

**WATER AND SANITATION
BUSINESS UNIT
INFRASTRUCTURE PLANNING AND
IMPLEMENTATION DIVISION**



TENDER REFERENCE: WSBU 15 2025/26

**TENDER FOR THE REFURBISHMENT OF
BRONKHORSTSPRUIT WATER TREATMENT PLANT FOR A
PERIOD OF TWENTY-FOUR (24) MONTHS**

VOLUME 1

A Tender for Category **Level 8EP** (Electrical Engineering) /**ME** (Mechanical Engineering) Works - Infrastructure or higher CIDB Registered Contractors

ISSUED BY:	PREPARED BY:
The Divisional Head Supply Chain Management Tshwane House 320 Madiba Street Pretoria 0002 Tel: 012 358 0343	The Group Head Water and Sanitation Business Unit P O Box 1022 Pretoria 0001 Tel: 012 345 4101/ 3832

Registered Name of Tenderer:	
Trading Name of Tenderer:	
Registration No. of Entity:	
Postal Address of Tenderer:	
Contact Person:	CoT Vendor No:
Tel. No:	E-mail Address:
Cell No:	Fax No:
CIDB CRS Number(s):	
Offer:	

CITY OF TSHWANE WATER AND SANITATION BUSINESS UNIT

CONTRACT NO: WSBU 15 2025/26 TENDER FOR THE REFURBISHMENT OF BRONKHORSTSPRUIT WATER TREATMENT PLANT FOR A PERIOD OF TWENTY-FOUR (24) MONTHS FROM COMMENCEMENT DATE.

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Contract No: WSBU 15 2025/26

Tender for the refurbishment of Bronkhorstspuit water treatment plant for a period of twenty-four (24) months from commencement date.

Volume 1: General Clauses, Tender Procedures, Contract Data, Pricing Data, Schedule of Quantities and Scope of Works

Portion 1: Tender

Part T1: Tender Procedures

**CITY OF TSHWANE
WATER AND SANITATION BUSINESS UNIT**

CONTRACT NO: WSBU 15 2025/26

**TENDER FOR THE REFURBISHMENT OF BRONKHORSTSPRUIT WATER
TREATMENT PLANT FOR A PERIOD OF TWENTY-FOUR (24) MONTHS FROM
COMMENCEMENT DATE.**

PORTION 1 : TENDER

PART T1 : TENDERING PROCEDURES

T1 TENDERING PROCEDURES

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T1.1 TENDER NOTICE AND INVITATION TO TENDER

CITY OF TSHWANE WATER AND SANITATION BUSINESS UNIT



CONTRACT NO: WSBU 15 2025/26

TENDER FOR THE APPOINTMENT OF A CONTRACTOR FOR THE REFURBISHMENT OF BRONKHORSTSPRUIT WATER TREATMENT PLANT FOR A PERIOD OF TWENTY-FOUR (24) MONTHS FROM COMMENCEMENT DATE .

Tenders are hereby invited for the above services.

Tenderers should have a Construction Industry Development Board (CIDB) contractor grading designation **Level 8EP (Electrical Engineering Works) /ME (Mechanical Engineering works) or higher.**

Tenders will be evaluated on the basis of awarding points for price and Broad-Based Black Economic Empowerment (B-BBEE) Status Level of Contribution. The 90/10 Preference Point System will be applied to this Tender.

The tender documents will be obtainable for download on www.tshwane.gov.za and www.etender.gov.za from

A COMPULSORY CLARIFICATION MEETING with a representative of the Employer will take place at Admin Building of Bronkhorstspuit Water Treatment Works on 27 February 2026 at 10:00. Coordinates: 25°23'02.32"S 28°16'23.06"E.

The lowest or any tender will not necessarily be accepted, and the Municipality reserves the right to accept a tender as a whole or in part.

Tenders must remain valid for a period of **90 days** after the closing date for the submission of tenders, during which period a tender may not be amended or withdrawn and may be accepted at any time by the Municipality. The City reserves the right to extend the validity period after consultation with the concerned parties.

The closing time for receipt of tenders is 23 March 2026 at 10:00. Tenders will be received on the closing date and time shown, must be enclosed in sealed envelopes bearing the applicable tender heading and reference number, as well as the closing time and due date, and must be addressed to the CHIEF FINANCIAL OFFICER: FINANCIAL SERVICES DEPARTMENT, SUPPLY CHAIN MANAGEMENT, PRETORIA, 0001 and must be submitted in the tender box situated at the (at the entrance to the Tshwane house), 320 Madiba Street, Pretoria central. Tenders will be opened at the latter address at the time indicated.

Only bidders registered on the central supplier database (CSD) and with a CSD number will be considered for this tender, as this is a requirement from the National Treasury.

“Note: Bidders are required to submit electronic copies of the bid either by memory stick/USB flash drive/CD/DVD together with the hard copy of the Bid/Proposals”

TECHNICAL ENQUIRIES:

Employer's Representative:
Telephone:
E mail:

Ms. Elelwani Ragali
012 358 7722
elelwanir@tshwane.gov.za

SUPPLY CHAIN MANAGEMENT: Employer's Representative:
Telephone:
E mail:

Ms Lukkiet Thobejane-Selowe
012 358 6282
lukkiet3@tshwane.gov.za

**Mr Johan Mettler
CITY MANAGER
NOTICE 12 of 2026**

T1.2 TENDER DATA

The conditions of tender are the Standard Conditions of Tender as contained in Annex C of the Construction Industry Development Board (CIDB) Board Notice 423 of 2019 (contained in Government Gazette No. 42622 of 08 August 2019), bound into section T1.3.

The Standard Conditions of Tender makes several references to the Tender Data. The Tender Data also contains project-specific amendments to the Standard Conditions of Tender applicable to this document. 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.

Reference to relevant clauses in Standard Conditions of Tender		Addition or Variation to Standard Condition of Tender
C.1.1	Actions	The Employer is THE CITY OF TSHWANE . The term "bid" in the context of this standard is synonymous with the term "tender".
C.1.2	Tender documents	<u>Volume 1: General Clauses, Tender Procedures, Contract Data, Pricing Data, Schedule of Quantities and Scope of Works,</u> This document in which are bound the Tender Procedures, Returnable Documents, Agreements and Contract Data <u>Volume 2: Construction Specifications and Drawings</u> This document in which are bound the Project Specifications and Drawings
C.1.3	Interpretation	<i>Replace this sub-clause with the following:</i> These Conditions of Tender, the Tender Data, List of Returnable Documents and Returnable Schedules and Bill of Quantities, which are required for tender evaluation purposes, shall form part of the Contract arising from the invitation to tender.
C.1.3.2		
C.1.3	Interpretation	Add the following new clauses: "C1.3.4 The Tender documents have been drafted in English. The contract arising from the invitation of tender shall be interpreted and construed in English." "C1.3.5 The following words will have the same meaning: CITY OF TSHWANE or CITY
C.1.4	The detail of the Employer is:	<i>Delete the first sentence of the clause and replace with the following:</i> Verbal or any other form of communication, from the Employer, its employees, agents or advisors during site visits/clarification meetings or at any other time prior to the award of the Contract, will not be regarded as binding on the Employer, unless communicated by the Employer in writing to SUPPLY CHAIN MANAGEMENT. Representative: Elelwani Radali Telephone: 012 358 7722 E mail: elelwanir@tshwane.gov.za
C.2.1	Eligibility	All the following mandatory requirements must be complied with, or the tender will be regarded as non-responsive and not be considered further:

Reference to relevant clauses in Standard Conditions of Tender		Addition or Variation to Standard Condition of Tender	
		Mandatory Criteria	Supporting Evidence
		Construction Industry Development Board (CIDB) Grading of 8EP / ME or higher.	Valid CIDB grading certificate
		Company Experience - Electrical: Proof of at least 5 projects successfully completed of Construction, refurbishment or upgrade of water purification plant or Wastewater Treatment Works Works exceeding the value of R20 000 000.	1. Appointment Letter 2. Reference Letter – on the Clients Letter head. The reference letter should contain the following: - Description of service rendered related to Electrical works. - Value of work, related Electrical works 3. Completion Certificate
		Company Experience - Mechanical: Proof of at least 5 projects successfully completed of Construction, refurbishment or upgrade of water purification plant or Wastewater Treatment Works. Works exceeding the value of R10 000 000.	1. Appointment Letter 2. Reference Letter – on the Clients Letter head. The reference letter should contain the following: - Description of service rendered related to Mechanical works. - Value of work, related Mechanical works 3. Completion Certificate
		Company Experience - Civil: Proof of at least 5 projects successfully completed of Construction, refurbishment or upgrade of water purification plant or Wastewater Treatment Works. .	1. Appointment Letter 2. Reference Letter – on the Clients Letter head. The reference letter should contain the following: - Description of service rendered related to electrical works. - Value of work, related to Civil works 3. Completion Certificate details for verification purposes.
		Contracts Manager with a NQF Level 7 or Higher in Civil Engineering or Mechanical Engineering or Electrical Engineering	Certified copy of qualification
		Contracts Manager to be registered South African Council for Project and	Certified Copy of SACPCMP Certificate

Reference to relevant clauses in Standard Conditions of Tender	Addition or Variation to Standard Condition of Tender	
		Construction Management Professions (SACPCMP) as a Professional Construction Manager
		Contracts Manager Experience: Minimum of five (5) projects completed related to Water treatment Plant or Wastewater Treatment Works.
		Detailed CV indicating number of projects completed. Letters confirming employment. <i>The City reserves the right to verify/confirm employment and qualification.</i>
		Site Agent with a NQF Level 6 or higher in Civil Engineering or Mechanical Engineering or Electrical Engineering
		Certified copy of qualification.
		Site Agent Experience: Minimum of five (5) projects completed related to Water treatment Plant or Wastewater Treatment Works.
		Detailed CV indicating number of projects completed. Letters confirming employment. <i>The City reserves the right to verify/confirm employment and qualification.</i>
		Foreman with a NQF Level 4 or higher in Civil Engineering or Mechanical Engineering or Electrical Engineering
		Certified copy of qualification.
		Foreman Experience: Minimum of ten (10) projects completed related to Water treatment Plant / Wastewater Treatment Works.
		Detailed CV indicating number of projects completed. Letters confirming employment. <i>The City reserves the right to verify/confirm employment and qualification.</i>
		Mechanical Engineer with a NQF Level 7 qualification or higher
		Certified copy of qualification
		Registration as a Professional Mechanical Engineer or Professional Technologist in Mechanical Engineering
		Mechanical Engineer: Experience: Minimum of eight (8) projects related to designs for the construction or refurbishment or upgrade of water treatment plant or Wastewater Treatment Work
		Detailed CV indicating number of projects completed. Letters confirming employment. <i>The City reserves the right to verify/confirm employment and qualification</i>
		Electrical Engineer with a NQF Level 7 qualification or higher
		Certified copy of qualification

Reference to relevant clauses in Standard Conditions of Tender		Addition or Variation to Standard Condition of Tender	
		Registration as a Professional Electrical Engineer or Professional Engineer Technologist in Electrical Engineering Electrical Engineer: Experience: Minimum of eight (8) projects related to designs for the construction or refurbishment or upgrade of water treatment plant or Wastewater Treatment Work Safety Officer registered with the South African Council for the Project and Construction Management Professions (SACPCMP) as a Construction Health and Safety Officer (CHSO). A minimum Level C bank rating, as well as confirmation of raised capital of not less than R90 000 000 from the bidder's registered banking institution must be provided with the tender.	ECSA registration as Professional Electrical Engineer or Professional Technologist in Electrical Engineering Detailed CV indicating number of projects completed. Letters confirming employment. <i>The City reserves the right to verify/confirm employment and qualification</i> Certified copy of professional registration certificate Bank confirmation letter obtained from registered bank institution
		Only those tenderers who are registered with the CIDB, or are capable of being so prior to the evaluation of submissions, in a contract grading designation equal to or higher than a contractor grading designation determined in accordance with the sum tendered for a 8EP/ME or higher class of construction work, are eligible to submit tenders. Joint ventures are eligible to submit tenders provided that: - every member of a joint venture is registered with the CIDB within 10 days of the closing date of tenderers; - the lead partner has a contractor grading designation in the 7EP/ME or higher class of construction work; and - The combined contractor grading designation calculated in accordance with the Construction Industry Development Regulations is equal to or higher than a contractor designation in accordance with the sum tendered for a 8EP/ME or higher class of construction work or a value determined in accordance with Regulation 25(1B) or 25(7A) of the Construction Industry Development Regulations.	
	Cost of tendering	Add the following to the sub-clause C2.2.1: "Accept that the Employer will not compensate the tenderer for any costs incurred in attending interviews in the office of the Employer or the Employer's Agent (if required)."	

Reference to relevant clauses in Standard Conditions of Tender		Addition or Variation to Standard Condition of Tender
C2.5	Reference Documents	Add the following: Unless specified otherwise in this document, the following standards and conditions of contract will be applicable under this Contract: - The document “Standard Specifications for Municipal Civil Engineering Works”, Third Edition, 2005” issued by the Divisional Head: Roads and Stormwater of the City of Tshwane. This document is obtainable free of charge on the website www.tshwane.gov.za. - The latest print version as current at 30 days before close of tenders of the document “General Conditions of Contract for Construction Works 3rd Edition, 2015” including corrections thereto as current at 30 days before close of tenders, as published by the <i>South African Institution of Civil Engineering</i>. The document may be purchased in hard copy from the <i>South African Institution of Civil Engineering</i> or may be purchased online as an electronic reference document in PDF format by following the relevant links on www.saice.org.za. The corrections may be downloaded from the SAICE website www.saice.org.za.
C.2.7	Clarification meeting	Where applicable, details of the compulsory clarification meeting with a representative of the Employer are stated in the Tender Notice and Invitation to Tender (Section T1.1 of the document). Confirmation of attendance will be recorded on site in the attendance register to be signed by all tenderers and in the Site Inspection Certificate. Tenderers should be represented at the site/clarification meeting by a person who is suitably qualified and experienced to comprehend the implications of the work involved. Tender documents will not be made available at the site visit and/or clarification meeting. Detail relating to the collection of tender documents is indicated in the Tender Notice and Invitation to Tender (Section T1.1 of the document).
C.2.8	Seek clarification	Replace the clause with the following: <i>Request clarification of the tender documents, if necessary, by notifying the employer at least 7 (seven) working days before the closing time stated in the tender data.</i> The document is downloadable on the National Treasury website (www.etenders.gov.za) and City of Tshwane website (www.tshwane.gov.za)
C.2.9	Insurance	Add the following to the clause “Accept that the submission of a Tender shall be construed as an acknowledgement by the Tenderer that he is satisfied with, where applicable, the insurance cover the Employer will effect under the contract.”
C2.10	Pricing the tender offer	Add the following sub-clause C2.10.5: “A digital copy of the Bill of Quantities can be obtained from the Employer’s Agent from the office of the Engineer upon sufficient notice.”
C.2.11	Alterations to documents	Add the following to the clause: “In the event of a mistake having been made, it shall be crossed out in black ink and the corrected entry made above in black ink and shall be accompanied by the full signatures of the authorised signatories next to every correction.”

Reference to relevant clauses in Standard Conditions of Tender	Addition or Variation to Standard Condition of Tender
	<u>No correction fluid may be used.</u> If correction fluid has been used, the tender as a whole will not be considered. The Municipality will reject the bid if corrections are not made in accordance with the above.”
C.2.12	Alternative tender offers
C.2.13	No alternative tender offers will be considered.
C.2.13.3	Submitting a Tender Offer • The tender offer <u>shall be completed in non-erasable black ink</u> • Any entry made by the tenderer in the document which the tenderer desires to change, <u>shall not be erased or painted out.</u> A line shall be drawn through the incorrect entry, and the correct entry shall be written above in <u>non-erasable black ink</u>, and the <u>full signature</u> of the tenderer shall be placed next to the correction. <u>Add the following</u> to the clause: “Submission of copies of the tender document is NOT required. Tenderer will be required to submit the completed ORIGINAL tender documents as listed above in C1.2 PLUS any required supporting documentation.” In addition to the hard copy submission, each tenderer is required to submit a scanned copy of the <u>fully completed and signed</u> tender submission document. This is to be on a memory stick attached to the original tender submission documents, adequately identifiable as belonging to the tenderer, be in PDF format scanned at 400 DPI, and be in full colour.
C.2.13.4	<u>Add the following</u> to the clause: “Only authorised signatories may sign the original and all copies of the tender offer where required in terms of C.2.13.3 In the case of a ONE-PERSON CONCERN submitting a tender, this shall be clearly stated. In case of a COMPANY submitting a tender, include a copy of a <u>resolution by its board of directors</u> authorising a director or other official of the company to sign the documents on behalf of the company. In the case of a CLOSE CORPORATION submitting a tender, include a copy of a <u>resolution by its members</u> authorising a member or other official of the corporation to sign the documents on each member’s behalf. In the case of a PARTNERSHIP submitting a tender, <u>all the partners</u> shall sign the documents, unless one partner or a group of partners has been authorised to sign on behalf of each partner, in which case <u>proof of such authorisation</u> shall be included in the Tender. In the case of a JOINT VENTURE/CONSORTIUM submitting a tender, include <u>a resolution</u> of each company of the Joint Venture together with a resolution by its members authorising a member of the Joint Venture to sign the documents on behalf of the Joint Venture.

Reference to relevant clauses in Standard Conditions of Tender		Addition or Variation to Standard Condition of Tender
		In cases where the Tenderer has not submitted proof of authorisation with the Tender, the Employer reserves the right to, at any time after the closure of the Tender, but before the award of the Tender, request the Tenderer to provide proof of authorisation within 7 (seven) calendar days from date of notification. <u>Accept that failure to submit proof of authorisation to sign the tender shall result in a Tender Offer being regarded as non-responsive.</u>
C.2.13.5		The Employer's address for delivery of tender offers and identification details to be shown on each tender offer package are as follows: Correct Tender Reference no. : WSBU 15 2025/26 TENDER FOR THE REFURBISHMENT OF BRONKHORSTSPRUIT WATER TREATMENT PLANT FOR A PERIOD OF TWENTY-FOUR (24) MONTHS FROM COMMENCEMENT DATE. Correct closing time : 10:00 Correct due date : 23 March 2026 Each tender shall be enclosed in a sealed envelope, bearing the correct identification details and shall be placed in the tender box located at: TSHWANE HOUSE BUILDING 320 Madiba street Pretoria central This address is 24 hours available for delivery of Tender offers. The name and address of the tender shall be entered on the back of the envelope.
C.2.13.6		A two-envelope procedure will not be followed.
		Telephonic, telegraphic, telex, facsimile or e-mailed offers will not be accepted.
C.2.13.10		Add the following new sub-clause C2.13.10: <i>Accept that all conditions, which are printed or written upon any stationary used by the Tenderer for the purpose of or in connection with the submission of a tender offer for this Contract, which is in conflict with the conditions laid down in this document shall be waived, renounced and abandoned.</i>
C.2.14	Information and Data to be completed in all respects	Add the following to the clause: "The Tenderer is required to enter information in the following sections of the document: Section T2.2 : Returnable Schedules Section C1.1 : Form of Offer and Acceptance Section C1.2 : Contract Data (Part 2) Section C2.2 : Bill of Quantities The above sections shall be signed by the Tenderer (and witnesses where required). Individual pages should only be initialled by the successful Tenderer and by the witnesses after acceptance by the Employer of the Tender Offer. The Tenderer shall complete and sign the Form of Offer prior to the submission of a Tender Offer.

Reference to relevant clauses in Standard Conditions of Tender	Addition or Variation to Standard Condition of Tender
	The Schedule of Deviations (if applicable) shall be signed by the successful Tenderer after acceptance by the Employer of the Tender Offer. Accept that the Employer shall in the evaluation of tenders take due account of the Tenderer's past performance in executing for similar works of comparable magnitude, and the degree to which he possesses the necessary technical, financial and other resources to enable him to complete the works successfully within the contract period. Satisfy the Employer and Engineer as to his ability to perform and complete the Works timeously, safely and with satisfactory quality, by furnishing details in Part T2 – Returnable Documents. <u>Accept that failure to provide the information and data required in the Returnable Documents (Part T2) , including the Technical Schedules may result in a Tender Offer being regarded as non-responsive.</u> Accept that the Employer is restricted in accordance with clause 5 (1) of the Construction Regulations, 2014, to only appoint a contractor whom he is satisfied has the necessary competencies and resources to carry out the work safely. Accept that submitting inferior and inadequate information relating to health and safety (as required in clause 2.23) shall be regarded as justifiable and compelling reasons not to accept the Tender Offer of the Tenderer scoring the highest number of tender evaluation points.
C.2.15 C.2.15.1	Closing Time Details of the closing time for submission of tender offers are stated in the Tender Notice and Invitation to tender (Section T.1.1 of the document).
C.2.16 C.2.16.1	Tender Offer validity The Tender Offer validity period is 90 days. <u>Add the following</u> to the Clause "If the tender validity expires on a Saturday, Sunday or public holiday, the Tender Offer shall remain valid and open for acceptance until the closure of business on the following working day."
C.2.16.5	<u>Add the following</u> new clause: Accept that should the Tenderer unilaterally withdraw his tender during the tender validity period, the Employer shall, without prejudice to any other rights he may have, be entitled to accept any less favourable tender for the Works from those received, or to call for fresh tenders, or to otherwise arrange for execution of the Works, and the Tenderer shall pay on demand any additional expense incurred by the Employer on account of the adoption of the said courses, as well as either the difference in cost between the tender withdrawn (as corrected in terms of clause 3.9 of the Conditions of Tender) and any less favourable tender accepted by the Employer or the difference between the tender withdrawn (as corrected) and the cost of execution of the Works by the Employer as well as any other amounts the Employer may have to pay to have the Works completed.
C.2.16.6	<u>Add</u> the following new clause: Accept that should the Tenderer unilaterally withdraw his tender during the tender validity period, the Employer shall, without prejudice to any other rights he may have, be entitled to accept any less favourable tender for the Works from those received, or to call for fresh tenders, or to otherwise arrange for execution of the Works, and the

Reference to relevant clauses in Standard Conditions of Tender		Addition or Variation to Standard Condition of Tender
		Tenderer shall pay on demand any additional expense incurred by the Employer on account of the adoption of the said courses, as well as either the difference in cost between the tender withdrawn (as corrected in terms of clause 3.9 of the Conditions of Tender) and any less favourable tender accepted by the Employer, or the difference between the tender withdrawn (as corrected) and the cost of execution of the Works by the Employer as well as any other amounts the Employer may have to pay to have the Works completed.
C.2.17	Clarification of Tender Offer after Submission	Replace the contents of the clause with the following clause: "Provide clarification of a Tender Offer in response to a request to do so from the Employer during the evaluation of Tender Offers. This may include providing a breakdown of rates or prices and correction of arithmetical errors resulting from the product of the unit rate and the quantity by the adjustment of certain line-item totals. No change in the unit rate or prices or substance of the Tender Offer is sought, offered, or permitted."
C.2.18	Provide other material	Add the following to the clause: "Accept that if requested, the Tenderer shall within 7 days of the date upon which he is requested to do so, submit a full report from his banker as to his financial standing. The Employer may, in its discretion, and subject to the provisions of Section 4(1)(d) of the State Tender Board Act 86 of 1968, condone any failure to comply with the foregoing condition. Accept that the Employer or his agent reserves the right to approach the Tenderer's banker or guarantor(s) as indicated in the tender document, or the bankers of each of the individual members of any joint venture that is constituted for purposes of this Contract, with a view to ascertaining whether the required guarantee will be furnished, and for purposes of ascertaining the financial strength of the Tenderer or of the individual member of such venture."
C.2.18.1		
C.2.19	Inspections, tests and analysis	Add the following at the end of the clause: "...or upon written request."
C.2.20	Submit securities, bonds, policies, etc.	The tenderer is required to submit with his tender proof of his Professional Indemnity Insurance.
C.2.22	Return of other tender documents	Return all retained tender documents prior to the closing time for the submission of Tender Offers.
C.2.23	Certificates	Refer to Part T2 : Returnable Documents for a list of documents that are to be returned with the tender.
<i>Add the following new clause: "C.2.24"</i>	Canvassing and obtaining of additional information by tenderer	"Accept that no Tenderer shall make any attempt either directly or indirectly to canvass any of the Employers officials or the Employer's agent in respect of his tender, after the opening of the tenders but prior to the Employer arriving at a decision thereon." "No Tenderer shall make any attempt to obtain particulars of any relevant information, other than that disclosed at the opening of tenders."

Reference to relevant clauses in Standard Conditions of Tender	Addition or Variation to Standard Condition of Tender
Add the following new clause: "C.2.25"	Prohibitions on awards to persons in service of the state "Accept that the Employer is prohibited to award a tender to a person - who is in the service of the state; or - if that person is not a natural person, of which any director, manager, principal shareholder or stakeholder is a person in the service of the state; or - a person who is an advisor or consultant contracted with the municipality <u>or</u> municipal entity. "In the service of the state" means to be – - a member of – - any municipal council; - any provincial legislature; or - the National Assembly or the National Council of Provinces; - a member of the board of directors of any municipal entity; - an official of any municipality or municipal entity; - an employee of any national or provincial department; - provincial public entity or constitutional institution within the meaning of the Public Finance Management Act, 1999 (Act No.1 of 1999); - a member of the accounting authority of any national or provincial public entity; or - an employee of Parliament or a provincial legislature." In order to give effect to the above, the questionnaire for the declaration of interests in the tender of persons in service of state in part T2 – Returnable Documents must be completed."
Add the following new clause: "C.2.26"	Awards to close family members of persons in the service of the state "Accept that the notes to the Employer's annual financial statements must disclose particulars of any award of more than R2000 to a person who is a spouse, child or parent of a person in the service of the state (defined in clause C2.25), or has been in the service of the state in the previous twelve months, including – - the name of that person; - the capacity in which that person is in the service of the state; and - the amount of the award. 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."
Add the following new clause: "C.2.27"	Vendor registration Add the following new clause The contractor will be required to register as a supplier/ service provider on the City of Tshwane's vendor register before any payment can be done. If the tenderer is already registered as a vendor, it is required to record the vendor number in space provided on the cover page of this Tender document. Vendor registration documents are available from the Procurement Advice Centre or can be downloaded from: https://www.tshwane.gov.za/sites/business/RegistrationofSuppliers/pages/registration-of-suppliers.aspx All parties of a joint venture or consortium submitting a tender shall comply with the requirements of this clause.

Reference to relevant clauses in Standard Conditions of Tender		Addition or Variation to Standard Condition of Tender
Add the following new clause: "C.2.28"	Tax	Add the following new clause National Treasury SCM Instruction no. 7 of 2017/18 clause 4 application during SCM Processes state that: The designated official(s) must verify the tenderer's tax compliance status prior to the finalisation of the award of the tender or price quotation. Where the recommended tenderer is not tax compliant, the tenderer should be notified of their non-compliant status and the tenderer must be requested to submit to the municipality or municipal entity, within 7 working days, written proof from South African Revenue Services of their tax compliance status or proof from SARS that they have made an arrangement to meet their outstanding tax obligations. The proof of tax compliance status submitted by the tenderer to the municipality or municipal entity must be verified via the Central Supplier Database or eFiling Accept that the tenderer will be rejected if such tenderer fails to provide proof of tax compliance status in terms of clause 4.2 of National Treasury SCM Instruction no. 7 of 2017/18
C2.29	B-BBEE Status Level of Contributor	Add the following new clause A valid B-BBEE Verification Certificate from a Verification Agency accredited by the South African Accreditation System (SANAS) or a Registered Auditor approved by the Independent Regulatory Board of Auditors (IRBA) or an Accounting Officer as contemplated in the Close Corporation Act (CCA) must be submitted with this tender document In the case of a Joint Venture/Consortium a valid B-BBEE Status Level of Contributor certificate must be submitted by each individual party to the Joint Venture/Consortium. Failure by the tenderer to comply with this clause will result in the tenderer scoring 0 points for preference.
C.3.1 C.3.1.1	Respond to requests from tenderer	Replace the contents of the clause with the following: Respond to a request for clarification received up to ten (10) working days before the Tender closing time stated in the Tender Data and notify all Tenderers who provided their contact details on the attendance register at the Compulsory Clarification meeting within two (2) working days of the same date.
C.3.4 C.3.4.1	Opening of Tender submissions	The time and location for the tender submissions and details of the tender opening are stated in the Tender Notice and Invitation to Tender (Section T1.1 of the document).
C.3.5	Two-envelope system	A two-envelope procedure will not be followed.
C.3.8 C.3.8.1	Test for responsiveness	Add the following to the sub-clause: Failure on the part of the Tenderer to submit a tender offer as stipulated in clause C2.13 prior to the closing time as stipulated in clause C2.15 shall be just cause for the Employer to consider the tender offer as being non-responsive. Failure on the part of the Tenderer to submit any one of the returnable documents or certificates listed in clause C2.23 within the period stipulated shall be just cause for the Employer to consider the tender offer as being non-responsive.

Reference to relevant clauses in Standard Conditions of Tender		Addition or Variation to Standard Condition of Tender
C3.9	Arithmetical errors, omissions and discrepancies	Replace the contents of the clause with the following: 1. Check responsive tenders for discrepancies between amounts in words and amount in figures. Where there is a discrepancy between the amounts in figures and the amounts in words, the amount in words shall govern. 2. Check responsive tender offers for arithmetical errors, correcting them in the following manner: a) If a bill of quantities (or schedule of quantities or schedule of rates) applies and there is an error in the line item total resulting from the product of the unit rate and the quantity, the unit rate shall govern and the line item total shall be corrected. b) 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 corrected total of the prices shall govern. c) Where there is a discrepancy between the amount indicated in the Tenderer's tender offer and the corrected amount obtained after completing the above steps, the corrected amount shall govern. 3. Notify a tenderer upon written request received after the closing date of tenders of all arithmetical errors made by that particular tenderer.
C.3.11	Evaluation of Tenders	Add the following to the sub-clause: Tenders received will be evaluated in the following stages: • Stage 1: Administrative Compliance • Stage 2: Mandatory Requirements • Stage 3: Technical Evaluation • Stage 4: Preference Point System
C.3.11.1	General	Method 2 will be used to evaluate all responsive tender offers in terms of Clause C.3.11.2 of the Standard Conditions of Tender Add the following new clause: • STAGES OF EVALUATION This bid will be evaluated in into four stages namely: • Stage 1: Administrative compliance • Stage 2: Mandatory requirements • Stage 3: Technical Evaluation • Stage 4: Preference Point System STAGE 1: ADMINISTRATIVE COMPLIANCE All the bids will be evaluated against the administrative responsiveness requirements as set out in the list of returnable documents. A compulsory site meeting and briefing session to be held:

Reference to relevant clauses in Standard Conditions of Tender		Addition or Variation to Standard Condition of Tender		
		Compulsory Returnable Documentation (Submission of these are compulsory)	Submitted (YES or NO)	Checklist (Guide for Bidder and the Bid Evaluation Committee)
		a) To enable The City to verify the bidder's tax compliance status, the bidder must provide; • Tax compliance status PIN. - or • Central Supplier Database (CSD)		Tax status must be compliant before the award.
		b) A copy of their Central Supplier Database (CSD) registration; or indicate their Master Registration Number / CSD Number;		CSD must be valid.
		c) Confirmation that the bidding company's rates and taxes are up to date: Original or copy of Municipal Account Statement of the Bidder (bidding company) not older than 3 months and account must not be in arrears for more than ninety (90) days; or ,signed lease agreement or In case of bidders located in informal settlement, rural areas or areas where they are not required to pay Rates and Taxes a letter from the local councillor confirming they are operating in that area		Was a Municipal Account Statement or landlord letter provided for the bidding company? The name and / or addresses of the bidder's statement correspond with CIPC document, Address on CSD or Company profile? Are all payment(s) up to date (i.e. not in arrears for more than 90 days?
		d) In addition to the above, confirmation that all the bidding company's owners / members / directors / major shareholders rates and taxes are up to date: • Original or copy of Municipal Account Statement of all the South African based owners / members / directors / major shareholders not older than 3 months and the account/s may not be in arrears for more than ninety (90) days; or a signed lease agreement of owners / members / directors / major shareholders or In case of bidders located in informal settlement, rural areas or areas where they are not required to pay Rates and Taxes a letter from the local councillor confirming they are residing in that area		Was a Municipal Account Statement or landlord letter provided for the bidding company? The name and / or addresses of the bidder's statement correspond with CIPC document, Address on CSD or Company profile? Are all payment(s) up to date (i.e. not in arrears for more than 90 days?
		e) Duly Signed and completed MBD forms (MBD 1, 4, 5, 8 and 9) The person signing the bid documentation must be authorized to sign on behalf of the bidder. Where the signatory is not a Director / Member / Owner / Shareholder of the company, an		All documents fully completed (i.e. no blank spaces)? All documents fully signed by (any director / member / trustee as indicated on the CIPC document,

Reference to relevant clauses in Standard Conditions of Tender	Addition or Variation to Standard Condition of Tender			
		official letter of authorization or delegation of authority should be submitted with the bid document. NB: Bidders must ensure that the directors, trustees, managers, principal shareholders, or stakeholders of this company, declare any interest in any other related companies or business, whether or not they are bidding for this contract. <u>See Question 3.14 of MBD 4. Failure to declare interest will result in a disqualification</u>		alternatively a delegation of authority would be required? Documents completed in black ink (i.e. no "Tippex" corrections, no pencil, no other colour ink, or non-submission of the MBD forms, will be considered)?
		f) Audited Financial Statements for the most recent three (3) years or Audited Financial Statements from date of existence for companies less than three years old. NB: The bidder must submit signed audited annual financial statements for the most recent three years, or if established for a shorter period, submit audited annual financial statements from date of establishment. If the bidder is not required by law to prepare signed annual financial statements for auditing purposes, then the bidder must submit proof that the bidder is not required by law to prepare audited financial statements.		Applicable for tenders above R10m in conjunction with MBD 5) Are Audited financial statements provided (Audited financials must be signed by auditor) Or proof that the bidder is not required by law to prepare audited financial statements.
		g) Joint Ventures (JV) – (Only applicable when the bidder tenders as a joint venture) Where the bidder bids as a joint venture (JV), the required or relevant documents as per (a) to (f) above must be provided for all JV parties. In addition to the above the bidder must submit a Joint Venture (JV) agreement signed by the relevant parties. NB: It is a condition of this bid that the successful bidder will continue with the same Joint Venture (JV) for the duration of the contract unless prior approval is obtained from the City.		If applicable. JV agreement provided? JV agreement complete and relevant? Agreement signed by all parties? All required documents as per (i.e. a to f) must be provided for all partners of the JV.
		h) Bidder attended a compulsory briefing session where applicable		A compulsory briefing register must be signed by the bidder. Bidders will be disqualified should they

Reference to relevant clauses in Standard Conditions of Tender		Addition or Variation to Standard Condition of Tender		
				fail to attend compulsory briefing session
		i) Pricing schedule (All items must be quoted for in pricing schedule and if not, all items are quoted the bidder will be disqualified). Unless the tender is awarded per item or per section where the bidder only quoted the items or sections, they are interested in.		Incomplete pricing schedule results in totals being incomparable. Bidder must be disqualified. Bidder will be disqualified should they make corrections on the price schedule without attaching a signature or initialising thereto. Bidder will be disqualified should they use tippex/ correction ink, on the price schedule.
STAGE 2: MANDATORY REQUIREMENTS				
The following mandatory requirements must be submitted with the tender documents and failure to do so will lead to immediate disqualification:				
It is expected that the bidder will deploy experienced key personnel that have in the past tenant installation/fit-out works, and this team should possess the relevant skills adequate for performing the tasks set out in this specification document.				
The following information must be provided:				

Reference to relevant clauses in Standard Conditions of Tender		Addition or Variation to Standard Condition of Tender	
		Company Experience - Mechanical: Proof of at least 5 projects successfully completed of Construction, refurbishment or upgrade of water purification plant or Wastewater Treatment Works. Works exceeding the value of R10 000 000.	4. Appointment Letter 5. Reference Letter – on the Clients Letter head. The reference letter should contain the following: • Description of service rendered related to Mechanical works. • Value of work, related Mechanical works 6. Completion Certificate
		Company Experience - Civil: Proof of at least 5 projects successfully completed of Construction, refurbishment or upgrade of water purification plant or Wastewater Treatment Works. .	4. Appointment Letter 5. Reference Letter – on the Clients Letter head. The reference letter should contain the following: • Description of service rendered related to electrical works. • Value of work, related to Civil works 6. Completion Certificate details for verification purposes.
		Contracts Manager with a NQF Level 7 or Higher in Civil Engineering or Mechanical Engineering or Electrical Engineering	Certified copy of qualification
		Contracts Manager to be registered South African Council for Project and Construction Management Professions (SACPCMP) as a Professional Construction Manager	Copy of SACPCMP Certificate
		Contracts Manager Experience: Minimum of five (5) projects completed related to Water treatment Plant or Wastewater Treatment Works.	Detailed CV indicating number of projects completed. Letters confirming employment. <i>The City reserves the right to verify/confirm employment and qualification.</i>
		Site Agent with a NQF Level 6 or higher in Civil Engineering or Mechanical Engineering or Electrical Engineering	Certified copy of qualification.
		Site Agent Experience: Minimum of five (5) projects completed related to Water treatment Plant or Wastewater Treatment Works.	Detailed CV indicating number of projects completed. Letters confirming employment.

