4		<b>BOX OUT HOLES/FORM VOIDS</b>  Small circular holes of diameter 0.35m up to 0.65m sealed with a bentonite strip when grouted. Inflow and Outflow pipes	No	2		0,00
11.6.5		<b>High-tensile steel bars reinforcement</b>  Diameters 10 mm to 40 mm: average price as indicated on schedules	t	3		0,00
11.7		<b>CONCRETE</b> <b>Blinding layer in 15 MPa/19 mm concrete:</b>				
11.7.1		50 mm minimum thickness	m²	20		0,00
11.7.2		<b>Strength concrete: 20 MPa/19 mm:</b> Concrete for Air Valve chamber base	m³	6		0,00
11.7.3		<b>Strength concrete: 35 MPa/19 mm:</b> Air Valve chamber walls	m³	15		0,00
11.7.4		<b>Strength concrete: 35 MPa/19 mm:</b> Air Valve chamber roof cover	m³	3		0,00
11.8		<b>UNFORMED SURFACE FINISHINGS</b>				
11.8.1		<b>Wood floated finishings:</b> Air Valve chamber base	m²	20		0,00
11.8.2		Air Valve chamber roof	m²	20		0,00
11.8.3		<b>CHAMBER L.P.C 5 - ISOLATION-SCOUR VALVE CHAMBER</b> <b>Refer to drawing CO1486-CP22 &amp; 23</b> <b>Formwork</b> Smoth vertical plane to Isolation-Scour valve chamber	m²	110		0,00
11.8.4		<b>BOX OUT HOLES/FORM VOIDS</b>  Small circular holes of diameter 0.35m up to 0.65m sealed with a bentonite strip when grouted. Inflow and Outflow pipes	No	3		0,00
11.8.5		<b>High-tensile steel bars reinforcement</b>  Diameters 10 mm to 40 mm: average price as indicated on schedules	t	3		0,00
11.9		<b>CONCRETE</b> <b>Blinding layer in 15 MPa/19 mm concrete:</b>				
11.9.1		50 mm minimum thickness	m²	25		0,00
TOTAL CARRIED FORWARD						R 0,00

ITEM NO	PAYMENT REFERS	SHORT DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
TOTAL BROUGHT FORWARD					R	0,00
11.9.2		<b>Strength concrete: 20 MPa/19 mm:</b> Concrete for Air-valve chamber base	m³	5		0,00
11.9.3		<b>Strength concrete: 35 MPa/19 mm:</b> Isolation-Scour-Valve chamber walls	m³	25		0,00
11.9.4		<b>Strength concrete: 35 MPa/19 mm:</b> Isolation-Scour Valve chamber roof cover	m³	5		0,00
11.10		UNFORMED SURFACE FINISHINGS				
11.10.1		<b>Wood floated finishings:</b> Isolation-Scour Valve chamber base	m²	25		0,00
11.10.2		Isolation-Scour Valve chamber roof	m²	25		0,00
11.10.3		<b>CHAMBER L.P.C 6 - AIR VALVE</b> <b>Refer to drawing CO1486-CP18 &amp; 19</b> <b>Formwork</b> Smoth vertical plane to air-valve chamber	m²	90		0,00
11.10.4		<b>BOX OUT HOLES/FORM VOIDS</b>  Small circular holes of diameter 0.35m up to 0.65m sealed with a bentonite strip when grouted. Inflow and Outflow pipes	No	2		0,00
11.10.5		<b>High-tensile steel bar reinforcement</b>  Diameters 10 mm to 40 mm: average price as indicated on schedules	t	3		0,00
11.11		CONCRETE <b>Blinding layer in 15 MPa/19 mm concrete:</b>				
11.11.1		50 mm minimum thickness	m²	20		0,00
11.11.2		<b>Strength concrete: 20 MPa/19 mm:</b> Concrete for Air-valve chamber base	m³	6		0,00
11.11.3		<b>Strength concrete: 35 MPa/19 mm:</b> Air-Valve chamber walls	m³	15		0,00
11.11.4		<b>Strength concrete: 35 MPa/19 mm:</b> Air-Valve chamber roof cover	m³	3		0,00
11.12		UNFORMED SURFACE FINISHINGS				
11.12.1		<b>Wood floated finishings:</b> Air-Valve chamber base	m²	20		0,00
11.12.2		Air-Valve chamber roof	m²	20		0,00
11.12.3		<b>CHAMBER L.P.C 7 - AIR VALVE Refer to drawing CO1483-CP18 &amp; 19</b> <b>Formwork</b> Smoth vertical plane to isolation-scour valve chamber	m²	20		0,00
11.12.4		<b>BOX OUT HOLES/FORM VOIDS</b>  Small circular holes of diameter 0.35m up to 0.65m sealed with a bentonite strip when grouted. Inflow and Outflow pipes	No	2		0,00
TOTAL CARRIED FORWARD					R	0,00

ITEM NO	PAYMENT REFERS	SHORT DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
TOTAL BROUGHT FORWARD						R 0,00
11.12.5		<b>High-tensile steel bars reinforcement</b> Diameters 10 mm to 40 mm: average price as indicated on schedules	t	3		0,00
11.13		<b>CONCRETE</b> <b>Blinding layer in 15 MPa/19 mm concrete:</b>				
11.13.1		50 mm minimum thickness	m <sup>2</sup>	20		0,00
11.13.2		<b>Strength concrete: 20 MPa/19 mm:</b> Concrete for isolation-scour valve chamber base	m <sup>3</sup>	6		0,00
11.13.3		<b>Strength concrete: 35 MPa/19 mm:</b> isolation-scour valve chamber walls	m <sup>3</sup>	15		0,00
11.13.4		<b>Strength concrete: 35 MPa/19 mm:</b> isolation-scour valve chamber roof cover	m <sup>3</sup>	3		0,00
11.14		<b>UNFORMED SURFACE FINISHINGS</b>				
11.14.1		<b>Wood floated finishings:</b> Air valve chamber base	m <sup>2</sup>	20		0,00
11.14.2		Air valve chamber roof	m <sup>2</sup>	20		0,00
11.14.3		<b>CHAMBER L.P.C 8 - ISOLATION VALVE</b> <b>Refer to drawing CO1486-CP24 &amp; 25</b> <b>Formwork</b> Smoth vertical plane to air-valve chamber	m <sup>2</sup>	90		0,00
11.14.4		<b>BOX OUT HOLES/FORM VOIDS</b>  Small circular holes of diameter 0.35m up to 0.65m sealed with a bentonite strip when grouted. Inflow and Outflow pipes	No	2		0,00
11.14.5		<b>High-tensile steel bars reinforcement</b> Diameters 10 mm to 40 mm: average price as indicated on schedules	t	3		0,00
11.15		<b>CONCRETE</b> <b>Blinding layer in 15 MPa/19 mm concrete:</b>				
11.15.1		50 mm minimum thickness	m <sup>2</sup>	20		0,00
11.15.2		<b>Strength concrete: 20 MPa/19 mm:</b> Concrete for Air-valve chamber base	m <sup>3</sup>	6		0,00
11.15.3		<b>Strength concrete: 35 MPa/19 mm:</b> Air-Valve chamber walls	m <sup>3</sup>	15		0,00
11.15.4		<b>Strength concrete: 35 MPa/19 mm:</b> Air-Valve chamber roof cover	m <sup>3</sup>	3		0,00
11.16		<b>UNFORMED SURFACE FINISHINGS</b>				
11.16.1		<b>Wood floated finishings:</b> Air-Valve chamber base	m <sup>2</sup>	20		0,00
11.16.2		Air-Valve chamber roof	m <sup>2</sup>	20		0,00
TOTAL CARRIED FORWARD						R 0,00

ITEM NO	PAYMENT REFERS	SHORT DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
TOTAL BROUGHT FORWARD						R 0,00
11.16.3		<b>CHAMBER L.P.C 9 - ISOLATION VALVE</b> Refer to drawing CO1486-CP24 & 25 <b>Formwork</b> Smoth vertical plane to air-valve chamber	m <sup>2</sup>	90		0,00
11.16.4		<b>BOX OUT HOLES/FORM VOIDS</b>  Small circular holes of diameter 0.35m up to 0.65m sealed with a bentonite strip when grouted. Inflow and Outflow pipes	No	2		0,00
11.16.5		<b>High-tensile steel bars reinforcement</b>  Diameters 10 mm to 40 mm: average price as indicated on schedules	t	3		0,00
11.17		<b>CONCRETE</b> <b>Blinding layer in 15 MPa/19 mm concrete:</b>				
11.17.1		50 mm minimum thickness	m <sup>2</sup>	20		0,00
11.17.2		<b>Strength concrete: 20 MPa/19 mm:</b> Concrete for Air-valve chamber base	m <sup>3</sup>	6		0,00
11.17.3		<b>Strength concrete: 35 MPa/19 mm:</b> Air-Valve chamber walls	m <sup>3</sup>	15		0,00
11.17.4		<b>Strength concrete: 35 MPa/19 mm:</b> Air-Valve chamber roof cover	m <sup>3</sup>	3		0,00
11.18		<b>UNFORMED SURFACE FINISHINGS</b>				
11.18.1		<b>Wood floated finishings:</b> Air-Valve chamber base	m <sup>2</sup>	20		0,00
11.18.2		Air-Valve chamber roof	m <sup>2</sup>	20		0,00
11.19		<b>THRUST BLOCK</b>				
11.19.1		<b>Strength concrete: 20 MPa/19 mm:</b> Thrust block	m <sup>3</sup>	12		0,00
11.19.2		<b>CONCRETE CUBE-TESTING MACHINE</b>  Testing of concrete cubes Supply cube-testing machine on site with recent calibration certificate and water trough	No	72		0,00
11.19.3			Sum	1		0,00
TOTAL FOR SECTION 11 CARRIED TO SUMMARY						R 0,00

ITEM NO	PAYMENT REFERS	SHORT DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
12	<b>SABS 1200 G</b>	<b>SECTION 12: CONCRETE (ELEVATED TOWER)</b>				
12.1	8.2	<b>FORMWORK</b>				
	8.2.2	<u>Smooth vertical plane to:</u>				
12.1.1		Roof edge upstand Beam	m <sup>2</sup>	80		0,00
12.1.2		Arch Shaped Beam at level 1645,15	m <sup>2</sup>	215		0,00
12.1.3		Circular RC Beam (400mm in tank floor) at Level 1645,15 soffit	m <sup>2</sup>	33		0,00
12.1.4		Straight RC Beams at level 1645,15	m <sup>2</sup>	248		0,00
12.1.5		Columns from level 1644,75 to 1638,75	m <sup>2</sup>	230		0,00
12.1.6		Circular Ring Beam at level 1638,75	m <sup>2</sup>	109		0,00
12.1.7		Straight RC Beams at level 1638,75	m <sup>2</sup>	142		0,00
12.1.8		Columns from level 1638,75 to 1632,75	m <sup>2</sup>	230		0,00
12.1.9		Circular Ring Beam at level 1632,75	m <sup>2</sup>	109		0,00
12.1.10		Straight RC Beams at level 1632,75	m <sup>2</sup>	142		0,00
12.1.11		Columns from level 1632,75 to 1626,75	m <sup>2</sup>	230		0,00
12.1.12		Circular Ring Beam at level 1626,75	m <sup>2</sup>	109		0,00
12.1.13		Straight RC Beams at level 1626,75	m <sup>2</sup>	142		0,00
12.1.14		Columns from level 1626,75 to 1621,15	m <sup>2</sup>	215		0,00
12.1.15		Pile Caps	m <sup>2</sup>	249		0,00
12.1.16		Pile Cap Ring	m <sup>2</sup>	42		0,00
12.1.17		Straight RC Ground Beams	m <sup>2</sup>	129		0,00
12.1.18		Circular RC Ground Beams (Ring Beam)	m <sup>2</sup>	136		0,00
12.1.19		900mm Wide V-Channel	m <sup>2</sup>	19		0,00
12.1.20		Central Core Stair Landings	m <sup>2</sup>	20		0,00
12.1.21		Pipe Support Plinths	m <sup>2</sup>	19		0,00
		<u><b>25x25mm Chamfers to Edges of :</b></u>				
12.1.22		Roof Edge Upstand Beam	m	168		0,00
12.1.23		Arch Shaped Beam at level 1645,15	m	134		0,00
12.1.24		Circular RC Beam (400mm in tank floor) at Level 1645,15 soffit	m	84		0,00
12.1.25		Straight RC Beams at level 1645,15	m	381		0,00
12.1.26		Columns from level 1644,75 to 1638,75	m	288		0,00
12.1.27		Circular Ring Beam at level 1638,75	m	271		0,00
12.1.28		Straight RC Beams at level 1638,75	m	355		0,00
12.1.29		Columns from level 1638,75 to 1632,75	m	288		0,00
12.1.30		Circular Ring Beam at level 1632,75	m	271		0,00
12.1.31		Straight RC Beams at level 1632,75	m	355		0,00
<b>TOTAL CARRIED FORWARD</b>						<b>R 0,00</b>