Reference to relevant clauses in Standard Conditions of Tender		Addition or Variation to Standard Condition of Tender	
			<i>The City reserves the right to verify/confirm employment and qualification.</i>
		Foreman with a NQF Level 4 or higher in Civil Engineering or Mechanical Engineering or Electrical Engineering	Certified copy of qualification.
		Foreman Experience: Minimum of ten (10) projects completed related to Water treatment Plant / Wastewater Treatment Works.	Detailed CV indicating number of projects completed. Letters confirming employment. <i>The City reserves the right to verify/confirm employment and qualification.</i>
		Mechanical Engineer with a NQF Level 7 qualification or higher	Certified copy of qualification
		Mechanical Engineer: Registration as a Professional Engineer	ECSA registration as Professional Engineer as a Mechanical Engineer
		Mechanical Engineer: Experience: Minimum of eight (8) projects related to designs for the construction or refurbishment or upgrade of water treatment plant or Wastewater Treatment Work	Detailed CV indicating number of projects completed. Letters confirming employment. <i>The City reserves the right to verify/confirm employment and qualification</i>
		Electrical Engineer with a NQF Level 7 qualification or higher	Certified copy of qualification
		Electrical Engineer: Registration as a Professional Engineer	ECSA registration as Professional Engineer
		Electrical Engineer: Experience: Minimum of eight (8) projects related to designs for the construction or refurbishment or upgrade of water treatment plant or Wastewater Treatment Work	Detailed CV indicating number of projects completed. Letters confirming employment. <i>The City reserves the right to verify/confirm employment and qualification</i>
		Safety Officer registered with the South African Council for the Project and Construction Management Professions (SACPCMP) as a	Copy of professional registration certificate

Reference to relevant clauses in Standard Conditions of Tender		Addition or Variation to Standard Condition of Tender	
		Construction Health and Safety Officer (CHSO).	
		A minimum Level C bank rating, as well as confirmation of raised capital of not less than R90 000 000 from the bidder's registered banking institution must be provided with the tender.	Bank confirmation letter obtained from registered bank institution
STAGE 3: TECHNICAL EVALUATION			
The proper completion of the technical schedules under Part T2.3 is critical to the evaluation of the tender and hence failure to complete the schedule will lead to the rejection of the bid. The forms will be the basis of technical evaluation, equipment offered should meet the minimum requirements			
The following forms will form part of the technical evaluation.			
- T2.3 Technical schedules – mechanical data sheets - T2.4 Technical schedules – electrical data sheets - T2.5 Technical schedules – instrumentation data sheets			
The technical evaluation will be done by Bid Evaluation Committee with the assistance of the Business Unit.			
STAGE 4: PREFERENCE POINT SYSTEM			
The preferential point system used will be the 90/10 points system in terms of the Preferential Procurement Policy Framework Act, 2000 (Act 5 of 2000) Regulations 2022			
90 points for price 10 points for specific goals			
SPECIFIC GOALS			
- Bidders are required to submit supporting documents for their bids to claim the specific goal points. - Non-compliance with specific goals will not lead to disqualification but bidders will not be allocated specific goal points. Bidders will score points out of 90 for price only and zero (0) points out of 10 for specific goals.			

Reference to relevant clauses in Standard Conditions of Tender		Addition or Variation to Standard Condition of Tender		
		The City shall act against any bidder or person when it detects that the specific goals were claimed or obtained on a fraudulent basis		
		Specific goals	90/10 preference point system	Proof of specific goals to be submitted
		BB-BEE score of companies • Level 1 • Level 2 • Level 3 • Level 4 • Level 5 • Level 6 • Level 7 • Level 8 • Non-compliant	• 4 Points • 3.5 Points • 3 Points • 2.5 Points • 2 Points • 1.5 Points • 1 Point • 0.5 Points 0 Points	Valid Certified copy of BBBEE certificate. Sworn Affidavit for B-BBEE qualifying small enterprise or Exempt Micro Enterprises or CIPC BBBEE certificate.
		EME and/ or QSE	1 Point	Valid Sworn affidavit for B-BBEE qualifying small enterprise or Exempt Micro Enterprises or CIPC BBBEE certificate
		At least 51% of Women-owned companies	1 Point	Certified copy of Identity Document/s and proof of ownership (Sworn affidavit for B-BBEE qualifying small enterprise or Exempt Micro Enterprises, CIPC registration or any other proof of ownership)
		At least 51% owned companies by People with disability	1 Point	Medical Certificate with doctor's details (Practice Number, Physical Address, and contact numbers) and proof of ownership (Sworn affidavit for B-BBEE qualifying small enterprise or Exempt Micro Enterprises, CIPC registration or any other proof of ownership)
		At least 51% owned companies by Youth	1 Point	Certified copy of Identity Document/s and proof of ownership (Sworn affidavit for B-BBEE qualifying small enterprise or Exempt Micro Enterprises, CIPC registration or any other proof of ownership)
		Local Economic Participation • City of Tshwane • Gauteng • National	2 Points 1 Point 1 Point	Municipal Account statement/Lease agreement.

Reference to relevant clauses in Standard Conditions of Tender		Addition or Variation to Standard Condition of Tender
C.3.16	Registration of the award	Add the following to the clause: Notice of non-acceptance of the tender will not be sent to individual unsuccessful tenderers. Particulars of the accepted tender can be obtained from the Employer' Agent.
C.3.17	Provide Copies of Contract	One signed copy of the contract shall be provided by the Employer to the successful Tenderer.

T1.3 STANDARD CONDITIONS OF TENDER

CIDB STANDARD CONDITIONS OF TENDER

(August 2019 Edition)

(As contained in Annexure C of the CIDB Standard for Uniformity in Construction Procurement – August 2019)

C.1 General

C.1.1 Actions

C.1.1.1 The employer and each tenderer submitting a tender offer shall comply with these conditions of tender. In their dealings with each other, they shall discharge their duties and obligations as set out in C.2 and C.3, timeously and with integrity, and behave equitably, honestly and transparently, comply with all legal obligations and not engage in anticompetitive practices.

C.1.1.2 The employer and the tenderer and all their agents and employees involved in the tender process shall avoid conflicts of interest and where a conflict of interest is perceived or known, declare any such conflict of interest, indicating the nature of such conflict. Tenderers shall declare any potential conflict of interest in their tender submissions. Employees, agents and advisors of the employer shall declare any conflict of interest to whoever is responsible for overseeing the procurement process at the start of any deliberations relating to the procurement process or as soon as they become aware of such conflict and abstain from any decisions where such conflict exists or recuse themselves from the procurement process, as appropriate.

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

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

C.1.1.3 The employer shall not seek and a tenderer shall not submit a tender without having a firm intention and the capacity to proceed with the contract.

C.1.2 Tender Documents

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

C.1.3 Interpretation

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

C.1.3.2 These conditions of tender, the tender data and tender schedules which are required for tender evaluation purposes, shall form part of any contract arising from the invitation to tender.

C.1.3.3 For the purposes of these conditions of tender, the following definitions apply:

a) **conflict of interest** means any situation in which:

- i) someone in a position of trust has competing professional or personal interests which make it difficult to fulfil his or her duties impartially;
- ii) an individual or tenderer is in a position to exploit a professional or official capacity in some way for their personal or corporate benefit; or
- iii) incompatibility or contradictory interests exist between an employee and the tenderer who employs that employee.

b) **comparative offer** means the price after the factors of a non-firm price and all unconditional discounts it can be utilised to have been taken into consideration;

c) **corrupt practice** means the offering, giving, receiving or soliciting of anything of value to influence the action of the employer or his staff or agents in the tender process;

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

C.1.4 Communication and employer's agent

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

C.1.5 Cancellation and Re-Invitation of Tenders

C.1.5.1 An employer may, prior to the award of the tender, cancel a tender if-

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

C.1.5.2 The decision to cancel a tender invitation must be published in the same manner in which the original tender invitation was advertised

C.1.5.3 An employer may only with the prior approval of the relevant treasury cancel a tender invitation for the second time.

C.1.6 Procurement procedures

C.1.6.1 General

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

C.1.6.2 Competitive negotiation procedure

C.1.6.2.1 Where the tender data require that the competitive negotiation procedure is to be followed, tenderers shall submit tender offers in response to the proposed contract in the first round of submissions. Notwithstanding the requirements of C.3.4, the employer shall announce only the names of the tenderers who make a submission. The requirements of C.8 relating to the material deviations or qualifications which affect the competitive position of tenderers shall not apply.

C.1.6.2.2 All responsive tenderers or at least a minimum of not less than three responsive tenderers that are highest ranked in terms of the evaluation criteria stated in the tender data shall be invited to enter into competitive negotiations based on the principle of equal treatment, keeping confidential the proposed solutions and associated information.

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

C.1.6.2.3 At the conclusion of each round of negotiations, tenderers shall be invited by the employer to revise their tender offer based on the same evaluation criteria, with or without adjusted weightings. Tenderers shall be advised when they are to submit their best and final offer.

C.1.6.2.4 The contract shall be awarded in accordance with the provisions of C.3.11 and C.3.13 after tenderers have been requested to submit their best and final offer.

C.1.6.3 Proposal procedure using the two stage-system

C.1.6.3.1 Option 1

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

C.1.6.3.2 Option 2

C.1.6.3.2.1 Tenderers shall submit in the first stage only technical proposals. The employer shall invite all responsive tenderers to submit tender offers in the second stage, following the issuing of procurement documents.

C.1.6.3.2.2 The employer shall evaluate tenders received during the second stage in terms of the method of evaluation stated in the tender data and award the contract in terms of these conditions of tender.

C.2 Tenderer's obligations

C.2.1 Eligibility

C.2.1.1 Submit a tender offer only if the tenderer satisfies the criteria stated in the tender data and the tenderer, or any of his principals, is not under any restriction to do business with employer.

C.2.1.2 Notify the employer of any proposed material change in the capabilities or formation of the tendering entity (or both) or any other criteria which formed part of the qualifying requirements used by the employer as the basis in a prior process to invite the tenderer to submit a tender offer and obtain the employer's written approval to do so prior to the closing time for tenders.

C.2.2 Cost of tendering

C.2.2.1 Accept that, unless otherwise stated in the tender data, the employer will not compensate the tenderer for any costs incurred in the preparation and submission of a tender offer, including the costs of any testing necessary to demonstrate that aspects of the offer complies with requirements.

C.2.2.2 The cost of the tender documents charged by the employer shall be limited to the actual cost incurred by the employer for printing the documents. Employers must attempt to make available the tender documents on its website so as not to incur any costs pertaining to the printing of the tender documents.

C.2.3 Check documents

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

C.2.4 Confidentiality and copyright of documents

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

C.2.5 Reference documents

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

C.2.6 Acknowledge addenda

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

C.2.7 Clarification meeting

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

C.2.8 Seek clarification

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

C.2.9 Insurance

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

C.2.10 Pricing the tender offer

- C.2.10.1 Include in the rates, prices, and the tendered total of the prices (if any) all duties, taxes except Value Added Tax (VAT), and other levies payable by the successful tenderer, such duties, taxes and levies being those applicable fourteen (14) days before the closing time stated in the tender data.
- C.2.10.2 Show VAT payable by the employer separately as an addition to the tendered total of the prices.
- C.2.10.3 Provide rates and prices that are fixed for the duration of the contract and not subject to adjustment except as provided for in the conditions of contract identified in the contract data.
- C.2.10.4 State the rates and prices in Rand unless instructed otherwise in the tender data. The conditions of contract identified in the contract data may provide for part payment in other currencies.

C.2.11 Alterations to documents

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

C.2.12 Alternative tender offers

- C.2.12.1 Unless otherwise stated in the tender data, submit alternative tender offers only if a main tender offer, strictly in accordance with all the requirements of the tender documents, is also submitted as well as a schedule that compares the requirements of the tender documents with the alternative requirements that are proposed.
- C.2.12.2 Accept that an alternative tender offer must be based only on the criteria stated in the tender data or criteria otherwise acceptable to the employer.
- C.2.12.3 An alternative tender offer must only be considered if the main tender offer is the winning tender.

C.2.13 Submitting a tender offer

- C.2.13.1 Submit one tender offer only, either as a single tendering entity or as a member in a joint venture to provide the whole of the works identified in the contract data and described in the scope of works, unless stated otherwise in the tender data.
- C.2.13.2 Return all returnable documents to the employer after completing them in their entirety, either electronically (if they were issued in electronic format) or by writing legibly in non-erasable ink.

- C.2.13.3 Submit the parts of the tender offer communicated on paper as an original plus the number of copies stated in the tender data, with an English translation of any documentation in a language other than English, and the parts communicated electronically in the same format as they were issued by the employer.
- C.2.13.4 Sign the original and all copies of the tender offer where required in terms of the tender data. The employer will hold all authorized signatories liable on behalf of the tenderer. Signatories for tenderers proposing to contract as joint ventures shall state which of the signatories is the lead partner whom the employer shall hold liable for the purpose of the tender offer.
- C.2.13.5 Seal the original and each copy of the tender offer as separate packages marking the packages as "ORIGINAL". The package shall state on the outside the employer's address and identification details stated in the tender data, as well as the tenderer's name and contact address.
- C.2.13.6 Where a two-envelope system is required in terms of the tender data, place and seal the returnable documents listed in the tender data in an envelope marked "financial proposal" and place the remaining returnable documents in an envelope marked "technical proposal". Each envelope shall state on the outside the employer's address and identification details stated in the tender data, as well as the tenderer's name and contact address.
- C.2.13.7 Seal the original tender offer and copy packages together in an outer package that states on the outside only the employer's address and identification details as stated in the tender data.
- C.2.13.8 Accept that the employer will not assume any responsibility for the misplacement or premature opening of the tender offer if the outer package is not sealed and marked as stated.
- C.2.13.9 Accept that tender offers submitted by facsimile or e-mail will be rejected by the employer, unless stated otherwise in the tender data.

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

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

C.2.15 Closing time

- C.2.15.1 Ensure that the employer receives the tender offer at the address specified in the tender data not later than the closing time stated in the tender data. Accept that proof of posting shall not be accepted as proof of delivery.
- C.2.15.2 Accept that, if the employer extends the closing time stated in the tender data for any reason, the requirements of these conditions of tender apply equally to the extended deadline.

C.2.16 Tender offer validity

- C.2.16.1 Hold the tender offer(s) valid for acceptance by the employer at any time during the validity period stated in the tender data after the closing time stated in the tender data.
- C.2.16.2 If requested by the employer, consider extending the validity period stated in the tender data for an agreed additional period with or without any conditions attached to such extension.
- C.2.16.3 Accept that a tender submission that has been submitted to the employer may only be withdrawn or substituted by giving the employer's agent written notice before the closing time for tenders that a tender is to be withdrawn or substituted. If the validity period stated in C.2.16 lapses before the employer evaluating tender, the contractor reserves the right to review the price based on Consumer Price Index (CPI).
- C.2.16.4 Where a tender submission is to be substituted, a tenderer must submit a substitute tender in accordance with the requirements of C.2.13 with the packages clearly marked as "SUBSTITUTE".

C.2.17 Clarification of tender offer after submission

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

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

C.2.18 Provide other material

C.2.18.1 Provide, on request by the employer, any other material that has a bearing on the tender offer, the tenderer's commercial position (including notarized joint venture agreements), preferencing arrangements, or samples of materials, considered necessary by the employer for the purpose of a full and fair risk assessment.

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

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

C.2.19 Inspections, tests and analysis

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

C.2.20 Submit securities, bonds and policies

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

C.2.21 Check final draft

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

C.2.22 Return of other tender documents

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

C.2.23 Certificates

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

C.3 The employer's undertakings

C.3.1 Respond to requests from the tenderer

C.3.1.1 Unless otherwise stated in the tender Data, respond to a request for clarification received up to five (5) working days before the tender closing time stated in the Tender Data and notify all tenderers who collected tender documents.

C.3.1.2 Consider any request to make a material change in the capabilities or formation of the tendering entity (or both) or any other criteria which formed part of the qualifying requirements used to prequalify a tenderer to submit a tender offer in terms of a previous procurement process and deny any such request if as a consequence:

- a) an individual firm, or a joint venture as a whole, or any individual member of the joint venture fails to meet any of the collective or individual qualifying requirements;
- b) the new partners to a joint venture were not prequalified in the first instance, either as individual firms or as another joint venture; or
- c) in the opinion of the Employer, acceptance of the material change would compromise the outcome of the prequalification process.

C.3.2 Issue Addenda

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

C.3.3 Return late tender offers

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

C.3.4 Opening of tender submissions

- C.3.4.1 Unless the two-envelope system is to be followed, open valid tender submissions in the presence of tenderers' agents who choose to attend at the time and place stated in the tender data. Tender submissions for which acceptable reasons for withdrawal have been submitted will not be opened.
- C.3.4.2 Announce at the meeting held immediately after the opening of tender submissions, at a venue indicated in the tender data, the name of each tenderer whose tender offer is opened and, where applicable, the total of his prices.

C.3.5 Two-envelope system

- C.3.5.1 Where stated in the tender data that a two-envelope system is to be followed, open only the technical proposal of valid tenders in the presence of tenderers' agents who choose to attend at the time and place stated in the tender data and announce the name of each tenderer whose technical proposal is opened.
- C.3.5.2 Evaluate functionality of the technical proposals offered by tenderers, then advise tenderers who remain in contention for the award of the contract of the time and place when the financial proposals will be opened. Open only the financial proposals of tenderers, who score in the functionality evaluation more than the minimum number of points for functionality stated in the tender data, and announce the score obtained for the technical proposals and the total price and any points claimed on specific goals. Return unopened financial proposals to tenderers whose technical proposals failed to achieve the minimum number of points for functionality.

C.3.6 Non-disclosure

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

C.3.7 Grounds for rejection and disqualification

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

C.3.8 Test for responsiveness

- C.3.8.1 Determine, after opening and before detailed evaluation, whether each tender offer properly received:
 - a) complies with the requirements of these Conditions of Tender,
 - b) has been properly and fully completed and signed, and
 - c) is responsive to the other requirements of the tender documents.

C.3.8.2 A responsive tender is one that conforms to all the terms, conditions, and specifications of the tender documents without material deviation or qualification. A material deviation or qualification is one which, in the Employer's opinion, would:

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

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

C.3.9 Arithmetical errors, omissions and discrepancies

C.3.9.1 Check responsive tenders for discrepancies between amounts in words and amounts in figures. Where there is a discrepancy between the amounts in figures and the amount in words, the amount in words shall govern.

C.3.9.2 Check the highest ranked tender or tenderer with the highest number of tender evaluation points after the evaluation of tender offers in accordance with C.3.11 for:

- a) the gross misplacement of the decimal point in any unit rate;
- b) omissions made in completing the pricing schedule or bills of quantities; or
- c) arithmetic errors in:
 - (i) line item totals resulting from the product of a unit rate and a quantity in bills of quantities or schedules of prices; or
 - (ii) the summation of the prices.

C.3.9.3 Notify the tenderer of all errors or omissions that are identified in the tender offer and either confirm the tender offer as tendered or accept the corrected total of prices.

C.3.9.4 Where the tenderer elects to confirm the tender offer as tendered, correct the errors as follows:

- a) 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.
- b) Where there is an error in the total of the prices either as a result of other corrections required by this checking process or in the tenderer's addition of prices, the total of the prices shall govern and the tenderer will be asked to revise selected item prices (and their rates if bills of quantities apply) to achieve the tendered total of the prices.

C.3.10 Clarification of a tender offer

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

C.3.11 Evaluation of tender offers

The activities associated with evaluating tender offers are as follows:

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

C.3.11.1 General

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

The CIDB Standard Conditions of Tender are based on a procurement system that satisfies the following system requirements:	
Requirement	Qualitative interpretation of goal
Fair	The process of offer and acceptance is conducted impartially without bias, providing simultaneous and timely access to participating parties to the same information.
Equitable	Terms and conditions for performing the work do not unfairly prejudice the interests of the parties.
Transparent	The only grounds for not awarding a contract to a tenderer who satisfies all requirements are restrictions from doing business with the employer, lack of capability or capacity, legal impediments and conflicts of interest.
Competitive	The system provides for appropriate levels of competition to ensure cost effective and best value outcomes.
Cost effective	The processes, procedures and methods are standardized with sufficient flexibility to attain best value outcomes in respect of quality, timing and price, and least resources to effectively manage and control procurement processes.

C.3.12 Insurance provided by the employer

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

C.3.13 Acceptance of tender offer

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

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

C.3.14 Prepare contract documents

C.3.14.1 If necessary, revise documents that shall form part of the contract and that were issued by the employer as part of the tender documents to take account of:

- addenda issued during the tender period,
- inclusion of some of the returnable documents and
- other revisions agreed between the employer and the successful tenderer.

C.3.14.2 Complete the schedule of deviations attached to the form of offer and acceptance, if any.

C.3.15 Complete adjudicator's contract

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

C.3.16 Registration of the award

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

C.3.17 Provide copies of the contracts

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

C.3.18 Provide written reasons for actions taken

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

Contract No: WSBU 15 2025/26

Tender for the refurbishment of Bronkhorstspuit water treatment plant for a period of twenty-four (24) months from commencement date.

Volume 1: General Clauses, Tender Procedures, Contract Data, Pricing Data, Schedule of Quantities and Scope of Works

Portion 1: Tender

Part T2: Returnable Documents

**CITY OF TSHWANE
WATER AND SANITATION BUSINESS UNIT**

CONTRACT NO: WSBU 15 2025/26

**TENDER FOR THE REFURBISHMENT OF BRONKHORSTSPRUIT WATER
TREATMENT PLANT FOR A PERIOD OF TWENTY-FOUR (24) MONTHS FROM
COMMENCEMENT DATE.**

PORTION 1 : TENDER

PART T2 : RETURNABLE DOCUMENTS

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PART T2: RETURNABLE DOCUMENTS

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T2.1 LIST OF RETURNABLE DOCUMENTS

RD.A MANDATORY RETURNABLE DOCUMENTS

Note: *Failure to submit, fully complete and sign the applicable documents and submit all required attachments will result in the tender offer being disqualified from further consideration*

Document Name	Reference	Confirmation of Document Included (Tenders may use this column to confirm documents have been completed and included in the tender)
Compulsory Enterprise Questionnaire	Form RD.A.1	
MBD 4: Declaration of interest in tender of persons in service of state	Form RD.A.2	
MBD 8: Declaration of tenderer's past supply chain management practises	Form RD.A.3	
MBD 9: Certificate of independent tender determination	Form RD.A.4	
Certificate of authority of signatory	Form RD.A.5	
Certificate of authority of signatory for joint ventures and consortia	Form RD.A.6	
Declaration and Commitment	Form RD.A.7	

RD.B RETURNABLE DOCUMENTS REQUIRED FOR PREFERENTIAL PROCUREMENT EVALUATION PURPOSES

Note: *Failure to submit, fully complete and sign the applicable documents and submit all required attachments will result in the tender offer being awarded 0 (zero) preference points*

Document Name	Reference	Confirmation of Document Included (Tenders may use this column to confirm documents have been completed, signed and included in the tender)
MBD 6.1: Preference Points Claim Form in terms of the Preferential Procurement Regulations 2022	Form RD.B.1	
Valid B-BBEE Status Level of Contributor Certificate	Form RD.B.2	
B-BBEE Exempted Micro Enterprise – Sworn Affidavit	Form RD.B.3	
Promotion of local enterprises (Local Economic Participation)	Form RD.B.4	
At least 51% Women owned companies and at least 51% owned companies by Youth	Form RD.B.5	

Contract No: WSBU 15 2025/26

Tender for the refurbishment of Bronkhorstspuit water treatment plant for a period of twenty-four (24) months from commencement date. Volume 1: General Clauses, Tender Procedures, Contract Data, Pricing Data, Schedule of Quantities and Scope of Works

Portion 1: Tender

Part T2: Returnable Documents

At least 51% owned companies by People with disability	Form RD.B.6	

RD.C ADDITIONAL RETURNABLE DOCUMENTS REQUIRED FOR TENDER EVALUATION PURPOSES

Document Name	Reference	Confirmation of Document Included (Tenders may use this column to confirm documents have been completed and included in the tender)
Proof of registration on CSD with National Treasury	RD.C.1	
MBD 5: Declaration for procurement above R10 million (all applicable taxes included)	RD.C.2	
Proof of Registration with CIDB	RD.C.3	
Compliance with OHSA (Act 85 of 1993)	RD.C.4	
Record of services provided to organs of state	RD.C.5	
Commercial bank rating	RD.C.6	
Status of concern submitting tender	RD.C.7	
Classification of business	RD.C.8	
Letter of intent to provide a performance guarantee	RD.C.9	
Proof of municipal rates and taxes	RD.C.10	
Proof of registration as a Professional Construction Manager in terms of the Project and Construction Management Professions Act, 2000	RD.C.11	
Proof of registration as Professional Engineer (Pr Eng) in terms of the Engineering Professions Act, 2000	RD.C.12	
Proof of registration as Construction Health and Safety Officer in terms of the Project and Construction Management Professions Act, 2000	RD.C.13	
Schedule of tenderer's experience	RD.C.14	
Key personnel	RD.C.15	
Curriculum vitae of key personnel	RD.C.16	

RD.D OTHER DOCUMENTS THAT WILL FORM PART OF THE CONTRACT

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Portion 1: Tender

Part T2: Returnable Documents

Document Name	Reference	Confirmation of Document Included (Tenders may use this column to confirm documents have been completed and included in the tender)
Record of addenda to tender documents	RD.D.1	
Schedule of proposed subcontractors	RD.D.2	
Cost Price Adjustment (CPA) IMPORTED CONTENT (FOREX)	RD.D.3	
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FORM RD.A.1 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: CSD number:

Section 5: 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 6: Particulars of companies and close corporations

Company registration number:

Close corporation number:

Tax reference number:

Section 7: MBD4 issued by National Treasury must be completed for each tender and be attached as a tender requirement.

Section 9: MBD8 issued by National Treasury must be completed for each tender and be attached as a tender requirement.

Section 10: MBD9 issued by National Treasury must be completed for each tender and be attached as a tender requirement.

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

- i) authorizes the employer to verify the tenderers tax clearance status from the South African Revenue Services that it is in order;
- ii) confirms that the neither the name of the enterprise or the name of any partner, manager, director or other person, who wholly or partly exercises or may exercise, control over the enterprise appears on the Register of Tender Defaulters established in terms of the Prevention and Combating of Corrupt Activities Act of 2004;
- iii) confirms that no partner, member, director or other person, who wholly or partly exercises, or may exercise, control over the enterprise appears, has within the last five years been convicted of fraud or corruption;
- iv) confirms that I / we are not associated, linked or involved with any other tendering entities submitting tender offers and have no other relationship with any of the tenderers or those responsible for compiling the scope of work that could cause or be interpreted as a conflict of interest; and
- v) 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	
<i>Enterprise Name:</i>			

FORM RD.A.2 MBD 4: DECLARATION OF INTEREST

1. No bid will be accepted from persons in the service of the state¹.
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/her representative: _____
 - 3.2 Identity Number: _____
 - 3.3 Position occupied in Company:
(Director, trustee, shareholder²) _____
 - 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.

¹ MSCM Regulations: "in the service of the state" means to be –

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

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

3.8 Are you presently in the service of the state?

YES	NO

If yes, furnish particulars _____

3.9 Have you been in the service of the state for the past twelve months?

YES	NO

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

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

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

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

If yes, furnish particulars _____

3.14 Do you or any of the directors, trustees, managers, principal 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

If yes, furnish particulars _____

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

Full Name	Identity Number	State Employee Number

The undersigned, who warrants that he / she is duly authorised to do so on behalf of the enterprise, confirms that the contents of this schedule are within my personal knowledge and are to the best of my belief both true and correct.

Person authorized to sign the tender:

Full name (in BLOCK letters): _____

Signature: _____

Date: _____

FORM RD.A.3 MBD 8: DECLARATION OF TENDER'S PAST SUPPLY CHAIN MANAGEMENT PRACTISES

1. This municipal tender document must form part of all tenders invited.
2. It serves as a declaration to be used by municipalities and municipal entities in ensuring that when goods and services are being procured, all reasonable steps are taken to combat the abuse of the supply chain management system.
3. The tender of any tenderer may be rejected if that tenderer, or any of its directors have:
 - a. abused the municipality's/municipal entity's supply management system or committed any improper conduct in relation to such system;
 - b. been convicted for fraud or corruption during the past five years;
 - c. wilfully neglected, reneged on or failed to comply with any government, Municipal or other public sector contract during the past five years; or
 - d. been listed in the Register for Tender Defaulters in terms of Section 29 of the Prevention and Combating of Corrupt Activities Act, 2004 (Act 12 of 2004).
4. In order to give effect to the above, the following questionnaire must be completed and submitted with the tender:

Item	Question	Response	
4.1	Is the tenderer, any of its directors listed on the National Treasurer's database as a company or persons prohibited from doing business with the public sector? (Companies for 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	NO
	If so, furnish particulars:		
4.2	Is the tenderer 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, 2004 (Act 12 of 2004)? (The Register for Tender Defaulters can be accessed on the National Treasury's website (www.treasury.gov.za) by clicking on its link at the bottom of the home page.)	YES	NO
	If so, furnish particulars:		
4.3	Was the tenderer or any of its directors convicted by a court of law (including a court of law outside the Republic of South Africa) for fraud or corruption during the past five years?	YES	NO
	If so, furnish particulars:		

Item	Question	Response	
4.4	Does the tenderer or any of its directors owe any municipal rates and taxes or municipal charges to the municipality/municipal entity, or to any other municipality/municipal entity, that is in arrears for more than three months?	YES	NO
	If so, furnish particulars:		
4.5	Was any contract between the tenderer and the municipality/municipal entity or any other organ of state terminated during the past five years on account of failure to perform on or comply with the contract?	YES	NO
	If so, furnish particulars:		

The undersigned, who warrants that he / she is duly authorised to do so on behalf of the enterprise, confirms that the contents of this schedule are within my personal knowledge and are to the best of my belief both 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.

Person authorized to sign the tender:

Full name (in BLOCK letters): _____

Signature: _____

Date: _____

FORM RD.A.4 MBD 9: CERTIFICATION OF INDEPENDENT TENDER DETERMINATION

1. This Municipal Bidding Document (MBD) must form part of all bids ³invited.
2. Section 4 (1) (b) (iii) of the Competition Act Nol. 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 tendering (or bid rigging⁴). Collusive tendering is a *per 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 tender of any tenderer if that tenderer 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 tendering process or the execution of the contract.
4. This will serve as a certificate of declaration that would be used by institutions to ensure that, when tenders are considered, reasonable steps are taken to prevent any form of tender-rigging.
5. In order to give effect to the above, the attached Certificate of Tender Determination must be completed and submitted with the tender.

³ Includes price quotations, advertised competitive bids, limited bids and proposals.

⁴ 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.

FORM RD.A.5 CERTIFICATE OF AUTHORITY OF SIGNATORY**RESOLUTION** of the a meeting of the *Board of Directors/Members/Partners of

(Legally correct full name and registration number, if applicable, of the enterprise)

Held at: _____ (place)

On: _____ (date)

RESOLVED that:

- The enterprise submits a tender to the Tshwane Metro Municipality in respect of the following project:

Tender Number:	WSBU 15 2025/26
Tender Description:	TENDER FOR THE REFURBISHMENT OF BRONKHORSTSPRUIT WATER TREATMENT PLANT FOR A PERIOD OF TWENTY-FOUR (24) MONTHS FROM COMMENCEMENT DATE

- *Mr/Ms:
in *his/her capacity
as

and who will sign as follow:

Proof signature	Proof signature

be, and is hereby authorised to sign the tender, and any and all other documents and/or correspondence in connection with and relating to the tender for the enterprise mentioned above

NAME	CAPACITY	SIGNATURE

Note: *Delete which is not applicable. - IMPORTANT: This resolution <u>must</u> be signed by all the directors/members/ partners of the tendering enterprise. - Should the number of directors/members/partners exceed the space available above, additional names and signatures must be supplied on a separate page.	Enterprise stamp

FORM RD.A.6 CERTIFICATE OF AUTHORITY OF SIGNATORY FOR JOINT VENTURES AND CONSORTIA

*Joint venture/consortium
name: _____

We, the undersigned, are submitting this tender in a *joint venture/consortium and hereby authorise *Mr/Ms
_____ authorised signatory of the enterprise

_____ acting in the capacity of lead partner

to sign the tender, and any and all other documents and/or correspondence in connection with and relating to the tender for the *joint venture/consortium mentioned above.

Registered name of enterprise	Registration number	% of contract value	Address	Duly authorised signatory	Mark with (x) for lead partner

Note:

1. *Delete which is not applicable.
2. IMPORTANT: This resolution must be signed by all the parties of the joint venture/consortium and every duly authorised signatory for each party to the joint venture/consortium must complete a Form RD.C.15.
3. Should the number of directors/members/partners exceed the space available above, additional names and signatures must be supplied on a separate page.