ITEM NO	PAYMENT REFERS	SHORT DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
TOTAL BROUGHT FORWARD					R	0,00
12.1.32	8.2.2	Columns from level 1632,75 to 1626,75	m	288		0,00
12.1.33		Circular Ring Beam at level 1626,75	m	271		0,00
12.1.34		Straight RC Beams at level 1626,75	m	355		0,00
12.1.35		Columns from level 1626,75 to 1621,15	m	269		0,00
12.1.36		Around Staircase Landings	m	33		0,00
		<b><u>Special (circular formwork) smooth vertical plane to:</u></b>				
12.1.37		Tank External Walls (External Face)	m²	610		0,00
12.1.38		Tank External Walls (Internal Face)	m²	548		0,00
12.1.39		Tank Internal Walls (External Face)	m²	88		0,00
12.1.40		Tank Internal Walls (Internal Face)	m²	66		0,00
12.1.41	Central Core Walls (External Face)	m²	430		0,00	
12.1.42	Central Core Walls (Internal Face)	m²	371		0,00	
	8.2.2	<b><u>Smooth horizontal to:</u></b>				
12.1.43		Roof Edge Upstand Beam	m²	34		0,00
12.1.44		Upper Landing	m²	20		0,00
12.1.45		Tank Floor	m²	539		0,00
12.1.46		Arch Shaped Beam at level 1645,15	m²	40		0,00
12.1.47		Circular RC Beam (400mm in tank floor) at Level 1645,15 soffit	m²	13		0,00
12.1.48		Straight RC Beams at level 1645,15	m²	93		0,00
12.1.49		Circular Ring Beam at level 1638,75	m²	34		0,00
12.1.50		Straight RC Beams at level 1638,75	m²	44		0,00
12.1.51		Circular Ring Beam at level 1632,75	m²	34		0,00
12.1.52		Straight RC Beams at level 1632,75	m²	44		0,00
12.1.53		Circular Ring Beam at level 1626,75	m²	34		0,00
12.1.54		Straight RC Beams at level 1626,75	m²	44		0,00
12.1.55		Central Core Stair Landings	m²	25		0,00
	8.2.4	<b><u>Smooth domed formwork:</u></b>				
12.1.56		Domed Roof Soffit formwork	m²	558		0,00
	PSG 8.10	<b>BOX OUT HOLES/FORM VOIDS</b> <b>Small circular holes of diameter up to 0.35m sealed with a bentonite strip when grouted.</b>				
12.1.57		Scour and overflow pipes	No	4		0,00
	PSG 8.10	<b>Small circular holes of diameter 0.35m up to 0.65m sealed with a bentonite strip when grouted.</b>				
12.1.58		Inflow and Outflow pipes	No	5		0,00
	PSG 8.10	<b><u>Rectangular box outs:</u></b>				
12.1.59		1200mm x 300mm openings for air ventilation	No	16		0,00
12.1.60		2100mm x 900mm door opening	No	1		0,00
TOTAL CARRIED FORWARD					R	0,00

ITEM NO	PAYMENT REFERS	SHORT DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
TOTAL BROUGHT FORWARD						R 0,00
12.2	8.3	<b>REINFORCEMENT</b>				
		<b>Columns:</b>				
	8.3.1	<b><u>Mild steel bars:</u></b>				
12.2.1		Diameters 8 mm to 40 mm: average price as indicated on schedules	t	8		0,00
	8.3.1	<b><u>High-tensile steel bars average price:</u></b>				
12.2.2		Diameters 10 mm to 40 mm: average price as indicated on schedules	t	26		0,00
		<b>Central Core, Bracing Beams and Stair Landings:</b>				
	8.3.1	<b><u>Mild steel bars:</u></b>				
12.2.3		Diameters 8 mm to 40 mm: average price as indicated on schedules	t	7		0,00
	8.3.1	<b><u>High-tensile steel bars average price:</u></b>				
12.2.4		Diameters 10 mm to 40 mm: average price as indicated on schedules	t	31		0,00
		<b>Tank Floor Beams:</b>				
	8.3.1	<b><u>Mild steel bars:</u></b>				
12.2.5		Diameters 8 mm to 40 mm: average price as indicated on schedules	t	0,2		0,00
	8.3.1	<b><u>High-tensile steel bars average price:</u></b>				
12.2.6		Diameters 10 mm to 40 mm: average price as indicated on schedules	t	32		0,00
		<b>Tank Internal Walls:</b>				
	8.3.1	<b><u>Mild steel bars:</u></b>				
12.2.7		Diameters 8 mm to 40 mm: average price as indicated on schedules	t	0,1		0,00
	8.3.1	<b><u>High-tensile steel bars average price:</u></b>				
12.2.8		Diameters 10 mm to 40 mm: average price as indicated on schedules	t	7		0,00
		<b>Tank External Walls:</b>				
	8.3.1	<b><u>Mild steel bars:</u></b>				
12.2.9		Diameters 8 mm to 40 mm: average price as indicated on schedules	t	0,7		0,00
	8.3.1	<b><u>High-tensile steel bars average price:</u></b>				
12.2.10		Diameters 10 mm to 40 mm: average price as indicated on schedules	t	40		0,00
		<b>Floor Slab:</b>				
	8.3.1	<b><u>Mild steel bars:</u></b>				
12.2.11		Diameters 8 mm to 40 mm: average price as indicated on schedules	t	0,1		0,00
	8.3.1	<b><u>High-tensile steel bars average price:</u></b>				
12.2.12		Diameters 10 mm to 40 mm: average price as indicated on schedules	t	18		0,00
TOTAL CARRIED FORWARD						R 0,00

ITEM NO	PAYMENT REFERS	SHORT DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
TOTAL BROUGHT FORWARD						R 0,00
12.3	8.4	<b>CONCRETE</b>				
	8.4.3	<b><u>Strength concrete: 25 MPa/19 mm:</u></b>				
12.3.1		150mm Thick Mesh RC Floor	m³	3		0,00
12.3.2		900 Wide V-Channel	m³	9		0,00
12.3.3		Pipe Support Plinths	m³	2		0,00
	8.4.3	<b><u>Strength concrete: 40 MPa/19 mm:</u></b>				
12.3.4		Dome Roof	m³	139		0,00
12.3.5		Roof Edge Upstand Beam	m³	25		0,00
12.3.6		Upper Landing	m³	6		0,00
12.3.7		Tank External Walls	m³	223		0,00
12.3.8		Tank Internal Walls	m³	24		0,00
12.3.9		Tank Floor	m³	215		0,00
12.3.10		Arch Shaped Beam at Level 1645,15	m³	65		0,00
12.3.10		300x800mm Circular RC Beam (400mm in tank floor) at Level 1645,15	m³	5		0,00
12.3.11		Straight RC Beams at Level 1645,15	m³	66		0,00
12.3.12		Columns from level 1644,75 to 1638,75	m³	43		0,00
12.3.13		Circular Ring Beam at Level 1638,75	m³	27		0,00
12.3.14		Straight RC Beam at Level 1638,75	m³	36		0,00
12.3.15		Columns from level 1638,75 to 1632,75	m³	43		0,00
12.3.16		Circular Ring Beam at Level 1632,75	m³	27		0,00
12.3.17		Straight RC Beam at Level 1632,75	m³	36		0,00
12.3.18		Columns from level 1632,75 to 1626,75	m³	43		0,00
12.3.19		Circular Ring Beam at Level 1626,75	m³	27		0,00
12.3.20		Straight RC Beam at Level 1626,75	m³	36		0,00
12.3.21		Columns from level 1626,75 to 1621,15	m³	40		0,00
12.3.22		Central Core Walls	m³	160		0,00
12.3.23		Central Core Stair Landings	m³	8		0,00
12.3.24		Pile Caps	m³	190		0,00
12.3.25		Pile Cap Ring	m³	81		0,00
12.3.26		Straight RC Ground Beams	m³	32		0,00
12.3.27		Circular RC Ground Beams (Ring Beam)	m³	34		0,00
12.3.28		Waterproofing Crystalline Concrete Admixture in Tank Roof, Walls and Floor	Kg	10 374		0,00
TOTAL CARRIED FORWARD						R 0,00

ITEM NO	PAYMENT REFERS	SHORT DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
TOTAL BROUGHT FORWARD					R	0,00
12.4	8.4.4	<b>UNFORMED SURFACE FINISHINGS</b>				
		<u>Steel floated finishings:</u>				
12.4.1		Top of Dome Roof	m²	558		0,00
12.4.2		Top of Roof Edge Upstand Beam	m²	34		0,00
12.4.3		Top of Upper Landing	m²	20		0,00
12.4.4		Top of Tank Floor	m²	539		0,00
12.4.5		Top of Circular Ring Beam at level 1638,75	m²	34		0,00
12.4.6		Top of Straight RC Beams at level 1638,75	m²	44		0,00
12.4.7		Top of Circular Ring Beam at level 1632,75	m²	34		0,00
12.4.8		Top of Straight RC Beams at level 1632,75	m²	44		0,00
12.4.9		Top of Circular Ring Beam at level 1626,75	m²	34		0,00
12.4.10		Top of Straight RC Beams at level 1626,75	m²	44		0,00
12.4.11		Top of Central Core Stair Landings	m²	25		0,00
12.4.12		Top of Pile Caps	m²	112		0,00
12.4.13		Top of Pile Cap Ring	m²	48		0,00
12.4.14		Top of Straight RC Ground Beams	m²	32		0,00
12.4.15		Top of Circular RC Ground Beams (Ring Beam)	m²	34		0,00
12.4.16		Top of 150mm Thick Mesh RC Floor	m²	20		0,00
12.4.17		Top of 900 Wide V-Channel	m²	66		0,00
12.5		<b>PROVISIONAL SUMS FOR PILE FOUNDATIONS</b>				
12.5.1		Site Establishment including Plant and Equipment	Prov. Sum	600 000	600 000,00	600 000,00
12.5.2		Preliminaries and General (Fixed and Time-Related)	Prov. Sum	806 000	806 000,00	806 000,00
12.5.3		Piling Guarantee, Contractual Insurances, Design Engineer fees and completion certificate	Prov. Sum	100 000	100 000,00	100 000,00
12.5.4		Setting Out and Surveying	Prov. Sum	60 000	60 000,00	60 000,00
12.5.5		Installation of 600mm dia. Auger Piles up to 18m below NGL including Reinforcement and Concrete.	Prov. Sum	3 200 000	3 200 000,00	3 200 000,00
12.5.6		Pile Integrity Testing	Prov. Sum	70 000	70 000,00	70 000,00
12.5.7		Mark-up for items .....to.....	%	10,00%		0,00
TOTAL CARRIED FORWARD					R	4 836 000,00

ITEM NO	PAYMENT REFERS	SHORT DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
TOTAL BROUGHT FORWARD						R 4 836 000,00
12.6	8,5	<b>JOINTS</b>  <u>Horizontal construction joints in accordance with 5.5.7.3 of SANS 1200G including for 100mm bandage type sealant on internal face (Sikadur combiflex or similar approved):</u>				
12.6.1		Tank External Walls	m	248		0,00
12.6.2		Tank Internal Walls	m	29		0,00
12.6.3		Surface Bed	m	16		0,00
12.7		<b>MISCELLANEOUS</b>  <u>Stone Ballast</u>				
12.7.1		75mm thick layer of 40mm crushed stone placed on dome roof	m²	558		0,00
	PSA 8.4.7	<u>Water Tightness Testing</u>				
12.7.2		3,0ML Water Tower	Sum	1		0,00
	PSA 8.4.7	<u>Sterilisation</u>				
12.7.3		3,0ML Water Tower	Sum	1		0,00
		<u>Protection Systems</u>				
12.7.4		Aircraft warning light	Prov. Sum	1	120 000,00	120 000,00
		<u>Signage</u>				
12.7.5		Johannesburg Water (JW) Signage on Tank Wall	Sum	1		0,00
	8.3.12	<b>Security Door</b>				
12.7.6		Supply and Install "TDL" type door from STRONG DOOR or similar approved.	No	1		0,00
12.8	<b>SANS 1200 ME</b>	<b>SUBBASE</b>				
12.8.1	8.3.2	Construct subbase in 150mm layers with G5 quality material from commercial source and compact to 97% Mod AASHTO for paved areas	m³	321,46		0,00
	<b>SANS 1200 MJ</b>	<b>SEGMENTED PAVING</b>				
		Construction of paving complete with bedding sand compacted to 100% Mod AASHTO Density:				
12.8.2	8.2.2	60mm paving blocks 35MPa interlocking grey or similar approved CBP on 20mm bedding sand	m²	357		0,00
12.8.3	8.2.3	Cut paving units to fit edge restraints for :				
12.8.3.1		i) Straight Cutting	m	20		0,00
12.8.3.2		ii) Curved cutting up to 12m radius	m	69		0,00
TOTAL FOR SECTION 12 CARRIED TO SUMMARY						R 4 956 000,00

ITEM NO	PAYMENT REFERS	SHORT DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
13	<b>SABS</b>	<b>SECTION 13: CONCRETE (PUMPSTATION)</b>				
	<b>1200 G</b>					
13.1	8.2	FORMWORK				
	8.2.2	<b>Smooth vertical plane to:</b>				
13.1.1		Pump Station Foundations	m <sup>2</sup>	85		0,00
13.1.2		Thrust blocks	m <sup>2</sup>	30		0,00
13.2	8.2	FORMWORK				
	8.2.2	<b>Special smooth vertical plane to:</b>				
13.2.1		Internal and External Pumpstation Walls	m <sup>2</sup>	400		0,00
13.2.2		Pump Station Beams	m <sup>2</sup>	130		0,00
13.2.3		Pump Station Columns and Buttresses	m <sup>2</sup>	550		0,00
13.2.4		Chamber 9 Internal and External Walls	m <sup>2</sup>	120		0,00
13.2.5		Chamber 10 Internal and External Walls	m <sup>2</sup>	160		0,00
13.2.6		Chamber 11 Internal and External Walls	m <sup>2</sup>	20		0,00
13.2.7		Chamber 12 Internal and External Walls	m <sup>2</sup>	310		0,00
13.2.8		Chamber 13 Internal and External Walls	m <sup>2</sup>	80		0,00
13.2.9		Chamber 14 Internal and External Walls	m <sup>2</sup>	120		0,00
	8.2.2	<b>Smooth horizontal to:</b>				
13.2.10		Pumpstation Roof Slab & Stairs	m <sup>2</sup>	300		0,00
13.2.11		Pump Station Beams	m <sup>2</sup>	50		0,00
13.2.12		Chamber 9 soffits	m <sup>2</sup>	15		0,00
13.2.13		Chamber 10 soffits	m <sup>2</sup>	25		0,00
13.2.14		Chamber 11 soffits	m <sup>2</sup>	30		0,00
13.2.15		Chamber 12 soffits	m <sup>2</sup>	110		0,00
13.2.16		Chamber 13 soffits	m <sup>2</sup>	6		0,00
13.2.17		Chamber 14 soffits	m <sup>2</sup>	15		0,00
	8.2.5	<b>Formwork to sides</b>				
		Edges, risers, ends, reveals not exceeding 30mm high or wide				
13.2.18		Pumpstation	m	75		0,00
13.2.19		Chamber 9 Bases & Roofs	m	30		0,00
13.2.20		Chamber 10 Bases & Roofs	m	40		0,00
13.2.21		Chamber 11 Bases & Roofs	m	50		0,00
13.2.22		Chamber 12 Bases & Roofs	m	100		0,00
13.2.23		Chamber 13 Bases & Roofs	m	25		0,00
13.2.24		Chamber 14 Bases & Roofs	m	30		0,00
13.2.25		Stairs	m	60		0,00
13.3		BOX OUT HOLES/FORM VOIDS				
	PSG 8.10	<b>Circular holes of diameter up to 0.7m sealed with a bentonite strip when grouted.</b>				
13.3.1		Inlet and outlet pipes	No	22		0,00
	PSG 8.10	<b>Circular holes of diameter 0.5m sealed</b>				
13.3.2		Outlet pipe from existing reservoir	No	1		0,00
13.4	8.3	REINFORCEMENT				
	8.3.1	<b>Mild steel bars:</b>				
13.4.1		Diameters 8 mm to 40 mm: average price for Pump Station	t	3		0,00
13.4.2		Diameters 8 mm to 40 mm: average price for chambers				
	8.3.1	<b>High-tensile steel bars average price:</b>				
13.4.3		Diameters 10 mm to 40 mm: average price as indicated on schedules	t	55		0,00
<b>TOTAL CARRIED FORWARD</b>						<b>0,00</b>

ITEM NO	PAYMENT REFERS	SHORT DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
TOTAL BROUGHT FORWARD						R 0,00
13.5	8.4	CONCRETE				
	8.4.2	<b>Blinding layer in 15 MPa/19 mm concrete:</b>				
		50 mm minimum thickness				
13.5.1		Pump Station	m <sup>2</sup>	2		0,00
13.5.2		Chamber 9	m <sup>2</sup>	2		0,00
13.5.3		Chamber 10	m <sup>2</sup>	3		0,00
13.5.4		Chamber 11	m <sup>2</sup>	3		0,00
13.5.5		Chamber 12	m <sup>2</sup>	10		0,00
13.5.6		Chamber 13	m <sup>2</sup>	2		0,00
13.5.7		Chamber 14	m <sup>2</sup>	2		0,00
	8.4.3	<b>Mass concrete: 15MPa/19 mm:</b>				
13.5.8		Below tower foundation	m <sup>3</sup>			0,00
	8.4.3	<b>Strength concrete: 35 MPa/19 mm:</b>				
13.5.9		Pump Station base	m <sup>3</sup>	200		0,00
13.5.10		Pump Station surface-bed	m <sup>3</sup>	40		0,00
13.5.11		Pump Station walls	m <sup>3</sup>	120		0,00
13.5.12		Pump Station column bases	m <sup>3</sup>	5		0,00
13.5.13		Pump Station columns	m <sup>3</sup>	110		0,00
13.5.14		Pump Station stairs	m <sup>3</sup>	5		0,00
13.5.15		Pump Station raft foundation	m <sup>3</sup>	12		0,00
13.5.16		Chamber 9 Base and Thrust blocks	m <sup>3</sup>	5		0,00
13.5.17		Chamber 10 Base and Thrust blocks	m <sup>3</sup>	7		0,00
13.5.18		Chamber 11 Base and Thrust blocks	m <sup>3</sup>	12		0,00
13.5.19		Chamber 12 Base and Thrust blocks	m <sup>3</sup>	50		0,00
13.5.20		Chamber 13 Base and Thrust blocks	m <sup>3</sup>	2		0,00
13.5.21		Chamber 14 Base and Thrust blocks	m <sup>3</sup>	3		0,00
13.5.22		Thrust blocks and plinths	m <sup>3</sup>	5		0,00
	8.4.3	<b>Strength concrete: 20 MPa/19 mm:</b>				
13.5.23		Concrete apron	m <sup>3</sup>	8		0,00
13.5.24		Ramps	m <sup>3</sup>	2		0,00
	8.4.3	<b>Strength concrete: 40 MPa/19 mm:</b>				
13.5.25		Tank Walls	m <sup>3</sup>			0,00
13.6	8.4.4	UNFORMED SURFACE FINISHINGS				
		<b>Wood floated finishings:</b>				
13.6.1		Top of pump station base	m <sup>2</sup>	240		0,00
13.6.2		Top of pump station surface-bed	m <sup>2</sup>	130		0,00
13.6.3		Chamber 9 Base	m <sup>2</sup>	5		0,00
13.6.4		Chamber 10 Base	m <sup>2</sup>	8		0,00
13.6.5		Chamber 11 Base	m <sup>2</sup>	12		0,00
13.6.6		Chamber 12 Base	m <sup>2</sup>	45		0,00
13.6.7		Chamber 13 Base	m <sup>2</sup>	3		0,00
13.6.8		Chamber 14 Base	m <sup>2</sup>	5		0,00
		<b>Wood floated finishings:</b>				
13.6.9		Top of pump station floor screed	m <sup>2</sup>	130		0,00
13.6.10		Chamber 9 floor screed	m <sup>2</sup>	1		0,00
13.6.11		Chamber 10 floor screed	m <sup>2</sup>	2		0,00
13.6.12		Chamber 11 floor screed	m <sup>2</sup>	3		0,00
13.6.13		Chamber 12 floor screed	m <sup>2</sup>	10		0,00
13.6.14		Chamber 13 floor screed	m <sup>2</sup>	1		0,00
13.6.15		Chamber 14 floor screed	m <sup>2</sup>	1		0,00
		<b>Wood floated finishings:</b>				
13.6.16		Top of pump station roof	m <sup>2</sup>	225		0,00
13.6.17		Pump Room Stairs	m <sup>2</sup>	50		0,00
13.6.18		Chamber 9 roof	m <sup>2</sup>	15		0,00
13.6.19		Chamber 10 roof	m <sup>2</sup>	20		0,00
13.6.20		Chamber 11 roof	m <sup>2</sup>	30		0,00
13.6.21		Chamber 12 roof	m <sup>2</sup>	110		0,00
13.6.22		Chamber 13 roof	m <sup>2</sup>	6		0,00
13.6.23		Chamber 14 roof	m <sup>2</sup>	15		0,00
TOTAL CARRIED FORWARD						R 0,00

ITEM NO	PAYMENT REFERS	SHORT DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
TOTAL BROUGHT FORWARD						R 0,00
13.7		MOVEMENT JOINTS ETC				
		Isolation joints with 10mm "Jointex" filler between vertical concrete surfaces or between vertical concrete and brick work surfaces				
13.7.1		10mm joints not exceeding 300mm high	m	140		0,00
13.8	PSG8.9	CONCRETE CUBE-TESTING MACHINE				
13.8.1		Testing of concrete cubes	No	100		0,00
13.8.2		Supply cube-testing machine on site with recent calibration certificate and water trough	Sum	5		0,00
TOTAL FOR SECTION 13 CARRIED TO SUMMARY						R 0,00

ITEM NO	PAYMENT REFERS	SHORT DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
14	<b>SABS 1200 L</b>	<b>SECTION 14: PIPELINE (MAINS)</b>				
14.1	8.2.2	PIPE LINE				
		<b>Supplying, laying, and jointing of water pipes API 5L Grade X42, 6mm thick ,RPU external coating, solvent free epoxy (SFE) internal lining 600 microns.</b>				
14.1.1		(a) 650mm diameter Steel	m	303		0,00
		<b>Supplying, laying, and jointing of steel water pipes API 5L Grade X42, 6mm thick, RPU external coating , solvent free epoxy (SFE) internal lining 600 microns in accordance to SANS 719. The coatings are according to SANS 1217. The pipeline is flanged to standard SANS 1123, Table 1600/3</b>				
14.1.2		(b) 500mm diameter Steel	m	255		0,00
14.1.3		(c) 300mm diameter Steel	m	15		0,00
14.1.4		(d) 250mm diameter Steel	m	19		0,00
		<b>CONNECTION INTO TOWER MAIN</b>				
14.1.5		Connection to 650mm diameter water main at Tower, pipejack 1 point T1 as shown on Drawings CO1486-CP11,12	No	1		0,00
		<b>CONNECTION INTO EXISTING 200mm DIAMETER PIPELINE</b>				
14.1.6		Connection to existing 200mm diameter water main as shown on the drawings CO1486-CP15	No.	1		0,00
		<b>Bends</b>				
14.1.7		(a) Item 1.1: S.S 90 deg 650mm dia	No	1		0,00
14.1.8		(b) Item 1.1: S.S 90 deg 500mm dia	No	1		0,00
14.1.9		(c) Item 1.2: S.S 45 deg 650mm dia	No	9		0,00
14.1.10		(d) Item 1.2: S.S 45 deg 500mm dia	No	5		0,00
14.1.11		(e) Item 1.3: S.S 22.5 deg 650mm dia	No	9		0,00
		<b>Pressure Testing of steel pipeline and other tests as per Engineer requirements</b>				
14.1.12		Hydrostatic pressure testing of the steel water main and any other tests as per Engineer requirement	Prov Sum	1	250000,00	250 000,00
		<b>Valves</b>				
14.1.13		(a) Item 2.1: 200mm dia, air valve (See SANS1123 Table 1600)	No	6		0,00
14.1.14		(b) Item 2.2: 300mm dia, isolation valve, wedge gate valve (See SANS1123) Table	No	1		0,00
14.1.15		(c) Item 2.3: 160mm dia, isolation valve, wedge gate valve (See SANS1123) Table 1600)	No	1		0,00
14.1.16		(d) Item 2.4: 300mm dia, scour Valve	No	1		0,00
14.1.17		(e) Item 2.5: 500mm dia, isolation valve, wedge gate valve (See SANS1123) Table 1600)	No	1		0,00
14.1.18		(f) Item 2.6: 400mm dia, isolation valve, wedge gate valve (See SANS1123) Table 1600)	No	1		0,00
<b>TOTAL CARRIED FORWARD</b>					R	250 000,00

ITEM NO	PAYMENT REFERS	SHORT DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
TOTAL BROUGHT FORWARD					R	250 000,00
14.1.19	PSL 8.2.18  PL GD	<b>Reducers</b> Item 5.5: MS 650 x 500mm dia Concentric reducer	No	1		0,00
14.1.20		Item 5.6: MS 500 x 300mm dia Concentric reducer	No	1		0,00
14.1.21		Item 5.7: MS 400 x 160mm dia Concentric reducer	No	1		0,00
14.1.22		<b>T-Piece</b> Item 5.7: T-Piece	No	4		0,00
14.1.23		<b>Water Sampling Points</b> Water sampling point as per drawings	No	1		0,00
14.1.24		<b>Wrapping of butt welded Joints</b>  Wrapping of butt welded joints along the 500mm diameter pipeline	Prov Sum	1	10 000,00	10 000,00
14.1.25		<b>Pipeline route markers</b> Route markers are to be constructed with a 100mm pvc sleeve filled with 20MPa concrete, as per drawing CO1486-CP11	No	5		0,00
14.1.26		<b>Sundries</b>  Sundries	Prov Sum	1	500 000,00	500 000,00 0,00
14.1.27		Replacement of existing infrastructure	Prov Sum	Sum	600 000,00	600 000,00
TOTAL CARRIED FORWARD					R	1 360 000,00

ITEM NO	PAYMENT REFERS	SHORT DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
TOTAL BROUGHT FORWARD					R	1 360 000,00
14.2		<b>DAYWORKS</b>				
		Personnel during normaal working hours				
14.2.1		(a) Unskilled labour	hr	120		
14.2.2		(b) Semi-skilled labour	hr	120		
14.2.3		(c) Skilled labour	hr	120		
14.2.4		(d) Ganger	hr	120		
14.2.5		(e) Flagmen	hr	120		
		Personnel outside normal working hours				
14.2.6		(a) Personnel outside normal working hours and Saturdays				
14.2.6.1		(i) Unskilled labour	hr	120		
14.2.6.2		(ii) Semi-skilled labour	hr	120		
14.2.6.3		(iii) Skilled labour	hr	120		
14.2.6.4		(iv) Ganger	hr	120		
14.2.6.5		(v) Flagmen	hr	120		
14.2.7		(b) Sunday and Public Holidays				
14.2.7.1		(i) Unskilled labour	hr	60		
14.2.7.2		(ii) Semi-skilled labour	hr	60		
14.2.7.3		(iii) Skilled labour	hr	60		
14.2.7.4		(iv) Ganger	hr	60		
14.2.7.5		(v) Flagmen	hr	60		
		Plant				
14.2.8		(a) Grader (CAT 140G or similar)	hr	40		
14.2.9		(b) Pedestrian Roller (Bomag BW 90 ro similar)	hr	40		
14.2.10		(c) Water truck (5000 litres)	hr	40		
14.2.11		(d) Tipper truck, 10. m <sup>3</sup>	hr	24		
14.2.12		(e) Backhoe TLB type (Cat 428 or equivalent)	hr	24		
14.2.13		(f) Dewatering pump including generators and accessories (50mm pump, 600 litres per minute.)	hr	24		
14.2.14		(g) Compressor including hoses and tools (180 cfm)	hr	24		
		Materials				
14.2.15		(a) Procurement of materials	Prov. Sum	1	250 000,00	250 000,00
14.2.16		(b) Contractors handling costs, profit and all other charges in respect of sub-item (a) above.				
TOTAL FOR SECTION 14 CARRIED FORWARD TO SUMMARY					R	1 610 000,00