FORM RD.B.1 MBD 6.1: PREFERENCE POINTS CLAIM FORM IN TERMS OF THE PREFERENTIAL PROCUREMENT REGULATIONS 2022

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

NB BEFORE COMPLETING THIS FORM, TENDERERS MUST STUDY THE GENERAL CONDITIONS, DEFINITIONS AND DIRECTIVES APPLICABLE IN RESPECT B-BBEE, AS PRESCRIBED IN THE 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 To be completed by the organ of state
 - a) The applicable preference point system for this tender is the 90/10 preference point system.
 - b) The 90/10 preference point system will be applicable in this tender. The lowest/ highest acceptable tender will be used to determine the accurate system once tenders are received.
- 1.3 Points for this tender (even in the case of a tender for income-generating contracts) shall be awarded for:
 - (a) Price; and
 - (b) Specific Goals.

The maximum points for this tender are allocated as follows:

	POINTS
PRICE	90
SPECIFIC GOALS	10
Total points for Price and SPECIFIC GOALS	100

- 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

3.1.1 THE 90/10 PREFERENCE POINT SYSTEMS

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

90/10

$$P_s = 90 \left(1 - \frac{P_t - P_{min}}{P_{min}} \right)$$

Where

P_s = Points scored for price of tender under consideration

P_t = Price of tender under consideration

P_{min} = 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:
- 4.2. In cases where organs of state intend to use Regulation 3(2) of the Regulations, which states that, if it is unclear whether the 80/20 or 90/10 preference point system applies, an organ of state must, in the tender documents, stipulate in the case of—
 - (a) an invitation for tender for income-generating contracts, that either the 80/20 or 90/10 preference point system will apply and that the highest acceptable tender will be used to determine the applicable preference point system; or
 - (b) any other invitation for tender, that either the 80/20 or 90/10 preference point system will apply and that the lowest acceptable tender will be used to determine the applicable preference point system,

then the organ of state must indicate the points allocated for specific goals for both the 90/10 and 80/20 preference point system.

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

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

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

The specific goals allocated points in terms of this tender	Number of points allocated (90/10 system) (To be completed by the organ of state)	Number of points claimed (90/10 system) (To be completed by the tenderer)
BB-BEE score of companies		
Level 1	4 Points	
Level 2	3.5 Points	
Level 3	3 Points	
Level 4	2.5 Points	
Level 5	2 Points	
Level 6	1.5 Points	
Level 7	1 Point	
Level 8	0.5 Points	
Non-compliant	0 Points	
EME and/or QSE	1	
At least 51% Women owned companies	1	
At least 51% owned companies by People with disability	1	
At least 51% owned companies by Youth	1	
Local Economic Participation		
City of Tshwane Participants	2	
Gauteng Participants	1	
National participants	1	

DECLARATION WITH REGARD TO COMPANY/FIRM

- 4.3. **Name of company/firm**.....
- 4.4. **Company registration number:**
- 4.5. **TYPE OF COMPANY/ FIRM**
- ☐ Partnership/Joint Venture / Consortium
- ☐ One-person business/sole propriety
- ☐ Close corporation
- ☐ Public Company
- ☐ Personal Liability Company
- ☐ (Pty) Limited
- ☐ Non-Profit Company
- ☐ State Owned Company

[Tick applicable box]

- 4.6. I, the undersigned, who is duly authorised to do so on behalf of the company/firm, certify that the points claimed, based on the specific goals as advised in the tender, qualifies the company/ firm for the preference(s) shown and I acknowledge that:
- i) The information furnished is true and correct;
- ii) The preference points claimed are in accordance with the General Conditions 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.

NAME:
(in BLOCK letters)

CAPACITY:
(of authorized agent)

SIGNATURE:
(of authorized agent)

SIGNED at

**on
this**

day of

WITNESSES:
(Full name in BLOCK letters
and signature)

1.

2.

FORM RD.B.2 VALID B-BBEE STATUS LEVEL OF CONTRIBUTOR CERTIFICATE

Submit B-BBEE Verification Certificate from a Verification Agency accredited by the South African Accreditation System (SANAS) or a Registered Auditor approved by the Independent Regulatory Board of Auditors (IRBA) or an Accounting Officer as contemplated in the Close Corporation Act (CCA).

NOTE:

- a. Attach original copy of B-BBEE Verification Certificate to this page.
- b. In the case of a joint venture / consortium parties must each attach original copy of their B-BBEE Verification Certificates.

FORM RD.B.3 B-BBEE EXEMPTED MICRO ENTERPRISE – SWORN AFFIDAVIT

I, the undersigned

Full Name & Surname																
Identity Number							-					-			-	

Hereby declare under oath as follow:

1. The contents of this statement are to the best of my knowledge a true reflection of the facts.
2. I am a member / director / owner of the following enterprise and am duly authorised to act on its behalf.

Enterprise Name	
Trading Name	
Registration Number	
Enterprise Address	

3. I hereby declare under oath that:

- The enterprise is _____ % black owned;
- The enterprise is _____ % black woman owned;
- Based on the audited management accounts and other information available on the _____ financial year, the income did not exceed R 10,000,000 (ten million rands);
- Please confirm on the below the B-BBEE level contributor, by ticking the applicable box.

100% Black owned	Level One (135% B-BBEE procurement recognition)	
More than 51% Black owned	Level Two (125% B-BBEE procurement recognition)	
Less than 51% Black owned	Level Four (100% B-BBEE procurement recognition)	

4. The entity is an empowering supplier in terms of the dti Codes of Good Practice
5. I know and understand the contents of the contents of this affidavit, and I have no objection to take the prescribed oath and consider the oath binding on my conscience and on the owners of the enterprise which I represent in this matter.
6. The sworn affidavit will be valid for a period of 12 (twelve) month from the date signed by the commissioner.

Deponent Signature:	Date:
Commissioner of oaths (Signature and stamp)	

FORM RD.B.4 PROMOTION OF LOCAL ENTERPRISES

The City of Tshwane has mandated the promotion of local enterprises. To comply with this the tenderer must provide proof of the type of business unit and whether the unit resides within the Tshwane and will be scored as follow:

90/10 preference point system applies:

	Promotion of local enterprises
No Response (score 0)	The tenderer did not respond or comply with this evaluation schedule. A score of 0 will also be awarded for any misrepresentation made in this regard,
Satisfactory (score 1)	The tenderer operates a head office or fully staffed office or his sole office outside the boundaries of Gauteng Province. (I.e. no business unit or office resides within the boundaries of Tshwane Metropolitan Municipality)
Good (score 1)	The tenderer's office resides within the boundaries of Gauteng Province. (I.e. no business unit or office resides within the boundaries of Tshwane Metropolitan Municipality)
Very good (score 2)	The tenderer's office resides within the boundaries of the Tshwane Metropolitan Municipality.

Municipal Rates & Taxes not older than three months from tender advertisement date or Valid Lease Agreement should be attached as evidence.

(If necessary, the tenderer will be requested to present the office / business unit to officials of the City)

The undersigned, who warrants that he / she is duly authorized to do so on behalf of the enterprise, confirms that the contents of this schedule are within my personal knowledge and are to the best of my belief both true and correct.

Person authorized to sign the tender:

Full name (in BLOCK letters):

Signature:

Date:

The City of Tshwane has mandate for the promotion At least 51% Women owned companies and At least 51% owned companies by youth. To comply with this the tenderer must provide Certified copy of Identity Document/s that proof that company is 51% owned by Women or youth

	Promotion of At least 51% Women owned companies and At least 51% owned companies by youth
No Response (score 0)	The tenderer did not respond or comply with this evaluation schedule. A score of 0 will also be awarded for any misrepresentation made in this regard,
Good (score 1)	Certified copy of Identity Document/s that proof that company is 51% owned by Women and proof of ownership (Sworn affidavit for B-BBEE qualifying small enterprise or Exempt Micro Enterprises, CIPC registration or any other proof of ownership
Good (score 1)	Certified copy of Identity Document/s that proof that company is 51% owned by youth and proof of ownership (Sworn affidavit for B-BBEE qualifying small enterprise or Exempt Micro Enterprises, CIPC registration or any other proof of ownership

The City of Tshwane has mandate for the promotion of At least 51% owned companies by People with disability. To comply with this the tenderer must provide Medical Certificate with doctor's details (Practice Number, Physical Address and contact numbers that proof that company is 51% owned by People with disability

	Promotion of At least 51% owned companies by People with disability
No Response (score 0)	The tenderer did not respond or comply with this evaluation schedule. A score of 0 will also be awarded for any misrepresentation made in this regard,
Good (score 1)	Medical Certificate with doctor's details (Practice Number, Physical Address and contact numbers and proof of ownership (Sworn affidavit for B-BBEE qualifying small enterprise or Exempt Micro Enterprises, CIPC registration or any other proof of ownership

(If necessary the tenderer will be requested to present the office / business unit to officials of the City)

The undersigned, who warrants that he / she is duly authorized to do so on behalf of the enterprise, confirms that the contents of this schedule are within my personal knowledge and are to the best of my belief both true and correct.

Person authorized to sign the tender:

Full name (in BLOCK letters):

Signature:

Date:

FORM RD.C.1 PROOF OF REGISTRATION ON CSD WITH NATIONAL TREASURY

1. Attach original or certified copy of CSD registration certificate to this page.

2. In the case of a joint venture / consortium (excluding consulting engineering partners) the joint venture / consortium must attach original or certified copy of their CSD registration certificate to this page.

FORM RD.C.2 MBD 5: DECLARATION FOR PROCUREMENT ABOVE R10 MILLION

1. The tenderer is required by law to prepare annual financial statements for auditing their audited annual financial statements:

- i) for the past three years; or
ii) Since the establishment if established during the past three years.

Indicate whether these have been included in the tender:

YES	NO

2. Does the tenderer have any undisputed commitments for municipal services towards a municipality or other service provider in respect of which payment is overdue for more than 30 days?

YES	NO

If so, state
particulars _____

3. Has any contracts been awarded to the tenderer by an organ of state during the past five years?

YES	NO

If so, state
particulars _____

4. Has there been any material non-compliance or dispute concerning the execution of such contract?

YES	NO

If so, state
particulars _____

5. Is any portion of the goods or services expected to be sourced from outside the Republic?

YES	NO

If, so state what portion and whether any portion of payment from the municipality is expected to be transferred outside of the Republic.

The undersigned, who warrants that he / she is duly authorised to do so on behalf of the enterprise, confirms that the contents of this schedule are within my personal knowledge and are to the best of my belief both true and correct.

I accept that the state may act against me should this declaration prove to be false.

Person authorized to sign the
tender:

Full name (in BLOCK letters): _____

Signature: _____

Date: _____

FORM RD.C.3 PROOF OF REGISTRATION WITH THE CIDB

1. Attach original or certified copy of CIDB registration certificate to this page.
2. In the case of a joint venture / consortium (excluding consulting engineering partners) parties must each attach original or certified copy of their CIDB registration certificate.

Firm	CRS Number	CIDB Grading	Lead Partner (Indicate with X)
Combined CIDB Grading for Joint Venture / Consortium:			

(Calculator is available at <https://registers.cidb.org.za/common/jvcalc.asp>)

The undersigned, who warrants that he / she is duly authorised to do so on behalf of the enterprise, confirms that the contents of this schedule are within my personal knowledge and are to the best of my belief both true and correct.

Person authorized to sign the tender:

Full name (in BLOCK letters): _____

Signature: _____

Date: _____

FORM RD.C.4 COMPLIANCE WITH OHSA (ACT 85 OF 1993)

Tenderers are required to satisfy the employer and the engineer as to their ability and available resources to comply with the above by answering the following questions and providing the relevant information required below.

(Tick applicable box)

1. Are your company familiar with the OHSA (ACT 85 of 1993) and its Regulations?	YES	NO
2. Who will prepare your company's Health and Safety Plan? Provide a copy of the person/s curriculum vitae/s or company profile.		
3. Do your company have a health and safety policy? If YES provide a copy.	YES	NO
4. How is this policy communicated to your employees? Provide supporting documentation.	YES	NO
5. Do your company keep record of safety aspects of each site where work is performed? If YES what records are kept?	YES	NO
6. Do your company conduct monthly safety meetings? If YES , who is the chairperson of the meeting, and attend these meetings?	YES	NO
7. Do your company have a safety officer in its employment, responsible for overall safety of your company? If YES , explain his duties and provide a copy of his CV	YES	NO
8. Do your company have trained first aid employees? If YES , indicate who	YES	NO
9. Do your company have a safety induction training programme in place? If YES , provide a copy.	YES	NO
10. Does your company conduct medical surveillance for its employees?	YES	NO

The undersigned, who warrants that he / she is duly authorised to do so on behalf of the enterprise, confirms that the contents of this schedule are within my personal knowledge and are to the best of my belief both true and correct.

Person authorized to sign the tender:

Full name (in BLOCK letters): _____

Signature: _____

Date: _____

FORM RD.C.5 RECORD OF SERVICES PROVIDED TO ORGANS OF STATE

Tenderers are required to complete this record in terms of the Supply Chain Management Regulations issued in terms of the Municipal Finance Management Act of 2003.

Include only those contracts where the tenderer identified in the signature block below was directly contracted by the employer. Tenderers must not include services provided in terms of a sub-contract agreement.

Where contracts were awarded in the name of a joint venture and the tenderer formed part of that joint venture, indicate in the column entitled "Title of the contract for the service" that was in joint venture and provide the name of the joint venture that contracted with the employer. In the column for the value of the contract for the service, record the value of the portion of the contract performed (or to be performed) by the tender.

Complete the record or attach the required information in the prescribed tabulation

ALL SERVICES COMMENCED OR COMPLETED TO AN ORGAN OF STATE IN THE LAST FIVE YEARS				
	Organ of state, i.e. national or provincial department, public entity, municipality or municipal entity.	Title of contract for the service	Value of contract for service incl. VAT (Rand)	Date completed (State current if not yet completed)
1.				
2.				
3.				
4.				
5.				
6.				
7.				

(Attach additional pages if more space is required.)

The undersigned, who warrants that he / she is duly authorised to do so on behalf of the enterprise, confirms that the contents of this schedule are within my personal knowledge and are to the best of my belief both true and correct.

Person authorized to sign the tender:

Full name (in BLOCK letters): _____

Signature: _____

Date: _____

FORM RD.C.6 COMMERCIAL BANK RATING

Prospective bidders are to obtain the latest bank rating letter from the relevant bank and attach to this page. Failure to submit proof of the bank rating will result in the bidder be disqualified as this requirement is a mandatory requirement as provided for under Part T1 (refer to C2.1: Eligibility (mandatory requirements)).

Proof of a minimum Level C bank rating, as well as confirmation of raised capital of not less than R90 000 000 from the bidder's registered banking institution must be provided with the tender.

BANKER/INSURER:

NAME:

(in BLOCK letters)

CAPACITY:

(of authorized agent)

SIGNATURE:

(of authorized agent)

SIGNED at _____ on this _____ day of _____

WITNESSES:

(Full name in BLOCK letters and signature)

1.

2.

FORM RD.C.7 STATUS OF CONCERN SUBMITTING TENDER**1. General**

State whether the tenderer is a company, a closed corporation, a partnership, a sole practitioner, a joint venture/consortium or a co-operative

Public Company

Private Company

Closed Corporation

Partnership

Sole Proprietary

Joint Venture / Consortium

Co-operative

(Mark the appropriate option)

2. Information to be provided

If the Tendering Entity is a:		Documentation to be submitted with the tender
1	<u>Closed Corporation</u> , incorporated under the Close Corporation Act, 1984, Act 69 of 1984	CIPRO CK1 or CK2 (Certified copies of the founding statement) and list of members
2	<u>Private Company</u> incorporated with share capital, under the companies Act, 1973, Act 61 of 1973 (Including Companies incorporated under Art 53 (b))	Certified copies of: a) CIPRO CM 1 - Certificate of Incorporation b) CIPRO CM 29 – Contents of Register of Directors, Auditors and Officers c) Shareholders Certificates of all Members of the Company, plus a signed statement of the Company's Auditor, certifying each Member's ownership/shareholding percentage relative to the total.
3	<u>Private Company</u> incorporated with share capital, under the companies Act, 1973, Act 61 of 1973 in which any, or all, <u>shares are held by another</u> Closed Corporation or company with, or without, share capital.	Certified copies of documents referred to in 1 and/or 2 above in respect of all such Closed Corporations and/or Companies
4	<u>Public Company</u> incorporated with share capital, under the companies Act, 1973, Act 61 of 1973 (Including Companies incorporated under Art 21)	A signed statement of the Company's Secretary confirming that the Company is a public Company.
5	<u>Sole Proprietary</u> or a <u>Partnership</u>	Certified copy of the Identity Document of: a) such Sole Proprietary, or b) Each of the Partners in the Partnership Certified copy of the Partnership agreement.

If the Tendering Entity is a:		Documentation to be submitted with the tender
6	<u>Co-operative</u>	CIPRO CR2 - Certified copies of Company registration document.
7	<u>Joint Venture / Consortium</u>	All the documents (as described above) as applicable to each partner in the joint venture / consortium as well as a certified copy of the joint venture / consortium agreement.

Note:

1. If the shares are held in trust provide a copy of the Deed of Trust (only the front page and pages listing the trustees and beneficiaries are required) as well as the Letter of Authority as issued by the Master of the Supreme Court wherein trustees have been duly appointed and authorised
2. Include a certified copy of the Certificate of Change of Name (CM9) if applicable.

3. Registered for VAT proposes in terms of the Value-Added Tax Act (89 of 1991)

Yes

☐

No

☐

(Make an X in the appropriate space)

REGISTRATION NO: _____

FORM RD.C.8 CLASSIFICATION OF BUSINESS

1. The Small Businesses are defined in the National Small Business Act, 1996 (Act 102 of 1996).
2. Information furnished with regard to the classification of Small businesses
 - (b.) Indicate whether the company/entity is defined as a small, medium or micro enterprise by the National Small Business Act.

YES	NO

(Tick appropriate box)

- (c.) If the response to 2.(a.) is **YES**, the following must be completed:

- i. Sector/sub-sector in accordance with the Standard Industrial classification:

- ii. Size or class:

- iii. Total full-time equivalent of paid employees:

- iv. Total annual turnover:

- v. Total gross asset value (fixed property excluded):

(A schedule indicating the different sectors is attached to this form.)

- (d.) The tenderer should substantiate the information provided by submitting the following documentation:
 - i. A letter from the tenderer's auditor or an affidavit from the South African Police Services confirming the correctness of the abovementioned information,
 - ii. Company profile indicating the tenderer's staff compliment, and
 - iii. 3 year financial statement or since their establishment if established during the past 3 years.

SCHEDULE OF SECTORS

SIZE OF CLASS	THE TOTAL FULL-TIME EQUIVALENT OF PAID EMPLOYEES	TOTAL TURNOVER	TOTAL GROSS ASSET VALUE (FIXED PROPERTY EXCLUDED)
AGRICULTURE			
Medium	100	R 5 mil	R 5 mil
Small	50	R 3 mil	R 3 mil
Very Small	10	R 500 000	R 500 000
Micro	5	R 200 000	R 100 000
MINING AND QUARRYING			
Medium	200	R 39 mil	R 23 mil
Small	50	R 10 mil	R 6 mil
Very Small	20	R 4 mil	R 2 mil
Micro	5	R 200 000	R 100 000
MANUFACTURING			
Medium	200	R 51 mil	R 19 mil
Small	50	R 13 mil	R 5 mil
Very Small	20	R 5 mil	R 2 mil
Micro	5	R 200 000	R 100 000
ELECTRICITY, GAS & WATER			
Medium	200	R 51 mil	R 19 mil
Small	50	R 13 mil	R 5 mil
Very Small	20	R 5.1 mil	R 1.9 mil
Micro	5	R 200 000	R 100 000
CONSTRUCTION			
Medium	200	R 26 mil	R 5 mil
Small	50	R 6 mil	R 1 mil
Very Small	20	R 3	R 500 000
Micro	5	R 200 000	R 100 000
RETAIL AND MOTOR TRADE & REPAIR SERVICES			
Medium	200	R 39 mil	R 6 mil
Small	50	R 19 mil	R 3 mil
Very Small	20	R 4 mil	R 600 000
Micro	5	R 200 000	R 100 000
WHOLESALE TRADE, COMMERCIAL AGENTS AND ALLIED SERVICES			
Medium	200	R 64 mil	R 10 mil
Small	50	R 32 mil	R 5 mil
Very Small	20	R 6 mil	R 600 000
Micro	5	R 200 000	R 100 000
CATERING, ACCOMMODATION AND OTHER TRADE			
Medium	200	R 13 mil	R 3 mil
Small	50	R 6 mil	R 1 mil
Very Small	20	R 5.1 mil	R 1.9 mil
Micro	5	R 200 000	R 100 000
TRANSPORT, STORAGE & COMMUNICATIONS			
Medium	200	R 26 mil	R 6 mil
Small	50	R 13 mil	R 3 mil
Very Small	20	R 3 mil	R 600 000
Micro	5	R 200 000	R 100 000
FINANCE & BUSINESS SERVICES			
Medium	200	R 26 mil	R 5 mil
Small	50	R 13 mil	R 3 mil
Very Small	20	R 3 mil	R 500 000
Micro	5	R 200 000	R 100 000
COMMUNITY, SOCIAL AND PERSONAL SERVICES			
Medium	200	R 13 mil	R 6 mil
Small	50	R 6 mil	R 3 mil
Very Small	20	R 1mil	R 600 000
Micro	5	R 200 000	R 100 000

FORM RD.C.9 LETTER OF INTENT TO PROVIDE A PERFORMANCE GUARANTEE

It is hereby agreed that a Performance Bond drafted **exactly** as set out in the attached examples (See Section C1.3: Form of Guarantee) will be provided by the Surety named below:

Name of Surety (Bank or Insurer)

Address:

Signed:

Name:

Capacity:

On behalf of Tenderer (name of tenderer)

Date:

CONFIRMED BY Surety's Authorised representative

Signature(s):

Name (print):

Capacity

On behalf of Surety (Bank or Insurer)

Date:

Note: Refer to the Annexure to **C1.3 Form of Guarantee** for the List of Institutions from who Contract/Deposit Guarantees will be accepted.

FORM RD.C.10 PROOF OF MUNICIPAL RATES AND TAXES

1. Attach a certified copy of recent municipal Rates and Taxes statement for the company as well as each Director of the Company to this page.

The tenderer must provide proof of persons in their **full-time employ** that are registered in terms of the Engineering Professions Act, 2000 (Act 46 of 2000). The tenderer must confirm that registered employees are in their full-time employ by means of a declaration to this effect on the company's letterhead and duly signed.

NAME	REGISTRATION			Confirm full time employed
	Professional Category	Discipline	ECSA Number	

(Attach required documentary proof to this page)

The undersigned, who warrants that he / she is duly authorized to do so on behalf of the enterprise, confirms that the contents of this schedule are within my personal knowledge and are to the best of my belief both true and correct.

Person authorized to sign the tender:

Full name (in BLOCK letters): _____

Signature: _____

Date: _____

The tenderer must provide proof of persons in their **full-time employ** that are registered as a Health and Safety Officer in terms of the Project and Construction Management Professions Act, 2000 (Act 48 of 2000). The tenderer must confirm that registered employees are in their full-time employ by means of a declaration to this effect on the company's letterhead and duly signed.

[illegible]

The undersigned, who warrants that he / she is duly authorized to do so on behalf of the enterprise, confirms that the contents of this schedule are within my personal knowledge and are to the best of my belief both true and correct.

Date:

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The tenderer must provide proof of persons in their **full-time employ** that are registered as a Professional Construction Manager (Pr.CM) in terms of the Project and Construction Management Professions Act, 2000 (Act 48 of 2000). The tenderer must confirm that registered employees are in their full-time employ by means of a declaration to this effect on the company's letterhead and duly signed.

NAME	REGISTRATION			Confirm full time employed
	Professional Category	Discipline	SACPCMP Number	

(Attach required documentary proof to this page)

The undersigned, who warrants that he / she is duly authorized to do so on behalf of the enterprise, confirms that the contents of this schedule are within my personal knowledge and are to the best of my belief both true and correct.

Person authorized to sign the tender:

Full name (in BLOCK letters): _____

Signature: _____

Date: _____

FORM RD.C.14 SCHEDULE OF TENDERER'S EXPERIENCE

Employer, contact person and telephone number	Description of contract	Final Approval Certificate	Completion Certificate

(Attach additional pages if more space is required)

FORM RD.C.15 KEY PERSONNEL

The tenderer shall list in the table below the key personnel to be engaged for this project.

Refer to clause C.2.1 of Part T1: Eligibility (mandatory requirements)

Note: Form RD.C.14 must be complete for each person listed below. The Tenderer shall insert in the spaces below, the name of key personnel to be engaged on the Contract.

	NAME	CATEGORY *	QUALIFICATION	EXPERIENCE (NUMBR OF RELEVANT PROJECT)
1.				
2.				
3.				
4.				
5.				
6.				

(Attach additional pages if more space is required.)

Note: Failure to comply with the mandatory requirements of keystaff will result in disqualification of your tender.

Note: Please ensure that a CV for all the key personnel entered in the table above is attached on submission of your tender document.

The undersigned, who warrants that he / she is duly authorised to do so on behalf of the enterprise, confirms that the contents of this schedule are within my personal knowledge and are to the best of my belief both true and correct.

Person Authorized to sign Tender:

FULL NAME (BLOCK LETTERS):

SIGNATURE:

DATE:

FORM RD.D.16 CURRICULUM VITAE OF KEY PERSONNEL**Note:** This form should be completed for each key person listed in Form RD.D.13

Name:	Date of birth:
Profession:	Nationality:
Qualifications:	
Professional membership:	
Name of employer (firm):	
Current position:	Years with firm:
Employment record: (list in chronological order starting with earliest work experience)	
Experience record pertinent to required service:	
Certification:	
I, the undersigned, certify that to the best of my knowledge and belief, this data correctly describes me, my qualifications and my experience.	
_____	_____
<i>(Signature of person named in schedule)</i>	Date:

FORM RD.E.1 RECORD OF ADDENDA TO TENDER DOCUMENTS

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

	DATE	REFERENCE	TITLE
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

The undersigned, who warrants that he / she is duly authorised to do so on behalf of the enterprise, confirms that the contents of this schedule are within my personal knowledge and are to the best of my belief both true and correct.

Person authorized to sign the tender:

Full name (in BLOCK letters): _____

Signature: _____

Date: _____

CONTENTS

The proper completion of the technical schedules under this section is critical to the evaluation of the tender. Failure to complete the schedule will lead to the disqualification of the bidder.

Once the Contract has been awarded to the successful bidder, equipment shall be supplied as recorded in the technical schedules and the Contractor's Proposal, unless written acceptance of any variances thereto is issued by the Engineer.

Tenderers shall note that equipment in accordance with the relevant Specifications and with a proven track record with local operational installations shall be proposed as required. Failure to adhere to this requirement implies that the equipment offered does not meet tender prescriptions and may lead to disqualification of the bid.

Where the Contractor's offer includes equipment, which does not comply with the requirements of these schedules, it shall include separate technical data sheets with its tender.

T2.3 TECHNICAL SCHEDULES – MECHANICAL DATA SHEETS

<u>Document</u>	<u>Page</u>
Returnable data sheet that will be incorporated into the contract	
T2.3.1.1 Raw abstraction water pumps	T2.3-4
T2.3.2.1 Clean / (high lift) water pumps	T2.3-7
T2.3.3.1 Back Wash Pumps	T2.3-10
T2.3.4.1 Lime Pumps	T2.3-14
T2.3.5.1 Sludge Pumps	T2.3-19

T2.3.1: RAW ABSTRACTION WATER PUMPS REQUIREMENTS DATA

Item	Equipment Data	Value	Comments
1	Equipment Title	Vertical Can	
2	Equipment No	P-001/002	
3	Total No	2	
4	Working No	1	
5	Standby No	1	
6	Fluid Capacity (L/s)	190.0	
7	Fluid Capacity (m³/h)	684.0	
8	Discharge Head – Design	43.6	
9	Differential Head	45.9 m	
10	NPSH Available (min)	-2.6 m	
11	Flowrate – Nominal	684.00 m³/h	
12	Flowrate – Min	342.00 m³/h	
13	Flowrate – Max	684.00 m³/h	
14	Velocity – Discharge	0.53 m/s	
15	pH Range	5 – 8	
16	Corrosion Due To	Particles; Chemicals; Other: [Specify]	
17	Fluid Temperature	25 °C	
18	Liquid Vapour Pressure	2.7 kPa	
19	Density of Carrier Solution	0.998 kg/m³	
20	Density of Fluid	1.000 kg/m³	
21	Density of Solids	[kg/m³]	
22	Solids Concentration	0%	
23	Solids Type	Undissolved impurities; Ore; [Specify]	
24	Particle Size Distribution	d50 = 90 µm; d80 = 150 µm	
25	Largest Particle Size	[µm]	
26	Fluid Viscosity	10 cP	
27	Shear Behaviour	N/A; Thickening; Thinning:	
28	Solids Abrasiveness	N/A; Low; Moderate; High:	
29	External Flush Available	Yes; No:	

T2.3.1.1: TO BE COMPLETED BY THE BIDDER**TECHNICAL DATA SHEET 01: RAW ABSTRACTION WATER PUMPS**

Item	Description	Unit(s)	Tenderer's Proposal
1	PUMP DETAILS		
1.1	Manufacturer	-	
1.2	Country of Manufacture	-	
1.3	Year of Manufacture	-	
1.4	Type	-	
1.5	Model	-	
1.6	Serial Number	-	
1.7	Pump Service	-	
1.8	Quantity	-	
2	TECHNICAL DETAILS		
2.1	Casing Type		
2.2	Casing Pressure	kPa	
2.3	Suction Internal Diameter	mm	
2.4	Discharge Internal Diameter	mm	
2.5	Impeller Diameter	mm	
2.6	Impeller Type	-	
2.7	Suction Flange Size	mm	
2.8	Discharge Flange Size	mm	
2.9	Flange Rating	KPa	
2.10	Type of Pump/Motor Coupling	-	
2.11	Type of Bearings	-	
2.12	Lubrication System (bearings)	-	
2.13	Mass	kg	
2.14	Shaft Speed	rpm	
2.15	Normal Operative Speed (Pump)	rpm	
2.16	Critical Speed of rotating Element	rpm	
2.17	Noise Level	dB	
2.18	Self Priming (Yes/No)	-	
2.19	Liquid Temperature	° C	
2.20	Pump Construction materials	-	
2.21	Corrosion Protection	-	
2.22	Solids Handling	%	
3	PUMP PERFORMANCE DETAILS		
3.1	Performance curves Attached to covering Letter (COMPULSORY)	Yes	

T2.3.1.1: RAW ABSTRACTION WATER PUMPS (Continued)

	At Rated Duty:	Yes/No	
3.2	Power Demand	kW	
3.3	NPSH for pump layout as shown	m	
3.4	Efficiency	%	
4	CENTRIFUGAL PUMP MOTOR DETAILS		
4.1	Manufacturer	-	
4.2	Place of manufacture	-	
4.3	Type	-	
4.4	Type of frame	-	
4.5	Insulation Class	-	
4.6	Compliance with SANS 948		
4.7	Speed of rotation	rpm	
4.8	Rated output at Site	kW	
4.9	Full load current	A	
	Efficiency at:		
4.10	Full load	%	
4.11	1/2 load	%	
	Power factor at:		
4.12	Full load	%	
4.13	1/2 load	%	
4.14	Operating voltage	V	
4.15	Starting method	-	
4.16	Starting current	A	
4.17	Temperature detectors in windings	Yes/No	
4.18	Temperature detectors on bearings	Yes/No	
4.19	Anti condensation heaters	Yes/No	
4.20	Mass of motor	Kg	

SIGNED ON BEHALF OF TENDERER :**NAME (in print) :****DATE :**

T2.3.2: CLEAN /(HIGH LIFT) WATER PUMPS REQUIREMENTS DATA

Item	Equipment Data	Value	Comments
1	Equipment Title	CENTRIFUGAL PUMP — INLET WORKS	
2	Equipment No	[Equipment No]	
3	Total No	4	
4	Working No	1	
5	Standby No	0	
6	Fluid Capacity (L/s)	190.0	
7	Fluid Capacity (m³/h)	684.0	
8	Discharge Head – Design	223.5	
9	Differential Head	211.0 m	
10	NPSH Available (min)	12.2 m	
11	Flowrate – Nominal	684.00 m³/h	
12	Flowrate – Min	342.00 m³/h	
13	Flowrate – Max	684.00 m³/h	
14	Velocity – Discharge	0.49 m/s	
15	pH Range	5 – 8	
16	Corrosion Due To	Particles; Chemicals; Other: [Specify]	
17	Fluid Temperature	25 °C	
18	Liquid Vapour Pressure	2.7 kPa	
19	Density of Carrier Solution	0.998 kg/m³	
20	Density of Fluid	1.000 kg/m³	
21	Density of Solids	[kg/m³]	
22	Solids Concentration	0%	
23	Solids Type	Undissolved impurities; Ore; [Specify]	
24	Particle Size Distribution	d50 = 90 µm; d80 = 150 µm	
25	Largest Particle Size	[µm]	
26	Fluid Viscosity	10 cP	
27	Shear Behaviour	N/A; Thickening; Thinning:	
28	Solids Abrasiveness	N/A; Low; Moderate; High:	
29	External Flush Available	Yes; No:	

**T2.3.2.1: TO BE COMPLETED BY THE BIDDER
CLEAN/ (HIGH LIFT) WATER PUMPS**

Description		Unit	Tenderer's Proposal
1	PUMP DETAILS		
1.1	Manufacturer	-	
1.2	Country of Manufacture	-	
1.3	Year of Manufacture	-	
1.4	Type	-	
1.5	Model	-	
1.6	Serial Number	-	
1.7	Pump Service	-	
1.8	Quantity	-	
2	TECHNICAL DETAILS		
2.1	Casing Type		
2.2	Casing Pressure	kPa	
2.3	Suction Internal Diameter	mm	
2.4	Discharge Internal Diameter	mm	
2.5	Impeller Diameter	mm	
2.6	Impeller Type	-	
2.7	Suction Flange Size	mm	
2.8	Discharge Flange Size	mm	
2.9	Flange Rating	KPa	
2.10	Type of Pump/Motor Coupling	-	
2.11	Type of Bearings	-	
2.12	Lubrication System (bearings)	-	
2.13	Mass	kg	
2.14	Shaft Speed	rpm	
2.15	Normal Operative Speed (Pump)	rpm	
2.16	Critical Speed of rotating Element	rpm	
2.17	Noise Level	dB	
2.18	Self Priming (Yes/No)	-	
2.19	Liquid Temperature	° C	
2.20	Pump Construction materials	-	
2.21	Corrosion Protection	-	
2.22	Solids Handling	%	
3	PUMP PERFORMANCE DETAILS		
3.1	Performance curves Attached to covering Letter (COMPULSORY)	Yes	

T2.3.2.1: CLEAN/(HIGH LIFT) WATER PUMPS (Continued)

	At Rated Duty:	Yes/No	
3.2	Power Demand	kW	
3.3	NPSH for pump layout as shown	m	
3.4	Efficiency	%	
4	CENTRIFUGAL PUMP MOTOR DETAILS		
4.1	Manufacturer	-	
4.2	Place of manufacture	-	
4.3	Type	-	
4.4	Type of frame	-	
4.5	Insulation Class	-	
4.6	Compliance with SANS 948		
4.7	Speed of rotation	rpm	
4.8	Rated output at Site	kW	
4.9	Full load current	A	
	Efficiency at:		
4.10	Full load	%	
4.11	1/2 load	%	
	Power factor at:		
4.12	Full load	%	
4.13	1/2 load	%	
4.14	Operating voltage	V	
4.15	Starting method	-	
4.16	Starting current	A	
4.17	Temperature detectors in windings	Yes/No	
4.18	Temperature detectors on bearings	Yes/No	
4.19	Anti condensation heaters	Yes/No	
4.20	Mass of motor	Kg	