ITEM NO	PAYMENT REFERS	SHORT DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
15	SABS 1200 LB	<b>SECTION 15: PIPELINE (BEDDING AND FILLING FOR PIPES)</b>				
15.1	8.2.1	PROVISION OF BEDDING <b>Available from trench excavation without the need for screening or treatment:</b> <b>Steel pipes (non flexible pipe bedding)</b>				
15.1.1		(a) Selected granular material	m³	510		0,00
15.1.2		(b) Selected fill material	m³	510		0,00
		<b>Including screening and/or other treatment:</b> <b>Steel pipes (non flexible pipe bedding)</b>				
15.1.3		(a) Selected granular material	m³	0		0,00
15.1.4		(b) Selected fill material	m³	0		0,00
	8.2.2	<b>Supply of imported bedding material from:</b>				
	8.2.2.2 & 8.2.2.3	Borrow pits or commercial sources (Provisional)				
15.1.5		(a) Selected granular material	m³	0		0,00
15.1.6		(b) Selected fill material	m³	0		0,00
15.1.7		Supply and place 6-20 mm graded stone as directed by the Engineer	m³	0		0,00
15.1.8	PSLB 8.2.6	Extra over items 8.2.1 and 8.2.2 for bedding stabilized with 5% cement	m³	0		Rate only
15.2		<b>PROVISION OF FILLING</b>				
15.2.1		<b>Filling with imported material from commercial sources</b>	m³	2 300		0,00
<b>TOTAL FOR SECTION 15 CARRIED FORWARD TO SUMMARY</b>					<b>R</b>	<b>0,00</b>

ITEM NO	PAYMENT REFERS	SHORT DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
16	SABS 1200 L	<b>SECTION 16: PIPELINE (PUMPSTATION)</b>				
16.1	8.2.2	<b>PIPE LINE</b> Supplying, laying, and jointing of water pipes SAW to API 5L Grade X42, 6mm thick with 6mm CML and Rigid Polyurethane coating. The pipeline is flanged to standard SANS 1123, Table 1600/3				
16.1.1		(a) 700mm Steel	m	120		0,00
16.1.2		(b) 650mm Steel	m	45		0,00
16.1.3		(c) 600mm Steel	m	80		0,00
16.1.4		(d) 500mm Steel	m	10		0,00
16.1.5		(e) 300mm Steel	m	5		0,00
16.1.6		(e) 200mm Steel	m	60		0,00
16.1.7		(f) 150mm Steel	m	50		0,00
	8.2.2	<b>PIPE LINE FITTINGS</b> Supply, deliver and install complete with all jointing material, the following items:				
		<b>Inlet Pipe from reservoir to pumpstation</b>				
16.1.8		a) 700mmø non-rising class 16 anti-clockwise closing wedge gate valve with cap top	No.	1		0,00
16.1.9		b) 500mmø Cut length pipe, 1260mm long, both sides flanged	No	2		0,00
16.1.10		c) 500mmø 135° long bend, flanged all ends	No	2		0,00
16.1.11		d) 700 x 500mmø special concentric reducer, flanged all sides	No	1		0,00
		<b>Outlet Pipe from pumpstation to elevated tower</b>				
16.1.12		a) 500mmø 90° short radius bend, flanged both ends	No	1		0,00
16.1.13		b) 500mmø Cut length pipe, 500mm long, both sides flanged	No	2		0,00
		<b>Inlet Pipe from 1100ø pipe to elevated</b>				
16.1.14		a) 300mmø 90° short radius bend, flanged both ends	No	1		0,00
16.1.15		b) 500mmø Cut length pipe, 2000mm long, both sides flanged	No	1		0,00
16.1.16		c) 500mmø Cut length pipe, 700mm long, both sides flanged	No	2		0,00
16.1.17		d) 300mmø Cut length pipe, 500mm long, both sides flanged	No	1		0,00
16.1.18		e) 500 x 300mmø special concentric reducer, flanged all sides	No	1		0,00
16.1.19		f) 500mmø equal "T" piece, all sides flanged	No	2		0,00
16.1.20		g) 500mmø non-rising class 16 anti-clockwise closing wedge gate valve with cap top	No.	1		0,00
<b>TOTAL CARRIED FORWARD</b>						<b>0,00</b>

ITEM NO	PAYMENT REFERS	SHORT DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
TOTAL BROUGHT FORWARD					R	0,00
16.1.21		<b>Tower Bypass Pipeline to Outlet pipe</b> a) 600mmø 90° short radius bend, flanged both ends	No	2		0,00
16.1.22		b) 600mmø Cut length pipe, 1300mm long, both sides flanged	No	1		0,00
16.1.23		c) 600mmø equal "T" piece, all sides flanged	No	2		0,00
16.1.24		d) 650mmø to 600mmø Reducing "T" piece, all sides flanged	No	1		0,00
16.1.25		e) 600ø PN16 cast iron Non Return Valve swing type	No.	1		0,00
16.1.26		f) 600mmø non-rising class 16 anti-clockwise closing wedge gate valve with cap top	No.	1		0,00
		<b>CONNECTION INTO EXISTING</b> Connection to existing pipeline complete as shown on drawings including excavation and all specials				
16.1.27		Connection to existing pipe junctions including excavation and making good. (On the 1100mm dia pipeline)	No	1		0,00
16.1.28		Connection to existing pipe junction at Reservoir site including excavation, breaking through walls and making good.	No	1		0,00
		<b>8.2.1 VALVE CHAMBER 09 - Outlet from Elevated Tower</b> Supply, deliver and install complete with all jointing material, the following items as shown on drawing C01486-PS15				
16.1.29		a) 650mmø Puddle pipe, 1000mm long, flanged one side, plain ended the other side, with puddle flange	No	2		0,00
16.1.30		b) 150mmø non-rising class 16 anti-clockwise closing wedge gate valve with cap top	No.	1		0,00
16.1.31		c) 150mmø 90° short radius bend, flanged one side	No	1		0,00
16.1.32		d) 650mmø non-rising class 16 anti-clockwise closing wedge gate valve with cap top	No.	1		0,00
16.1.33		e) 150mmø Cut length pipe, 200mm long, both sides flanged	No	1		0,00
		f) 650ø PN16 cast iron Non Return Valve swing type	No.	1		
16.1.34		g) 600ø PN16 dynamic turbine flowmeter with flanges drilled to SANS 1123-1600	No	1		0,00
		<b>8.2.1 VALVE CHAMBER 10 - Inlet to Pump Station</b> Supply, deliver and install complete with all				
16.1.35		a) 700 x 500mmø special flanged concentric	No	1		0,00
16.1.36		b) 500mmø Puddle pipe, 1000mm long,	No	2		0,00
16.1.37		c) 500mmø Cut length pipe, 500mm long, both	No	2		0,00
16.1.38		d) 500mmø non-rising class 16 anti-clockwise	No.	1		0,00
TOTAL CARRIED FORWARD					R	0,00

ITEM NO	PAYMENT REFERS	SHORT DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
TOTAL BROUGHT FORWARD					R	0,00
16.1.39	8.2.1	e) 500ø PN16 flanged strainer with flanges drilled to SANS 1123-1600	No	1		0,00
16.1.40		f) 500ø PN16 dynamic turbine flowmeter with flanges drilled to SANS 1123-1600	No	1		0,00
VALVE CHAMBER 11 - Outlet from Pump Station Supply, deliver and install complete with all jointing material, the following items as shown on drawing C01486-PS15						
16.1.41		a) 500mmø Puddle pipe, 1000mm long, flanged all sides, with puddle flange	No	1		0,00
16.1.42		b) 500 x 300mmø special flanged concetric reducer, 500mm long, flanged both ends	No	1		0,00
16.1.43		c) 600mmø 90° short radius bend, flange both ends flanged to SANS 1123 Table 1600	No	1		0,00
16.1.44		d) 300mmø Cut length pipe, 500mm long, both sides flanged	No	5		0,00
16.1.45		e) 300mmø non-rising class 16 anti-clockwise closing wedge gate valve with cap top	No.	2		0,00
16.1.46		f) 300ø PN16 flanged strainer with flanges drilled to SANS 1123-1600	No	1		0,00
16.1.47		g) 300ø PN16 dynamic turbine flowmeter with flanges drilled to SANS 1123-1600	No	1		0,00
16.1.48		h) 300ø PN16 cast iron Non Return Valve swing type	No	1		0,00
16.1.49		i) 600 x 300mmø special flanged concetric reducer, 500mm long, flanged both ends.	No	1		0,00
16.1.50		j) 600mmø Puddle pipe, 1000mm long, flanged all sides, with puddle flange	No	1		0,00
VALVE CHAMBER 12 - PRV & Altitude Flow Control Supply, deliver and install complete with all jointing material, the following items as shown on drawing C01486-PS16						
16.1.51	a) 300mmø Puddle pipe, 1000mm long, flanged one side, plain ended the other side, with puddle flange	No	2		0,00	
16.1.52	b) 300mmø 135° short radius bend, flanged ends	No	6		0,00	
16.1.53	c) 300mmø special gusset Y-piece, flanged one end, plain ended on the two branch sides, one branch with concetric reducer to 200mm	No	2		0,00	
16.1.54	d) 300mmø special gusset Y-piece, flanged all sides	No	2		0,00	
16.1.55	e) 300mmø non-rising class 16 anti-clockwise closing wedge gate valve with cap top	No.	6		0,00	
16.1.56	f) 200mmø non-rising class 16 anti-clockwise closing wedge gate valve with cap top	No.	1		0,00	
16.1.57	g) 300ø PN16 flanged strainer with flanges drilled to SANS 1123-1600	No	1		0,00	
16.1.58	h) 300ø PN16 dynamic turbine flowmeter with flanges drilled to SANS 1123-1600	No	1		0,00	
16.1.59	i) 300ø PN16 cast iron Non Return Valve	No	1		0,00	
TOTAL CARRIED FORWARD					R	0,00

ITEM NO	PAYMENT REFERS	SHORT DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
<b>TOTAL BROUGHT FORWARD</b>					R	0,00
16.1.60		j) 300ø Singer 106-A Type 4 with Differential Control One-Way Flow Altitude Valve or Equivalent	No.	1		0,00
16.1.61		k) 300mmø Cut length pipe, 300mm long, both sides flanged	No	2		0,00
16.1.62		l) 300mmø Cut length pipe, 400mm long, both sides flanged	No	11		0,00
16.1.63		m) 300mmø 90° short radius bend, flanged both ends	No	3		0,00
16.1.64		n) 600 x 300mmø concentric reducer, 500mm long, flanged both ends	No	1		0,00
16.1.65		o) 300mmø Cut length pipe, 2500mm long, both sides flanged	No	1		0,00
16.1.66		p) 300mmø length pipe, 1900mm long, both sides flanged	No	1		0,00
16.1.67		q) 200mmø Cut length pipe, 2550mm long, both sides flanged	No	1		0,00
16.1.68		l) 200mmø 135° short radius bend, flanged	No	2		0,00
16.1.69		m) 300mmø clayton PRV, or similar approved	No	1		0,00
16.1.70		q) 200mmø Cut length pipe, 1100mm long, both sides flanged	No	1		0,00
16.1.71		k) 300mmø Cut length pipe, 500mm long, both sides flanged	No	1		0,00
	<b>8.2.1</b>	<b>VALVE CHAMBER 13 - Bypass connection</b>  Supply, deliver and install complete with all jointing material, the following items as shown on drawing C01486-PS18				
16.1.72		a) 1100 x 300mmø special flanged concentric reducing Tee with 300mm spool piece	No	1		0,00
16.1.73		b) 300mmø non-rising class 16 anti-clockwise closing wedge gate valve with cap top	No.	1		0,00
16.1.74		c) 300mmø Puddle pipe, 500mm long, flanged both side, with puddle flange	No	1		0,00
		<b>PUMP STATION</b> Supply, deliver, install complete with all jointing material and commission the following items:				
16.1.75		KSB SA OMEGA 250-370A (389 impeller) with a WEG 160kW 380v 315 S/M 4p motor or similar approved including base plate, supply and delivery pipe modifications to ensure fit, capable of following duty: 280l/s at 45.0m with NPSH, max of 5m.	Item	3		0,00
16.1.76		Provisional sum for pipe work modifications to suit selected pump on inlets and outlets	Prov Sum	1	150 000,00	150 000,00
		<b>General Fittings</b>				
16.1.78		a) 500mmø/300mmø custom made 135° reducing Y-piece, flanged all ends	No	3		0,00
16.1.79		b) 300mmø 135° short bend, flanged all ends	No	3		0,00
16.1.80		c) 250mmø 90° short radius bend, flanged both ends	No	6		0,00
<b>TOTAL CARRIED FORWARD</b>					R	150 000,00

ITEM NO	PAYMENT REFERS	SHORT DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
TOTAL BROUGHT FORWARD					R	150 000,00
16.1.81		d) 250mmø 135° short bend, flanged all ends	No	3		0,00
16.1.82		e) 500mmø 135° short bend, flanged all ends	No	1		0,00
16.1.83		f) 500mmø x 250mmø concentric reducer, flanged both ends	No	3		0,00
16.1.84		g) 250mmø dismantling joint	No	3		0,00
16.1.85		h) Clamp-on Ultrasonic Flow Meter with ±2% accuracy for a Steel pipe DN250mm with vibration resistance up to 50Hz	No.	3		0,00
16.1.86		i) 500mmø Custom made 135° Y-piece, flanged all ends	No.	3		0,00
16.1.87		j) 500mmø end cap flanged	No.	2		0,00
<b>Valves</b>						
16.1.88		a) 300mmø non-rising class 16 anti-clockwise closing wedge gate valve with cap top	No.	3		0,00
16.1.89		b) 250mmø non-rising class 16 anti-clockwise closing wedge gate valve with cap top	No.	3		0,00
16.1.90		c) 250mmø PN16 cast iron Non Return Valve swing type	No	3		0,00
<b>Cut Lengths</b>						
16.1.91		a) 300mmø Cut length pipe, 315mm long, both sides flanged	No	3		0,00
16.1.92		b) 250mmø Cut length pipe, 580mm long, both sides flanged	No	3		0,00
16.1.93		c) 250mmø Puddle pipe, 1175mm long, flanged all sides, with puddle flange	No	3		0,00
16.1.94		d) 250mmø Cut length pipe, 400mm long, flanged both sides	No	3		0,00
16.1.95		e) 300mmø Cut length pipe, 150mm long, both sides flanged	No	3		0,00
16.1.96		f) 500mmø Cut length pipe, 2080mm long, both sides flanged	No	1		0,00
16.1.97		g) 500mmø Cut length pipe, 1950mm long, both sides flanged	No	1		0,00
16.1.98		h) 500mmø Cut length pipe, 1240mm long, both sides flanged	No	2		0,00
16.1.99		i) 250mmø Cut length pipe, 3755mm long, both sides flanged	No	3		0,00
16.1.100		j) 250mmø Cut length pipe, 500mm long, both sides flanged	No	3		0,00
16.1.101		k) 250mmø Cut length pipe, 1885mm long, both sides flanged	No	3		0,00
16.1.102		l) 500mmø Puddle pipe, 2700mm long, flanged both side, with puddle flange	No	1		0,00
16.1.103		m) 500mmø Cut length pipe, 2360mm long, both sides flanged	No	1		0,00
16.1.104		n) 300mmø Cut length pipe, 265mm long, both sides flanged	No	3		0,00
TOTAL CARRIED FORWARD					R	150 000,00