SIGNED ON BEHALF OF TENDERER :**NAME (in print) :****DATE :**

T2.3.3: BACKWASH PUMPS REQUIREMENTS DATA

Item	Equipment Data	Value	Comments
1	Equipment Title	CENTRIFUGAL PUMP — INLET WORKS	
2	Equipment No	[Equipment No]	
3	Total No	6	
4	Working No	1	
5	Standby No	0	
6	Fluid Capacity (L/s)	46.1	
7	Fluid Capacity (m³/h)	166.0	
8	Discharge Head – Design	59.0	
9	Differential Head	46.6 m	
10	NPSH Available (min)	12.1 m	
11	Flowrate – Nominal	166.00 m³/h	
12	Flowrate – Min	83.00 m³/h	
13	Flowrate – Max	166.00 m³/h	
14	Velocity – Discharge	3.71 m/s	
15	pH Range	5 – 8	
16	Corrosion Due To	Particles; Chemicals; Other: [Specify]	
17	Fluid Temperature	25 °C	
18	Liquid Vapour Pressure	2.7 kPa	
19	Density of Carrier Solution	0.998 kg/m³	
20	Density of Fluid	1.000 kg/m³	
21	Density of Solids	[kg/m³]	
22	Solids Concentration	0%	
23	Solids Type	Undissolved impurities; Ore; [Specify]	
24	Particle Size Distribution	d50 = 90 µm; d80 = 150 µm	
25	Largest Particle Size	[µm]	
26	Fluid Viscosity	10 cP	
27	Shear Behaviour	N/A; Thickening; Thinning:	
28	Solids Abrasiveness	N/A; Low; Moderate; High:	
29	External Flush Available	Yes; No:	

**T2.3.3.1: TO BE COMPLETED BY THE BIDDER
BACKWASH PUMPS**

Description		Unit	Tenderer's Proposal
1	PUMP DETAILS		
1.1	Manufacturer	-	
1.2	Country of Manufacture	-	
1.3	Year of Manufacture	-	
1.4	Type	-	
1.5	Model	-	
1.6	Serial Number	-	
1.7	Pump Service	-	
1.8	Quantity	-	
2	TECHNICAL DETAILS		
2.1	Casing Type		
2.2	Casing Pressure	kPa	
2.3	Suction Internal Diameter	mm	
2.4	Discharge Internal Diameter	mm	
2.5	Impeller Diameter	mm	
2.6	Impeller Type	-	
2.7	Suction Flange Size	mm	
2.8	Discharge Flange Size	mm	
2.9	Flange Rating	KPa	
2.10	Type of Pump/Motor Coupling	-	
2.11	Type of Bearings	-	
2.12	Lubrication System (bearings)	-	
2.13	Mass	kg	
2.14	Shaft Speed	rpm	
2.15	Normal Operative Speed (Pump)	rpm	
2.16	Critical Speed of rotating Element	rpm	
2.17	Noise Level	dB	
2.18	Self Priming (Yes/No)	-	
2.19	Liquid Temperature	° C	
2.20	Pump Construction materials	-	
2.21	Corrosion Protection	-	
2.22	Solids Handling	%	
3	PUMP PERFORMANCE DETAILS		
3.1	Performance curves Attached to covering Letter (COMPULSORY)	Yes	

T2.3.3.1: BACKWASH PUMPS (Continued)

	At Rated Duty:	Yes	
3.2	Power Demand	kW	
3.3	NPSH for pump layout as shown	m	
3.4	Efficiency	%	
4	CENTRIFUGAL PUMP MOTOR DETAILS		
4.1	Manufacturer	-	
4.2	Place of manufacture	-	
4.3	Type	-	
4.4	Type of frame	-	
4.5	Insulation Class	-	
4.6	Compliance with SANS 948		
4.7	Speed of rotation	rpm	
4.8	Rated output at Site	kW	
4.9	Full load current	A	
	Efficiency at:		
4.10	Full load	%	
4.11	1/2 load	%	
	Power factor at:		
4.12	Full load	%	
4.13	1/2 load	%	
4.14	Operating voltage	V	
4.15	Starting method	-	
4.16	Starting current	A	
4.17	Temperature detectors in windings	Yes	
4.18	Temperature detectors on bearings	Yes	
4.19	Anti condensation heaters	Yes	
4.20	Mass of motor	Kg	

SIGNED ON BEHALF OF TENDERER :**NAME (in print) :****DATE :**

T2.3.4: LIME PUMPS REQUIREMENT DATA

Item	Equipment Data	Value	Comments
1	Equipment Title	CENTRIFUGAL PUMP — INLET WORKS	
2	Equipment No	[Equipment No]	
3	Total No	2	
4	Working No	1	
5	Standby No	1	
6	Fluid Capacity (L/s)	190.0	
7	Fluid Capacity (m³/h)	684.0	
8	Discharge Head – Design	223	
9	Differential Head	45.9 m	
10	NPSH Available (min)	2.6 m	
11	Flowrate – Nominal	684.00 m³/h	
12	Flowrate – Min	342.00 m³/h	
13	Flowrate – Max	684.00 m³/h	
14	Velocity – Discharge	0.53 m/s	
15	pH Range	5 – 8	
16	Corrosion Due To	Particles; Chemicals; Other: [Specify]	
17	Fluid Temperature	25 °C	
18	Liquid Vapour Pressure	2.7 kPa	
19	Density of Carrier Solution	0.998 kg/m³	
20	Density of Fluid	1.000 kg/m³	
21	Density of Solids	[kg/m³]	
22	Solids Concentration	0%	
23	Solids Type	Undissolved impurities; Ore; [Specify]	
24	Particle Size Distribution	d50 = 90 µm; d80 = 150 µm	
25	Largest Particle Size	[µm]	
26	Fluid Viscosity	10 cP	
27	Shear Behaviour	N/A; Thickening; Thinning:	
28	Solids Abrasiveness	N/A; Low; Moderate; High:	
29	External Flush Available	Yes; No:	

**T2.3.4.1: TO BE COMPLETED BY THE BIDDER
LIME PUMPS**

Description		Unit	Tenderer's Proposal
1	PUMP DETAILS		
1.1	Manufacturer	-	
1.2	Country of Manufacture	-	
1.3	Year of Manufacture	-	
1.4	Type	-	
1.5	Model	-	
1.6	Serial Number	-	
1.7	Pump Service	-	
1.8	Quantity	-	
2	TECHNICAL DETAILS		
2.1	Casing Type		
2.2	Casing Pressure	kPa	
2.3	Suction Internal Diameter	mm	
2.4	Discharge Internal Diameter	mm	
2.5	Impeller Diameter	mm	
2.6	Impeller Type	-	
2.7	Suction Flange Size	mm	
2.8	Discharge Flange Size	mm	
2.9	Flange Rating	KPa	
2.10	Type of Pump/Motor Coupling	-	
2.11	Type of Bearings	-	
2.12	Lubrication System (bearings)	-	
2.13	Mass	kg	
2.14	Shaft Speed	rpm	
2.15	Normal Operative Speed (Pump)	rpm	
2.16	Critical Speed of rotating Element	rpm	
2.17	Noise Level	dB	
2.18	Self Priming (Yes/No)	-	
2.19	Liquid Temperature	° C	
2.20	Pump Construction materials	-	
2.21	Corrosion Protection	-	
2.22	Solids Handling	%	
3	PUMP PERFORMANCE DETAILS		
3.1	Performance curves Attached to covering Letter	Yes/No	

T2.3.4.1: LIME PUMPS (Continued)

	At Rated Duty:	Yes/No	
3.2	Power Demand	kW	
3.3	NPSH for pump layout as shown	m	
3.4	Efficiency	%	
4	CENTRIFUGAL PUMP MOTOR DETAILS		
4.1	Manufacturer	-	
4.2	Place of manufacture	-	
4.3	Type	-	
4.4	Type of frame	-	
4.5	Insulation Class	-	
4.6	Compliance with SANS 948		
4.7	Speed of rotation	rpm	
4.8	Rated output at Site	kW	
4.9	Full load current	A	
	Efficiency at:		
4.10	Full load	%	
4.11	1/2 load	%	
	Power factor at:		
4.12	Full load	%	
4.13	1/2 load	%	
4.14	Operating voltage	V	
4.15	Starting method	-	
4.16	Starting current	A	
4.17	Temperature detectors in windings	Yes/No	
4.18	Temperature detectors on bearings	Yes/No	
4.19	Anti condensation heaters	Yes/No	
4.20	Mass of motor	Kg	

SIGNED ON BEHALF OF TENDERER :**NAME (in print) :****DATE :**

T2.3.5: SLUDGE PUMPS REQUIREMENT DATA

Item	Equipment Data	Value	Comments
1	Equipment Title	CENTRIFUGAL PUMP — INLET WORKS	
2	Equipment No	[Equipment No]	
3	Total No	2	
4	Working No	1	
5	Standby No	1	
6	Fluid Capacity (L/s)	190.0	
7	Fluid Capacity (m³/h)	684.0	
8	Discharge Head – Design	223	
9	Differential Head	45.9 m	
10	NPSH Available (min)	2.6 m	
11	Flowrate – Nominal	684.00 m³/h	
12	Flowrate – Min	342.00 m³/h	
13	Flowrate – Max	684.00 m³/h	
14	Velocity – Discharge	0.53 m/s	
15	pH Range	5 – 8	
16	Corrosion Due To	Particles; Chemicals; Other: [Specify]	
17	Fluid Temperature	25 °C	
18	Liquid Vapour Pressure	2.7 kPa	
19	Density of Carrier Solution	0.998 kg/m³	
20	Density of Fluid	1.000 kg/m³	
21	Density of Solids	[kg/m³]	
22	Solids Concentration	0%	
23	Solids Type	Undissolved impurities; Ore; [Specify]	
24	Particle Size Distribution	d50 = 90 µm; d80 = 150 µm	
25	Largest Particle Size	[µm]	
26	Fluid Viscosity	10 cP	
27	Shear Behaviour	N/A; Thickening; Thinning:	
28	Solids Abrasiveness	N/A; Low; Moderate; High:	
29	External Flush Available	Yes; No:	

**T2.3.5.1: TO BE COMPLETED BY THE BIDDER
TECHNICAL DATA SHEET 05: SLUDGE PUMPS**

Description		Unit	Tenderer's Proposal
1	PUMP DETAILS		
1.1	Manufacturer	-	
1.2	Country of Manufacture	-	
1.3	Year of Manufacture	-	
1.4	Type	-	
1.5	Model	-	
1.6	Serial Number	-	
1.7	Pump Service	-	
1.8	Quantity	-	
2	TECHNICAL DETAILS		
2.1	Casing Type		
2.2	Casing Pressure	kPa	
2.3	Suction Internal Diameter	mm	
2.4	Discharge Internal Diameter	mm	
2.5	Impeller Diameter	mm	
2.6	Impeller Type	-	
2.7	Suction Flange Size	mm	
2.8	Discharge Flange Size	mm	
2.9	Flange Rating	KPa	
2.10	Type of Pump/Motor Coupling	-	
2.11	Type of Bearings	-	
2.12	Lubrication System (bearings)	-	
2.13	Mass	kg	
2.14	Shaft Speed	rpm	
2.15	Normal Operative Speed (Pump)	rpm	
2.16	Critical Speed of rotating Element	rpm	
2.17	Noise Level	dB	
2.18	Self Priming (Yes/No)	-	
2.19	Liquid Temperature	° C	
2.20	Pump Construction materials	-	
2.21	Corrosion Protection	-	
2.22	Solids Handling	%	
3	PUMP PERFORMANCE DETAILS		
3.1	Performance curves Attached to covering Letter (COMPULSORY)	Yes	

TECHNICAL DATA SHEET 05: SLUDGE PUMPS (Continued)

	At Rated Duty:	Yes/No	
3.2	Power Demand	kW	
3.3	NPSH for pump layout as shown	m	
3.4	Efficiency	%	
4	CENTRIFUGAL PUMP MOTOR DETAILS		
4.1	Manufacturer	-	
4.2	Place of manufacture	-	
4.3	Type	-	
4.4	Type of frame	-	
4.5	Insulation Class	-	
4.6	Compliance with SANS 948		
4.7	Speed of rotation	rpm	
4.8	Rated output at Site	kW	
4.9	Full load current	A	
	Efficiency at:		
4.10	Full load	%	
4.11	1/2 load	%	
	Power factor at:		
4.12	Full load	%	
4.13	1/2 load	%	
4.14	Operating voltage	V	
4.15	Starting method	-	
4.16	Starting current	A	
4.17	Temperature detectors in windings	Yes/No	
4.18	Temperature detectors on bearings	Yes/No	
4.19	Anti condensation heaters	Yes/No	
4.20	Mass of motor	Kg	

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IMPORTED CONTENT SHEET : FORWARD EXCHANGE COVER FOR IMPORTED GOODS

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

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

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

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

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

Country	Exchange Rate

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DATE :

Tender for the refurbishment of Bronkhorstspuit water treatment plant for a period of twenty-four (24) months from commencement date. Volume 1: General Clauses, Tender Procedures, Contract Data, Pricing Data, Schedule of Quantities and Scope of Works
Portion 1: Tender

[illegible]

T2.4 TECHNICAL SCHEDULES – ELECTRICAL DATA SHEETS

<u>Document</u>	<u>Page</u>
3. Returnable data sheet that will be incorporated into the contract	
T2.4.1 Purification MCC datasheet	T2.4-2
T2.4.2 Raw Water Extraction MCC datasheet	T2.4-3
T2.4.3 400/231V Distribution board datasheet	T2.4-5
T2.4.4 400/231V UPS Distribution board datasheet	T2.4-6
T2.4.5 10kVA Uninterrupted Power Supply datasheet	T2.4-7
T2.4.6 Interface Relay Panel datasheet	T2.4-8
T2.4.7 Interface Relay Panel (Irp) – Datasheet	T2.4-9
T2.4.8 Stop / Start Station – Datasheet	T2.4-10

T2.4.1: PURIFICATION MCC- DATASHEET

Category	Parameter	Specification	Bidder Offer
General	Tag Number / Name	Main Purification MCC	
	Standards / Compliance	SANS 61439-1&2 / SANS 1973-1	
	Service Location	Indoor / Plant Room	
	Number of MCCs	2	
Electrical	Nominal Voltage	400V AC (3-Phase + N + E)	
	Frequency	50 Hz	
	Busbar Rating (Amps)	1250A	
	Fault Level (Icu)	50kA for 1 sec	
	Main Isolator Type	Air Circuit Breaker (ACB) / MCCB	
Mechanical	Form of Separation	Minimum Form 3b	
	Ingress Protection (IP)	IP54 or IP55	
	Paint Colour / Finish	Electric Orange (SANS 1091 C12) or Grey	
	Cable Entry	Bottom Entry	
Tier / Starter	Starter Types	DOL, VSD, Soft Starter	
	DOL Starter Make	Main components (Breaker, Int O/L Relay, Contactor)	
	Soft starter make	Make and type number	
	VSD make	Bidder to state	
	Utilisation	AC3, Type 2 coordination	
	Number of Starters	New MCC starter location to align with existing	
	Control Voltage	220V AC	
	Intelligent Overloads	Profinet	
	Controls	Hardwired and profinet	
Safety	Arc Flash Protection	Arc-containment design / Passive	
	Door Interlocking	Required (Mechanical & Electrical)	
	Emergency Stop	Master E-Stop on Incomer Section	

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T2.4.2: RAW WATER EXTRACTION MCC- DATASHEET

Category	Parameter	Specification	Bidder Offer
General	Tag Number / Name	Raw Water Extraction MCC	
	Standards / Compliance	SANS 61439-1&2 / SANS 1973-1	
	Service Location	Indoor / Plant Room	
	Number of MCCs	1	
Electrical	Nominal Voltage	400V AC (3-Phase + N + E)	
	Frequency	50 Hz	
	Busbar Rating (Amps)	1250A	
	Fault Level (Icu)	50kA for 1 sec	
	Main Isolator Type	Air Circuit Breaker (ACB) / MCCB	
Mechanical	Form of Separation	Form 3b or Form 4b Type 2	
	Ingress Protection (IP)	IP54 or IP55	
	Paint Colour / Finish	Electric Orange (SANS 1091 C12) or Grey	
	Cable Entry	Bottom Entry	
Tier / Starter	Starter Types	VSD	
	VSD make and type	Bidder to state	
	Utilisation	AC3, Type 2 coordination	
	Number of Starters	New MCC starter location to align with existing	
	Control Voltage	220V AC or 110V AC	
	Intelligent Overloads	Profinet	
Control/Comms	Controls	Mini local PLC with HMI	
	Module	Fibre optic comm	
Control Power	5kVA UPS	Panel inbuilt UPS	
Safety	Arc Flash Protection	Arc-containment design / Passive	
	Door Interlocking	Required (Mechanical & Electrical)	
	Emergency Stop	Master E-Stop on Incomer Section	

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T2.4.3: 400/231V DISTRIBUTION BOARD – DATASHEET

Category	Parameter	Specification	Bidder Offer
General	Tag Number / Name	L&SP DB	
	Standard Compliance	SANS 10142-1 / SANS 1973-3	
	Mounting Type	Surface Mounted / Flush / Floor Standing	
	Number of ways	30	
	Quantity of DB's	1	
Electrical	Rated Voltage	400V (Line-to-Line) / 231V (Line-to-Neutral)	
	Phase Configuration	3-Phase, 4-Wire + Earth (3P+N+E)	
	Incomer Rating	3p, 80A	
	Outgoing breaker ratings	1p, 20A -15off 1p,10A – 10off	
	Fault Level (kA)	10kA	
	Frequency	50 Hz	
Mechanical	Enclosure Material	Mild Steel (Powder Coated) or Thermoplastic	
	Ingress Protection (IP)	IP65 (Outdoor)	
	Colour	Electric Orange (SANS 1091 C12) or White	
	Cable Entry	Bottom	
Protection	Main Breaker	3-Pole MCCB	
	Earth Leakage (EL)	30mA Sensitivity (Required for socket outlets)	
	Surge Protection (SPD)	Class II / Type 2 (Recommended for RSA)	
	MCB Type	Curve C (General)	
Labels	Legend Card	Required inside the door	
	Safety Signage	"Danger - 400V" Flash required on the exterior	

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T2.4.4: 400/231V UPS DISTRIBUTION BOARD – DATASHEET

Category	Parameter	Specification	Bidder Offer
General	Tag Number / Name	UPS DB	
	Standard Compliance	SANS 10142-1 / SANS 1973-3	
	Mounting Type	Surface Mounted / Flush / Floor Standing	
	Number of ways	35	
	Quantity of DB's	1	
Electrical	Rated Voltage	400V (Line-to-Line) / 231V (Line-to-Neutral)	
	Phase Configuration	3-Phase, 4-Wire + Earth (3P+N+E)	
	Incomer Rating	4P, 80A	
	Outgoing Breaker Ratings	1P, 2A – 20 off 1P-16A – 15 off	
	Fault Level (kA)	10kA	
	Frequency	50 Hz	
Mechanical	Enclosure Material	Mild Steel (Powder Coated) or Thermoplastic	
	Ingress Protection (IP)	IP42 (Indoor)	
	Colour	Electric Orange (SANS 1091 C12) or White	
	Cable Entry	Bottom	
Protection	Main Breaker	3-Pole MCCB	
	Earth Leakage (EL)	Not required	
	Surge Protection (SPD)	Class II / Type 2 (Recommended for RSA)	
	MCB Type	Curve C (General)	
Labels	Legend Card	Required inside the door	
	Safety Signage	"Danger - 400V" Flash required on the exterior	

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T2.4.5: 10kVA UPS – DATASHEET

Category	Parameter	Specification / Value	Bidder Offer
General	Manufacturer / Model	Bidder to state	
	Topology	Online Double Conversion (VFI)	
	Rating (Power)	10 kVA / 9 kW or 10 kW (Unity PF)	
Input (AC)	Nominal Voltage	400V AC (3-Phase + N + E)	
	Input Voltage Range	305V – 477V AC at full load	
	Input Frequency	50 Hz (Auto-sensing)	
	Input Power Factor	> 0.99 (at full load)	
Output (AC)	Nominal Voltage	400V AC (3-Phase + N + E)	
	Voltage Regulation	± 1% (Static)	
	Output Frequency	50 Hz ± 0.1%	
	Total Harmonic Distortion (THDv)	< 2% (Linear Load) / < 5% (Non-linear)	
	Transfer Time	0 ms (Seamless)	
Battery	Battery Type	NiCad	
	DC Bus Voltage	192V DC or 240V DC	
	Backup Time (Autonomy)	30 mins at Full Load	
	Recharge Time	< 5 hours to 90%	
Bypass	Static Bypass	Integrated (Automatic on overload or fault)	
	Maintenance Bypass	Integrated (Manual)	
Communication	Ports	RS232, USB, RJ45 (SNMP)	
	Management	Web/SNMP Card (for SCADA/Network monitoring)	
Mechanical	Dimensions (H x W x D)	Bidder to state	
	Weight	Bidder to state	
	Ingress Protection	IP20 (Standard for Indoor)	

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T2.4.6: INTERFACE RELAY PANEL (IRP) – DATASHEET

Category	Parameter	Specification / Value	Bidder Offer
General	Tag Number / Name	IRP01/02	
	Application	Interposing & Signal Isolation	
	Standard Compliance	SANS 10142-1 / SANS 1973-3	
	Number of IRPs	2 (one for each Purification MC)	
Relay Specs	Relay Type	Slimline / Plug-in / Electromechanical	
	Manufacturer / Range	Bidder to state	
	Coil Voltage	24V DC (PLC side) or 110V AC/DC	
	Contact Rating	6A / 10A @ 250V AC	
	Contact Configuration	1 C/O (SPDT) or 2 C/O (DPDT)	
	Mechanical Indicator	Included (Visual LED + Flag)	
	Number of Relays	4 per DOL Starter (see drawing RAL-BRK-05-ECI-001_Rev A Schematic DOL)	
Mechanical	Enclosure Type	Wall Mounted / Floor Standing	
	Dimensions (H x W x D)	Bidder to state	
	Ingress Protection (IP)	IP54 or IP65	
	Terminal Type	Screw Clamp or Push-in (Vibration resistant)	
Wiring	Wire Type	1.0mm ² Flexible Copper (Panel Wire)	
	Ferrule Type	Bootlace with identifying tags	
	Trunking Type	PVC Slotted (Halogen-free preferred)	
Safety	Isolation Voltage	4kV between Coil and Contact	
	Surge Protection	Snubber / Diode module for back-EMF	

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T2.4.7: INTERFACE RELAY PANEL (IRP) – DATASHEET

Category	Parameter	Specification / Value	Bidder Offer
General	Tag Number / Name		
	Application	Interposing & Signal Isolation	
	Standard Compliance	SANS 10142-1 / SANS 1973-3	
	Number of IRPs	2 (Purification MCC and Lime Handling MCC)	
Relay Specs	Relay Type	Slimline / Plug-in / Electromechanical	
	Manufacturer / Range		
	Coil Voltage	24V DC (PLC side) or 110V AC/DC	
	Contact Rating	6A / 10A @ 250V AC	
	Contact Configuration	1 C/O (SPDT) or 2 C/O (DPDT)	
	Mechanical Indicator	Included (Visual LED + Flag)	
	Number of Relays	As per existing hardwire MCC signals	
Mechanical	Enclosure Type	Wall Mounted / Floor Standing	
	Dimensions (H x W x D)		
	Ingress Protection (IP)	IP54 or IP65	
	Terminal Type	Screw Clamp or Push-in (Vibration resistant)	
Wiring	Wire Type	1.0mm ² Flexible Copper (Panel Wire)	
	Ferrule Type	Bootlace with identifying tags	
	Trunking Type	PVC Slotted (Halogen-free preferred)	
Safety	Isolation Voltage	4kV between Coil and Contact	
	Surge Protection	Snubber / Diode module for back-EMF	

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T2.4.8: STOP / START STATION – DATASHEET

Parameter	Specification / Requirement	Bidder offer
General Information		
Equipment Name	Stop / Start Station	
Manufacturer	Bidder to state	
Part Number	Bidder to state	
Quantity	20	
Enclosure Material	Polycarbonate	
IP / NEMA Rating	IP67 (minimum)	
Mounting Type	Wall Mount, Column Mount	
Cable Entry	2 x M20 Bottom	
Operator Configuration		
Pushbutton 1 (Function)	Start (Green - Flush)	
Pushbutton 1 (Contacts)	2 x NO	
Pushbutton 2 (Function)	Stop (Red - Extended)	
Pushbutton 2 (Contacts)	2 x NC	
Voltage Rating	240V AC	
Electrical Ratings		
Rated Current (Ith)	10 Amps	
Rated Insulation (Ui)	600V	

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T2.5 TECHNICAL SCHEDULES – INSTRUMENTATION DATA SHEETS

<u>Document</u>	<u>Page</u>
3. Returnable data sheet that will be incorporated into the contract	
T2.5.1 Turbine Flowmeter Type1 - 700mm diameter	T2.5-2
T2.5.2 Turbine Flowmeter Type2 - 32mm diameter	T2.5-3
T2.5.3 Turbine Flowmeter Type3 -15mm diameter	T2.5-4
T2.5.4 Magnetic Flowmeter Type4 -150mm diameter	T2.5-5
T2.5.5 Magnetic Flowmeter Type4 - 700mm diameter	T2.5-6
T2.5.6 Motorised Valve1 - 600mm diameter	T2.5-7
T2.5.7 Motorised Valve2 - 300mm diameter	T2.5-8
T2.5.8 Motorised Valve3 - 200mm diameter	T2.5-9
T2.5.9 Motorised Valve4 -100mm diameter	T2.5-10
T2.5.10 Motorised Valve5 - 60mm diameter	T2.5-11
T2.5.11 Open channel flow meter	T2.5-12
T2.5.12 Turbidity transmitter	T2.5-13
T2.5.13 Level transmitter	T2.5-14
T2.5.14 PLC	T2.5-15
T2.5.15 SCADA	T2.5-16
T2.5.16 Commissioning Windows Laptop	T2.5-17

T2.6.1: TURBINE FLOWMETER TYPE 1 - 700mm DIAMETER- DATA

Category	Parameter	Specification / Value	Bidder Offer
General	Manufacturer / Model	Bidder to State	
	Tag Number		
	Quantity	1	
Process Conditions	Fluid Media	Water	
	Operating Temperature	-20°C to +120°C	
	Operating Pressure	1.6 MPa / 16 Bar	
	Flow Range	4 to 40 m³/h	
	Density / Viscosity	1	
Performance	Accuracy Class	±0.5% or ±1.0% of reading	
	Repeatability	±0.1%	
	Turn-down Ratio	10:1 or Bidder to State	
Mechanical	Pipe Diameter (DN)	700mm	
	Connection Type	Flanged	
	Body Material	SS304 or SS316L	
	Rotor/Bearing Material	Tungsten Carbide / CD4MCu	
Electrical	Power Supply	230V AC or 24V DC	
	Output Signal	4-20mA	
	Ingress Protection	IP65 or IP67	
	Local Control Panel Unit	Yes	

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T2.6.2: TURBINE FLOWMETER TYPE 2 - 32mm DIAMENETER- DATA

Category	Parameter	Specification / Value	Bidder Offer
General	Manufacturer / Model	Bidder to State	
	Tag Number		
	Quantity	4	
Process Conditions	Fluid Media	Water	
	Operating Temperature	-20°C to +120°C	
	Operating Pressure	1.6 MPa / 16 Bar	
	Flow Range	4 to 40 m³/h	
	Density / Viscosity	1	
Performance	Accuracy Class	±0.5% or ±1.0% of reading	
	Repeatability	±0.1%	
	Turn-down Ratio	10:1 or Bidder to State	
Mechanical	Pipe Diameter (DN)	32mm	
	Connection Type	Flanged	
	Body Material	SS304 or SS316L	
	Rotor/Bearing Material	Tungsten Carbide / CD4MCu	
Electrical	Power Supply	230V AC or 24V DC	
	Output Signal	4-20mA	
	Ingress Protection	IP65 or IP67	
	Local Control Panel Unit	Yes	

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T2.6.3: TURBINE FLOWMETER TYPE 3 - 15mm DIAMETER- DATA

Category	Parameter	Specification / Value	Bidder Offer
General	Manufacturer / Model	Bidder to State	
	Tag Number		
	Quantity	4	
Process Conditions	Fluid Media	Water	
	Operating Temperature	-20°C to +120°C	
	Operating Pressure	1.6 MPa / 16 Bar	
	Flow Range	4 to 40 m³/h	
	Density / Viscosity	1	
Performance	Accuracy Class	±0.5% or ±1.0% of reading	
	Repeatability	±0.1%	
	Turn-down Ratio	10:1 or Bidder to State	
Mechanical	Pipe Diameter (DN)	15mm	
	Connection Type	Flanged	
	Body Material	SS304 or SS316L	
	Rotor/Bearing Material	Tungsten Carbide / CD4MCu	
Electrical	Power Supply	230V AC or 24V DC	
	Output Signal	4-20mA	
	Ingress Protection	IP65 or IP67	
	Local Control Panel Unit	Yes	

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T2.6.4: MAGNETIC FLOWMETER TYPE 4 - 150mm DIAMETER- DATA

Category	Parameter	Specification / Value	Bidder Offer
General	Manufacturer / Model	Bidder to State	
	Tag Number		
	Quantity	2	
Process Conditions	Fluid Media	Water	
	Operating Temperature	-20°C to +120°C	
	Operating Pressure	1.6 MPa / 16 Bar	
	Flow Range	4 to 40 m³/h	
	Density / Viscosity	1	
Performance	Accuracy Class	±0.5% or ±1.0% of reading	
	Repeatability	±0.1%	
	Turn-down Ratio	10:1 or Bidder to State	
Mechanical	Pipe Diameter (DN)	150mm	
	Connection Type	Flanged	
	Body Material	SS304 or SS316L	
	Rotor/Bearing Material	Tungsten Carbide / CD4MCu	
Electrical	Power Supply	230V AC or 24V DC	
	Output Signal	4-20mA	
	Ingress Protection	IP65 or IP67	
	Local Control Panel Unit	Yes	

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T2.6.5: MAGNETIC FLOWMETER TYPE 4 - 700mm DIAMETER- DATA

Category	Parameter	Specification / Value	Bidder Offer
General	Manufacturer / Model	Bidder to State	
	Tag Number		
	Quantity	2	
Process Conditions	Fluid Media	Water	
	Operating Temperature	-20°C to +120°C	
	Operating Pressure	1.6 MPa / 16 Bar	
	Flow Range	4 to 40 m³/h	
	Density / Viscosity	1	
Performance	Accuracy Class	±0.5% or ±1.0% of reading	
	Repeatability	±0.1%	
	Turn-down Ratio	10:1 or Bidder to State	
Mechanical	Pipe Diameter (DN)	700mm	
	Connection Type	Flanged	
	Body Material	SS304 or SS316L	
	Rotor/Bearing Material	Tungsten Carbide / CD4MCu	
Electrical	Power Supply	230V AC or 24V DC	
	Output Signal	4-20mA	
	Ingress Protection	IP65 or IP67	
	Local Control Panel Unit	Yes	

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T2.6.6: MOTORISED VALVE TYPE 1 - 600mm DIAMETER- DATASHEET

Category	Parameter	Specification / Value	Bidder Offer
General	Tag Number / Service		
	Valve Type	Gate	
	Action	Control	
	Quantity	10	
Valve Body	Nominal Diameter (DN)	600mm	
	Pressure Rating	PN16, PN40, or ANSI 150	
	End Connections	Flanged SANS 1123 / Wafer / Lugged	
	Body / Ball / Disc Material	WCB Carbon Steel	
	Seat / Seal Material	PTFE (Soft) or Metal Seated	
Actuator	Type	Electric (Quarter-turn or Multi-turn)	
	Manufacturer / Model	Bidder to State	
	Supply Voltage	400V 3-Phase	
	Torque Requirement	Bidder to State	
	Enclosure Rating	Non Ex	
Control & Signal	Control Signal	4-20mA (Modulating)	
	Feedback Signals	Open/Closed Limits, 4-20mA Position	
	Fail-Safe Position	Stayput, Fail-Close (requires battery/spring)	
	Local Control	Local/Remote Switch & Open/Close buttons	
Operating Data	Operating Temperature	-10°C to +80°C	
	Stroke Time (Open/Close)	< 30 seconds	

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T2.6.7: MOTORISED VALVE TYPE 2 - 300mm DIAMETER- DATASHEET

Category	Parameter	Specification / Value	Bidder Offer
General	Tag Number / Service		
	Valve Type	Gate	
	Action	Control	
	Quantity	30	
Valve Body	Nominal Diameter (DN)	300mm	
	Pressure Rating	PN16, PN40, or ANSI 150	
	End Connections	Flanged SANS 1123 / Wafer / Lugged	
	Body / Ball / Disc Material	WCB Carbon Steel	
	Seat / Seal Material	PTFE (Soft) or Metal Seated	
Actuator	Type	Electric (Quarter-turn or Multi-turn)	
	Manufacturer / Model	Bidder to State	
	Supply Voltage	400V 3-Phase	
	Torque Requirement	Bidder to State	
	Enclosure Rating	Non Ex	
Control & Signal	Control Signal	4-20mA (Modulating)	
	Feedback Signals	Open/Closed Limits, 4-20mA Position	
	Fail-Safe Position	Stayput, Fail-Close (requires battery/spring)	
	Local Control	Local/Remote Switch & Open/Close buttons	
Operating Data	Operating Temperature	-10°C to +80°C	
	Stroke Time (Open/Close)	< 30 seconds	

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T2.6.8: MOTORISED VALVE TYPE 3 - 200mm DIAMETER- DATASHEET

Category	Parameter	Specification / Value	Bidder Offer
General	Tag Number / Service		
	Valve Type	Gate	
	Action	Control	
	Quantity	10	
Valve Body	Nominal Diameter (DN)	200mm	
	Pressure Rating	PN16, PN40, or ANSI 150	
	End Connections	Flanged SANS 1123 / Wafer / Lugged	
	Body / Ball / Disc Material	WCB Carbon Steel	
	Seat / Seal Material	PTFE (Soft) or Metal Seated	
Actuator	Type	Electric (Quarter-turn or Multi-turn)	
	Manufacturer / Model	Bidder to State	
	Supply Voltage	400V 3-Phase	
	Torque Requirement	Bidder to State	
	Enclosure Rating	Non Ex	
Control & Signal	Control Signal	4-20mA (Modulating)	
	Feedback Signals	Open/Closed Limits, 4-20mA Position	
	Fail-Safe Position	Stayput, Fail-Close (requires battery/spring)	
	Local Control	Local/Remote Switch & Open/Close buttons	
Operating Data	Operating Temperature	-10°C to +80°C	
	Stroke Time (Open/Close)	< 30 seconds	

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T2.6.9: MOTORISED VALVE TYPE 4 - 100mm DIAMETER- DATASHEET