ITEM NO	PAYMENT REFERS	SHORT DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
TOTAL BROUGHT FORWARD					R	150 000,00
16.1.105	PSL 8.2.18	Supply a portable Submersible Drainage Pump with a float switch with a minimum capacity of 6L/s at 10m head. <i>The pump should fit narrow spaces (30cm dia) and should handle a maximum submersion depth of 7m.</i>	No.	2		0,00
16.1.106		<b>Pipeline route markers</b> Route markers are to be constructed with a 100mm pvc sleeve filled with 20MPa concrete, as per drawing	No	8		0
TOTAL FOR SECTION 16 CARRIED FORWARD TO SUMMARY					R	150 000,00

ITEM NO	PAYMENT REFERS	SHORT DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
17	<b>SABS 1200 LB</b>	<b>SECTION 17: PUMPSTATION (BEDDING FOR PIPES)</b>				
17.1	8.2.1	PROVISION OF BEDDING <b>Available from trench excavation without the need for screening or treatment:</b> <b>Steel pipes (non flexible pipe bedding)</b>				
17.1.1		(a) Selected granular material	m <sup>3</sup>	50		0,00
17.1.2		(b) Selected fill material	m <sup>3</sup>	1 200		0,00
		<b>Including screening and/or other treatment:</b> <b>Steel pipes (non flexible pipe bedding)</b>				
17.1.3		(a) Selected granular material	m <sup>3</sup>	100		0,00
17.1.4		(b) Selected fill material	m <sup>3</sup>	500		0,00
	8.2.2	<b>Supply of imported bedding material from:</b>				
	8.2.2.2 & 8.2.2.3	Borrow pits or commercial sources (Provisional)				
17.1.5		(a) Selected granular material	m <sup>3</sup>	50		0,00
17.1.6		(b) Selected fill material	m <sup>3</sup>	500		0,00
17.1.7		Supply and place 6-20 mm graded stone as directed by the Engineer	m <sup>3</sup>	30		0,00
17.1.8	PSLB 8.2.6	Extra over items 8.2.1 and 8.2.2 for bedding stabilized with 5% cement	m <sup>3</sup>			Rate only
<b>TOTAL FOR SECTION 17 CARRIED FORWARD TO SUMMARY</b>					<b>R</b>	<b>0,00</b>

ITEM NO	PAYMENT REFERS	SHORT DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
18		<b>SECTION 18: ELEVATED TOWER PIPEWORK</b>				
18.1	<b>SABS 1200 L</b>	<b>STEEL PIPES &amp; FITTINGS</b>				
	PSL 8.2.5 PSL 8.2.7 PB 8.2 PB 8.3	(Refer also to specification PSL, PA, PB, PD, PE, PX & PI  Supply, deliver, install, handle, lay, bed, joint,  Unless otherwise specified all steel pipes and specials in this sections shall be Grade <ul style="list-style-type: none"> <li>Flanges to Table 1000/3 SANS 1123</li> <li>Rates to include for 'denso-wrapping'</li> <li>Rates to include for casting into</li> <li>Puddle pipes to be tape wrapped to specifications</li> </ul> <b>Elevated Tower Inlet Pipework</b>  Item IN1: 500mm Ø 90° steel short radius bend, FBE  Item IN2: 500mmØ,steel pipe 1236mm long, FBE  Item IN3: 500mmØ steel pipe 3200 mm long, FBE  Item IN4: 500mmØ steel pipe 3133 mm long, FBE  Item IN5: 500mm Ø 90° steel short radius bend with puddle flange and base plate, FBE  Item IN6: 500mmØ steel pipe 4000 mm long, FBE  Item IN7: 500mmØ steel pipe 3002 mm long, FBE  Item IN8: 500mmØ steel pipe s-bend, FBE  Item IN9: 500mmØ steel pipe 3226 mm long, FBE  Item IN10: 500mm Ø 90° steel short radius bend with puddle flange and bellmouth OE and FOE				
18.1.1		500mm Ø 90° steel short radius bend, FBE	Nº	2		0,00
18.1.2		500mmØ,steel pipe 1236mm long, FBE	Nº	1		0,00
18.1.3		500mmØ steel pipe 3200 mm long, FBE	Nº	2		0,00
18.1.4		500mmØ steel pipe 3133 mm long, FBE	Nº	1		0,00
18.1.5		500mm Ø 90° steel short radius bend with puddle flange and base plate, FBE	Nº	1		0,00
18.1.6		500mmØ steel pipe 4000 mm long, FBE	Nº	4		0,00
18.1.7		500mmØ steel pipe 3002 mm long, FBE	Nº	1		0,00
18.1.8		500mmØ steel pipe s-bend, FBE	Nº	1		0,00
18.1.9		500mmØ steel pipe 3226 mm long, FBE	Nº	2		0,00
18.1.10		500mm Ø 90° steel short radius bend with puddle flange and bellmouth OE and FOE	Nº	1		0,00
<b>TOTAL CARRIED FORWARD</b>					R	0,00

ITEM NO	PAYMENT REFERS	SHORT DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
TOTAL BROUGHT FORWARD						R 0,00
		<b>Elevated Tower Outlet Pipework</b>				
18.1.11		Item OT1: 500mm Ø 90° steel short radius bend, FBE	Nº	3		0,00
18.1.12		Item OT2: 500mmØ,steel pipe 1236mm long, FBE	Nº	1		0,00
18.1.13		Item OT3: 500mmØ steel pipe 3000 mm long, FBE	Nº	2		0,00
18.1.14		Item OT4: 500mmØ steel pipe 2989 mm long, FBE	Nº	1		0,00
18.1.14		Item OT5: 500mm Ø 90° steel short radius bend with puddle flange and base plate, FBE	Nº	1		0,00
18.1.15		Item OT6: 500mmØ steel pipe 4000 mm long, FBE	Nº	4		0,00
18.1.16		Item OT7: 500mmØ steel pipe 2994 mm long, FBE	Nº	1		0,00
18.1.17		Item OT8: 500mmØ steel pipe 2257 mm long, FBE	Nº	1		0,00
		<b>Elevated Tower Overflow Pipework</b>				
18.1.18		Item OV1: 200mm Ø 90° steel short radius bend, FBE	Nº	3		0,00
18.1.19		Item OV2: 200mmØ,steel pipe 1236mm long, FBE	Nº	1		0,00
18.1.20		Item OV3: 200mmØ,steel pipe 3000mm long, FBE	Nº	2		0,00
18.1.21		Item OV4: 200mmØ,steel pipe 3060mm long, FBE	Nº	1		0,00
18.1.22		Item OV5: 200mmØ,steel pipe 2276mm long, FBE	Nº	1		0,00
18.1.23		Item OV6: 200mmØ,steel pipe 1172mm long, FBE	Nº	1		0,00
18.1.24		Item OV7: 200mm Ø 90° steel short radius bend with puddle flange and base plate, FBE	Nº	1		0,00
18.1.25		Item OV8: 200mmØ,steel pipe 4000mm long, FBE	Nº	4		0,00
18.1.26		Item OV9: 200mmØ,steel pipe 4323mm long, FBE	Nº	1		0,00
TOTAL CARRIED FORWARD						R 0,00

ITEM NO	PAYMENT REFERS	SHORT DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
TOTAL BROUGHT FORWARD						R 0,00
18.1.27		Item OV10: 200mmØ,steel s-bend, FBE	Nº	1		0,00
18.1.28		Item OV11: 200mmØ,steel pipe 2600mm long, FBE	Nº	2		0,00
18.1.29		Item OV12: 200mm Ø 90° steel short radius bend, FBE	Nº	1		0,00
18.1.30		Item OV13: 200mm Ø 90° steel short radius bend, FBE	Nº	1		0,00
18.1.31		Item OV14: 200mmØ,steel pipe 463mm long, FBE	Nº	1		0,00
<b>Elevated Tower Scour Pipework</b>						
18.1.32		Item SC1: 150mm Ø 90° steel short radius bend, FBE	Nº	3		0,00
18.1.33		Item SC2: 150mmØ,steel pipe 1236mm long, FBE	Nº	1		0,00
18.1.34		Item SC3: 150mmØ,steel pipe 3000mm long, FBE	Nº	2		0,00
18.1.35		Item SC4: 150mmØ,steel pipe 3060mm long, FBE	Nº	1		0,00
18.1.36		Item SC5: 200mmØ,steel pipe 1038mm long, FBE	Nº	1		0,00
18.1.37		Item SC6: 200mmØ,steel pipe 1038mm long, FBE	Nº	1		0,00
18.1.38		Item SC7: 150mm Ø 90° steel short radius bend with puddle flange and base plate, FBE	Nº	1		0,00
18.1.39		Item SC8: 150mmØ,steel pipe 4000mm long, FBE	Nº	4		0,00
18.1.40		Item SC9: 150mmØ,steel pipe 2362mm long, FBE	Nº	1		0,00
18.1.41		Item SC10: 150mmØ,steel pipe 2738mm long, FBE	Nº	1		0,00
TOTAL FOR SECTION 18 CARRIED FORWARD TO SUMMARY						R 0,00

ITEM NO	PAYMENT REFERS	SHORT DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
19	SANS 1200LG	SECTION 19: PIPE JACKING				
19.1	8.2.1	PIPE JACKING AT ROAD CROSSINGS Jacking Establishment for Pipejack 1 - Pipejack 3 position:				
19.1.1		Fixed charges	Sum	3		0,00
19.1.2		Time related charges	Hours	1		rate
	8.3	PIPE JACK 1 (refer to drawing CO1486-CP12 )				
19.1.3	8.3.1	Excavate jacking pit ,face,provision for safe guarding and stabilizing of excavations.	No.	1		0,00
19.1.4		a) soft and intermediate	m³	50		0,00
19.1.5		Extra Over Item:8.3a in rock SANS 1200 R1-R5	m³	1		Rate Only
	8.3.2	Supply Pipes Supply pipes to be jacked				
19.1.6		a) 1430 diameter class 100D with in-the wall SABS677	m	20		0,00
19.1.7		b) Soft and intermediate	m³	32		0,00
19.1.8		c) Extra over item 7.6 excavation in rock SANS 1200 R1-R5	m³	1		Rate Only
	8.3.3	Jacking of pipes Jacking of pipes into their final positions				
19.1.9		a) 1430mm diameter class 100D with in the-wall pipes SABS677	m	20		0,00
19.1.10		Standing time for pipe jacking ganag complete with equipement(where approved)	hr	1		Rate Only
	8.3.4	Grouting Grouting by injection of cement/sand grout mix (ratio of 1:4) where ordered				
19.1.11		Provision and establishment of equipment on site and removal on completion	sum	1		0,00
19.1.12		Operation of equiment	days	3		0,00
19.1.13		Grout	m³	5		0,00
TOTAL CARRIED FORWARD						R 0,00

TOTAL BROUGHT FORWARD						R	0,00
19.2	8.4	<b>PIPE JACK 2 (refer to drawing CO1483-CP13 )</b>					
	8.4.1	Excavate jacking pit ,face,provision for safe guarding and stabilizing of excavations.	No.	1			0,00
19.2.1		a) soft and intermediate	m³	50			0,00
19.2.2		Extra Over Item:8.4.1a in rock as per SANS - R1 to R5	m³	1			Rate Only
	8.4.2	<b>Supply Pipes</b> <b>Supply pipes to be jacked</b>					
19.2.3		a) 1430 diameter class 100D with in-the wall SABS677	m	35			0,00
19.2.4		a) Soft and intermediate	m³	51			0,00
19.2.5		b) Extra over item 8.4.2a excavation in rock SANS 1200 R1-R5	m³	1			Rate Only
	8.4.3	<b>Jacking of pipes</b> <b>Jacking of pipes into their final positions</b>					
19.2.6		a) 1430mm diameter class 100D with in the-wall pipes SABS677	m	35			0,00
19.2.7		Standing time for pipe jacking ganag complete with equipememt(where approved)	hr	1			Rate Only
	8.4.4	<b>Grouting</b> <b>Grouting by injection of cement/sand grout mix (ratio of 1:4) where ordered</b>					
19.2.8		Provision and establishment of equipment on site and removal on completion	Sum	1			0,00
19.2.9		Operation of equiment	days	3			0,00
19.2.10		Grout	m³	5			0,00
19.3	8.5	<b>PIPE JACK 3 (refer to drawing CO1483-CP14 )</b>					
19.3.1	8.5.1	Excavate jacking pit ,face,provision for safe guarding and stabilizing of excavations.	No.	1			0,00
19.3.2		a) soft and intermediate	m³	6			0,00
19.3.3		Extra Over Item 8.5.1a as per SANS 1200 - R1 to R5	m³	1			Rate Only
	8.5.2	<b>Supply Pipes</b> <b>Supply pipes to be jacked</b>					
19.3.4		SABS677	m	15			0,00
TOTAL CARRIED FORWARD						R	0,00

TOTAL BROUGHT FORWARD						R	0,00
19.3.5	8.5.3	a) Soft and intermediate	m³	6			0,00
19.3.6		Extra over item 8.5.2a in rock as per SANS 1200-R1 to R5	m³	1			Rate Only
		<b>Jacking of pipes</b>					
		<b>Jacking of pipes into their final positions</b>					
19.3.7		a) 1430mm diameter class 100D with in the-wall pipes SABS677	m	15			0,00
19.3.8	8.5.4	Standing time for pipe jacking ganag complete with equipement(where approved)	hr	1			Rate Only
		<b>Grouting</b>					
		<b>Grouting by injection of cement/sand grout mix (ratio of 1:4) where ordered</b>					
19.3.9		Provision and establishment of equipment on site and removal on completion	Sum	1			0,00
19.3.10		Operation of equipment	Days	3			0,00
19.3.11		Grout	m³	5			0,00
TOTAL SECTION 19 CARRIED TO SUMMARY						R	0,00