Category	Parameter	Specification / Value	Bidder Offer
General	Tag Number / Service		
	Valve Type	Gate	
	Action	Control	
	Quantity	10	
Valve Body	Nominal Diameter (DN)	100mm	
	Pressure Rating	PN16, PN40, or ANSI 150	
	End Connections	Flanged SANS 1123 / Wafer / Lugged	
	Body / Ball / Disc Material	WCB Carbon Steel	
	Seat / Seal Material	PTFE (Soft) or Metal Seated	
Actuator	Type	Electric (Quarter-turn or Multi-turn)	
	Manufacturer / Model	Bidder to State	
	Supply Voltage	400V 3-Phase	
	Torque Requirement	Bidder to State	
	Enclosure Rating	Non Ex	
Control & Signal	Control Signal	4-20mA (Modulating)	
	Feedback Signals	Open/Closed Limits, 4-20mA Position	
	Fail-Safe Position	Stayput, Fail-Close (requires battery/spring)	
	Local Control	Local/Remote Switch & Open/Close buttons	
Operating Data	Operating Temperature	-10°C to +80°C	
	Stroke Time (Open/Close)	< 30 seconds	

SIGNED ON BEHALF OF TENDERER :**NAME (in print) :****DATE :**

T2.6.10: MOTORISED VALVE TYPE 5 - 60mm DIAMETER- DATASHEET

Category	Parameter	Specification / Value	Bidder Offer
General	Tag Number / Service		
	Valve Type	Gate	
	Action	Control	
	Quantity	5	
Valve Body	Nominal Diameter (DN)	60mm	
	Pressure Rating	PN16, PN40, or ANSI 150	
	End Connections	Flanged SANS 1123 / Wafer / Lugged	
	Body / Ball / Disc Material	WCB Carbon Steel	
	Seat / Seal Material	PTFE (Soft) or Metal Seated	
Actuator	Type	Electric (Quarter-turn or Multi-turn)	
	Manufacturer / Model	Bidder to State	
	Supply Voltage	400V 3-Phase	
	Torque Requirement	Bidder to State	
	Enclosure Rating	Non Ex	
Control & Signal	Control Signal	4-20mA (Modulating)	
	Feedback Signals	Open/Closed Limits, 4-20mA Position	
	Fail-Safe Position	Stayput, Fail-Close (requires battery/spring)	
	Local Control	Local/Remote Switch & Open/Close buttons	
Operating Data	Operating Temperature	-10°C to +80°C	
	Stroke Time (Open/Close)	< 30 seconds	

SIGNED ON BEHALF OF TENDERER :**NAME (in print) :****DATE :**

T2.6.11: OPEN CHANNEL FLOWMETER - DATASHEET

Category	Parameter	Specification / Value	Bidder Offer
General	Manufacturer / Model	Bidder to State	
	Tag Number		
	Quantity	3	
Process Conditions	Fluid Media	Water	
	Operating Temperature	-20°C to +120°C	
	Flow Range	4 to 40 m³/h	
	Density / Viscosity	1	
Performance	Accuracy Class	±0.5% or ±1.0% of reading	
	Repeatability	±0.1%	
	Turn-down Ratio	10:1 or Bidder to State	
Mechanical	Mounting	Bracket over channel or side mount	
	Connection Type	Ultrasonic	
Electrical	Power Supply	230V AC or 24V DC	
	Output Signal	4-20mA	
	Ingress Protection	IP65 or IP67	
	Local Control Panel Unit	Yes	

SIGNED ON BEHALF OF TENDERER :

NAME (in print) :

DATE :

T2.6.12: LEVEL TRANSMITTER - DATASHEET

Category	Parameter	Specification / Value	Bidder Offer
General	Manufacturer / Model	Bidder to State	
	Tag Number		
	Quantity	4	
Process Conditions	Fluid Media	Water	
	Operating Temperature	-20°C to +120°C	
	Range	0 to 15 m	
	Density / Viscosity	1	
Performance	Accuracy Class	±0.5% or ±1.0% of reading	
	Repeatability	±0.1%	
	Blocking distance	0.1m	
Mechanical	Type	Lens	
	Material	Stainless steel	
Electrical	Power Supply	230V AC or 24V DC	
	Output Signal	4-20mA	
	Ingress Protection	IP68	
	Local Control Panel Unit	Yes, with LCD	

SIGNED ON BEHALF OF TENDERER :**NAME (in print) :****DATE :**

T2.6.13: TURBIDITY TRANSMITTER- DATASHEET

Category	Parameter	Specification / Value	Bidder Offer
General	Manufacturer / Model	Bidder to State	
	Tag Number		
	Quantity	3	
Process Conditions	Fluid Media	Water	
	Measuring Range	0.001 to 4000 NTU /FNU	
	Max Pressure	1.6 MPa / 16 Bar	
	Flow Range	4 to 40 m³/h	
	Density / Viscosity	1	
Performance	Accuracy Class	±0.5% or ±1.0% of reading	
	Repeatability	±0.1%	
	Response Time (T90)	>30sec	
Mechanical	Mount	Wall mount	
	Connection Type	Immersion	
Electrical	Power Supply	230V AC or 24V DC	
	Output Signal	4-20mA	
	Ingress Protection	IP65 or IP67	
	Local Control Panel Unit	Yes, Touchscreen	
	Cable	15m integrated	

SIGNED ON BEHALF OF TENDERER :**NAME (in print) :****DATE :**

T2.6.14: MAIN PLANT PLC SYSTEM - DATASHEET

Category	Parameter	Bidder Offer
General	Manufacturer / Range	
	PLC Tag / Designation	
	Architecture	
CPU Specs	Processor / Execution Speed	
	Work Memory / Load Memory	
	Retentive Memory	
I/O Capacity	Digital Inputs (DI)	
	Digital Outputs (DO)	
	Analog Inputs (AI)	
	Analog Outputs (AO)	
	Expansion Capability	
Comms	Integrated Interfaces	
	Protocols Supported	
Electrical	Supply Voltage	
	Current Consumption	
Environment	Operating Temp Range	
	Mounting Type	

SIGNED ON BEHALF OF TENDERER :

NAME (in print) :

DATE :

T2.6.15: MAIN PLANT SCADA SYSTEM - DATASHEET

Category	Minimum Parameters	Bidder Offer
Software	Developer / Platform	
	Version / Build	
	License Type	
System	Architecture	
	500 Tag Counts	
	Client Count	
Historian	Data Logging Rate	
	Database Type	
	Storage Capacity	
Features	Alarm Management	
	Reporting Tools	
	Security	
Comms	Driver Library	
	Web Access	
HMI	2 x 27inch screens	
Processor	1GHz	

SIGNED ON BEHALF OF TENDERER :**NAME (in print) :****DATE :**

Contract No: WSBU 15 2025/26

Tender for the refurbishment of Bronkhorstspuit water treatment plant for a period of twenty-four (24) months from commencement date. Volume 1: General Clauses, Tender Procedures, Contract Data, Pricing Data, Schedule of Quantities and Scope of Works

Portion 1: Tender

Part T2: Returnable Documents

T2.6.16: COMISSIONING STAND ALONE WINDOWS LAPTOP

Category	Min Parameter	Bidder Offer
Software	Firmware:Windows	
	Storage:500GB ssd	
	Ram:16GB	
	Process:i5	
	Intelligent relay software (preloaded)	
	Pdf reader	

SIGNED ON BEHALF OF TENDERER :

NAME (in print) :

DATE :

Contract No: WSBU 15 2025/26

Tender for the refurbishment of Bronkhorstspuit water treatment plant for a period of twenty-four (24) months from commencement date.

Volume 1: General Clauses, Tender Procedures, Contract Data, Pricing Data, Schedule of Quantities and Scope of Works

Portion 2: Contract

Part C1: Agreements and Contract Data

**CITY OF TSHWANE
WATER AND SANITATION DEPARTMENT**

CONTRACT NO: WSBU 15 2025/26

**TENDER FOR THE REFURBISHMENT OF BRONKHORSTSPRUIT WATER
TREATMENT PLANT FOR A PERIOD OF TWENTY-FOUR (24) MONTHS FROM
COMMENCEMENT DATE.**

PORTION 2: CONTRACT

PART C1: AGREEMENTS AND CONTRACT DATA

C1 AGREEMENTS AND CONTRACT DATA

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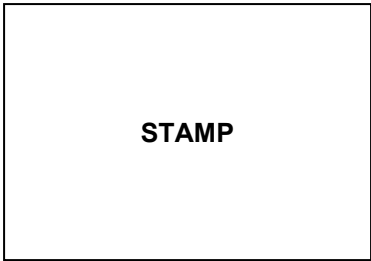
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C1.1 FORM OF OFFER AND ACCEPTANCE

OFFER

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

CONTRACT NO: WSBU 15 2025/26



TENDER FOR THE REFURBISHMENT OF BRONKHORSTSPRUIT WATER TREATMENT PLANT FOR A PERIOD OF TWENTY-FOUR (24) MONTHS FROM COMMENCEMENT DATE.

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

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

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

R(in figures)
.....(in words)

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

FOR AND ON BEHALF OF THE TENDERER:

NAME(s): (in block letters)	.....	.....
CAPACITY of authorized agents:	.....	.....
SIGNATURE(s) of authorized agents:	.....	.....
SIGNED at	 on this	 day of
WITNESSES: (Full name – in block letters – and signature)		
1.	.....	.....
2.	.....	.....

ACCEPTANCE

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

The terms of the contract, are contained in

Part T1 Tendering Procedures
Part T2 Returnable Documents
Part C1 Agreements and Contract Data, (which includes this Agreement)
Part C2 Pricing Data
Part C3 Scope of Work

and drawings and documents or parts thereof, which may be incorporated by reference into Parts C1 to C3 above.

Deviations from and amendments to the documents listed in the Tender Data and any addenda thereto listed in the Tender Schedules as well as any changes to the terms of the Offer agreed by the Tenderer and the Employer during this process of offer and acceptance, are contained in the Schedule of Deviations attached to and forming part of this Agreement. No amendments to or deviations from said documents are valid unless contained in this schedule.

The Tenderer shall within two weeks after receiving a letter of acceptance, contact the Employer's agent (whose details are given in the Contract Data) to arrange the delivery of guarantees, proof of insurance and any other documentation to be provided in terms of the Conditions of Contract identified in the Contract Data. Failure to fulfil any of these obligations in accordance with those terms shall constitute a repudiation of this Agreement.

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

FOR AND ON BEHALF OF THE EMPLOYER:

NAME(s): (BLOCK LETTERS)	.....	.....
CAPACITY of authorized agents:	.....	.....
SIGNATURE(s) of authorized agents:	.....	.....
SIGNED at	 on this	 day of
WITNESSE(s): (Full name – BLOCK LETTERS – and signature)		
1.	.....	.....
2.	.....	.....

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 Tenderer's covering letter shall not be included in the final contract document. Should any matter in such, letter, which constitutes a deviation as aforesaid become the subject of agreements reached during the process of, offer and acceptance, the outcome of such agreement shall be recorded here;
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;
4. Any change or addition to the tender documents arising from the above agreements and recorded here shall also be incorporated into the final draft of the Contract.

4.1	Subject	.....
	Details	.....
4.2	Subject	.....
	Details	.....
4.3	Subject	.....
	Details	.....
4.4	Subject	.....
	Details	.....
4.5	Subject	.....
	Details	.....

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

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

FOR AND ON BEHALF OF THE **TENDERER:**

NAME(s): (in block letters)

.....

CAPACITY of authorized agents:

.....

SIGNATURE(s) of authorized agents:

.....

SIGNED at

on this

day of

WITNESSES: (Full name – in block letters – and signature)

1.

.....

2.

.....

FOR AND ON BEHALF OF THE **EMPLOYER:**

NAME(s): (in block letters)

.....

CAPACITY of authorized agents:

.....

SIGNATURE(s) of authorized agents:

.....

SIGNED at

on this

day of

WITNESSES: (Full name – in block letters – and signature)

1.

.....

2.

.....

CONFIRMATION OF RECEIPT

The Tenderer, (now Contractor), identified in the Offer part of this Agreement hereby confirms receipt from the Employer, identified in the Acceptance part of this Agreement, of one fully completed original copy of this Agreement, including the Schedule of Deviations (if any) today
the _____ (day) of _____ (month) _____
_ (year) at _____ (place).

FOR AND ON BEHALF OF THE CONTRACTOR:

NAME:

(In BLOCK letters)

CAPACITY:

(Of authorized agent)

SIGNATURE:

(Of authorized agent)

SIGNED at _____ on this _____ day of _____

WITNESSES:

(Full name in BLOCK letters and
signature)

1. _____
2. _____

C1.2. CONTRACT DATA

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C1.2.1 GENERAL CONDITIONS OF CONTRACT

The general conditions of contract applicable to this contract shall be **General Conditions of Contract for Construction Works, Third Edition (2015)** of the South African Institution of Civil Engineering (SAICE), read together with the Variations and Additions to the Conditions of Contract as well as the Data provided by Employer.

Tenderers, contractors and subcontractors shall obtain their own copies of the document **General Conditions of Contract for Construction Works, Third Edition (2015)** for tendering purposes and for use for the duration of the contract from the Secretary of the South African Institution of Civil Engineering, Private Bag X200, Halfway House, Midrand, 1685 and shall bear all expenses in this regard:

South African Institution of Civil Engineering (SAICE)

Telephone: 011 80505947 / 48 / 53

E-Mail: civilinfo@saice.org.za

Web: www.saice.org.za

C1.2.2 VARIATIONS AND ADDITIONS TO THE CONDITIONS OF CONTRACT

The following variations and additions to the **General Conditions of Contract for Construction Works, Third Edition (2015)**, shall apply to this contract:

CLAUSE / SUB-CLAUSE	DESCRIPTION	VARIATION / ADDITION
1.1.1	Definitions	1.1.1.3 Certificate of Completion <u>Add</u> the following to the clause: <i>Unless specified otherwise in the Contract Data, separate Certificates of Completion will not be issued for portions or phases of the Works.</i> 1.1.1.24 Practical Completion <u>Add</u> the following to the clause: <i>Separate Certificates of Practical Completion (Sectional Practical Completion Certificates) shall be issued for each Section, namely:</i> Section 1 – Bronkhorstspuit WTP Module 1 Treatment Units Section 2 – Bronkhorstspuit WTP Module 2 and Remaining Works <i>The provisions of Clause 5.14 shall apply mutatis mutandis to each Section.</i> <u>Add</u> the following new clause: 1.1.1.35 Construction Work Permit <i>Construction Work Permit” means a statutory permit as defined in the Construction Regulations 2014.</i>
1.2.1	Delivery of notices	<u>Add</u> the following to the clause: <i>1.2.1.3 Sent by facsimile, electronic or any like communication irrespective of time of transmission;</i> <i>1.2.1.4 posted to the Contractor’s address, and delivered by the postal authorities; or</i> <i>1.2.1.5 delivered by a courier service or messenger, and signed for by the recipient or his representative.</i>
1.2.3	Authority representatives of	<u>Add</u> the following to the clause: <i>1.2.3.1 The Employer has authorised the Group Head: Water and Sanitation Business Unit to act on his behalf in respect of this Contract, save for such duties or functions:</i> <i>1.2.3.1.1 which other holders of office ex officio execute on behalf of the Employer; or</i> <i>1.2.3.1.2 for which the Group Head: Water and Sanitation Business Unit has no authority and the Employer’s approval is required before execution thereof.</i>

2.4.1	Ambiguity or Discrepancy	Delete the contents of the clause and insert the following: <i>The documents forming the Contract are to be taken as mutually explanatory of one another. For the purposes of interpretation, the priority of the documents shall be in accordance with the following sequence, listed from highest to lowest priority:</i> <i>a)Form of Offer and Acceptance b)Contract Data c)General Conditions of Contract d)Drawings e)Scope of Work f) Standard Specifications g)Bill of Quantities h)any other documents forming part of the Contract</i> <i>Upon finding any ambiguity in, or discrepancy between, or otherwise any error in the documents, the Contractor shall forthwith advise the Employer's Agent thereof before applying an interpretation in accordance with the above priority. If, after applying the above priority, an ambiguity in, or discrepancy between, or otherwise any remaining error in the documents remains, the Employer's Agent shall provide the necessary clarification or instruction.</i>
3.2.3	Specific approval of the Employer required	Replace clause 3.2.3 with the following: <i>In addition to the functions or duties set out in the Contract Data under Data Provided By The Employer, the Employer's Agent is required to obtain the specific prior approval of the Employer for:</i> <i>3.2.3.1 certification of expenditure that exceeds the Contract Price in terms of Clause 1.1.1.10;</i> <i>3.2.3.2 issuing of an order to suspend the progress of the Works in terms of Clause 5.11.2, the extra cost resulting from which order is to be borne by the Employer or the effect of which is liable to give rise to a claim by the Contractor for an extension of time under Clause 5.12 of these conditions;</i> <i>3.2.3.3 issuing of an instruction or order to vary the nature or quantity of the Works in terms of Clause 6.3, the estimated effect of which will be to increase the Contract Price by an amount exceeding R100 000, the evaluation of all variation orders in terms of Clause 6.4 and the adjustment of the sum(s) tendered for General Items in terms of Clause 6.11; or</i> <i>3.2.3.4 approval of any claim submitted by the Contractor in terms of Clause 10.1.</i>
4.1.2	Contractor's liability for own design errors	Add the following to the clause: <i>The Contractor shall provide the following to the Employer's Agent for retention by the Employer or his assignee in respect of all works designed by the Contractor:</i> <i>4.1.2.1 A Certificate of Stability of the Works signed by a registered Professional Engineer confirming that all such works have been designed in accordance with the appropriate codes of practice.</i> <i>4.1.2.2 Proof of registration and of adequate and current professional indemnity insurance cover held by the designer(s).</i> <i>4.1.2.3 Design calculations should the Employer's Agent request a copy thereof.</i> <i>4.1.2.4 Engineering drawings and workshop details (both signed by the relevant professional engineer), in order to allow the Employer's Agent to compare the design with the specified requirements and to record any comments he may have with respect thereto.</i> <i>4.1.2.5 "As-Built" drawings in DXF electronic format after completion of the Works.</i> <i>The Contractor shall be responsible for the design of the Temporary Works.</i>
4.3	Legal Provisions	Add the following new sub-clause:

		1.3.3 Wages and conditions of work: <i>i. For conventional construction works the Basic Conditions of Employment Act of 1997 (Act No 75 of 1997) shall apply and the minimum employment conditions which will apply shall be guided by the Bargaining Council for the Civil Engineering Industry Collective Agreement as published from time to time.</i> <i>ii. Basic Conditions of Employment Act of 1997 (Act No 75 of 1997) as per Government Notice R63 of 25 January 2002, shall apply to works described in the Scope of Work as being labour intensive and which are undertaken by unskilled or semi-skilled workers.</i> Add the following new sub-clause: <i>4.3.4 Notwithstanding any actions which the Employer may take, the Contractor accepts sole liability for due compliance with the relevant duties, obligations, prohibitions, arrangements and procedures imposed by the Occupational Health and Safety Act, 1993 (Act 85 of 1993), and all its regulations, including the Construction Regulations, 2014, for which he is liable as mandatory. By entering into this Contract it shall be deemed that the parties have agreed in writing to the above provisions in terms of Section 37(2) of the Act. The Contractor shall sign the Occupational Health and Safety Agreement for Contract Work in the City of Tshwane Metropolitan Municipality included in section C1.5.</i> Add the following new sub-clause: <i>4.3.5 The Employer retains an interest in all inquiries conducted under this Contract in terms of Section 31 and/or 32 of the Occupational Health and Safety Act, 1993 (Act 85 of 1993) and its Regulations following any incident involving the Contractor and/or Sub-Contractor and/or their employees. The Contractor shall notify the Employer in writing of all investigations, complaints or criminal charges which may arise pursuant to work performed under this Contract in terms of the Occupational Health and Safety Act, 1993 (Act 85 of 1993) and Regulations.</i> Add the following new sub-clause: 4.3.6 Contractor's Designer <i>The Contractor and his designer shall accept full responsibility and liability to comply with the Occupational Health and Safety Act, 1993 (Act 85 of 1993) and the Construction Regulations, 2014 for the design of the Temporary Works and those part of the Permanent Works which the Contractor is responsible to design in terms of the Contract</i>

		Add the following new sub-clause: 4.3.7 Construction Work Permit <i>Unless duly exempted or otherwise duly agreed with the Contractor, the Employer shall forthwith, where a Construction Work Permit in terms of Regulation 3(1) of the Construction Regulations 2014 is required to be obtained by the Employer without derogation from the Employer's duties, the Employer or his duly appointed Construction Health and Safety Agent in terms of Regulation 5(6) or otherwise, upon the Construction Work Permit becoming available, issue it to the Employer's Agent, who, in turn, shall forthwith issue it to the Contractor.</i> <i>Notwithstanding anything stipulated to the contrary in these Conditions, the Contractor shall not be entitled to any claim or extension of time arising from any delay in obtaining a Construction Work Permit which has been duly applied for, unless such delay exceeds 84 consecutive days.</i>
5.3.3	Time to instruct the commencement of the works	Replace both periods of "7 days" in Clause 5.3.3 with "14 days".
5.6.1	Programme of works	Add the following to the clause: <i>The Contractor shall have regard for the phases and sub-phases (if applicable) for the Works, which shall also be the order in which the Permanent Works shall be constructed, unless otherwise agreed between the parties and committed to writing. If phased construction is applicable, the phases and sub-phases will be described in the Scope of Works and/or will be indicated on the Phasing Plan which forms part of the Drawings,</i> <i>The Contractor's programme shall clearly identify the two Sections of the Works and their interdependencies..</i>
5.7.1	Rate of progress	Delete the last paragraph of the clause and replace with the following: <i>No instruction by the Employer's Agent to the Contractor to improve his rate of progress in this regard will qualify for additional compensation, unless the instruction explicitly states that the Contractor is entitled to additional compensation and cites the amount of such compensation or the basis upon which it is to be determined.</i>
5.9.2	Further drawings and instructions	Add the following to the clause: <i>All instructions shall be in writing</i>
5.12	Extension of time for Practical Completion	Add the following new sub-clause 5.12.5 Critical path provision <i>A delay in so far as extension of time is concerned, will be regarded as a delay only if, on a claim by the Contractor in accordance with the General Conditions of Contract, the Employer's Agent rules that all progress on an item or items of work on the critical path of the approved programme for the execution of the Works by the Contractor, has been brought to a halt. Delays on normal working days only, based on a working week, of five normal working days, will be taken in account for the extension of time.</i> <i>The Works shall be divided into Sections as defined in the Scope of Work. A Sectional Practical Completion Certificate shall be issued for each Section upon</i>

		<i>successful commissioning and satisfaction of functional requirements for that Section.</i> <i>Delay damages shall be administered per Section.</i> Add the following new sub-clause 5.12.6 Extension of time due to abnormal rainfall <i>Extension of time due to abnormal rainfall shall be determined by means of Method 1, if rainfall records and/or values derived from rainfall records are supplied in the Scope of Work, otherwise Method 2 shall apply.</i> <u>Method 1: Rainfall formula method</u> <i>The rainfall records and/or values derived from rainfall records from a suitable rainfall station near the Site, which are supplied in the Project Specifications, shall be considered suitable for the determination of extension of time due to abnormal rainfall in accordance with this method.</i> <i>Extension of time arising from abnormal rainfall, shall be calculated separately for each calendar month or part thereof for the full period of completion of the Contract, including any extension thereof, in accordance with the rainfall formula given below:</i> $V = (N_w - N_n) + \frac{(R_w - R_n)}{X}$ <i>If V is negative and its absolute value exceeds N_n, then V shall be equal to minus N_n.</i> <i>If V is positive and greater than the number of calendar days in the calendar month under consideration, V shall be taken as equal to the number of calendar days in the relevant calendar month.</i> <i>The symbols shall have the following meaning:</i> V = Extension of time in calendar days in respect of the calendar month under consideration N_w = Actual number of days during the calendar month on which a rainfall of Y mm or more has been recorded. R_w = Actual rainfall in mm for the calendar month under consideration. N_n = 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. Rainfall records and/or the derived values of N_n will be provided in the Specifications. R_n = Average rainfall in mm for the calendar month, as derived from existing rainfall records. Rainfall records and/or the derived values of R_n will be provided in the Project Specifications. X = 20 unless otherwise provided in the Project Specifications Y = 10 unless otherwise provided in the Project Specifications <i>The total extension of time shall be the algebraic sum of the monthly totals for the period under consideration. However, if the grand total is negative the time for completion shall not be reduced on account of abnormal rainfall. Extension of time for parts of a month shall be calculated by pro rata values of N_n and R_n being used.</i> <i>The factor (N_w – N_n) shall be considered to represent a fair allowance for variations</i>

		from the average number of days during which rainfall exceeds Y mm and wet conditions prevented or disrupted work. $\frac{(R_w - R_n)}{X}$ The factor $\frac{(R_w - R_n)}{X}$ shall be considered to represent a fair allowance for variations from the allowance for variations from the average number of days when wet conditions further to that allowed for the factor $(N_w - N_n)$, prevented or disrupted work during the calendar month. Accurate rain gauging shall be taken at a suitable point on Site and the Contractor shall, at his own expense, take all necessary precautions to ensure that the rain gauges cannot be interfered with. This formula does not take into account further on concurrent delays which could be caused by other abnormal climatic conditions such as floods, which have to be determined separately in accordance with Sub-Clause (5.12.5 Critical Path Provision) hereof. <u>Method 2: Expected delay method</u> The Contractor shall make provision in his programme for the execution of the Works, for an expected delay of "n" normal working days (based on a working week of five normal working days) due to normal rainfall, for which he will not receive any extension of time. Unless otherwise provided in the Project Specifications, the value of "n" shall be taken as equal to the tendered time for completion of the Works in months, rounded off to an integer. Extension of time during normal working days will be granted to the degree to which actual delays as determined in accordance with Sub-Clause (5.12.5 Critical Path Provision) hereof, exceed the number of "n" normal working days. The value of "n" does not take into account further or concurrent delays which are caused by other abnormal climatic conditions such as floods, which have to be determined separately in accordance with Sub-Clause (5.12.5 Critical Path Provision) hereof.
		Add 5.12.7 Conditional Delay Events under Variations: Delays arising from geohydrological investigations, yield testing, or the Water Use License (WUL) approval process shall not be deemed delays to the time for completion of the Works until Section 2 has formally commenced.
6.1	Payment Contractor to	Add the following new sub-clause: 6.1.2 Payment for works identified in the Scope of Work as being labour-intensive shall only be made in accordance with the provisions of the Contract if the works are constructed strictly in accordance with the provisions of the Scope of Work. Any non-payment for such works shall not relieve the Contractor in any way of his obligations either in contract or in delict. Add the following new sub-clause: 6.1.3 The Contractor's payment invoices shall be accompanied by labour

		<i>information for the corresponding period in a format specified by the employer. If the Contractor chooses to delay submitting payment invoices, labour returns shall still be submitted as per frequency and timeframe stipulated by the employer. The Contractors invoices shall not be paid until all pending labour information has been submitted.</i> Add the following new sub-clause <i>6.1.4 The Contractor shall be paid at Pretoria in the currency of the Republic of South Africa only at the Office of the Chief Financial Officer of the CITY OF TSHWANE, unless otherwise stated in the Data provided by Employer.</i>
6.2	Security	Add the following new sub-clause: <i>Should the Employer elect to split the Works into Sections, the performance guarantee shall remain valid until all Sections reach Practical Completion, but the Employer may, at its sole discretion, reduce the value of the guarantee proportionally upon certification of completion of Section 1.</i>
8.6	Insurances	Replace clause 8.6 with the following: 8.6 Insurances <i>8.6.1 Without limiting the Contractor's/Sub-contractor's obligation in terms of the Contract, the Employer will effect and maintain for the duration of the Contract until the issuing of the Final Approval Certificate, the following insurances in the name of the Contractor (including all Subcontractors whether nominated or otherwise):</i> <i>8.6.1.1 The Employer's insurer will indemnify the Contractor/Sub-contractor against physical loss of or damage to any part of the Property Insured not exceeding the maximum contract value or the final contract value estimated at inception including free issue materials were applicable as stated in the Contract Data:</i> <i>a. Whilst in transit including loading and unloading whilst temporarily stored at any premises and route to or from the Contract Site within the Territorial Limits;</i> <i>b. From the time of unloading, dismantling or preparation at the Contract Site and thereafter until the Property Insured has been officially accepted by the Employer and becomes his responsibility by means of a notice of completion certificate or similar evidence of legal transfer of risk;</i> <i>c. During the contractual defects liability or Maintenance Period which shall not exceed the period reflected in the Schedule but only so far as the Contractors and/or Sub-Contractors may be liable for such loss or damage under the defects liability or maintenance condition/s of the Insured Contract;</i> <i>d. Removal of debris;</i> <i>e. Surrounding property</i> <i>f. Work away;</i> <i>g. Off-site storage</i> <i>h. Temporary repairs;</i> <i>i. Contribution clause – marine;</i> <i>j. Escalation during Contract Period;</i> <i>k. Post loss escalation;</i> <i>l. Automatic reinstatement;</i>

		<i>m. Principals maintenance;</i> <i>n. Property taken over;</i> <i>o. Beneficial occupation;</i> <i>p. Escalation due to currency fluctuation;</i> <i>q. Manufacturers guarantees</i> 8.6.1.2 <i>The Employer's insurer will indemnify the Contractor/Sub-contractor against all sums for which the Contractor/Sub-contractor shall become legally liable towards third party claimants to pay for and in consequence of:</i> <i>a. Accidental death of or bodily injury to or illness or disease contracted by any person (excluding employees of the Contractor/Subcontractor);</i> <i>b. Accidental physical loss or damage to tangible property occurring during the Period of Insurance and arising out of or in connection with the performance of the Insured Contract at the Contract Site as defined in the Schedule. The minimum limit of indemnity for any one event is R10-million in respect of contracts with a contract value of up to R50-million (excluding VAT).</i> 8.6.2 <i>Insurance premium payable</i> <i>The Employer will pay the insurance premium for the works damage and public liability insurance cover. The insurance premium will be calculated based on the approved Capital Budget per financial year and the insurance premium will be charged out to the relevant departments by the Section: Insurance and Risk Management.</i> 8.6.3 <i>Additional insurance by the Employer</i> <i>The Employer shall be free to effect at his own cost any additional insurance, which he deems necessary in own interest to cover loss or damage not insured in terms of the insurance policies of Sub-Clause 8.6.1.1 of this Clause.</i> 8.6.4 <i>Additional insurance by the Contractor / Subcontractor</i> <i>The Contractor and Sub-contractor shall be free to effect and maintain at their own cost any additional insurance which the Contractor/Subcontractor deem necessary to cover damage, loss or injury not insured in terms of the insurance effected by the Employer's insurer. The cost of the additional insurance will be for the account of the Contractor/Subcontractor.</i> 8.6.5 <i>Contractor satisfied with insurance</i> <i>The submission of a tender shall be construed as acknowledgement by the Contractor that he is satisfied with the insurance cover effected by the Employer.</i> 8.6.6 <i>Contractor to observe conditions</i> <i>The Contractor shall give all notices and observe all conditions and requirements imposed by the relevant insurance policies, which shall be binding on the Contractor.</i> 8.6.7 <i>Contractor to insure</i> <i>The Contractor/Sub-contractor must obtain for the duration of the contract until the issuing of the Final Approval Certificate, the following insurance policies at an insurance company within 14 (fourteen) days of the notification of acceptance of the</i>

		<i>tender and must pay all premiums and supply proof thereof to the relevant Employer's Agent, 30 (thirty) days before the inception of the contract, that the policies have been taken out and that all premiums have been paid:</i> <i>a. All Risk Insurance cover with regard to all Plant and Materials and Equipment, owned, leased or hired by the Contractor that are used in the execution of the contract for the full replacement value thereof.</i> <i>b. Motor Vehicle and Liability Insurance cover indicating the registration numbers of the vehicles owned, leased or hired by the Contractor that are used in the execution of the contract to the amount of at least R10-million per claim with the number of claims unlimited.</i> <i>c. SASRIA cover for motor vehicles and Plant and Materials and Equipment owned, leased or hired by the Contractor that are used in the execution of the contract for the full replacement value thereof.</i> <i>d. In respect of Plant and Materials and Equipment and Motor Vehicles brought onto the Site by or on behalf of Subcontractors, the Contractor shall be deemed to have complied with the provisions of this Sub-Clause by ensuring that such Subcontractors have similarly insured such Plant and Materials and Equipment and Motor Vehicles.</i> <i>e. Proof must also be submitted that the Contractor complies with the conditions of the following legislation:</i> <i>- Compensation for Occupational Injuries and disease, 1993</i> <i>- Unemployment Insurance Act, 1996</i> <i>- The Contractor shall in respect of the Site of the contract works appoint in writing a Section 16 appointee to meet the requirements of the Health and Safety Act, No 85 of 1993 as amended.</i> 8.6.8 <i>The Employer's Agent involved must furnish the required insurance documentation 30 (thirty) days before the inception of the contract to the Section: Insurance and Risk Management.</i> 8.6.9 <i>Reporting of incidents</i> <i>In the event of an occurrence, which is likely to give rise to a claim under the insurance policy affected by the Employer, the Contractor / Subcontractors and Employer's Agent will adhere to the following procedures:</i> <i>a. In addition to any statutory obligations and/or requirements contained in the General Conditions of Contract, the Contractor shall notify the Employer and the Employer's Agent of every occurrence within 48 (forty-eight) hours giving the circumstances, nature and an estimate of the loss or damage.</i> <i>b. The Employer's Agent will be responsible to complete and submit the relevant claim documentation for each incident within 30 (thirty) days after the incident occurred to the Section: Insurance and Risk Management. Should the incident be reported by the Employer's Agent more than 30 (thirty) days after the incident occurred to the Section: Insurance and Risk Management, the claim will only be considered if the claim documentation is accompanied by a letter from the relevant Strategic Executive Director motivating the reason(s) for the late reporting of the incident, but the Employer's Agent must take note the Insurer might repudiate the loss if it is</i>

		<i>found that the insurers rights have been compromised as a result of the late reporting.</i> <i>c. The following documentation must be included with the claim documentation:</i> <i>- Photos of damages caused or suffered as proof or substantiation of the claims.</i> <i>d. In the event of Insured Property being damaged during the Contract Works beyond economical repair, the property must be safeguarded and be handed over to the Employer's insurer for salvage.</i> <i>e. The Section: Insurance and Risk Management will inform the Employer's insurer of the incident. The Contractor/Subcontractor shall afford all reasonable access to the Site to the Employer, the Employer's Agent, the Employer's insurers and/or representatives for the purpose of assessment of any loss or damage.</i> 8.6.10 Reporting of catastrophic incidents <i>In the event of an occurrence, which is likely to give rise to a claim, under the insurance policy effected by the Employer, with an estimated loss or damage of more than R250 000,00, the Contractor and the Employer's Agent will adhere to the following procedures:</i> <i>a. In addition to any statutory obligations and/or requirements contained in the General Conditions of Contract, the Contractor shall notify the Employer and the Employer's Agent of every occurrence within 24 (twenty-four) hours giving the circumstances, nature and an estimate of the loss or damage.</i> <i>b. The Employer's Agent must notify the Section: Insurance and Risk Management on the same day that the Contractor/Sub-contractor has notified the Employer's Agent of the incident.</i> <i>c. The Section: Insurance and Risk Management will notify the Employer's insurer of the incident. The Contractor/Sub-contractor shall afford all reasonable access to the Site to the Employer, the Employer's Agent, the Employer's insurers and/or representatives for the purpose of assessment of any loss or damage.</i> <i>d. The Employer's Agent will be responsible to complete and submit the relevant claim documentation for each incident within 30 (thirty) days after the incident occurred to the Section: Insurance and Risk Management. Should the incident be reported by the Employer's Agent more than 30 (thirty) days after the incident occurred to the Section: Insurance and Risk Management, the claim will only be considered if the claim documentation is accompanied by a letter from the relevant Strategic Executive Officer motivating the reason(s) for the late reporting of the incident. Should the relevant claim documentation not be submitted within 30 (thirty) days, the claim will be repudiated.</i> 8.6.11 Reporting of crime related incidents <i>All crime related incidents, losses or shortages irrespective of the value, must be reported within 24 (twenty-four) hours by the person who was involved or who has discovered the incident to the nearest South African Police Services (SAPS) station. The name of the Police Station, Investigation Officer and the Case number must be obtained and stated on the Contractor Claim Form. Should the incident not be</i>

		<i>reported to the SAPS, the claim will be repudiated.</i> 8.6.12 Claim documentation <i>The Employer's Agent must obtain all relevant information from the Contractor/Sub-contractor and complete the Contractor Claim Form, included in this report as Annexure B that is available on the Intranet. The project number must be stated on the Contractor Claim Form.</i> <i>The Employer's Agent must submit with the Contractor Claim Form a detailed cost sheet indicating the estimate of the loss or damage.</i> <i>Any misrepresentation, misdescription or non-disclosure of material facts, at the option of the insurers, can result in claims submitted being declared null and void.</i> 8.6.13 Authorization of claim forms <i>It is imperative that a formally delegated official or his nominee of the Employer should authorize the Contractor Claim forms as proof of the appropriate authorization, verification and approval of claims submitted. The Divisional Head must provide an authorization letter to the Section: Insurance and Risk Management stating the names and the specimen signatures of the delegated official or his nominee within 30 (thirty) days from approval of this report by Council. Should the delegated official or his nominee not sign the relevant claim form, the claim will be repudiated as this may lead to inappropriate independent verification of the validity of claims, thereby increasing the risk of insurance fraud and consequent reputation damage to the Employer.</i> 8.6.14 Contractor to pay deductibles <i>Any claim in terms of the insurance affected by the Employer shall be subject to the Contractor being responsible for the payment of the amount stated in the Annexure to the Policies as being the deductible (first amount payable or Excess) as defined in the Certificate of Insurance issued by the Employer's insurer in terms of the Policy.</i> 8.6.15 Settlement of claims <i>All incidents reported to the Section: Insurance and Risk Management in respect of an occurrence, which is likely to give rise to a claim will be forwarded to the Employer's insurer who will take the necessary actions for the settlement of any such claims.</i> <i>The Contractor <u>shall negotiate</u> for the settlement of claims with the Employer or the Employer's insurer through the Section: Insurance and Risk Management. The Employer's Chief Financial Officer will authorize all settlements of claims.</i> <i>Should action for the settlement of any such claim to the satisfaction of the Employer's Agent not be taken by the Contractor/sub-contractor within 30 (thirty) days after receipt of such claim by the Contractor/sub-contractor, the Employer or the Employer's insurer may settle any such claim, after giving the Contractor notice of its intention to do so; provided that no such claim shall be settled by the Employer or the Employer's insurer without first consulting the Contractor/sub-contractor.</i> <i>The foregoing provisions of this Sub-Clause shall apply mutatis mutandis to any such claim received by the Contractor directly.</i>

C1.2.3 DATA PROVIDED BY THE EMPLOYER

CLAUSE/OPTION		DATA																			
1.1.1.13	The Defects Liability period is:	12 (twelve) months from the date of the Certificate of Completion.																			
1.1.1.14	The time for achieving Sectional Practical Completion is:	The time for achieving Sectional Practical Completion is: - Section 1 – 12 months from commencement - Section 2 – 12 months from Section 1 Practical Completion (with early works commencing as soon as practical)																			
1.1.1.15	The name of the Employer is:	City of Tshwane Metropolitan Municipality.																			
1.1.1.26	The Pricing Strategy is:	Re-measurement Contract																			
1.2.1.2	The address of the Employer is:	Physical Address:	126 Sisulu Street Pretoria Central																		
		Postal Address:	P.O. Box 1409 PRETORIA 0002																		
1.1.1.16	The name of the Employer's Agent is:	RALEMA Consulting Engineers																			
1.2.1.2	The address of the Employer's Agent is:	Physical Address:	11 Princeton Office Park No. 1 Olievenhoutbosch Street Highveld Techno Park Centurion, 015																		
		Postal Address:	11 Princeton Office Park No. 1 Olievenhoutbosch Street Highveld Techno Park Centurion, 015																		
		E-Mail Address:	admin@ralemacons.co.za																		
3.1.3		- The Employer's Agent is required to obtain approval of the Employer: - for expenditure on the Contract to exceed the Contract Price; - prior to the execution of any of the following duties of functions: <table><tr><th>CLAUSE</th><th>DUTY/FUNCTION</th></tr><tr><td>3.2.1</td><td>Nomination of person as Employer's Agent's Representative</td></tr><tr><td>3.3.4</td><td>Authorization to Employer's Agent's Representative or any other person</td></tr><tr><td>4.10.1</td><td>Approval to use the Site for any other purpose such as housing</td></tr><tr><td>5.3.1</td><td>Delivery of the written notice to commence the execution of the works</td></tr><tr><td>5.6.3</td><td>Approval of programme of construction</td></tr><tr><td>5.7.2</td><td>Permission to carry out work by day and by night</td></tr><tr><td>5.8.1.1</td><td>Approval to work on special non-working days and between sunset and sunrise</td></tr><tr><td>5.9.7</td><td>Approval of Contractor's designs</td></tr></table>		CLAUSE	DUTY/FUNCTION	3.2.1	Nomination of person as Employer's Agent's Representative	3.3.4	Authorization to Employer's Agent's Representative or any other person	4.10.1	Approval to use the Site for any other purpose such as housing	5.3.1	Delivery of the written notice to commence the execution of the works	5.6.3	Approval of programme of construction	5.7.2	Permission to carry out work by day and by night	5.8.1.1	Approval to work on special non-working days and between sunset and sunrise	5.9.7	Approval of Contractor's designs
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5.9.7	Approval of Contractor's designs																				

CLAUSE/OPTION		DATA	
		5.11	Suspension of progress of the Works
		5.13.2	Reduction of penalty for delay
		5.14.2	The issue of a Certificate of Practical Completion
		5.14.4	The issue of a Certificate of Completion
		5.16.1	The issue of a Final Approval Certificate
		6.3.1	Variation Orders in respect of variations which are not small
		6.6	Instruction to expend on Provisional and Prime Cost Sums
		6.11	Adjustment of Preliminary and General allowances
		7.8.1	Order to execute work of repair, etc. during the Defects Liability Period
		7.8.2	Determination of value of repair work
		8.2.2.2	Order to repair and make good damage arising from any excepted risk
5.3.1	The documentation required before commencement with Works execution are:	• Health and Safety Plan (Refer to Clause 4.3) • Initial programme (Refer to Clause 5.6) • Security (Refer to Clause 6.2) • Proof that all contributions required in terms of the provisions of the Workman's Compensation Act (Act no 30 of 1941) as amended in 1993, 2002 have been paid (Refer to Cause 4.3.2) • A certified copy of Unemployment Insurance Certificate, Act of 1996 (Refer to Clause 4.3.2)	
5.3.2	The time to submit the documentation required from the Commencement Date is:	14 days	
5.8.1	The non-working days are:	Sundays	
	The special non-working days are:	• Annual builders holiday • Statutory public holidays	
5.12	Extension of Time	Delays arising from geohydrological investigations, yield testing, or the Water Use License (WUL) approval process shall not be deemed delays to the time for completion of the Works until Section 2 has formally commenced."	
5.13.1	The penalty for failing to complete the works is:	Delay damages shall apply per Section as follows: • Section 1 – R10,000 per calendar day • Section 2 – R8,000 per calendar day	
5.14.1	Requirements for achieving Practical Completion	Section 1 – Bronkhorstspuit Water Treatment Plant (WTP): Sectional Practical Completion shall be achieved when all civil, mechanical, and electrical refurbishment works for Priority 1 are complete, tested, and commissioned to deliver treated water meeting	

CLAUSE/OPTION		DATA																		
		SANS 241 standards, with the WTP operating in automatic control mode via the integrated SCADA system. Section 2 – Bronkhorstspuit Water Treatment Plant (WTP): Sectional Practical Completion shall be achieved Priority 2 and all other civil, mechanical, and electrical refurbishment works are complete, tested, and commissioned as for Section 1. Each section shall undergo operational testing for at least 14 consecutive days prior to issuance of the relevant Certificate of Sectional Practical Completion.																		
5.16.3	The latent defect period is:	10 (ten) Years																		
6.1.3	Labour returns:	Labour returns will be submitted monthly .																		
6.2.1	Type of security for due performance:	- Guarantee from approved financial institution - Bidders are advised that a Form of Guarantee is required. An example format is provided on Part C1.3 for guidance. The guarantee shall be compliant with the City's Supply Chain Management (SCM) policy. Bidders must familiarise themselves with the policy, available on the City's website / upon request.																		
	Liability of performance guarantee/cash deposit	The liability of the guarantee shall be for 10 (ten) % of the Contract Sum, excluding contingencies and VAT.																		
6.2.2	Retention money guarantee	Not permitted																		
6.8.2	Adjustment in rates and/or prices	- The value of the certificates issued shall be adjusted in accordance with the Contract Price Adjustment Schedule with the following values: <table border="1"> <thead> <tr> <th>Coefficient</th><th>Description</th><th>Value</th></tr> </thead> <tbody> <tr> <td><i>x</i></td><td>Portion not subject to adjustment</td><td>0.10</td></tr> <tr> <td><i>a</i></td><td>Labour</td><td>0.20</td></tr> <tr> <td><i>b</i></td><td>Electrical Engineering Plant</td><td>0.05</td></tr> <tr> <td><i>c</i></td><td>Electrical Engineering Materials</td><td>0.65</td></tr> <tr> <td><i>d</i></td><td>Fuel</td><td>0.10</td></tr> </tbody> </table> (Coefficients a, b, c and d must sum to one) - The area nearest the Site is Gauteng. - The base month is <u>the month and year prior to the closing of the tender.</u>	Coefficient	Description	Value	<i>x</i>	Portion not subject to adjustment	0.10	<i>a</i>	Labour	0.20	<i>b</i>	Electrical Engineering Plant	0.05	<i>c</i>	Electrical Engineering Materials	0.65	<i>d</i>	Fuel	0.10
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<i>c</i>	Electrical Engineering Materials	0.65																		
<i>d</i>	Fuel	0.10																		
6.8.3	Price adjustment for variations in the cost of special materials	Allowed																		
6.10.1.5	The percentage advance on materials not yet built into the Permanent Works is:	80% (Eighty percent)																		
6.10.3	Percentage retention is:	10% (ten percent) of Contract Sum, excluding contingencies and VAT																		
	The limit of retention money is:	5% (five percent) of Contract Sum, excluding contingencies and VAT.																		

CLAUSE/OPTION		DATA
8.6	Insurance of the Works and Public Liability Insurance	The Employer shall arrange this insurance. A copy of the policy and the list of excesses may be obtained from Contractors All Risk and Liability Insurance Ms. Morongwa Mokoena (Tel: 012 358 1126) (morongwam@tshwane.gov.za) Mrs Ronett Marlow-Reid (Tel: 012 358 1131) (ronettm@tshwane.gov.za) Mr Lawrence Matjila (Tel: 012 358 1374) (lawrencem@tshwane.gov.za)
	The value of plant and materials supplied by the Employer to be included in the insurance sum is:	R 0 (zero)
	Responsibility for payment of deductibles in respect of Insurance of Works as well as Public Liability Insurance:	Deductibles are the responsibility of the Contractor
	Construction Plant:	Contractor to insure. Policy to be approved by Employer
10.5	Determination of disputes	Ad-hoc Adjudication Board
10.5.3	Number of Adjudication Board members to be appointed:	One
10.6	Disagreement with Adjudication Board's decision, refer matters to:	Court proceedings

C1.2.4 DATA PROVIDED BY CONTRACTOR

CLAUSE/OPTION		DATA		
1.1.1.9	The name of the Contractor is:			
1.2.1.2	The address of the Contract is:	• Physical Address:		
		• Postal Address:		
		• Fax to E-Mail:		
		• E-Mail Address:		
6.2.1	The security to be provided by the Contractor shall be one of the following:	Performance guarantee (10% (ten percent) of the Contract Sum, excluding contingencies ad VAT)		
6.5.1.2.3	The percentage allowance to cover profits and overhead charges for dayworks is:	_____ %. (Maximum of 15% will be allowed) <i>(In the case of the Contractor not providing a percentage the percentage as per the General Conditions of Contract will prevail)</i>		
6.8.3	Price adjustments for variations in the cost of special materials	The variation in cost of special materials is:		
		Type of material	Unit	Base Rate or Price
		Bitumen		
		Steel		

Item	Clause	Entry
Contractor's Name and Address	1.1.2.3 & 1.3	..... ..... ..... ..... .....
Percentage for Adjustment of Provisional Sums	13.5(b)	%..... Carried over to Pay Item PS001.07 in the Bill of Quantities/
Local Labour Rate charge allowed for by the Contractor		 R/hour

Signature

On behalf of

Date:

ANNEXURE A

EMPLOYER'S INSURANCE POLICY

THE ANNUAL INSURANCE RENEWAL TERMS OF THE CITY OF TSHWANE METROPOLITAN MUNICIPALITY INSURANCE PORTFOLIO REGARDING THE IMPLEMENTATION OF CONTRACT WORKS DECLARATION AND CLAIMS REPORTING PROCEDURES

- 1. DECLARATION OF CONTRACT WORKS WITHIN THE MAXIMUM ANY ONE CONTRACT VALUE OF R50-MILLION EACH (EXCLUDING VAT) AND THE ESTIMATED CONTRACT PERIOD AT COMMENCEMENT OF THE CONTRACT NOT EXCEEDING 24 MONTHS AS STIPULATED IN THE PRINCIPAL CONTROLLED CONTRACTORS ALL RISK POLICY**
- 1.1 All Contract Works within the maximum any one contract value of R50-million each (excluding VAT) must be declared to the Department Finance, Section: Insurance and Risk Management, 30 (thirty) calendar days before the contractor may commence with site establishment and with the physical work thereafter.
- 1.2 The Contract Works must be declared on the Contract Declaration Form that is available at Tshwane or the internet and a copy of the Letter of Appointment issued to the Contractor must be attached to the completed Contract Declaration Form. The Project Manager and Contractor must sign off the completed Contract Declaration Form included and excluded.
- 1.3 The Principal Controlled Contractors All Risk Policy is arranged on the basis that the Principal (the Council) and not the contractor awarded the contract arranges Insurance where Principal controlled insurance is adopted.
- 1.4 The following Perils are covered under the Principal Controlled Contractors All Risk Policy:
 - Contract Works
 - Storm, Earthquake, Flood, Fire, Lightning, Theft, etc.
 - Public Liability
 - Loss or damage to third party property or injury or death to third parties.
 - Defects Contingency
 - Cost necessary to replace or repair or rectify any component or individual item of the property which is defective in design plan specification materials or workmanship.
- 1.5 The following occurrences are not covered under the Principal Controlled Contractors All Risk Policy:
 - Deliberate damage.
 - Defective workmanship and/or material.
 - Productivity – extended contract periods and costs.
 - Underpinning (contract must be declared separately)
 - Any wet risks (contract must be declared separately).
 - Specific contracts involved bridges, over water courses, tunnels, viaducts and dams (contract must be declared).
- 1.6 The extension of the contract period must be declared 30 (thirty) calendar days before the extension of the contract period commences to the Section: Insurance and Risk Management
- 1.7 The following deductibles will apply should a loss or damage incident occur:
 - Contract Works
 - R5 000-00 each and every occurrence
 - Own Surrounding Property
 - R5 000-00 each and every occurrence
 - Testing
 - R5 000-00 each and every occurrence
 - Liability
 - R5 000-00 each and every occurrence
 - Defects Contingency

R25 000-00 each and every occurrence

2. DECLARATION OF CONTRACT WORKS EXCEEDING THE MAXIMUM ANY ONE CONTRACT VALUE OF R50-MILLION EACH (EXCLUDING VAT) AND FALLING OUTSIDE THE SCOPE OF WORK AND/OR 36 MONTH CONTRACT PERIOD AS STIPULATED IN THE SEPARATELY ARRANGED PRINCIPAL CONTROLLED CONTRACTORS ALL RISK POLICIES

The infrastructure contract types must be declared as per the declaration procedure irrespective of the value of the contract.

All Contract Works exceeding the maximum any one contract value of R50-million each (excluding VAT) must be declared to the Department Finance, Section: Insurance and Risk Management, 30 (thirty) calendar days before the contractor may commence with site establishment and with the physical work thereafter.

2.2 The following information must be provided in a formal letter and the relevant Strategic Executive Officer or Head of the Department must sign the letter:

- Contract Number;
- Contract Title;
- Contractor(s) including sub-contractors awarded to;
- Budgeted Tender Price (inclusive of VAT and contingencies);
- Value of free issue material;
- Anticipated contract period until final handover;
- Construction contract or Maintenance contract;
- Maintenance period of the contract;
- Testing period;
- If lateral support actions will be under taken, details thereof;
- Details of City of Tshwane and third party surrounding property.

2.3 The following documentation must be attached to the letter:

- (i) Full tender documentation plan and specifications as completed by the tenderer and submitted by the Project Manager;
- (ii) Bill of quantities;
- (iii) Work plan schedules;
- (iv) If blasting is applicable, certificate of blasting and method of blasting;
- (v) Information regarding the security at premises e.g. fencing, security guards, central stores where high valued items are stored etc;
- (vi) In the case of open trenches: average depth and average open length;
- (vii) In the case of road works: exposed base works – length at any one time; and/or
- (viii) When applicable Geo technical reports for each site and or civil works involving dolomite.

2.4 All Contract Works that are not declared before the commencement dates of the contracts are not insured until all the above documentation has been submitted to the Section: Insurance and Risk Management and the quotation issued by the Insurer have been accepted by the relevant department.

2.5 All Contract Works exceeding the maximum any one contract value of R50-million (excluding VAT) each must be declared and insured separately and quotations with deductible structures to be obtained by the

Insurance Broker from 3 (three) Insurers and the recommended quotation with the deductible structure to be approved by the relevant Strategic Executive Officer or Head of department prior to inception of insurance cover.

- 2.6 The Project Manager must ensure that the quotation and conditions of the insurance policy recommended by the Employers' insurance broker be signed by the Contractor/Sub-contractor, Project Manager and the Strategic Executive Officer within 5 (five) days after the quotations were submitted by the Section: Insurance and Risk Management to the Project Manager and the signed documentation must be returned to the Section: Insurance and Risk Management within 2 (days).

3. CONTRACT WORKS CLAIMS REPORTING PROCEDURES

3.1 REPORTING OF INCIDENTS

In the event of an occurrence, which is likely to give rise to a claim under the insurance policy affected by the Employer, the Contractor/Sub-contractors and Project Manager will adhere to the following procedures:

- a) In addition to any statutory obligations and/or requirements contained in the General Conditions of Contract, the Contractor shall notify the Employer and the Project Manager of every occurrence within 48 (forty-eight) hours giving the circumstances, nature and an estimate of the loss or damage.
- b) The Project Manager will be responsible to complete and submit the relevant claim documentation for each incident within 30 (thirty) days after the incident occurred to the Section: Insurance and Risk Management. Should the incident be reported by the Project Manager more than 30 (thirty) days after the incident occurred to the Section: Insurance and Risk Management, the claim will only be considered if the claim documentation is accompanied by a letter from the relevant Strategic Executive Officer motivating the reason(s) for the late reporting of the incident, but the Project Manager must take note the Insurer might repudiate the loss if it is found that the insurers rights have been compromised as a result of the late reporting.
- c) The following documentation must be included with the claim documentation:
 - Photos of damages caused or suffered as proof or substantiation of the claims.
- d) In the event of Insured Property being damaged during the Contract Works beyond economical repair, the property must be safeguarded and be handed over to the Employer's insurer for salvage.
- d) The Section: Insurance and Risk Management will inform the Employer's insurer of the incident. The Contractor/Subcontractor shall afford all reasonable access to the Site to the Employer, the Project Manager, the Employer's insurers and/or representatives for the purpose of assessment of any loss or damage.

3.2 REPORTING OF CATASTROPHIC INCIDENTS

In the event of an occurrence, which is likely to give rise to a claim, under the insurance policy effected by the Employer, with an estimated loss or damage of more than R250 000,00, the Contractor and the Project Manager will adhere to the following procedures:

- a) In addition to any statutory obligations and/or requirements contained in the General Conditions of Contract, the Contractor shall notify the Employer and the Project Manager of every occurrence within 24 (twenty-four) hours giving the circumstances, nature and an estimate of the loss or damage.
- b) The Project Manager must notify the Section: Insurance and Risk Management on the same day that the Contractor/Sub-contractor has notified the Project Manager of the incident.

- c) The Section: Insurance and Risk Management will notify the Employer's insurer of the incident. The Contractor/Sub-contractor shall afford all reasonable access to the Site to the Employer, the Project Manager, the Employer's insurers and/or representatives for the purpose of assessment of any loss or damage.
- d) The Project Manager will be responsible to complete and submit the relevant claim documentation for each incident within 30 (thirty) days after the incident occurred to the Section: Insurance and Risk Management. Should the incident be reported by the Project Manager more than 30 (thirty) days after the incident occurred to the Section: Insurance and Risk Management, the claim will only be considered if the claim documentation is accompanied by a letter from the relevant Strategic Executive Officer motivating the reason(s) for the late reporting of the incident. Should the relevant claim documentation not be submitted within 30 (thirty) days, the claim will be repudiated.

3.3 REPORTING OF CRIME RELATED INCIDENTS

All crime related incidents, losses or shortages irrespective of the value, must be reported within 24 (twenty-four) hours by the person who was involved or who has discovered the incident to the nearest South African Police Services (SAPS) station. The name of the Police Station, Investigation Officer and the Case number must be obtained and stated on the Contractor Claim Form. Should the incident not be reported to the SAPS, the claim will be repudiated.

3.4 CLAIM DOCUMENTATION

The Project Manager must obtain all relevant information from the Contractor/Sub-contractor and complete the Contractor Claim Form. The project number must be stated on the Contractor Claim Form.

The Project Manager must submit with the Contractor Claim Form a detailed cost sheet indicating the estimate of the loss or damage.

Any misrepresentation, mis-description or non-disclosure of material facts, at the option of the insurers, can result in claims submitted being declared null and void.

3.5 CONTRACTOR TO PAY DEDUCTIBLES

Any claim in terms of the insurance affected by the Employer shall be subject to the Contractor being responsible for the payment of the amount stated in the Annexure to the Policies as being the deductible (first amount payable or Excess) as defined in the Certificate of Insurance issued by the Employer's insurer in terms of the Policy.

3.6 SETTLEMENT OF CLAIMS

The Contractor shall negotiate for the settlement of claims with the Employer or the Employer's insurer through the Section: Insurance and Risk Management. The Employer's Chief Financial Officer will authorize all settlements of claims. The Contractor will also sign the Agreement of Loss document issued by the Insurer in order to settle the claims.

Should action for the settlement of any such claim to the satisfaction of the Project Manager not be taken by the Contractor/sub-contractor within 30 (thirty) days after receipt of such claim by the Contractor/sub-contractor, the Employer or the Employer's insurer may settle any such claim, after giving the Contractor notice of its intention to do so; provided that no such claim shall be settled by the Employer or the Employer's insurer without first consulting the Contractor/sub-contractor.

The foregoing provisions of this Sub-Clause shall apply *mutatis mutandis* to any such claim received by the Contractor directly.

It is distinctly understood that should the Employer or the Employer's insurer not settle any such claim at the earliest opportunity, it shall in no way prejudice the Employer or the Employer's insurer's rights to

recover from the Contractor nor shall the Contractor raise any such defence against the Employer or the Employer's insurer.

Any moneys which become payable as a result of a claim under the insurance effected by the Employer shall be paid to the Employer after deduction of the deductible amount (first amount payable or Excess), who shall pay such amount to the Contractor or to the party rectifying, repairing or reinstalling or who has suffered the loss or damage, but this shall in no way affect the Contractor's obligations in terms of the Contract.

4. INSURANCE RELATING TO INSTALLATION, CONSTRUCTION, MAINTENANCE OR ENGINEERING CONTRACT WORKS

4.1 Employer to Insure

Without limiting the Contractor's/Sub-contractor's obligation in terms of the Contract, the Employer will effect and maintain for the duration of the Contract until the issuing of the Defects Certificate or the end of the Maintenance Period, the following insurances in the name of the Contractor (including all Subcontractors whether nominated or otherwise):

1. The Employer's insurer will indemnify the Contractor/Sub-contractor against physical loss of or damage to any part of the Property Insured not exceeding the maximum contract value or the final contract value estimated at inception including free issue materials were applicable as stated in the Contract Data:
 - a) Whilst in transit including loading and unloading whilst temporarily stored at any premises en route to or from the Contract Site within the Territorial Limits.
 - a) From the time of unloading, dismantling or preparation at the Contract Site and thereafter until the Property Insured has been officially accepted by the Employer and becomes his responsibility by means of a notice of completion certificate or similar evidence of legal transfer of risk.
 - b) During the contractual defects liability or Maintenance Period which shall not exceed the period reflected in the Schedule but only so far as the Contractors and/or Sub-Contractors may be liable for such loss or damage under the defects liability or maintenance condition/s of the Insured Contract.
 - c) Removal of debris;
 - d) Surrounding property;
 - e) Work Away;
 - f) Off Site Storage;
 - g) Temporary repairs;
 - h) Contribution Clause – Marine;
 - i) Escalation during Contract Period;
 - j) Post Loss Escalation;
 - k) Automatic Reinstatement;
 - l) Principals Maintenance;
 - m) Property taken over;
 - n) Beneficial Occupation;
 - o) Escalation due to Currency fluctuation;
 - p) Manufacturers Guarantees
2. The Employer's insurer will indemnify the Contractor/Sub-contractor against all sums for which the

Contractor/Sub-contractor shall become legally liable towards third party claimants to pay for and in consequence of:

- a) Accidental death of or bodily injury to or illness or disease contracted by any person (excluding employees of the Contractor/Sub-contractor). It remains the responsibility of the Contractor/Sub-contractor to mitigate the risk of employees sustaining injuries or contracting occupational diseases during lunch times and after working hours at their workplace on the project site as stipulated in Section 22 of the COIDA Act;
- b) Accidental physical loss or damage to tangible property occurring during the Period of Insurance and arising out of or in connection with the performance of the Insured Contract at the Contract Site as defined in the Schedule. The minimum limit of indemnity for any one event is R10-million in respect of contracts with a contract value of up to R50-million (excluding VAT).

4.2 Insurance Premium payable

The Employer will pay the insurance premium for the works damage and public liability insurance cover. The insurance premium will be calculated based on the approved Capital Budget per financial year and the insurance premium will be debited out to the relevant departments by the Section: Insurance and Risk Management.

4.3 Additional insurance by the Employer

The Employer shall be free to effect at his own cost any additional insurance, which he deems necessary in own interest to cover loss or damage not insured in terms of the insurance policies of Sub-Clause 1 of this Clause.

4.4 Additional insurance by Contractor/Sub-contractor

The Contractor and Sub-contractor shall be free to effect and maintain at their own cost any additional insurance which the Contractor/Sub-contractor deem necessary to cover damage, loss or injury not insured in terms of the insurance effected by the Employer's insurer. The cost of the additional insurance will be for the account of the Contractor/Sub-contractor.

4.5 Contractor satisfied with insurance

The submission of a tender shall be construed as acknowledgement by the Contractor that he is satisfied with the insurance cover effected by the Employer.

4.6 Contractor to observe conditions

The Contractor shall give all notices and observe all conditions and requirements imposed by the relevant insurance policies, which shall be binding on the Contractor.

4.7 Contractor to Insure

The Contractor/Sub-contractor must obtain for the duration of the contract until the issuing of the Defects Certificate or the end of the Maintenance Period, the following insurance policies at an insurance company within 14 (fourteen) days of the notification of acceptance of the tender and must pay all premiums and supply proof thereof to the relevant Project Manager, 30 (thirty) days before the inception of the contract, that the policies have been taken out and that all premiums have been paid:

- a) All Risk Insurance cover with regard to all Plant and Materials and Equipment, owned, leased or hired by the Contractor that are used in the execution of the contract for the full replacement value thereof.
- b) Motor Vehicle and Liability Insurance cover indicating the registration numbers of the vehicles owned, leased or hired by the Contractor that are used in the execution of the contract to the amount of at least R10-million per claim with the number of claims unlimited.

- c) SASRIA cover for motor vehicles and Plant and Materials and Equipment owned, leased or hired by the Contractor that are used in the execution of the contract for the full replacement value thereof.
- d) In respect of Plant and Materials and Equipment and Motor Vehicles brought onto the Site by or on behalf of Subcontractors, the Contractor shall be deemed to have complied with the provisions of this Sub-Clause by ensuring that such Subcontractors have similarly insured such Plant and Materials and Equipment and Motor Vehicles.
- e) Proof must also be submitted that the Contractor complies with the conditions of the following legislation:
 - Compensation for Occupational Injuries and Diseases, 1993.
 - Unemployment Insurance Act, 1996.
 - The Contractor shall in respect of the Site of the contract works appoint in writing a competent person to meet the requirements of the Health and Safety Act, No 85 of 1993 as amended.

4.8 The Project Manager involved must furnish the required insurance documentation 30 (thirty) days before the inception of the contract to the Section: Insurance and Risk Management.

5. CONTRACTOR TO INSURE

The Contractor shall insure against professional negligence, errors and omissions under a Professional Indemnity policy for at least R10-million per claim and the number of claims unlimited.

The Project Manager involved must furnish the required insurance documentation 30 (thirty) days before the inception of the contract to the Section: Insurance and Risk Management.

The Contractor must provide proof of such insurance to the Project Manager within 14 (fourteen) days after the notification of acceptance of the tender. Should the renewal of an existing policy fall within the period prior to the Defects Certificate being issued, a letter of confirmation from the insurance company that such a policy will be renewed and that all premiums have been paid must be attached and the copy of the renewed policy be submitted within 2 (two) months of renewal to the Project Manager.

C1.3 FORM OF GUARANTEE

WHEREAS

THE CITY OF TSHWANE

(hereinafter referred to as the "Council"),

enters into a Contract (No.....) with

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

for

AND WHEREAS in terms of Clause 4.2 of the General Conditions of the Contract the Contractor, the Contractor is required to furnish an acceptable performance security for the due and proper fulfilment by him of all his duties and obligations in terms of the said contract.

NOW THEREFORE we the undersigned
.....[full names of authorized agent(s)]

and acting in my/our capacity as

and

and as such duly authorized thereto, do hereby bind the said

(hereinafter referred to as the "Guarantor") as surety and co-principal Debtor in *solidum* for the sum of:-

R (.....)
.....

for the due and proper fulfilment by the Contractor of all or any of his duties and obligations in terms of the said Contract. This guarantee shall not be interpreted as accessory to the contract between Council and the Contractor.

The Guarantor further undertakes, in the event of the Contractor failing duly and properly to fulfil any of his duties and obligations in terms of the said Contract or if the Contractor is placed under provisional liquidation or in the event of termination of the Contract by the Council in terms of the General Conditions of Contract, to pay to the Council, the said sum of R (.....)
.....

or such portion thereof as may be required by the Council, immediately upon receiving written demand from the Council which written demand shall be addressed to the Guarantor at

(*domicilium* address).

.....
The Guarantor further hereby renounces the benefits of the legal exceptions:

Exceptio non numerate pecuniae

Exception non causa debiti

Beneficium duobus vel pluribus reis debendi

Beneficium ordinis deu excussionis

Beneficium Divisionis

and all other defence which could be pleaded against the validity of this guarantee, with the meaning and effect of which it declares itself to be fully acquainted.

This undertaking shall remain in full force and effect up to and including the date of issue of the Performance Certificate, as provided for in the General Conditions of Contract, unless the Guarantor is advised in writing by the Council 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. Notwithstanding the aforesaid, the Council may at its' sole discretion elect to have the amount provided for under this guarantee, paid out directly to it in the case of breach of contract by the Contractor by giving the Guarantor written notice to that effect, notwithstanding the fact that the Council may decide not to institute any further legal action against the contractor.

This document is not negotiable or transferable.

NAME(s): (BLOCK LETTERS)

CAPACITY of authorized agents:

SIGNATURE(s) of authorized agents:

SIGNED at on this day of

WITNESSE(s): (Full name – in block letters – and signature)

1.

2.

ANNEXURE B

LIST OF INSTITUTIONS FOR ACCEPTED GUARANTEES ARE NOT LIMITED TO THE FOLLOWING

1. ABSA Bank
2. CAPITEC Bank
3. Credit Agricole Indosuez (South Africa Branch)
4. Development Bank of South Africa
5. FirstRand Bank
6. ING Bank N.V. (South Africa Branch)
7. Investec Bank
8. Landbank
9. National Housing Finance Co.
10. Nedcor Bank
11. South African Reserve Bank
12. Standard Bank
13. AIG South Africa
14. Credit Guarantee Insurance Co
15. Emerald Insurance Company
16. Federated Employers Mutual Assurance Co
17. Global Insurance Company
18. Guardrisk Insurance Company
19. Hannover Re:
20. Home Loan Guarantee Company
21. Lion of Africa Insurance Company
22. Metropolitan Life
23. Metropolitan Odyssey Ltd
24. MUA Insurance
25. Mutual & Federal Insurance Company
26. Rand Mutual Assurance Company
27. Regent Insurance Company
28. SA Eagle Insurance Company
29. Lombard Insurance

C1.4 HEALTH AND SAFETY AGREEMENT

ARTICLE OF AGREEMENT IN TERMS OF SECTION 37(2) OF THE OCCUPATIONAL SAFETY ACT, 1993 BETWEEN

THE CITY OF TSHWANE
(Hereinafter referred to as the "EMPLOYER")
AND

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

Herein represented by in his/her capacity as duly
authorised by virtue of a resolution dated, Attached hereto
Annexure A, of the said
..... (herein after referred to as the "CONTRACTOR")

.....
WHEREAS the CONTRACTOR is the mandatory of the EMPLOYER as contemplated in an agreement in respect
of
.....
..... Contract number

AND WHEREAS section 37 of the Occupational Health and Safety act, 1993 (Act 85 of 1993, hereinafter referred
to as the "ACT"), imposes certain powers and duties upon the EMPLOYER.

AND WHEREAS the parties have agreed to enter into an agreement in terms of section 37(2) of the ACT.