ITEM NO	PAYMENT REFERS	SHORT DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
20	<b>SABS 1200 HA</b>	<b>SECTION 20 : STRUCTURAL STEELWORK (ELEVATED TOWER)</b>				
20.1		<u><b>Supply and Fabrication</b></u>				
20.1.1		Preparation and submission to the Engineer for approval of shop detail drawings.	t	3,1		0,00
	8.3.1	<u><b>Supply and fabrication of steelwork:</b></u>				
20.1.2		200 x 75 mm PFC Sections	t	3,1		0,00
20.1.3		Rectagrid Grating RS40-40x4,5 Bearer Bar Size- Banded Finish: Hot Dip Galvanised	m²	25		
	8.3.2	<u><b>Deliver</b></u>				
20.1.4	8.3.2.1	Delivery of steelwork to site of all items under 8.3.1 above	t	3,1		0,00
	8.3.3	<u><b>Erection</b></u>				
20.1.5		Offloading of steel, stacking on site, and erection of steelwork of all items under 8.3.1 above	t	3,1		0,00
	8.3.4	<u><b>Erection Bolts</b></u> Supply, deliver and storage of bolts, washer and nuts as indicated on drawing <a href="#">1440a/WA/DET09</a>				
20.1.6		M16	t	0,1		0,00
	8.3.7	<u><b>Handrails</b></u>				
20.1.7		Handrails assembly complete as per drawing <a href="#">1440a/WA/DET09</a>				
20.1.7.1		a) Horizontal	m	18		0,00
20.1.7.2		b) Sloping on stairs at 45 deg angle	m	66		0,00
	8.3.8	<u><b>Ladders</b></u>				
20.1.8		Supply and install Hot dip galvanized mild steel Catladders as detailed on drawing <a href="#">1440a/WA/DET03</a>	m	11		0,00
20.1.9		Supply and install Stainless Steel Catladders as detailed on drawing <a href="#">1440a/WA/DET03</a>	m	8		0,00
		<u><b>Air Vents</b></u>				
20.1.10		Supply and install one pair of 150mm Ø galvanised steel air vents as detailed on <a href="#">Drg 8010/006/139</a>	No	6		0,00
		<u><b>Manholes</b></u>				
	PSA 8.4.7	Supply and install hot dip galvanised lockable manhole cover and frame to access openings, rate includes for all fixings, locks, etc:				
	PSA 8.4.8	Supply and install hot dip galvanised lockable manhole cover and frame to access openings, rate includes for all fixings, locks, etc:				
20.1.11		1000 x 1000mm Drg <a href="#">8010/006/164</a>	No.	3		0,00
		<u><b>Rain Water Outlets</b></u>				
20.1.12		Supply and install 110mm Ø C.I rain water outlets with 12x3.3mm Ø stainless steel Mesh 1260mm long 550mm wide and bolted with 6 No. 6 Ø SS masonry anchor bolts as detailed <a href="#">on Drg.....</a>	No.	12		0,00
<b>TOTAL FOR SECTION 20 CARRIED TO SUMMARY</b>					<b>R</b>	<b>0,00</b>

ITEM NO	PAYMENT REFERS	SHORT DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
21	<b>SABS 1200 HA</b>	<b>SECTION 21 : STRUCTURAL STEELWORK (PUMPSTATION)</b>				
21.1	8.3.1	SUPPLY AND FABRICATION				
21.1.1	8.3.1.1	Preparation and submission to the Engineer for approval of shop detail drawings.	t	1,2		0,00
		Supply and fabrication of steelwork <b>A. Hot rolled steel</b> <b>(a) PFC Sections for platforms</b>				
21.1.2		1. 230 x 90 mm	t	0,0		Rate only
21.1.3		Trial assembly of platforms	No	0,0		Rate only
	8.3.2	DELIVERY				
21.1.4	8.3.2.1	Delivery of steelwork to site of all items under 8.3.1 above	t	1,2		0,00
	8.3.3	ERECTION				
21.1.5		Offloading of steel, stacking on site, and erection of steelwork of all items under 8.3.1 above	t	1,2		0,00
	8.3.4	ERECTION BOLTS				
		Supply, deliver and storage of bolts, washer and nuts as indicated on drawing 1440a/WA/DET09				
21.1.6		(a) M16	t	0,1		0,00
	8.3.7	HANDRAILS				
		Handrails assembly complete as per drawings C01486-PS14				
21.1.7		a) Horizontal	m	30		0,00
21.1.8		b) Sloping on stairs at 45 deg angle	m	60		0,00
	8.3.8	LADDERS				
21.1.9		Supply and install Hot dip galvanized mild steel Catladders as detailed on drawing C01486-PS14	m	15		0,00
	8.3.10	NON-DESTRUCTIVE TESTING				
21.1.10		Testing of welding as indicated by the engineer including supply of test certificates.	No.	10		0,00
	PSH 8.3.17	CRAWL BEAMS				
21.1.11		254 x 146 mm x 43kg/m I-section beams with cast in plates and bolts	t	1,20		0,00
21.1.12		UC254x254x132	t			
21.1.13		UB533x210x101 with cast in plates and bolts	t			
21.1.14	PSH 8.3.18	Security Concrete desk steel support structure Equal angles (50x50x5), to include installation, and connections.	t	1		0,00
21.1.15	PSH 8.3.19	Equal angles (40x40x5) with lugs to be cast into concrete edges	t	0,10		0,00
21.1.16	PSH 8.3.20	Mentis grid as detailed in Pump station drawings	m²	40		0,00
<b>TOTAL CARRIED FORWARD</b>					R	0,00

TOTAL BROUGHT FORWARD					R	0,00
21.2		<b>MISCELLANEOUS</b>				
21.2.1	BD 08.02.01a	Customised 1525x3060mm steel doors with DV vent at the bottom. Including frame refer to dwg C01486-PS09	No.	2		0,00
21.2.2	BD 08.02.01a	2700x3000mm steel doors with DV vent at the bottom. Including frame	No.	1		0,00
21.2.3	BD 08.02.01a	915mm X 2135mm Standard Steel Door and Frame Type B (Vermin Proofed Single Louvre) and Painted To Specifications	No.	2		0,00
		Hold down pipe clamps (250mmø discharge pipes in pump station)				
21.2.4	BD 08.02.01c	400mm x 400mm Steel Ventilation Louvr, including the frame.	No.	46		0,00
21.2.5	BD 08.05	Coring through concrete walls	Prov Sum	1	40 000,00	40 000,00
	8.3.12	<b>SECURITY ACCESS DOOR</b>				
21.2.6		Supply and Install steel door "L1"- L shape profile, multi-point locking system, with four 16mm locking bolts and drill resistant plate as shown on drawing C01486-PS05	No	2		0,00
21.3	<b>SABS 1200 HC</b>	<b>SECTION HC: CORROSIONPROTECTION OF STRUCTURAL STEELWORK</b>				
	8.2.3	<b>SURFACE PREPARATION AND COATING APPLICATION</b>				
		<b>Shopwork:</b>				
21.3.1		Surface preparation (acid bath) and cleaning	t	2,7		0,00
21.3.2		Hot dip Galvanzied coating	t	2,7		0,00
<b>TOTAL FOR SECTION 21 CARRIED TO SUMMARY</b>					<b>R</b>	<b>40 000,00</b>

ITEM NO	DESCRIPTION	UNIT	QTY	RATE	AMOUNT R
22	<b>SECTION 22: ELECTRICAL EQUIPMENT: LINBRO PUMP STATION</b>				
22.1	<b>LV MCC EQUIPMENT</b>				
	<b><u>LV Motor Control Centre (MCC)</u></b>				
	LV MCC in accordance with applicable Clauses of the Particular Specification.				
	<b>Procurement/Manufacture/Testing of Pump station MCC and delivery to Site and off loading</b>				
22.1.1	MCC- LINBRO Pump Station	Item	1,00		R0,00
	<b>Installation, testing and commissioning of Pump station MCC</b>				
22.1.2	MCC- LINBRO Pump Station	Item	1,00		R0,00
	<b><u>Generator</u></b>				
	Generator in accordance with applicable of the Particular Specification				
	<b>Procurement/Manufacture/Testing of Generator and delivery to Site and off loading</b>				
22.1.3	500kVA Prime Power Generator - Linbro PS	Item	1,00		R0,00
22.1.4	Site acceptance testing and commissioning the 500kVA, 400V, 3-phase diesel generator set as specified complete with the fuel tank system	Item	1,00		R0,00
	<b>Installation, testing and commissioning of Generator</b>				
22.1.5	500kVA Prime Power Generator - Linbro PS	Item	1,00		R0,00
22.1.6	Site acceptance testing as specified and all paper work	Item	1,00		R0,00
22.1.7	Diesel Fuel For All Tests and First Tank Fill including delivery to site	L	1 200,00		R0,00
	<b><u>Generator Room - Small Power and Lighting</u></b>				
	Generator room Small power and lighting Distribution				
	<b>Supply, delivery and offloading</b>				
22.1.8	Small Power Lighting Distribution	Item	1,00		R0,00
	<b>Site Installation</b>				
22.1.9	Small Power Lighting Distribution	Item	1,00		R0,00
	<b><u>Area Lighting Kiosks</u></b>				
	<b>Supply, delivery, offloading and storage</b>				
22.1.10	Area lighting Kiosks	Item	2,00		R0,00
22.1.11	Concrete Plinth for Kiosks	Item	2,00		R0,00
	<b>Site Installation and Testing</b>				
22.1.12	Area lighting Kiosks	Item	2,00		R0,00
22.1.13	Concrete Plinth for Kiosks	Item	2,00		R0,00
22.1.14	Site Acceptance testing and commissioning	Item	2		R0,00
Total Carried Forward					R0,00

ITEM NO	DESCRIPTION	UNIT	QTY	RATE	AMOUNT R
Brought Forward					R0,00
	<b><u>LV Cables</u></b>				
	PVCPVCSWAPVC 600/1000V copper conductor cables in accordance with applicable clause of the Particular Specification.				
	<b>Supply, delivery, offloading and storage</b>				
22.1.15	4c x 185mm <sup>2</sup>	m	200,00		R0,00
22.1.16	4c x 150mm <sup>2</sup>	m	150,00		R0,00
22.1.17	4c x 70mm <sup>2</sup>	m	100,00		R0,00
22.1.18	4c x 2.5mm <sup>2</sup>	m	40,00		R0,00
	<b>Site installation and testing</b>				
22.1.19	4c x 185mm <sup>2</sup>	m	200,00		R0,00
22.1.20	4c x 150mm <sup>2</sup>	m	150,00		R0,00
22.1.21	4c x 70mm <sup>2</sup>	m	100,00		R0,00
22.1.22	4c x 2.5mm <sup>2</sup>	m	40,00		R0,00
	<b><u>LV Cables Terminations</u></b>				
	LV Cable terminations in accordance with applicable clause 12 of the Particular Specification				
	<b>Supply, delivery, offloading and storage</b>				
22.1.23	4c x 185mm <sup>2</sup>	No	6		R0,00
22.1.24	4c x 150mm <sup>2</sup>	No	6		R0,00
22.1.25	4c x 70mm <sup>2</sup>	No	6		R0,00
22.1.26	4c x 2.5mm <sup>2</sup>	No	2		R0,00
	<b>Site installation and testing</b>				
22.1.27	4c x 185mm <sup>2</sup>	No	6		R0,00
22.1.28	4c x 150mm <sup>2</sup>	No	6		R0,00
22.1.29	4c x 70mm <sup>2</sup>	No	6		R0,00
22.1.30	4c x 2.5mm <sup>2</sup>	No	2		R0,00
	<b><u>Earthing Conductors</u></b>				
	Earthing conductors in accordance with Clause 14 of the Particular Specification.				
	<b>Supply, delivery, offloading and storage</b>				
22.1.31	95m <sup>2</sup> BCEW	m	200,00		R0,00
22.1.32	70mm <sup>2</sup> BCEW	m	150,00		R0,00
22.1.33	2m long 16 mm diam. earthing rods	No	4,00		R0,00
Total Carried Forward					R0,00

ITEM NO	DESCRIPTION	UNIT	QTY	RATE	AMOUNT R
Brought Forward					R0,00
	<b>Site installation and testing</b>				
22.1.34	95m² BCEW	m	200,00		R0,00
22.1.35	70mm² BCEW	m	150,00		R0,00
22.1.36	2m long 16 mm diam. earthing rods	No	4,00		R0,00
	<b><u>Earthing Cables Terminations</u></b>				
	<b>Supply, delivery, offloading and storage</b>				
22.1.37	95m² BCEW	No	6,00		R0,00
22.1.38	70mm² BCEW	No	6,00		R0,00
	<b>Site installation and testing</b>				
22.1.39	95m² BCEW	No	6,00		R0,00
22.1.40	70mm² BCEW	No	6,00		R0,00
22.1.41	Supply and Install Main LV earth bar	Item	1		R0,00
22.1.42	Bonding of all electrical equipment in accordance with applicable Clause of the Particular Specification in	Item	1,00		R0,00
22.1.43	Earth electrode resistance measurement	Item	1,00		R0,00
22.1.44	Bonding and earthing conductors continuity tests, report and C.O.C for entire site	Item	1,00		R0,00
22.1.45	Earthing and Lightning protection System	Prov Sum	1	R50 000,00	R50 000,00
	<b><u>Cable Trench Excavations</u></b>				
	Excavation and backfilling of cable trenches in accordance with Clause of Standard Specification XXX				
	Trench 600mm wide by 600mm deep.				
22.1.46	Excavation in soft material	m	150,00		R0,00
22.1.47	Hard rock excavations	m	70,00		R0,00
22.1.48	Boulder excavations, Class A	m	40,00		R0,00
22.1.49	Boulder excavations, Class B	m	40,00		R0,00
22.1.50	Backfilling and Compacting	m³	60,00		R0,00
	Supply and Installation of danger tape 300mm above cables as specified				
22.1.51	Cable marking tape - Supply	m	150,00		R0,00
22.1.52	Cable marking tape - Install	m	150,00		R0,00
	<b>SAFEGUARDING OF EXCAVATIONS</b>				
22.1.53	Provide adequate barricading at all times to safeguard all open excavations.	Item	1,00		R0,00
Total Carried Forward					R50 000,00