NOW THEREFORE the parties agree as follows:

- a) The CONTRACTOR undertakes to acquaint the appropriate officials and employees of the
CONTRACTOR with all relevant provisions of the ACT and the regulations promulgated in terms thereof.
- b) The CONTRACTOR undertakes that all relevant duties, obligations and prohibitions imposed in terms of
the ACT and Regulations will be fully complied with. Provided that should the EMPLOYER prescribe
certain arrangements and procedures, that same shall be observed and adhered to by the
CONTRACTOR, his officials and employees. The CONTRACTOR shall bear the onus of acquainting
himself/herself/itself with such arrangements and procedures.
- c) The CONTRACTOR hereby accepts sole liability for such due compliance with the relevant duties,
obligations, prohibitions, arrangements and procedure, if any, imposed by the ACT and Regulations and
the EMPLOYER expressly absolves the EMPLOYER from itself being obliged to comply with any of the
aforesaid duties, obligations, prohibitions, arrangements and procedure as the case may be.
- d) The CONTRACTOR agrees that any duly authorised officials of the EMPLOYER shall be entitled,

although not obliged, to take such steps as may be necessary to ensure that the CONTRACTOR has complied with the undertakings as more fully set out in paragraphs 1 and 2 above, which steps may include, but shall not be limited to, the right to inspect any appropriate site or premises occupied by the CONTRACTOR, or to inspect any appropriate records held by the CONTRACTOR or to take such steps it may deem necessary to remedy the default of the CONTRACTOR at the cost of the CONTRACTOR.

- e) The CONTRACTOR shall be obliged to report forthwith to the EMPLOYER any investigations, complaint or criminal charge which may arise as a consequence of the provisions of the ACT and Regulations, pursuant to work performed in terms of this agreement, and shall, on written demand, provide full details in writing of such an investigation, complaint or criminal charge as the case may be.

FOR AND ON BEHALF OF THE **EMPLOYER**:

NAME(s): (BLOCK LETTERS)

CAPACITY of authorized agents:

SIGNATURE(s) of authorized agents:.....

SIGNED at on this day of

WITNESSES: (Full name – in block letters – and signature)

1.....

2.....

FOR AND ON BEHALF OF THE **CONTRACTOR**:

NAME(s): (BLOCK LETTERS)

CAPACITY of authorized agents:

SIGNATURE(s) of authorized agents:.....

SIGNED at on this day of

WITNESSES: (Full name – in block letters – and signature)

1.....

2.....

C1.5 CONSTRUCTION PERMIT

APPLICATION FOR A PERMIT TO DEPARTMENT OF LABOUR TO DO CONSTRUCTION WORK

Annexure 1

Occupational Health and Safety Act, 1993 (Regulation 3(2) of the Construction Regulations, 2014)

APPLICATION FOR A PERMIT TO DO CONSTRUCTION WORK

This application must be submitted with the following documents:

- a) Health and Safety specification
- b) Health and Safety plan
- c) Baseline risk assessment.

1.	Name, postal address and telephone numbers of the client	
2.	Details of the agent	
(a)	Title, Surname and initials:	
(b)	Identity number / Passport number:	
(c)	Registration number with SACPCMP:	
(d)	Office Tel. Number and/or Mobile number:	
(e)	Postal address:	
3.	Name, postal address and telephone numbers of the principal contractor	
4.	Name, postal address and telephone numbers of the designer of the project	

5.	Name, Postal address and telephone numbers of the following persons		
	(a)	Construction Manager:	
	(b)	Construction Health and Safety Officer	
	(c)	Construction Health and Safety Officer	
6.	Exact physical address of the construction and site office		
7.	Nature of construction work		
8.	Expected commencement date		
9.	Expected completion date		
10.	Estimated maximum number of persons on the construction site:		
11.	Planned number of contractors on the construction site accountable to the principal contractor:		
12	Names(s) of contractors appointed		

18.	Signature of Client / Client's Agent				
19.	Signature of the Principal Contractor				
FOR OFFICE USE ONLY					
Authorization / Unique No.		LABOUR CENTRE		OFFICE APPROVAL STAMP	
13.	Date of application:				
14.	Submitted documents prescribed in Construction Regulation 5(4). (Please tick v)				
	CR 5(1)(a)		CR 5(1)(b)		CR 5(1); (C-S)
15.	Result of the application. (Please tick v)		Approved		Declined
16.	Reason for declining the application				
17	Signature of the Supervisor:				
18	Signature of revoking officer / inspector:				

C1.6 ADJUDICATOR'S AGREEMENT

This agreement is made on the _____ day of _____ between:

_____ (name of company / organisation)

of _____

_____ (address) and

_____ (name of company / organisation)

of _____

_____ (address) (the Parties)

and

_____ (name of Adjudicator)

of _____

_____ (address) (the

Adjudicator).

Disputes or differences may arise/have arisen¹ between the Parties under a Contract dated _____ and known as _____

and these disputes or differences shall be/have been² referred to adjudication in accordance with the CIDB Adjudication Procedure, (hereinafter called "the Procedure") and the Adjudicator may be or has been requested to act.

IT IS NOW AGREED as follows:

- 1 The rights and obligations of the Adjudicator and the Parties shall be as set out in the Procedure.
- 2 The Adjudicator hereby accepts the appointment and agrees to conduct the adjudication in accordance with the Procedure.
- 3 The Parties bind themselves jointly and severally to pay the Adjudicator's fees and expenses in accordance with the Procedure as set out in the Contract Data.

¹ Delete as necessary

² Delete as necessary

- 4 The Parties and the Adjudicator shall at all times maintain the confidentiality of the adjudication and shall endeavour to ensure that anyone acting on their behalf or through them will do likewise, save with the consent of the other Parties which consent shall not be unreasonably refused.
- 5 The Adjudicator shall inform the Parties if he intends to destroy the documents which have been sent to him in relation to the adjudication and he shall retain documents for a further period at the request of either Party.

SIGNED by:

Name:

who warrants that he / she is duly authorised to sign for and on behalf of the first Party in the presence of

Witness

Name:

Address:

Date:

SIGNED by:

Name:

who warrants that he / she is duly authorised to sign for and behalf of the second Party in the presence of

Witness:

Name:

Address:

Date:

SIGNED by:

Name:

the Adjudicator in the presence of

Witness:

Name:

Address:

Date:

Contract Data

1	The Adjudicator shall be paid at the hourly rate of R _____ in respect of all time spent upon, or in connection with, the adjudication including time spent travelling.
2	The Adjudicator shall be reimbursed in respect of all disbursements properly made including, but not restricted to: (a) Printing, reproduction and purchase of documents, drawings, maps, records and photographs. (b) Telegrams, telex, faxes, and telephone calls. (c) Postage and similar delivery charges. (d) Travelling, hotel expenses and other similar disbursements. (e) Room charges. (f) Charges for legal or technical advice obtained in accordance with the Procedure.
3	The Adjudicator shall be paid an appointment fee of R _____. This fee shall become payable in equal amounts by each Party within 14 days of the appointment of the Adjudicator, subject to an Invoice being provided. This fee will be deducted from the final statement of any sums which shall become payable under item 1 and/or item 2 of the Contract Data. If the final statement is less than the appointment fee the balance shall be refunded to the Parties.
4	The Adjudicator is/is not ³ currently registered for VAT.

³ Delete as necessary

Contract No: WSBU15 2025/26

Tender for the refurbishment of Bronkhorstspuit water treatment plant for a period of twenty-four (24) months from commencement date

Volume 1: General Clauses, Tender Procedures, Contract Data, Pricing Data, Schedule of Quantities and Scope of Works

Portion 2: Contract

Part C1: Agreements and Contract Data

5	Where the Adjudicator is registered for VAT it shall be charged additionally in accordance with the rates current at the date of invoice.
6	All payments, other than the appointment fee (item 3) shall become due 7 days after receipt of invoice, thereafter interest shall be payable at 5% per annum above the Reserve Bank base rate for every day the amount remains outstanding.

Contract No: WSBU 15-2025/26

Tender for the refurbishment of Bronkhorstspuit water treatment plant for a period of twenty-four (24) months from commencement date

Volume 1: General Clauses, Tender Procedures, Contract Data, Pricing Data, Schedule of Quantities and Scope of Works

Portion 2: Contract

Part C2: Pricing Data

**CITY OF TSHWANE
WATER AND SANITATION BUSINESS UNIT**

CONTRACT NO: WSBU 15-2025/26

**TENDER FOR THE REFURBISHMENT OF BRONKHORSTSPRUIT WATER
TREATMENT PLANT FOR A PERIOD OF TWENTY-FOUR (24) MONTHS FROM
COMMENCEMENT DATE**

PORTION 2: CONTRACT

PART C2 PRICING DATA

C2 PRICING DATA

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C2.4	SUMMARY OF SCHEDULES	C2.4-1

Contract No: WSBU 15-2025/26

Tender for the refurbishment of Bronkhorstspuit water treatment plant for a period of twenty-four (24) months from commencement date

Volume 1: General Clauses, Tender Procedures, Contract Data, Pricing Data, Schedule of Quantities and Scope of Works

Part C2: Pricing Data

Section C2.1: Pricing Instructions

CITY OF TSHWANE WATER AND SANITATION BUSINESS UNIT

CONTRACT NO: WSBU 15-2025/26

**TENDER FOR THE REFURBISHMENT OF BRONKHORSTSPRUIT WATER
TREATMENT PLANT FOR A PERIOD OF TWENTY-FOUR (24) MONTHS FROM
COMMENCEMENT DATE**

C2.1 PRICING INSTRUCTIONS

C2.1 PRICING INSTRUCTIONS

The contract documents have been separated into 3 volumes to describe the general tender and contract requirements (Volume 1), pricing data and schedule of quantities (Volume 1), project specification (civil, mechanical, electrical and electronic) (Volume 2), and particular specification (Volume 2). All the tender drawings have been included in Volume 2.

Volume 1 contains the relevant schedule of quantities associated with the civil, electrical/electronic and mechanical works as well as preliminary and general charges for the contract as a whole. The total amounts for the preliminary charges, civil, electrical/electronic and mechanical works (as totalled in the summary of work packages provided in Volume 1) shall be carried over to Form of Offer and Acceptance included in Volume 1.

1. General

1.1 This section provides the tenderer with guidelines and requirements with regard to the completion of the Bill of Quantities. The Schedule has to be completed in black ink and the tenderer is referred to the Tender Data in regard to the correction of errors.

1.2 The Bill of Quantities shall be read with all the documents which form part of this Contract.

1.3 The following words shall have the meanings hereby assigned to them:

Unit: The unit of measurement for each item of work in terms of the Specifications.

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

Rate: The payment per unit of work at which the tenderer tenders to do the work.

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

Sum: An amount tendered for an item, the extent of which is described in the Bill of Quantities, the Specifications and the Drawings (if applicable), but the quantity of work of which is not measured in any units.

1.4 Reference shall be made to the General Conditions of Contract regarding Provisional and Prime Costs Sums.

2. Pricing of Mechanical and Electrical Works

The prices quoted for the supply of plant and equipment shall include for all handling, loading, transporting and off-loading required for the delivery of the plant and equipment to the site, including in the case of off-site storage for double handling at the store.

The prices quoted for erection and/or installation shall include for all handling, loading, transporting and off-loading to take plant and equipment to place on site where required, erection, installation, painting, guaranteeing for a period of twenty four (24) months and upholding for a period of twelve (12) months, all as specified.

The prices quoted for the commissioning of plant shall include for operating, mechanical and electrical testing, adjusting and handing over in a proper working order and for the provision of operating and maintenance manuals, all as specified.

Any additional charges in connection with off-site storage which there may be over and above the prices quoted in the various sections of this schedule of prices, shall be set-out in detail by the Tenderer.

The work of installation, erection and testing of the plant and equipment shall as far as possible be carried out in one continuous operation and the cost of transporting personnel between the Contractors

headquarters and the site will be paid at the tendered amount for same for only one return trip for such continuous operation, (if all installation and erection operations are carried out by same personnel) irrespective of the number of sections awarded. No additional payment will be made for any weekend or holiday trips back to the Contractor's headquarters. Additional trips for personnel will only be paid for if authorised, or when requested by the Engineer in writing.

Amounts allowed for provisional sums and contingencies will be spent in part or as a whole at the sole discretion of the Engineer.

The Council reserves the right to sub-divide the contract. Prices quoted in this Schedule are deemed to apply to that Section only. The tenderer may offer a reduction in price if awarded more than one section.

For the purposes of calculating Contract Price Adjustment, each mechanical and electrical item have been coded as follows and CPA calculations shall be based on these codes and the applicable CPA formulae.

M – Mechanical Equipment (Supply)

E – Electrical Equipment (Supply)

P – Mild Steel piping/material (Supply)

S – Stainless Steel piping/material (Supply)

I – Installation and Commissioning

G – Preliminary and General Items

3. Pay Items

- 3.1 The method of measurement published by the City of Tshwane in section 001 clause 04 and the clauses titled "Measurement and Payment" in the various sections of the Standard Specifications for Municipal Civil Engineering Works, Third Edition 2005, is applicable for all civil works, subject to the variations and amendments contained in section C3.4.3.
- 3.2 For preliminary and general charges, the method of measurement and payment shall be as specified in Volume 2 of the contract documents. Measurement and payment of mechanical and electrical equipment shall be as described in the Particular Specification, as amended, or as described in the Schedule of Quantities.
- 3.3 Descriptions in the Bill of Quantities are abbreviated and comply generally with those in the Specifications. The measurement and payment clause in the 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 in the Specification, or the Scope of Work, conflict with the terms of the Bill of Quantities, the requirements of the Specification or Scope of Work, as applicable, shall prevail.
- 3.4 The item numbers appearing in the Bill of Quantities refer to the corresponding item number in the Specifications or as amended in the Scope of Work. In the latter case, the item number is prefixed with the letter "B". The same applies to new clauses added to the Specifications.
- 3.5 Those parts of the contract to be constructed using labour-intensive methods have been marked in the bill of quantities with the letter LI in a separate column filled in against every item so designated. The works, or parts of the works so designated are to be constructed using labour-intensive methods only. The use of plant to provide such works, other than plant specifically provided for in the scope of work, is a variation to the contract. The items marked with the letters LI are not necessarily an exhaustive list of all the activities which must be done by hand, and this clause does not supercede any of the requirements in the generic labour intensive specification in the Scope of Works.
- 3.6 Payment for items which are designated to be constructed labour-intensive (either in this schedule or in the Scope of Works) will not be made unless they are constructed using labour-intensive methods. Any unauthorised use of plant to carry out work which was to be done labour-intensively will not be condoned and any works so constructed will not be certified for payment.
- 3.7 Unless otherwise stated, items are measured net in accordance with the drawings, and no allowance is

made for waste.

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

3.9 The units of measurement described in the Bill of Quantities are metric units. Abbreviations used in the Bill of Quantities are as follows:

mm	=	millimetre	h	=	hour
m	=	metre	kg	=	kilogram
km	=	kilometre	t	=	ton (1000kg)
m ²	=	square metre	no.	=	number
m ² .pass	=	square metre pass	sum	=	lump sum
ha	=	hectare	MN	=	meganewton
m ³	=	cubic metre	MN.m	=	meganewton-metre
m ³ .km	=	cubic metre-kilometre	PC sum	=	Prime Cost sum
ℓ	=	litre	Prov sum	=	Provisional sum
kl	=	kilolitre	%	=	Per cent
MPa	=	megapascal	kW	=	kilowatt
PS	=	Pipe Special number	V	=	Valve number

REFERENCE TO MUNICIPALITY TECHNICAL ABBREVIATIONS

For abbreviations related to technical standards, testing methods, and engineering practice standards used throughout this contract, refer to:

City of Tshwane Standard Specifications for Municipal Civil Engineering Works,
Third Edition 2005, Section 001 Clause 03

Key technical abbreviations include:

- AASHTO = American Association of State Highway and Transportation Officials (used for compaction standards, e.g., "90% of modified AASHTO density")
- SANS = South African National Standards
- TMH = Technical Methods for Highways
- WISA = Water Institute of South Africa
- CBR = California Bearing Ratio
- CSIR = Council for Scientific and Industrial Research

These abbreviations shall take precedence over any conflicting definitions and form part of this contract.

4. Rates

4.1 The prices and rates to be inserted in the Bill of Quantities are to be full inclusive prices for the work described under such items. Such prices and rates 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 on which the tender is based, as well as overhead charges and profit. Reasonable prices shall be inserted as these will be used as a basis for assessment of payment for additional work that may have to be carried out.

4.2 A price or rate is to be entered against each item in the Bill of Quantities, whether the quantities are stated or not. An item against which no price is entered or where a word or phrase such as "included" or "provided elsewhere" will be accepted as a rate of nil (R0,00) having been entered against such items and covered by the other prices or rates in the Schedule.

Any work executed to which such a pay item applies, shall be measured under the appropriate items in the Bill of Quantities and valued at a rate of nil (R0,00). The rate of nil shall be valid irrespective of any

change in the quantities during the execution of the Contract.

- 4.3 The Tenderer shall fill in a rate against all items.
- 4.4 The Tenderer shall not group together a number of items and tender one rate for such group of items.
- 4.5 All rates and sums of money quoted in the Bill of Quantities shall be in rands and whole cents. Fractions of a cent shall be discarded.
- 4.6 All prices and rates entered in the Bill of Quantities must be excluding VAT. VAT will be added last on the summary page of the Bill of Quantities.
- 4.7 Should excessively high unit prices be tendered, such prices may be of sufficient importance to warrant rejection of a tender by the Employer.
- 4.7.1 Where the Contractor is required to furnish detailed drawings and designs or other information in terms of the Contract Documents and no specific payment item has been included for this, all associated costs shall be deemed to have been provided for and included in the unit rates and sum amounts tendered for the items scheduled in the Bill of Quantities, and separate additional payments will not be made.

5. LABOUR-INTENSIVE CONSTRUCTION

- 5.1 Those parts of the contract to be constructed using labour-intensive methods have been marked in the schedule of quantities with the letters LIC. The works, or parts of the works so designated are to be constructed using labour-intensive methods only in accordance with the *Guidelines for the implementation of Labour-Intensive Infrastructure Projects under the Extended Public Works Programme (EPWP)*. includ.

The items marked LIC are not necessarily an exhaustive list of all the activities which must be done by hand.

- 5.2 Payments for items which are designated to be constructed labour-intensively will not be made unless they are constructed using labour-intensive methods. Any unauthorised use of plant to carry out work which was to be done labour-intensively will not be condoned and any works so constructed will not be certified for payment.

6. PIPE SCHEDULE

- 6.1 Pipes, fittings and specials are scheduled separately in the Pipe Schedules for each Section. The individual Pipe Schedule totals have to be carried forward to the relevant item in each Section.

- 6.2 The following abbreviations are used in the Pipe Schedule:

dia	- diameter	uPVC	- Unplasticised Polyvinyl Chloride
mat	- material	MS	- Mild Steel
SS	- Stainless Steel	AS	- As Specified
c to f	- centre to face	GMS	- Galvanised Mild Steel
d.f	- double flanged	o.a	- overall
p.f	- puddle flange	CI	- Cast Iron
NB	- Nominal Bore	w.t	- wall thickness

- 6.3 Applicable general material and corrosion protection specifications for the Pipe Schedule Items are (unless otherwise specified):

- (a) All mild steel pipes and fittings shall be treated with a polyamide-cured epoxy system similar and equal to Carboline 891 externally and internally to a dry film thickness of at least 300 micron.
- (b) Mild steel pipes shall comply with project material specifications outlined in Particular Specification C3.4.3.2.5.1 and shall include:
- Material grade in accordance with contract design standards

- Pipe wall thickness as detailed in Section C3.4.3.2.5.1 Pipe Materials and Specifications:
 - Nominal Bore 200-375 mm: 4 mm minimum
 - Nominal Bore 400-550 mm: 5 mm minimum
 - Nominal Bore 600-700 mm: 6 mm minimum
 - Nominal Bore 750-900 mm: 8 mm minimum
 - Nominal Bore 950-1550 mm: 10 mm minimum
 - Nominal Bore 1800 mm: 14 mm minimum
 - Polyamide-cured epoxy coating (Carboline 891 or equivalent) applied to minimum 300 micron dry film thickness
 - Surface preparation per ISO 8501-1 Sa2 minimum.
- (c) All bolts, nuts and washers shall be manufactured from stainless steel grade 304 (A4-70 minimum) for ALL applications including above ground, below water level, and below ground installations. Grade 304 stainless steel provides superior corrosion resistance in all soil and water conditions and prevents bi-metallic corrosion issues. Allowance shall be made for two washers (stainless steel grade 304) under each bolt and nut.
- (d) All rates shall be consistent for similar items of the same material and diameter. Where amendments are ordered, new rates shall be calculated by direct interpolation between the tender rates for the nearest two similar items. Only when amended or new items fall outside the range of similar items for which rates have been tendered, will new rates be negotiated.
- (e) Unless otherwise stated, the dimensions and drilling of flanges shall comply with the requirements of SANS 1123, Table 16 for pipes with a diameter of 150 mm and smaller and Table 10 for diameters exceeding 150 mm.

6.4 No pipes, fittings or specials shall be ordered unless authorised by the engineer in writing.

CORRECTION OF ENTRIES MADE BY TENDERER

Any entry made by the Tenderer in the Bill of Quantities, forms, etc, which the tenderer desires to change, shall not be erased or painted out. A line shall be drawn through the incorrect entry and the correct entry shall be written above in black ink and the full signature of the Tenderer shall be placed next to the correction.

**CITY OF TSHWANE
WATER AND SANITATION BUSINESS UNIT**

CONTRACT NO: WSBU 15-2025/26

**TENDER FOR THE REFURBISHMENT OF BRONKHORSTSPRUIT WATER
TREATMENT PLANT FOR A PERIOD OF TWENTY-FOUR (24) MONTHS FROM
COMMENCEMENT DATE**

C2.3 PRICING SCHEDULE

ITEM	PAYMENT REFERENCE	DESCRIPTION	UNIT	QTY	RATE (R)	AMOUNT (R)
0	SERIES 0	GENERAL				
0,1	Section 001	General Requirements and Charges				
	001.01	Preliminary and General Charges:				
0.1.1	001.01.01	Fixed Charges	sum	1		
0.1.2	001.01.02	Time-Related Charges	sum	1		
0.1.3	001.02	Locating Existing Services	sum	1		
0.1.4	001.03	Excavate by hand to expose existing services and backfill	m ³	500		
	001.04	Compliance with the Occupational Health and Safety Act and Applicable Regulations. Refer to Section C3.6 - Health & Safety Specifications.				
0.1.5	001.04.01	Provision of a Health and Safety Plan	sum	1		
0.1.6	001.04.02	Provision of a Health and Safety File	sum	1		
0.1.7	001.04.03	Provision of Construction Supervisors	sum	1		
0.1.8	001.04.04	Provision of a Full-Time Safety Officer	sum	1		
0.1.9	001.04.05	Health and Safety Training	sum	1		
0.1.10	001.04.06	Provision of Personal Protective Clothing and Equipment	sum	1		
0.1.11	001.04.07	Provision of Safety Fences, Signs and Barricades	sum	1		
0.1.12	B001.05	Community Liaison Officer (Refer to Section C3.4: Construction (Specification) Clause C3.4.1.25)	month	24	R16 905,00	R 405 969,00
	B001.05.01	Contractor's mark up on item B001.05 (limit to maximum of 10%)	%		R405 969,00	
	B001.06.01	Targeted labour	Prov.Sum	1		R 400 000,00
TOTAL CARRIED TO SUMMARY						

Signature of person authorised to sign the tender:	Date

ITEM	PAYMENT REFERENCE	DESCRIPTION	UNIT	QTY	RATE (R)	AMOUNT (R)
0.2	Section 002	Engineer's Accommodation Refer to C3.4.3.7 - Engineer's Office & Meeting Room Facilities				
	002.01	Services				
0.2.1	002.01.01	Services for Offices and Meeting Room	sum	1		
0.2.2	002.01.02	Services for Cooking and Ablution Facilities on Site for the Engineer's Site Staff	sum	1		
0.2.3	002.02	Treatment and Maintenance of Areas Surrounding Offices and Meeting Room	sum	1		
0.2.4	002.03	Offices and Meeting Room (including all furniture as specified)	sum	1		
0.2.5	002.04	Provision of Survey Equipment and Assistances	sum	1		
TOTAL CARRIED TO SUMMARY						

Signature of person authorised to sign the tender:	Date

ITEM	PAYMENT REFERENCE	DESCRIPTION	UNIT	QTY	RATE (R)	AMOUNT (R)
1	SERIES 1	ANCILLARY WORK				
1,1	Section 101	Site Clearing and Grubbing				
	101.01	Clearing and grubbing <i>Refer to Drawing: Ral-Brk-01-Gen-04</i> <i>Refer to Drawing: Ral-Brk-01-Gen-05</i> <i>Refer to Drawing: Ral-Brk-06-Civ-01</i>				
1.1.1	101.01.01	Areas for Module 1 & 2 High-Rate Clarifiers	m ²	1 095		
	101.02	Cutting and removing large trees with a girth -				
1.1.2	101.02.01	exceeding 1m and up to and including 2m	no.	5		
1.1.3	101.02.02	exceeding 2m and up to and including 3m	no.	2		
1.1.4	101.02.03	exceeding 3m and up to and including 4m	no.	2		
1.1.5	101.04	Re-clearing of areas (only on the written instructions of the Engineer)				
1.1.6	101.04.02	Areas not classified as strips	m ²	300		
TOTAL CARRIED FORWARD						

Signature of person authorised to sign the tender:	Date

ITEM	PAYMENT REFERENCE	DESCRIPTION	UNIT	QTY	RATE (R)	AMOUNT (R)
TOTAL BROUGHT FORWARD						
	101.05	Removal and disposal of specific elements				
1.1.7	101.05.01	Concrete kerbing / kerbing combinations	m	50		
	101.05.02	Concrete or brick elements (reinforced or unreinforced)				
1.1.8	101.05.02.01	230mm brickwork	m ²	20		
1.1.9	101.05.02.02	115mm brickwork	m ²	10		
1.1.10	101.05.02.04	Concrete elements (unreinforced - existing paving at Raw Water Pump Station)	m ³	10		
1.1.11	101.05.02.05	Concrete elements (reinforced - Raw Water Pump plinths)	m ²	20		
	101.08	Desludging of Reservoir and Sludge Lagoons Refer to Drawing: Ral-Brk-01-Gen-02 Refer to Drawing: Ral-Brk-01-Gen-04 Refer to Drawing: Ral-Brk-01-Gen-05				
1.1.12	101.08.01	Desludging of 2ML Reservoir - draining, sludge removal (mechanical), and safe disposal	m ³	670		
1.1.13	101.08.02	Desludging of existing sludge lagoons (mechanical excavation and transport)	m ³	190		
1.1.14	101.08.03	Temporary access/working platforms to reservoir structures	m ²	50		
1.1.15	101.08.04	Screening, containment or dewatering area for sludge	m ²	100		
1.1.16	101.08.05	Minor concrete repairs to floor/walls post-desludging	Lump Sum	1		
TOTAL CARRIED TO SUMMARY						

Signature of person authorised to sign the tender:	Date

ITEM	PAYMENT REFERENCE	DESCRIPTION	UNIT	QTY	RATE (R)	AMOUNT (R)
2	SERIES 2	EARTHWORKS				
2.1	Section 201	General				
2.1.1	201.01	Excess overburden at borrow pits provided by the Employer	m ³	120		
2.1.2	201.02	Temporary stockpiling of material	m ³	360		
TOTAL CARRIED TO SUMMARY						

Signature of person authorised to sign the tender:	Date

ITEM	PAYMENT REFERENCE	DESCRIPTION	UNIT	QTY	RATE (R)	AMOUNT (R)
	SERIES 2	EARTHWORKS <i>Refer to Drawing: Ral-Brk-05-Civ-01 (New Clari-Flocculator)</i> <i>Refer to Drawing: Ral-Brk-11-Civ-03 (New water Filling Station)</i>				
2.2	Section 202	Trenching				
	202.01	Trench excavation for Pipes in Clari-Flocculator & Water Filling Station				
	202.01.01	Up to 1,0m wide				
2.2.1	202.01.01.01	Up to 1,0m deep	m ³	15		
2.2.2	202.01.01.02	Over 1,0m deep and up to 1,5m deep	m ³	25		
2.2.3	202.01.01.03	Over 1,5m deep and up to 2,0m deep	m ³	15		
2.2.4	202.01.01.04	Over 2,0m deep and up to 2,5m deep	m ³	35		
2.2.5	202.01.02	Over 1,0m and up to 2,0m wide				
2.2.6	202.01.02.01	Up to 1,0m deep	m ³	10		
2.2.7	202.01.02.02	Over 1,0m deep and up to 1,5m deep	m ³	11		
2.2.8	202.01.02.03	Over 1,5m deep and up to 2,0m deep	m ³	1 909		
2.2.9	202.01.02.04	Over 2,0m deep and up to 2,5m deep	m ³	20		
2.2.10	202.01.02.05	Over 2,5m deep and up to 3,0m deep	m ³	20		
	202.02	Extra over items 202.01, 202.03 and 202.09 for excavating in -				
2.2.11	202.02.01	Intermediate material	m ³	382		
2.2.12	202.02.02	Hard material	m ³	191		
2.2.13	202.03	Excavations outside the normal trench profile	m ³	191		
2.2.14	202.04	Hand excavation (extra over item 202.01)	m ³	95		
TOTAL CARRIED FORWARD						

Signature of person authorised to sign the tender:	Date

ITEM	PAYMENT REFERENCE	DESCRIPTION	UNIT	QTY	RATE (R)	AMOUNT (R)
TOTAL BROUGHT FORWARD						
	202.07	Extra over items 202.06 and 202.13 for using backfill material obtained -				
2.2.15	202.07.01	From borrow areas	m ³	150		
	202.10	Removal of spoil material -				
2.2.16	202.10.01	To positions indicated on the Drawings or by the Engineer	m ³	150		
2.2.17	202.10.02	To dumping areas to be provided by Contractor	m ³	8 250		
2.2.18	202.12	Extra over item 202.06 for additional compaction of backfill to 93% of modified AASHTO density in road reserves	m ³	200		
TOTAL CARRIED TO SUMMARY						

Signature of person authorised to sign the tender:	Date

ITEM	PAYMENT REFERENCE	DESCRIPTION	UNIT	QTY	RATE (R)	AMOUNT (R)
5	SERIES 5	DRAINAGE AND EROSION PROTECTION				
5,6	Section B506	Filter Sand <i>Refer to C3.4.4 Particular Specification: Civil Works</i>				
5.6.1	B506.05.01	Supply of approved filter sand (2 Filters)	m ³	1 965		
5.6.2	B506.05.02	Placing and compaction of filter sand	m ³	1 965		
5.6.3	B506.05.03	Testing of filter sand (Prov sum)	Prov sum	1	R 120 000,00	R 120 000,00
TOTAL CARRIED TO SUMMARY						

Signature of person authorised to sign the tender:	Date

ITEM	PAYMENT REFERENCE	DESCRIPTION	UNIT	QTY	RATE (R)	AMOUNT (R)
6	SERIES 6	ROADS AND PARKING AREAS <i>Refer to Drawing: Ral-Brk-03-Civ-01</i>				
6.1	Section 601	Gravel Pavement Layers				
	601.01	Preparation and compaction of in situ subgrade material to -				
6.1.1	601.01.02	93% of modified AASHTO density	m ³	90		
	601.02	Gravel layers constructed from material obtained from commercial sources				
	601.02.03	Base				
6.1.2	601.02.03.01	Compacted to 98% of modified AASHTO density	m ³	90		
TOTAL CARRIED TO SUMMARY						

Signature of person authorised to sign the tender:	Date

ITEM	PAYMENT REFERENCE	DESCRIPTION	UNIT	QTY	RATE (R)	AMOUNT (R)
6.4	SERIES 6	ROADS AND PARKING AREAS <i>Refer to Drawing: Ral-Brk-03-Civ-01</i>				
	Section 604	Stabilization				
	604.01	Chemical stabilization extra over unstabilized compacted layers				
6.4.1	604.01.04	Base	m ³	90		
6.4.2	604.02	Chemical stabilizing agent				
	604.02.01	Cement	t	3		
6.4.3	604.09	Curing of stabilized layer	m ²	600		
6.4.4	604.10	Quality control for stabilized base (Moisture- Density & UCS tests)	Prov Sum	1	R 50 000,00	R 50 000,00
TOTAL CARRIED TO SUMMARY						

Signature of person authorised to sign the tender:	Date

ITEM	PAYMENT REFERENCE	DESCRIPTION	UNIT	QTY	RATE (R)	AMOUNT (R)
	SERIES 6	ROADS AND PARKING AREAS <i>Refer to Drawing: Ral-Brk-03-Civ-01</i>				
6,10	Section 610	Concrete Paving				
	610.01	Concrete Paving				
6.10.1	610.01	35Mpa, 150mm thick	m ²	600		
	610.02	Texturing and curing of concrete paving				
6.10.2	610.02.01	Wire-brush texturing	m ²	600		
6.10.3	610.02.02	Curing	m ²	600		
	6.10.04	Joints				
6.10.4	610.04.01	Expansion joints complete (exc. Dowels)	m	15		
		Longitudinal hinge joints				
6.10.5	610.04.02.02	Sawn hinge joints (sealed)	m	200		
		Transverse contraction joints				
6.10.6	610.04.03.01	Sawn contraction joints (sealed) complete in single operation	m	100		
6.10.7	610.04.04	Dowel bars (mild steel) (20mm, 400mm long)	No.	630		
6.10.8	610.04.05	Tie bars (12mm, 600mm long)	No.	630		
6.10.9	610.04.05	End caps for dowels at expansion joints	No.	630		
TOTAL CARRIED TO SUMMARY						

Signature of person authorised to sign the tender:	Date

ITEM	PAYMENT REFERENCE	DESCRIPTION	UNIT	QTY	RATE (R)	AMOUNT (R)
7	SERIES 7	STRUCTURES <i>Refer to Drawing: Ral-Brk-05-Civ-01 (New Clari-Floculator)</i> <i>Refer to Drawing: Ral-Brk-06-Civ-01 (New High-Rate Clarifier)</i> <i>Refer to Drawing: Ral-Brk-11-Civ-01 (New Septic Tank and Soakaway)</i> <i>Refer to Drawing: Ral-Brk-11-Civ-03 (New water Filling Station)</i>				
7.1	Section 701	Foundations For Structures				
7.1.1	701.01	Additional foundation investigations	Prov sum	1	R 200 000,00	R 200 000,00
	701.02	Excavation for structures				
	701.02.01	Excavation of soft material situated in the following depth ranges: <i>Refer to Drawing: Ral-Brk-05-Civ-01</i> <i>Refer to Drawing: Ral-Brk-06-Civ-01</i>				
7.1.2	701.02.01.01	0 m up to 2 m	m ³	300		
7.1.3	701.02.01.02	Exceeding 2 m up to 4 m	m ³	300		
7.1.4	701.02.02	Extra over subitem 701.02.01 for excavation in hard material irrespective of depth	m ³	90		
7.1.5	701.02.03	Extra over subitem 701.02.01 for additional excavation required by the Engineer after the excavation has been completed	m ³	90		
7.1.6	701.04	Dewatering of foundation excavations	sum	1		
	701.05	Backfill to excavations utilizing				
	701.05.01	Material from the excavation compacted to				
7.1.7	701.05.01.01	90% of modified AASHTO density	m ³	25		
7.1.8	701.05.01.02	93% of modified AASHTO density	m ³	190		
7.1.9	701.05.01.03	95% of modified AASHTO density	m ³	25		
	701.05.02	Imported material compacted to -				
7.1.10	701.05.02.01	90% of modified AASHTO density	m ³	25		
7.1.11	701.05.02.02	93% of modified AASHTO density	m ³	38		
7.1.12	701.05.02.03	95% of modified AASHTO density	m ³	25		
7.1.13	701.06	Fill within restricted areas (extra over item 203.01)	m ³	50		
TOTAL CARRIED FORWARD						