ITEM NO	DESCRIPTION	UNIT	QTY	RATE	AMOUNT R
Brought Forward					R50 000,00
	<b>Cable Ladder Support</b>				
	Cable ladders and cable trays in accordance with applicable Clause of the Particular Specification, including all , splice sets, reducers, elbows, threaded rods, screws, washers,unistrut, clamps and rawl-bolts.				
	<b>Supply, delivery, offloading and storage</b>				
22.1.54	1000mm wide (cable ladder straight lengths)	m	30,00		R0,00
22.1.55	300mm wide (cable ladder straight lengths)	m	150,00		R0,00
	<b>Site installation and testing</b>				
22.1.56	1000mm wide (cable ladder strait lengths)	m	30,00		R0,00
22.1.57	300mm wide (cable ladder strait lengths)	m	150,00		R0,00
	<b>Supply, delivery, offloading and storage</b>				
22.1.58	1000mm wide (cable ladder horizontal bends)	No.	2,00		R0,00
22.1.59	300mm wide (cable ladder horizontal bends)	No.	6,00		R0,00
	<b>Site installation and testing</b>				
22.1.60	1000mm wide (cable ladder horizontal bends)	No.	2,00		R0,00
22.1.61	300mm wide (cable ladder horizontal bends)	No.	6,00		R0,00
	<b>Supply, delivery, offloading and storage</b>				
22.1.62	1000mm wide (cable ladder vertical bends)	No.	2,00		R0,00
22.1.63	300mm wide (cable ladder vertical bends)	No.	6,00		R0,00
	<b>Site installation and testing</b>				
22.1.64	1000mm wide (cable ladder vertical bends)	No.	2,00		R0,00
22.1.65	300mm wide (cable ladder vertical bends)	No.	6,00		R0,00
	<b>Supply, delivery, offloading and storage</b>				
22.1.66	OL - 1000 Galvanized unistrut for cable support	m	150,00		R0,00
22.1.67	25mm dia galvanized conduit for cable support complete with brass bushes on the ends	m	60,00		R0,00
22.1.68	32mm dia galvanized conduit for cable support complete with brass bushes on the end	m	20,00		R0,00
	<b>Site installation and testing</b>				
22.1.69	OL - 1000 Galvanized unistrut for cable support	m	150,00		R0,00
22.1.70	25mm dia galvanized conduit for cable support complete with brass bushes on the ends	m	60,00		R0,00
22.1.71	32mm dia galvanized conduit for cable support complete with brass bushes on the end	m	20,00		R0,00
Total Carried Forward					R50 000,00

ITEM NO	DESCRIPTION	UNIT	QTY	RATE	AMOUNT R
Brought Forward					R50 000,00
	<b><u>Field Control Stations</u></b>				
22.1.72	Supply Field E-Stop Station	No	3,00		R0,00
22.1.73	Install Field E-Stop Station	No	3,00		R0,00
	<b><u>Field Control Station Cables</u></b>				
22.1.74	Supply 7C 1.5mm²	m	200,00		R0,00
22.1.75	Install 7C 1.5mm²	m	200,00		R0,00
22.1.76	Supply Termination 7C 1.5mm²	No	6,00		R0,00
22.1.77	Install Termination 7C 1.5mm²	No	6,00		R0,00
	<b><u>Accessories</u></b>				
	Three way Y type Pratley/CCG weather proof boxes complete with connector blocks				
	<b><u>Supply, delivery, offloading and storage</u></b>				
22.1.78	Ezee-Fit Size 1	No	12,00		R0,00
	<b><u>Site installation and testing</u></b>				
22.1.79	Ezee-Fit Size 1	No	12,00		R0,00
	<b><u>Area Lighting</u></b>				
	LED Floodlights and Aircraft Warning Light complete as per and in accordance with applicable Clause of the Particular Specification.				
	<b><u>Supply, delivery, offloading and storage</u></b>				
22.1.80	4 x 279W Flood light luminaire complete with suitable mounting bracket for attachment to high mast pole	No.	4,00		R0,00
22.1.81	2 x 279W Flood light luminaire complete with suitable mounting bracket for attachment to high mast pole	No	4,00		R0,00
22.1.82	1 x 279W Flood light luminaire complete with suitable mounting bracket for attachment to high mast pole	No	2,00		R0,00
22.1.83	10 meter heavy duty glass reinforced polyester (GRP) poles complete with pole dressing, clips and fixings as required	No	10,00		R0,00
	<b><u>Install</u></b>				
22.1.84	4 x 279W Flood light luminaire complete with suitable mounting bracket for attachment to high mast pole	No.	4,00		R0,00
22.1.85	2 x 279W Flood light luminaire complete with suitable mounting bracket for attachment to high mast pole	No	4,00		R0,00
22.1.86	1 x 279W Flood light luminaire complete with suitable mounting bracket for attachment to high mast pole	No	2,00		R0,00
22.1.87	10 meter heavy duty glass reinforced polyester (GRP) poles complete with pole dressing, clips and fixings as	No	10,00		R0,00
Total Carried Forward					R50 000,00

ITEM NO	DESCRIPTION	UNIT	QTY	RATE	AMOUNT R
Brought Forward					R50 000,00
22.2	<b>SMALL POWER AND LIGHTING</b> The schedule is for the supply (including delivery to site, quality assurance and temporary storage), factory testing, taking delivery, handling, erection, installation, testing, final painting and quality assurance of the following plant and equipment: <b>Distribution Boards</b> Supply				
22.2.1	DB Generator Room	Item	1,00		R0,00
22.2.2	DB Pump house	Item	1,00		R0,00
	Install				
22.2.3	DB Generator Room	Item	1,00		R0,00
22.2.4	DB Pump house	Item	1,00		R0,00
	Miscellaneous				
22.2.5	FAT costs including accomodation and travel	Sum	1,00		R0,00
22.2.6	SAT costs and commssioing	Sum	1,00		R0,00
	PVC insulated stranded copper conductors (L,N,E) installed in couduits, Prices must include for all terminations				
	Supply				
22.2.7	2.5mm²	m	250,00		R0,00
22.2.8	4mm²	m	100,00		R0,00
	Install				
22.2.9	2.5mm²	m	250,00		R0,00
22.2.10	4mm²	m	100,00		R0,00
	<b>Conduit for Electrical Installation</b> Complete as specified including draw boxes, fittings, couplings, adaptors, locknuts, bushes, saddles and accessories. Installed surface against walls, chased into brickwork, casted in concrete and fixed to roof structures.				
	Supply				
22.2.11	PVC 20mm Ø	m	300,00		R0,00
22.2.12	Conduits boxes and accessories	Sum	1,00		R0,00
	Install				
22.2.13	PVC 20mm Ø	m	300,00		R0,00
22.2.14	Conduits boxes and accessories	sum	1,00		R0,00
	<b>Light Switches</b> Supply				
22.2.15	16A 1-lever 1-way switch (IP65)-Metal clad complete with Photo-cells	No	4,00		R0,00
22.2.16		No	2,00		R0,00
	Install				
22.2.17	16A 1-lever 1-way switch (IP65)-Metal clad complete with Photo-cells	No	4,00		R0,00
22.2.18		No	2,00		R0,00
	<b>Socket Outlets</b> Supply				
22.2.19	16A double socket outlet, 3-pin, flushed complete with box	No	5,00		R0,00
22.2.20	32A 3ph welding socket outlet (IP65), surface mounted complete with box	No	1,00		R0,00
Total Carried Forward					R50 000,00

ITEM NO	DESCRIPTION	UNIT	QTY	RATE	AMOUNT R
Brought Forward					R50 000,00
	<b>Install</b>				
22.2.21	16A double socket outlet, 3-pin, flushed complete with box	No	5,00		R0,00
22.2.22	32A 3ph welding socket outlet (IP65), surface mounted complete with box	No	1,00		R0,00
	<b>Luminaires</b>				
	<b>Supply</b>				
22.2.23	Type L1 Beka Vapourline: IK08 IP65 46W with SS clips & Brackets	No	9,00		R0,00
22.2.24	Type L1E Beka Vapourline: IK08 IP65 46W with SS clips & Brackets	No	7,00		R0,00
22.2.25	Type L2 Beka LEDNOVA: IK07 IP66 70W suitable for wall mounting	No	10,00		R0,00
22.2.26	<b>Install</b>				
22.2.27	Type L1: Beka Vapourline: IK08 IP65 46W with SS clips & Brackets	No	9,00		R0,00
22.2.28	Type L1E: Beka Vapourline: IK08 IP65 46W with SS clips & Brackets	No	7,00		R0,00
22.2.29	Type L2: Beka LEDNOVA: IK07 IP66 70W with suitable for wall mounting	No	10,00		R0,00
	<b>Temporary Works</b>				
22.2.30	Temporary Works	Sum	1,00		R0,00
	<b>Miscellaneous.</b>				
	Supply and installation:				
22.2.31	Danger Signs and Notices	No	2,00		R0,00
22.2.32	Fire Extinguishers and First Aid Kits	No	1,00		R0,00
22.2.33	Supply all tools and accessories as specified	Item	1,00		R0,00
22.2.34	21 Strand Electric Fence including Energizer (250m)	m	250,00		R0,00
	<b>Testing and Commissioning</b>				
22.2.35	Testing and commissioning of the complete electrical installation including all relevant Test Certificates and Certificates of Compliance for electrical installations for each and every distribution board and all equipment	Sum	1,00		R0,00
22.2.36	Operating instruction and/or literature of all major items of equipment supplied and installed, bound into a manual.	Sum	1,00		R0,00
22.2.37	Drawings and Other Project Documentation	Sum	1,00		R0,00
22.2.38	On-site instruction and training of client's staff	Sum	1,00		R0,00
22.2.39	Travel and accommodation for Engineer and a representative of the Employer to attend factory tests outside Gauteng for items if applicable	Item	3,00		R0,00
22.2.40	All other items not included above but which are nevertheless necessary to meet the Scope of Work and/or are required for the proper, safe and effective operation of the plant (Specify):	Sum	1,00		R0,00
Total Carried Forward To Summary					R50 000,00

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY		AMOUNT R
23		<b>SECTION 23: ELECTRONIC EQUIPMENT: TELEMETRY, CONTROL AND INSTRUMENTATION</b>				
23.1		<b>Programmable Logic Controllers</b>  Design, supply, programming, configuration and delivery to site of PLC hardware, software and all associated panel and components to equip the PLC compartments/tiers as detailed in the Particular Specification				
23.1.1		- PLC Linbro Pump Station  <b>Installation, testing and commissioning of</b>	Item	1,00		R0,00
23.1.2		- PLC- Linbro Pump station  <b>Human Machine Interface</b>  Design, supply, programming, configuration and delivery to site of HMI hardware, software and all associated panel and components to equip the PLC compartments/tiers as detailed in the Particular Specification	Item	1,00		R0,00
23.1.3		- HMI- Linbro PS  <b>Installation, testing and commissioning of</b>	Item	1,00		R0,00
23.1.4		- HMI- Linbro PS  <b>Field Instrumentation</b>  Design, supply, installation, connection (incl. all mounting brackets, enclosures and posts where necessary) of field instrumentation as described in the Particular Specification	Item	1,00		R0,00
23.1.5		- Linbro PS Level Transmitter -Ultrasonic	Item	4,00		R0,00
23.1.6		- Linbro PS Flow Meter -Electromagnetic DN	Item	3,00		R0,00
23.1.7		- Linbro PS Flow Meter -Electromagnetic DN	Item	1,00		R0,00
23.1.8		- Linbro PS Flow Meter -Ultrasonic DN 700	Item	1,00		R0,00
23.1.8		- Linbro PS Pressure Transmitter	Item	8,00		R0,00
23.1.9		- Linbro PS Proximity Switch  <b>Installation, testing and commissioning of</b>	Item	12,00		R0,00
23.1.10		- Limbro PS Level Transmitter -Ultrasonic	Item	4,00		R0,00
23.1.11		- Linbro PS Flow Meter -Electromagnetic DN	Item	3,00		R0,00
23.1.12		- Linbro PS Flow Meter -Electromagnetic DN	Item	1,00		R0,00
23.1.13		- Linbro PS Flow Meter -Ultrasonic DN 700	Item	1,00		R0,00
23.1.14		- Linbro PS Pressure Transmitter	Item	8,00		R0,00
23.1.15		- Linbro PS Proximity Switch  <b>Control And Instrumentation Cabling</b>  Supply, and deliver to site of C&I cabling as described in the Particular Specification	Item	12,00		R0,00
23.1.16		Trenching and excavation	Prov Sum	1,00	25000,00	R25 000,00
Total Carried Forward						R25 000,00

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY		AMOUNT R
Brought Forward						R25 000,00
23.1.17		Excavation of Hard material (estimated 15%)	m³	15,00		R0,00
23.1.18		Excavation of intermediate material (estimated	m³	35,00		R0,00
23.1.19		Excavation of soft material (50% estimated )	m³	50,00		R0,00
23.1.20		Back filling and compacting	m³	105,00		R0,00
23.1.21		<b>Control Cabling</b> - 4 Core Cable	m	200,00		R0,00
23.1.22		- 2 IOS pair cable	m	200,00		R0,00
23.1.23		- 4 IOS pair Cable	m	200,00		R0,00
23.1.24		- 16 IOS pair Cable	m	200,00		R0,00
		<b>Networking Asseccsories</b>				
23.1.25		CAT 6 Cable and accessories	m	100,00		R0,00
23.1.26		Managed Network Switch	Item	1		R0,00
		<b>Installation, termination, testing and commissioning of Control and instrumentation cabling</b>				
23.1.27		- Trenching and excavation	Prov	1,00		R0,00
23.1.28		Excavation of Hard material (estimated 15%)	m³	15,00		R0,00
23.1.29		Excavation of intermediate material (estimated 35%)	m³	35,00		R0,00
23.1.30		Excavation of soft material (50% estimated )	m³	50,00		R0,00
23.1.31		Back filling and compacting	m³	105,00		R0,00
		<b>Control Cablig</b>				
23.1.32		- 4 Core Cable	m	200,00		R0,00
23.1.33		- 2 IOS pair cable	m	200,00		R0,00
23.1.34		- 4 IOS pair Cable	m	200,00		R0,00
23.1.35		- 16 IOS pair Cable	m	200,00		R0,00
		<b>Networking Accessories</b>				
23.1.36		CAT 6 Cable and accessories	m	100,00		R0,00
23.1.37		Managed Network Switch	each	1,00		R0,00
		<b>Terminations</b>				
23.1.38		- CAT 6 Cabling	each	10,00		R0,00
23.1.39		- 4 Core Cable	each	20,00		R0,00
23.1.40		- 2 IOS pair cable	each	20,00		R0,00
23.1.41		- 4 IOS pair Cable	each	30,00		R0,00
23.1.42		- 16 IOS pair Cable	each	20,00		R0,00
Total Carried Forward						R25 000,00

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY		AMOUNT R
Brought Forward						R25 000,00
		<b>Field Instrumentation Enclosures</b>				
		Design, supply, of field instrumentation				
23.1.43		- Linbro PS Level Transmitter -Ultrasonic -	Item	4,00		R0,00
23.1.44		- Linbro Flow Meter -Electromagnetic -	Item	7,00		R0,00
23.1.45		- Linbro instrument Junction boxes	Item	7,00		R0,00
		<b>Erection, reinforcing, termination and</b>				
23.1.46		- Linbro PS Level Transmitter -Ultrasonic -	Item	4,00		R0,00
23.1.47		- Linbro Flow Meter -Electromagnetic -	Item	7,00		R0,00
23.1.48		- Linbro instrumnet Junction boxes	Item	7,00		R0,00
		<b>UPS Equipment</b>				
		Design, supply and installation of UPS hardware and all associated panel and components to equip the PLC compartments/tiers as detailed in the				
23.1.49		- UPS- Linbro Pump station	Item	1,00		R0,00
		<b>Installation, testing and commissioning of UPS System</b>				
23.1.50		- UPS- Linbro Pump station	Item	1,00		R0,00
		<b>Specialist Services</b>				
23.1.51		New Telemetry System	PC Sum	1,00	600000,00	R600 000,00
23.1.52		- Contractors Mark up	%			
23.1.53		Update of SCADA mimics at Head Office	PC Sum	1,00	100000,00	R100 000,00
23.1.54		- Contractors Mark up	%			
23.1.55		Earthing and Lighting Protection Specialist	PC Sum	1,00	300000,00	R300 000,00
23.1.56		- Contractors Mark up	%			
		<b>Temporary Works Labour</b>				
23.1.57		Temporary Works Labour	PC Sum	1,00	150000,00	R150 000,00
23.1.58		- Contractors Mark up	%			
		<b>Inspection and Tests</b>				
		Carrying out inspections and test and issuing				
23.1.59		- Thin slice testing of PLC control objects	Item	1,00		R0,00
23.1.60		- Thin Slice testing of HMI mimic objects	Item	1,00		R0,00
Total Carried Forward						R 1 175 000,00

ITEM NO	DESCRIPTION	UNIT	QTY	AMOUNT R
Brought Forward				R 1 175 000,00
23.1.61	- FAT PLC panel construction	Item	1,00	R0,00
23.1.62	- FAT-PLC software configuration	Item	1,00	R0,00
23.1.63	- FAT HMI construction	Item	1,00	R0,00
23.1.64	- FAT - UPS system	Item	1,00	R0,00
23.1.65	- Practical and Final completion	Item	1,00	R0,00
	<b>Documentation and Drawings</b>			
	Supply of documentation, manuals training,			
23.1.66	- Design Data Pack	Item	1,00	R0,00
23.1.67	- P&ID - Linbro Pumpstation	Item	1,00	R0,00
23.1.68	- HAZOP Study Facilitator fees	hrs	40,00	R0,00
23.1.69	- HAZOP Study Coordination	Item	1,00	R0,00
23.1.70	- Updated pump Control Philosophy	Item	1,00	R0,00
23.1.71	- PLC/Topology drawing	Item	1,00	R0,00
23.1.72	- PLC FDS	Item	1,00	R0,00
23.1.73	- PLC I/O listing	Item	1,00	R0,00
23.1.74	- PLC Panel GA drawings	Item	1,00	R0,00
23.1.75	- PLC Panel schematic drawings	Item	1,00	R0,00
23.1.76	- Filed Instrumentation loop drawings	Item	1,00	R0,00
23.1.77	- Cable schedule	Item	1,00	R0,00
23.1.78	- Instrumentation List	Item	1,00	R0,00
23.1.79	- Quality plan/Manual	Item	1,00	R0,00
23.1.80	- Electronic copy in DXF format on CD	Item	1,00	R0,00
23.1.81	- As Built Drawings	Item	1,00	R0,00
23.1.82	-Operational and Maintenance Manuals	Item	3,00	R0,00
	<b>Training</b>			
	Provide requisite training as described in the			
23.1.83	- Maintenance Training	Item	1,00	R0,00
23.1.84	- Operator Training	Item	1,00	R0,00
23.1.85	All other items not included above but which are nevertheless necessary to meet the Scope of Work and/or are required for the proper, safe and effective operation of the plant			
Total Carried Forward				R 1 175 000,00

PAYMENT REFERS TO	ITEM NO	DESCRIPTION	UNIT	QUAN TITY	RATE	AMOUNT
24	1.00	<b><u>SECTION 24: LINBRO PARK PUMP STATION MECHANICAL</u></b>				
24.1	1.01	<b>Supply and installation of new Water Pumps, including commissioning</b>				
24.1.1	.01	Horizontal split casing centrifugal pump with a delivery of 280l/s, a total head of 45 m coupled to 160 kW electric motor. Assembly should be complete with base plate, coupling and ancillaries	No.	3		0,00
	.02	<b>Gauges and Sensors Personnel</b>				
24.1.2		Supply and install gauges for suction and delivery including horizontal vibration sensors.	Sum	1		0,00
	.03	<b>Training of Maintenance and Operations Personnel</b>				
24.1.3		Conduct training	Sum	1		0,00
	.04	<b>Operation and Maintenance Manuals</b>				
24.1.4		Prepare and supply three sets of detailed Operation and Maintenance Manuals including as-built drawings. An electronic version of the drawings shall also be supplied on compact disc in AutoCAD format. The manuals and compact disc shall be handed over to the Engineer.	Sum	1		0,00
	<b>TOTAL SECTION 24 - CARRIED TO SUMMARY</b>					<b>R -</b>

ITEM NO	PAYMENT REFERS	SHORT DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
25		<b>SECTION 25 :PAVING</b>				
25.1		CONSTRUCT PRECAST CONCRETE SEGMENTED PAVING				
25.1.1	PSMJ 8.2.2	<b>Provide and construct segmented paving lain in Herringbone pattern 60 mm thick, 25 Mpa Type S-A concrete paving blocks. Price must include bedding, sand layer, compaction and finishing (Colour to suit Client)</b>	m <sup>2</sup>	650		0,00
25.1.2	8.2.4	Roll to Locked-up Condition as Specified in clause 5.6.2 (provisional)	m <sup>2</sup>	650		0,00
	1200MJ 8.2.2	SURFACE DRAINS				
25.1.3		Construct surface concrete V-drains as per Drawing No. ?????	m	60		
	1200GA	CONCRETE PAVING				
25.1.4	8.4.1	Concrete apron, 100mm thick apron slab, class 20/19 concrete with wood float finish	m <sup>3</sup>	20		
TOTAL FOR SECTION 25 CARRIED FORWARD TO SUMMARY						R 0,00

ITEM NO	PAYMENT REFERS	SHORT DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
26		<b>SECTION 26: KERBING AND CHANNELLING</b>				
26.1	8.2.1	<b>CONCRETE KERBING</b>				
26.1.1		Figure 8b precast kerbs Radius over 20m	m	40		0,00
26.1.2		Radius less than 20m	m	25		0,00
26.1.3		Figure 7 precast kerbs	m	250		0,00
		<b>TRANSITIONS</b>				
26.1.4		From mountable kerb to vertical kerb	No	4		0,00
		<b>TRIMMING</b>				
26.1.5		Trimming of excavations for mountable kerbs :				
26.1.5.1		(a) Soft	m <sup>2</sup>	80		0,00
26.1.5.2		(b) Intermediate	m <sup>2</sup>	20		0,00
<b>TOTAL FOR SECTION 26 CARRIED FORWARD TO SUMMARY</b>						<b>R 0,00</b>

ITEM NO	PAYMENT REFERS	SHORT DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT
27		<b>SECTION 27: MISCELLANEOUS WORK FOR PUMP STATION AND VALVE CHAMBERS</b>				
27.1		<b>MASONRY</b>				
27.1.1	BD.03.01	230mm Facebrick wall	m <sup>2</sup>	600		0,00
27.1.2	BD.03.01	330 mm Facebrick wall	m <sup>2</sup>	0		Rate Only
27.1.3	BD.03.01	115 mm Facebrick wall	m <sup>2</sup>	200		0,00
27.2		<b>Brickwork reinforcement</b>				
27.2.1		a) Brick reinforcement 75mm wide built into brick walls with sufficient laps at end joints, angles and intersections (measured net)	m	200		0,00
27.2.2		b) Brick reinforcement 150mm wide built into brick walls with sufficient laps at end joints, angles and intersections (measured net)	m	450		0,00
27.3		<b>Brickwork sundries</b>				
27.3.1		a) Supply and install 6mm thick double glaze clear glass panel over half brickwall to ceiling (Isolate DB in Pumphouse)	m <sup>2</sup>	25		0,00
27.4	SANS 1200G	JOINTS IN WALLS, FLOORS AND ROOF				
27.4.1		Isolating joints on floor and apron	m	75		0,00
27.4.2		Isolating joints on walls	m	44		0,00
27.4.3		Maltoid on walls	m	60		0,00
27.4.4		Saw cut joints on floor and apron	m	30		0,00
27.5		<b>CONCRETE LINING /WATERPROOFING</b>				
27.5.1		Waterproofing of trench and sump walls	m <sup>2</sup>	180		0,00
27.5.2		Roof slab waterproofing( Laid to fall)	m <sup>2</sup>	400,00		0,00
27.5.3		Damp-proofing of walls and floor	m <sup>2</sup>	400,00		0,00
27.5.4		One unpunctured layer 250 micron waterproof sheets sealed at overlaps				
27.5.5		Under surface beds	m <sup>2</sup>	400,00		0,00
27.5.6		Epoxy to floors	m <sup>2</sup>	250,00		0,00
27.6	SANS 1200L	MANHOLES FOR VALVER CHAMBERS				
		Supply and Install 700mmø Heavy Duty Concrete Manhole covers including the manhole frame for all Valve Chambers	No	15,00		0,00
<b>TOTAL FOR SECTION 27 CARRIED TO SUMMARY</b>					<b>R</b>	<b>0,00</b>

<b>SUMMARY OF SCHEDULE OF QUANTITIES</b>			
<b>SECTION</b>	<b>DESCRIPTION</b>	<b>TOTAL</b>	
SECTION 1:	PRELIMINARY AND GENERAL	R	0,00
SECTION 2:	DAYWORKS	R	0,00
SECTION 3:	SITE CLEARANCE (PIPELINE)	R	0,00
SECTION 4:	SITE CLEARANCE (ELEVATED TOWER ONLY)	R	0,00
SECTION 5:	SITE CLEARANCE (PUMPSTATION AND TOWER SITE)	R	0,00
SECTION 6:	EARTHWORKS (PIPELINE VALVE CHAMBERS)	R	0,00
SECTION 7:	EARTHWORKS (PIPELINE TRENCHES)	R	0,00
SECTION 8:	EARTHWORKS (ELEVATED TOWER)	R	0,00
SECTION 9:	EARTHWORKS (PUMPSTATION)	R	0,00
SECTION 10:	EARTHWORKS (PUMPSTATION PIPELINE TRENCHES)	R	0,00
SECTION 11:	CONCRETE (PIPELINE VALVE CHAMBERS)	R	0,00
SECTION 12:	CONCRETE (ELEVATED TOWER)	R	0,00
SECTION 13:	CONCRETE (PUMPSTATION)	R	0,00
SECTION 14:	PIPELINES (MAIN)	R	0,00
SECTION 15:	PIPELINES (BEDDING AND FILLING)	R	0,00
SECTION 16:	PIPELINES (PUMPSTATION)	R	0,00
SECTION 17:	PIPELINES (PUMPSTATION BEDDING AND FILLING)	R	0,00
SECTION 18:	PIPELINES (ELEVATED TOWER)	R	0,00
SECTION 19:	PIPE JACKING	R	0,00
SECTION 20:	STRUCTURAL STEEL (ELEVATED TOWER)	R	0,00
SECTION 21:	STRUCTURAL STEEL AND CORROSION PROTECTION (PUMPSTATION R		0,00
SECTION 22:	ELECTRICAL WORKS	R	0,00
SECTION 23:	ELECTRONIC WORKS	R	0,00
SECTION 24:	MECHANICAL WORKS	R	0,00
SECTION 25:	PAVING	R	0,00
SECTION 26:	KERBING AND CHANNELLING	R	0,00
SECTION 27:	MISCELLANEOUS WORK FOR PUMP STATION AND VALVE HOUSE	R	0,00
<b>TOTAL FOR SCHEDULE OF QUANTITIES</b>		R	0,00
<b>ADD 10% CONTINGENCIES</b>		R	0,00
<b>SUB-TOTAL</b>		R	0,00
<b>ADD 15 % VAT</b>		R	0,00
<b>TOTAL FOR TENDER (FORWARD TO THE FORM OF TENDER)</b>		R	0,00