Signature of person authorised to sign the tender:	Date

ITEM	PAYMENT REFERENCE	DESCRIPTION	UNIT	QTY	RATE (R)	AMOUNT (R)
TOTAL BROUGHT FORWARD						
		New Septic Tank and Soakaway System Refer to Drawing: Ral-Brk-11-Civ-01				
7.1.14	701.05.01.01	Excavate for septic tank up to 2m deep	m ³	25		
7.1.15	701.05.03.01	G5 compacted bedding layer for tank base	m ³	6		
7.1.16	705.06.02.01	Water stop joint sealant to tank	m	10		
7.1.17	701.06.01.01	Backfilling and compaction around structure	m ³	20		
7.1.18	701.05.02.02	Precast concrete manhole cover slab with access	no.	1		
		Benching in DAFF				
7.1.19	704.07.01.01	Concrete benching inside DAFF unit (50mm-150mm)	m ³	5		
	701.05	New Water Filling Station Refer to Drawing: Ral-Brk-11-Civ-03/04				
7.1.20	701.05.01.02	Bulk excavation for tower foundation and column bases	m ³	15		
7.1.21	704.07.02.03	Reinforced concrete bases and pedestal	m ³	8		
7.1.22	703.05.01.02	Reinforcement steel to overhead support	ton	1		
7.1.23	801.06.03.01	Structural steel frame pipe gantry and fill arm (fabricated)	kg	1 200		
7.1.24	806.08.01.01	Non-slip finish to vehicle load area (concrete base)	m ²	35		
7.1.25	809.05.01.02	Pipe Specials from Pipe Schedules for Water Filling Station	Sum	1		
7.1.26	810.02.01.01	Pipe support brackets and protective cage	Sum	1		
7.1.27	810.02.01.02	200mm Diameter HDPE PE100 Pipe from the treatment plant to the Water filling station	m	600		
7.1.28	810.02.01.03	450 mm Diameter Stormwater Concrete pipe at the Water Filling Station	m	100		
		Clari-Flocculator Pipe Specials Refer to Drawing: Ral-Brk-05-Civ-01				
7.1.29	809.05.01.04	Pipe Specials from Pipe Schedules for Clari-Flocculator	Sum	1		
TOTAL CARRIED FORWARD						

Signature of person authorised to sign the tender:	Date

ITEM	PAYMENT REFERENCE	DESCRIPTION	UNIT	QTY	RATE (R)	AMOUNT (R)
	SERIES 7	STRUCTURES				
	Section 702	FALSEWORK, FORMWORK AND CONCRETE FINISH <i>Refer to Drawing: Ral-Brk-05-Civ-01</i> <i>Refer to Drawing: Ral-Brk-06-Civ-01</i> <i>Refer to Drawing: Ral-Brk-11-Civ-01</i> <i>Refer to Drawing: Ral-Brk-11-Civ-03</i>				
7.2	702.02	Formwork class F2 surface finish				
	702.02.01	Single-surface formwork				
7.2.1	702.02.01.01	Plane, horizontal	m ²	35		
7.2.2	702.02.01.02	Plane, sloping	m ²	30		
7.2.3	702.02.01.03	Plane, vertical	m ²	50		
	702.02.02	Double-surface formwork (both sides measured)				
7.2.4	702.02.02.01	Plane, horizontal	m ²	10		
7.2.5	702.02.02.02	Plane, sloping	m ²	15		
7.2.6	702.02.02.03	Plane, vertical	m ²	1 000		
	702.02.03	Beams				
7.2.7	702.02.03.01	Beam, soffits	m ²	10		
7.2.8	702.02.03.02	Beam, sides	m ²	30		
	702.07	Chamfers				
7.2.9	702.07.01	25 mm x 25 mm	m	160		
TOTAL CARRIED FORWARD						

Signature of person authorised to sign the tender:	Date

ITEM	PAYMENT REFERENCE	DESCRIPTION	UNIT	QTY	RATE (R)	AMOUNT (R)
	SERIES 7	STRUCTURES				
7.3	SECTION 703	STEEL REINFORCEMENT FOR STRUCTURES <i>Refer to Drawing: Ral-Brk-05-Civ-01</i> <i>Refer to Drawing: Ral-Brk-06-Civ-01</i> <i>Refer to Drawing: Ral-Brk-06-Str-01</i> <i>Refer to Drawing: Ral-Brk-06-Str-02</i> <i>Refer to Drawing: Ral-Brk-11-Civ-01</i> <i>Refer to Drawing: Ral-Brk-11-Civ-03</i>				
	703.04	Reinforcement for New Clarifier				
	703.04.01	Mild steel				
7.3.1	703.04.01.01	Bars with an 8 mm dia	t	55		
7.3.2	703.04.01.02	Bars with a 10 mm dia	t	2		
	703.04.02	High-yield-stress steel				
7.3.3	703.04.02.01	Bars with an 8 mm dia	t	2		
7.3.4	703.04.02.02	Bars with a 10 mm dia	t	4		
7.3.5	703.04.02.03	Bars with a 12 mm dia	t	5		
7.3.6	703.04.02.04	Bars with a 16 mm dia	t	8		
7.3.7	703.04.02.05	Bars with a 25mm dia	t	2		
	703.05	Reinforcement for Septic Tank				
7.3.8	703.05.01.01	Steel Reinforcement - high tensile (450 Mpa)	t	1		
TOTAL CARRIED TO SUMMARY						

Signature of person authorised to sign the tender:	Date

ITEM	PAYMENT REFERENCE	DESCRIPTION	UNIT	QTY	RATE (R)	AMOUNT (R)
7.4	SERIES 7	STRUCTURES				
	SECTION 704	CONCRETE				
	704.01	Cast in situ concrete <i>Refer to Drawing: Ral-Brk-05-Civ-01</i> <i>Refer to Drawing: Ral-Brk-06-Civ-01</i> <i>Refer to Drawing: Ral-Brk-06-Str-01</i> <i>Refer to Drawing: Ral-Brk-06-Str-02</i> <i>Refer to Drawing: Ral-Brk-11-Civ-03</i>				
7.4.1	704.01.01	30/19, Clarifier Walls	m ³	90		
7.4.2	704.01.02	30/19, Clarifier Slabs	m ³	80		
7.4.3	704.01.03	30/19, Clarifier Beams	m ³	12		
7.4.4	704.01.04	30/19, Flocculation Basin Walls	m ³	40		
7.4.5	704.01.05	30/19, Flocculation Basin Slabs	m ³	20		
7.4.6	704.01.06	30/19, Flocculation Basin Beams	m ³	8		
7.4.7	704.01.07	30/19, Raw Water Pump Station Plinths (Provisional to pump supplier details and foundation requirements)	m ³	20		
7.4.8	704.01.07	30/19, Dosing Stations (Provisional to mechanical equipment requirements)	m ³	45		
7.4.9	704.01.08	Water Filling Station: Boxes, Floor & Curb	m ³	30		
	704.07	Benching in DAFF				
7.4.10	704.07.03.01	Formwork to benching slopes and floor (1:100)	m ²	60		
7.4.11	705.06.01.01	Non-shrink grout at interface between bench	m ²	15		
7.4.12	701.05.02.01	Surface finishing and trowel float finish for int	m ²	50		
		Septic Tank <i>Refer to Drawing: Ral-Brk-11-Civ-01</i>				
7.4.13	704.07.01.02	Cast in-situ concrete for base slab and walls	m ³	12		
7.4.14	704.04	Epoxy bonding of new concrete surfaces to old	m ²	5		
7.4.15	704.07	Design of concrete mixes by a specialist organization appointed by the Engineer	Prov sum	1	R 150 000,00	R 150 000,00
TOTAL CARRIED TO SUMMARY						

Signature of person authorised to sign the tender:	Date

ITEM	PAYMENT REFERENCE	DESCRIPTION	UNIT	QTY	RATE (R)	AMOUNT (R)
	SERIES 7	STRUCTURES				
	SECTION 706	JOINTS IN STRUCTURES <i>Refer to Drawing: Ral-Brk-05-Civ-01</i> <i>Refer to Drawing: Ral-Brk-06-Civ-01</i> <i>Refer to Drawing: Ral-Brk-06-Str-01</i> <i>Refer to Drawing: Ral-Brk-06-Str-02</i>				
7.6	706.06	JOINTS				
	706.06.01	Filled joints (including formwork)				
	706.06.01.01	Joint filler consisting of closed cell expanded polyethylene with density not less than 120 kg/m3 including bullnose finish to both sides of joint.				
7.6.1	706.06.01.01.01	20mm wide between 150 mm concrete members	m	50		
7.6.2	706.06.01.01.02	20mm wide between 200 mm concrete members	m	50		
7.6.3	706.06.01.01.03	20mm wide between 250 mm concrete members	m	250		
7.6.4	706.06.01.01.04	20 mm wide between 300 mm concrete members	m	50		
	706.06.01.02	Joint sealer (20 x 15 mm) consistin of a two component polyether based polyurethane sealing compound on visible fece of joint including primer and bond breaker				
7.6.5	706.06.01.02.01	20 mm joints between concrete members	m	400		
	706.06.02	Bandaged Joints				
		Bandage to seal 20 mm wide joints on horizontal, sloping and vertical joints complete as specified				
7.6.6		200 mm wide bandage	m	450		
TOTAL CARRIED TO SUMMARY						

Signature of person authorised to sign the tender:	Date

ITEM	PAYMENT REFERENCE	DESCRIPTION	UNIT	QTY	RATE (R)	AMOUNT (R)
8.1	SECTION C.3.4.5	SECTION 8.1 : SUPPLY AND DELIVERY OF RAW WATER ABSTRACTION PUMPS				
8.1.1		SPECIFICATION C.3.4.6 Design, Manufacture, Transport Delivery of equipment and On Site/Off Storage for the mechanical works In accordance with the Specification				
		Refer to drawing no.Ral-Brk-03-Mech- 01/ Ral-Brk-03-Mech-02/Ral-Brk-02- Mech-01				
8.1.1.1	14.5.1/14.6.1 (a)	Vertical Centrifugal Pump complete with motor, base plate, piping, valves, and accessories. Pump Duty Point 360 L/s at 44 m , Estimated Rated Power: 280 kW in accordance with the specification.	No	2		
8.1.2		SECTION 8.1 : INSTALL & COMMISSION OF RAW WATER ABSTRACTION				
8.1.2.1		Installation, testing and commissioning of equipment for the mechanical works (including submission of O&M manuals and As- built drawings In accordance with the Specification				
8.1.2.2	14.5.2/14.6.1 (b)	Complete Water Abstraction System/New Vertical Pump as supplied under item 8.1.1.1	No	2		
8.1.2.3	14.5.3/14.6.1 (c)	Commissioning of the Water Abstraction System/New Vertical Pumps as supplied under item 8.1.1.1	No	2		
TOTAL CARRIED TO SUMMARY						
Signature of person authorised to sign the tender:					Date	

ITEM NO	PAYMENT REFERENCE	DESCRIPTION	UNIT	QTY	RATE (R)	AMOUNT (R)
8.2	SECTION C.3.4.5	SECTION 8.2 : SUPPLY AND DELIVERY OF INLET WORKS & CHEMICAL DOSING				
8.2.1		Design, Manufacture, Transport Delivery of equipment and On Site/Off Storage for the mechanical works In accordance with the Specification				
		Refer to drawing no. Ral-Brk-04-Mech-03/Ral-Brk-04- Mech-04/Ral-Brk-02-Mech-02 Chemical Dosing Systems: Poly, Chlorine, and Lime dosing systems complete with piping, actuated valves and fittings - Poly: 15mm PVC, Chlorine: 32mm PVC, Lime: 32 to 100 mm HDPE per SANS standards in accordance with the specification. Below are the dosing capacities Pre-Chlorine : 18 l/hr Lime : 166,7 l/hr Poly : 18:00 l/hr Post-Chlorine : 11,5 l/hr	Item			
8.2.1.1	14.5.1/14.6.3 (a)	Chemical Dosing Systems: Poly	Item	1		
8.2.1.1	14.5.1/14.6.3 (a)	Chemical Dosing Systems: Chlorine	Item	1		
8.2.1.3	14.5.1/14.6.3 (a)	Chemical Dosing Systems: Lime	Item	1		
8.2.1.4	14.5.1/14.6.3 (a)	Poly storage tank Poly storage tank and Piping System complete in accordance with the specification. 10 000 l, Thermoplastic Tanks, including Polypropylene piping and valves	Item	1		
TOTAL CARRIED FORWARD						
Signature of person authorised to sign the tender:					Date	

ITEM	PAYMENT REFERENCE	DESCRIPTION	UNIT	QTY	RATE (R)	AMOUNT (R)
TOTAL BROUGHT FORWARD						
8.2.2		SECTION 8.2 : INSTALL & COMMISSION OF INLET WORKS & CHEMICAL DOSING Installation, testing and of equipment for the mechanical works (including submission of O&M manuals and As-built drawings In accordance with the Specification				
8.2.2.1	14.5.2/14.6.3 (b)	Complete - Poly - Chemical Dosing Piping Systems as supplied under item 8.2.1.1	Item	1		
8.2.2.2	14.5.2/14.6.3 (b)	Complete - Poly - Chemical Dosing Piping Systems as supplied under item 8.2.1.2	Item	1		
8.2.2.3	14.5.2/14.6.3 (b)	Complete - Poly - Chemical Dosing Piping Systems as supplied under item 8.2.1.3	Item	1		
8.2.2.4	14.5.2/14.6.3 (b)	Complete New Poly Tank and Piping as supplied under item 8.2.1.4	Item	1		
8.2.2.5	14.5.3/14.6.3 (c)	Commissioning of Complete Chemical Dosing Systems as supplied under item 8.2.1	Item	1		
TOTAL CARRIED TO SUMMARY						
Signature of person authorised to sign the tender:						Date

ITEM NO	PAYMENT REFERENCE	DESCRIPTION	UNIT	QTY	RATE (R)	AMOUNT (R)
8.3	SECTION C.3.4.5	SECTION 8.3 : SUPPLY AND DELIVERY OF CLEAN WATER PUMPING				
8.3.1		Design, Manufacture, Transport Delivery of equipment and On Site/Off Storage for the mechanical works In accordance with the Specification Refer to drawing Ral-Brk-10-Mech-01/Ral-Brk-10-Mech- 02/Ral-Brk-02-Mech-08				
8.3.1.1	14.5.1/14.6.4 (a)	High-lift centrifugal pumps complete with motor, base plate, piping, valves, vibration isolators and accessories - Pump Duty Point Flow: 170 L/s at 212 m head, Estimated Rated Power: 550 kW 550 kW, 3 Phase, 3,3 kV, VSD Capable, in accordance with the specification.	No	3		
8.3.1.2	14.6.5 (a)	Refurbishment of Pump unit As per C3.4.5.5 in accordance with the specification	No	1		
8.3.1.3	14.6.5 (a)	Refurbishment of Electric motor for clean water pump - Rated Power: 550 kW, 3 Phase, 3,3 kV, VSD Capable in accordance with the specification.	No	1		
8.3.2		SECTION 8.3 : INSTALL & COMMISSION OF CLEAN WATER PUMPING				
8.3.2.1	C3.4.5-14	Installation, testing and of equipment for the mechanical works (including submission of O&M manuals and As-built drawings In accordance with the Specification				
8.3.2.2	14.5.2/14.6.4 (b)	Complete Clean Water Pumps as supplied under item 8.3.1.1	No	3		
8.3.2.3	14.6.5 (b)	Complete Clean Water Pump Only (Pump Unit) as supplied under item 8.3.1.2	No	1		
TOTAL CARRIED FORWARD						
Signature of person authorised to sign the tender:					Date	

ITEM	PAYMENT REFERENCE	DESCRIPTION	UNIT	QTY	RATE (R)	AMOUNT (R)
TOTAL BROUGHT FORWARD						
8.3.2.4	14.6.5 (b)	Complete Motor Only as supplied under item 8.3.1.3	No	1		
8.3.2.5	14.5.3/14.6.4 (c) /14.6.5 (c)	Commissioning of Complete Clean Water Pumps including the Motor as supplied under item 8.3.1.1/8.3.1.2/8.3.1.3	No	5		
TOTAL CARRIED TO SUMMARY						
Signature of person authorised to sign the tender:					Date	

ITEM NO	PAYMENT REFERENCE	DESCRIPTION	UNIT	QTY	RATE (R)	AMOUNT (R)
8.4	SECTION C.3.4.5	SECTION 8.4 : SUPPLY AND DELIVERY OF BACKWASH & RECIRCULATION				
8.4.1		Design, Manufacture, Transport Delivery of equipment and On Site/Off Storage for the mechanical works In accordance with the Specification				
		Refer to drawing Ral-Brk-10-Mech-02 /Ral-Brk-01-Pro-02-009				
8.4.1.1	14.5.1/14.6.6 (a)	Centrifugal pumps for recirculation and backwash duties - Refurbishment: Pump Duty Point : Flow: 20 L/s at 24 m head, Estimated Rated Power 30 kW, in accordance with the specification.	No	6		
8.4.2		SECTION 8.4 : INSTALL & COMMISSION OF BACKWASH & RECIRCULATION				
8.4.2.1	C3.4.5-14	Installation, testing and of equipment for the mechanical works (including submission of O&M manuals and As-built drawings				
		In accordance with the Specification				
8.4.2.2	14.5.2/14.6.6 (b)	Complete Recirculation Pumps/Backwash Pumps as supplied under item 8.4.1.1	No	6		
8.4.2.3	14.5.3/14.6.6 (c)	Commissioning of Complete Recirculation Pumps/Backwash Pumps as supplied under item 8.4.1.1	No	6		
TOTAL CARRIED TO SUMMARY						
Signature of person authorised to sign the tender:					Date	

ITEM NO	PAYMENT REFERENCE	DESCRIPTION	UNIT	QTY	RATE (R)	AMOUNT (R)
8.5	SECTION C.3.4.5	SECTION 8.5 : SUPPLY AND DELIVERY OF MIXING & AGITATION EQUIPMENT				
8.5.1		Design, Manufacture, Transport Delivery of equipment and On Site/Off Storage for the mechanical works In accordance with the Specification				
		Refer to drawing Ral-Brk-02-Mech-02				
8.5.1.1	14.5.1/14.6.7 (a)	Agitator motor with VSD - Power: 7.5 kW	No	2		
8.5.1.2	14.5.1/14.6.7 (a)	Agitator motor with VSD - Power: 4 kW	No	4		
8.5.2		SECTION 8.5 : INSTALL & COMMISSION OF MIXING & AGITATION EQUIPMENT				
8.5.2.1		Installation, testing and of equipment for the mechanical works (including submission of O&M manuals and As-built drawings In accordance with the Specification				
8.5.2.2	14.5.2/14.6.7 (b)	Complete Flocculation Agitator Motors 7.5 kW as supplied under item M05.1.1	No	2		
8.5.2.3	14.5.2/14.6.7 (b)	Complete Flocculation Agitator Motors 4 kW as supplied under item M05.1.2	No	4		
8.5.2.4	14.5.3/14.6.7 (c)	Commissioning of complete Flocculation Agitator Motors 7.5 kW as supplied under item 8.5.1.1	No	2		
8.5.2.5	14.5.3/14.6.7 (c)	Commissioning of Flocculation Agitator Motors 4 kW as supplied under item 8.5.1.2	No	4		
TOTAL CARRIED TO SUMMARY						
Signature of person authorised to sign the tender:					Date	

ITEM NO	PAYMENT REFERENCE	DESCRIPTION	UNIT	QTY	RATE (R)	AMOUNT (R)
8.6	SECTION C.3.4.5	SECTION 8.6 : SUPPLY AND DELIVERY OF FLOTATION & AERATION SYSTEMS				
8.6.1		Design, Manufacture, Transport Delivery of equipment and On Site/Off Storage for the mechanical works in accordance with the Specification				
		Refer to drawing Ral-Brk-02-Mech-04				
8.6.1.1	14.5.1/14.6.8 (a)	Air air blower, 3 000 Nm ³ /h @ 0.4 bar(g), complete with rated 80 kW motor, inlet filter/silencer, discharge silencer, NRV, isolation valves, flexible connectors, baseframe, Included with VSD.	No	2		
8.6.1.2	14.5.1/14.6.8 (a)	Air spargers and aeration equipment complete with piping - As per specification in accordance with the specification.	No	6		
8.6.1.2.1	14.5.1/14.6.8 (a)	9" fine-bubble disc diffusers, 64 per basin for 12 Basins	No	768		
8.6.1.2.2	14.5.1/14.6.8 (a)	DN150 SS 316L basin feed pipes from main header to basin walls, PN10, including supports	No	144		
8.6.1.2.3	14.5.1/14.6.8 (a)	DN150 SS 316L - All Associated Pipe Fittings and Specials basin feed pipes from main header to basin walls, PN10, including supports- Per Basin	No	12		
8.6.1.2.3	14.5.1/14.6.8 (a)	DN80 SS 316L-Laterals - All Associated Pipe Fittings and Specials basin feed pipes from main header to basin walls, PN10, including supports- Per Basin	No	12		
8.6.1.3	14.5.1/14.6.9 (a)	Motors for scrubbers - Refurbishment - Power: 0.37 kW in accordance with the specification.	No	12		
TOTAL CARRIED FORWARD						
Signature of person authorised to sign the tender:					Date	

ITEM	PAYMENT REFERENCE	DESCRIPTION	UNIT	QTY	RATE (R)	AMOUNT (R)
TOTAL BROUGHT FORWARD						
8.6.2		SECTION 8.6 : INSTALL & COMMISSION OF FLOTATION & Installation, testing and of equipment for the mechanical works (including submission of O&M manuals and As-built drawings In accordance with the Specification				
8.6.2.1	14.5.2/14.6.8 (b)	Air air blower, 3 000 Nm ³ /h @ 0.4 bar(g), complete with rated 80 kW motor, inlet filter/silencer, discharge silencer, NRV, isolation valves, flexible connectors, baseframe, Included with VSD.	No	2		
8.6.2.2	14.5.2/14.6.8 (b)	Air spargers and aeration equipment complete with piping - As per specification	No	6		
8.6.2.2.2	14.5.2/14.6.8 (b)	9" fine-bubble disc diffusers, 64 per basin for 12 Basins	No	768		
8.6.2.2.3	14.5.2/14.6.8 (b)	DN150 SS 316L basin feed pipes from main header to basin walls, PN10, including supports	No	144		
8.6.2.2.4	14.5.2/14.6.8 (b)	DN150 SS 316L - All Associated Pipe Fittings and Specials basin feed pipes from main header to basin walls, PN10, including supports- Per Basin	No	12		
8.6.2.2.5	14.5.2/14.6.8 (b)	DN80 SS 316L-Laterals - All Associated Pipe Fittings and Specials basin feed pipes from main header to basin walls, PN10, including supports- Per Basin	No	12		
8.6.2.3	14.5.2/14.6.9 (b)	Motors for scrubbers - Motor and Gear Box Refurbishment - Power: 0.37 kW under item 8.6.1.3	No	12		
8.6.2.4	14.5.3/14.6.8 (c) / 14.6.9 (c)	Commission of Complete Flotation and Aeration Equipment	No	12		
8.6.2.5	14.5.3/14.6.8 ©/ 14.6.9 (c)	Commision of complete Scrubber Motors as supplied under item	No	12		
TOTAL CARRIED TO SUMMARY						
Signature of person authorised to sign the tender:					Date	

ITEM NO	PAYMENT REFERENCE	DESCRIPTION	UNIT	QTY	RATE (R)	AMOUNT (R)
8.7	SECTION C.3.4.5	SECTION 7.7 : SUPPLY AND DELIVERY OF SETTLING & FILTRATION				
8.7.1		Design, Manufacture, Transport Delivery of equipment and On Site/Off Storage for the mechanical works In accordance with the Specification Refer to drawing Ral-Brk-02-Mech-05/Ral-Brk-02- Mech-06				
8.7.1.2	14.5.1/14.6.10 (a)	Settling Tank Agitator Motors Units including Gear Box - Refurbishment - Power: 4 kW	No	2		
8.7.1.3	14.5.1/14.6.10 (a)	Settling Tank Motor Units including Gear Box Refurbishment Power: 0.37 kW	No	4		
8.7.1.4	14.5.1/14.6.11 (a)	Filtration motor - Refurbishment - Power: 1.1 kW	No	4		
8.7.1.5	14.5.1/14.6.11 (a)	Filtration Recirculating Pump - Refurbishment - Power: 30 kW	No	4		
8.7.2		SECTION 8.7 : INSTALL & COMMISSION OF SETTLING & FILTRATION				
8.7.2.1		Installation, testing and of equipment for the mechanical works (including submission of O&M manuals and As-built drawings in accordance with the Specification				
8.7.2.3	14.5.2/14.6.10 (b)	Complete Settling Tank Agitator Motors Units including Gear Box as supplied under item 8.7.1.2	No	2		
8.7.2.4	14.5.2/14.6.10 (b)	Complete Settling Tank Motor Units as per 8.7.1.3	No	4		
8.7.2.5	14.5.2/14.6.11 (b)	Complete Filtration Tank Motors 0.37 kW as supplied under item 8.7.1.4	No	4		
8.7.2.6	14.5.2/14.6.11 (b)	Complete Filtration Tank Pumps and Motors as supplied under item 8.7.1.5	No	4		
TOTAL CARRIED FORWARD						
Signature of person authorised to sign the tender:					Date	

ITEM	PAYMENT REFERENCE	DESCRIPTION	UNIT	QTY	RATE (R)	AMOUNT (R)
TOTAL BROUGHT FORWARD						
8.7.2.7	14.5.3/14.6.10 (c) /14.5.2/14.6.11 (b)	Commission of the Settling and Filtration Tank Motors and Gear	No	14		
TOTAL CARRIED FORWARD						
Signature of person authorised to sign the tender:					Date	

ITEM NO	PAYMENT REFERENCE	DESCRIPTION	UNIT	QTY	RATE (R)	AMOUNT (R)
8.8	SECTION C.3.4.5	SECTION 8.8 : SUPPLY AND DELIVERY OF LIME DOSING SYSTEM				
8.8.1	C3.4.5-14	Design, Manufacture, Transport Delivery of equipment and On Site/Off Storage for the mechanical works In accordance with the Specification				
		Refer to drawing Ral-Brk-04-Mech-04/ Ral-Brk-02-Mech-09				
8.8.1.2	14.5.1/14.6.12 (a)	Lime dosing pumps - Head: 46m, Power: 30 kW, Flow: 20 L/s	No	3		
8.8.1.3	14.5.1/14.6.12 (a)	Deslurge pumps - Head: 30m, Power: 25 kW, Flow: 15 L/s	No	2		
8.8.1.4	14.5.1/14.6.3 (a)	Complete lime dosing system including tank, screw feeder, mixing tank, agitator, and pumps - As per specification and Ral-Brk-02-Mech-09	Item	1		
8.8.2		SECTION 8.8 : INSTALL & COMMISSION OF LIME DOSING SYSTEM				
8.8.2.1		Installation, testing and of equipment for the mechanical works (including submission of O&M manuals and As-built drawings In accordance with the Specification				
8.8.2.2	14.5.2/14.6.12 (b)	Complete Lime Pumps as supplied under item 8.8.1.2	No	3		
8.8.2.3	14.5.2/14.6.12 (c)	Complete Deslurge Pumps as supplied under item 8.8.1.3	No	2		
8.8.2.4	14.5.2/14.6.3 (b)	Complete New Lime System as supplied under item 8.8.1.4	Item	1		
8.8.2.5	14.5.3/14.6.12 (c)	Commissioning for complete Lime Pumps as supplied under item 8.8.1.2	Item	3		
8.8.2.6	14.5.3/14.6.12 (c)	Commissioning for complete Deslurge Pumps as supplied under item 8.8.1.3	Item	2		
8.8.2.7	14.5.3/14.6.3 (c)	Commissioning for Complete New Lime System as supplied under item 8.8.1.3	Item	1		
TOTAL CARRIED TO SUMMARY						
Signature of person authorised to sign the tender:						Date

ITEM NO	PAYMENT REFERENCE	DESCRIPTION	UNIT	QTY	RATE (R)	AMOUNT (R)
8.9	SECTION C.3.4.5	SECTION 8.9 : SUPPLY AND DELIVERY OF LIFTING EQUIPMENT				
8.9.1		Design, Manufacture, Transport Delivery of equipment and On Site/Off Storage for the mechanical works In accordance with the Specification				
8.9.1.1	14.5.1/14.6.2 (a)	5-ton, 6 kW motorised hoist gantry crane on existing structure - Capacity: 5 ton, Motor: 6 kW in accordance with the specification.	No	1		
8.9.2		SECTION 8.9 : INSTALL & COMMISSION OF LIFTING EQUIPMENT				
8.9.2.1		Installation, testing and of equipment for the mechanical works (including submission of O&M manuals and As-built drawings In accordance with the Specification				
8.9.2.2	14.5.2/14.6.2 (b)	Complete Overhead Gantry Crane as supplied under item 8.9.1.1	No	1		
8.9.2.3	14.5.3/14.6.2 (c)	Commissioning of Overhead Gantry Crane as supplied under item 8.9.1.1	No	1		
TOTAL CARRIED TO SUMMARY						
Signature of person authorised to sign the tender:					Date	

ITEM	PAYMENT REFERENCE	DESCRIPTION	UNIT	QTY	RATE (R)	AMOUNT (R)
9.1		SECTION 9.1: SUPPLY OF DISTRIBUTION BOARD				
	SECTION C.3.4.5	As specified in the Specification on C3.4.6				
	E18.12 (a)	Supply and deliver Distribution board				
9.1.1		400/231V 3ph +N, 20 way AC Distribution	no.	1		
9.1.2		400/231V 3ph +N, 35 way AC Distribution	no.	1		
	E18.12 (b)	Installation and commissioning Distribution board				
9.1.3		400/231V 3ph +N, 20 way AC Distribution	no.	1		
9.1.4		400/231V 3ph +N, 35 way AC Distribution	no.	1		
	E16.12 (a)	Supply and deliver of Uninterrupted Power Supply				
9.1.5		10kVA, 400V 3phase IN / 400V 3phase +N	no.	1		
	E16.12 (b)	Installation and commissioning of Uninterrupted Power Supply				
9.1.6		10kVA, 400V 3phase IN / 400V 3phase +N	no.	1		
TOTAL CARRIED FORWARD TO SUMMARY OF BILL OF QUANTITIES						

Signature of person authorised to sign the tender:	Date

ITEM	PAYMENT REFERENCE	DESCRIPTION	UNIT	QTY	RATE (R)	AMOUNT (R)
9.2		SECTION 9.2: SWITCHBOARD AND MOTOR CONTROL CENTRES (Reference drawing RAL-BRK-09-ECI- 005) As specified in the Specification - Section 4.1				
	E04.13.2 (b)	Supply and delivery of Motor Control Centres				
9.2.1		Panel Mounted LV Variable Frequency 400V, 3 x 350kW - Raw Water River Abstraction, complete with local PLC	sum	1		
	E04.13.2 (b)	Installation and commissioning Motor Control Centres				
9.2.2		Panel Mounted LV Variable Frequency 400V, 3 x 350kW - Raw Water River Abstraction, complete with local PLC	sum	1		
		Contractor to replace existing Purification MCC with new complete with relocated loads current in the Lime MCC - As specified in the Specification - Section 4.1				
	E04.13.1 (a)	Supply and delivery of Motor Control Centres				
9.2.3		400V, 50kA, Low Voltage MCC - Purification MCC (to include Lime MCC	sum	1		
	E04.13.2 (b)	Installation and commissioning Motor				
9.2.4		400V, 50kA, Low Voltage MCC - Purification MCC (to include Lime MCC loads)	sum	1		
		Repairs of existing Lighting and Small Power in the Administration Building and Lime Plant Building				
9.2.5		Test and replace of light fittings, switches	Prov sum	1	30 000,00	30 000,00
	E03.6 (a)	Supply and delivery of Stop / Start Stations				
9.2.6		Supply and delivery of new Start/Stop control stations complete with 1.2m steel stand mount and accessories	no.	20		
	E03.6 (a)	Installation and commissioning Stop / Start Station				
9.2.7		Supply and delivery of new Start/Stop control stations complete with 1.2m steel stand mount and accessories	no.	20		
TOTAL CARRIED FORWARD TO SUMMARY OF BILL OF QUANTITIES						

Signature of person authorised to sign the tender:	Date

ITEM	PAYMENT REFERENCE	DESCRIPTION	UNIT	QTY	RATE (R)	AMOUNT (R)
9.3		SECTION 9.3: LOW VOLTAGE AND INSTRUMENTATION				
	E01.3 (b)	Condition assesment and detailed report - Testing (as specification section 6):				
9.3.1		Low voltage and control cable runs	no.	30		
9.3.2		Medium voltage and control cable runs	no.	9		
		As specified in the Specification (final procurement of cables to be as per Engineers approved cable schedule after condition assessment report)				
9.3.3	E05.9 (b)	Provision for additional low voltage cables as required based on Condition assement Report	Prov sum	1	R600 000,00	
		New Low voltage PVC cable				
	E05.9 (a)	Supply and delivery of low-voltage cable				
9.3.4		25 mm2, 3-core	m	300		
	E06.17 (h)	Installation of low-voltage cable				
9.3.5		25 mm2, 3-core	m	300		
	E05.9 (a)	Supply and delivery of low-voltage cable				
9.3.6		16 mm2, 3-core	m	200		
	E06.17 (h)	Installation of low-voltage cable				
9.3.7		16 mm2, 3-core	m	200		
		Supply and delivery of low-voltage cable				
9.3.8	E05.9 (a)	10mm2, 3-core	m	300		
	E06.17 (h)	Installation of low-voltage cable				
9.3.9		10mm2, 3-core Install	m	300		
	E05.9 (a)	Supply and delivery of low-voltage cable				
9.3.10		4 mm2, 3-core	m	600		
	E06.17 (h)	Installation of low-voltage cable				
9.3.11		4 mm2, 3-core	m	600		
TOTAL CARRIED FORWARD						
Signature of person authorised to sign the tender:					Signature	

ITEM	PAYMENT REFERENCE	DESCRIPTION	UNIT	QTY	RATE (R)	AMOUNT (R)
TOTAL BROUGHT FORWARD						
9.3.12	E05.9 (a)	Supply and delivery of low-voltage cable 2,5 mm ² , 3-core	m	200		
9.3.13	E06.17 (h)	Installation of low-voltage cable 2,5 mm ² , 3-core	m	200		
9.3.14	E05.9 (a)	Supply and delivery of low-voltage cable 4 mm ² , 4-core	m	600		
9.3.15	E06.17 (h)	Installation of low-voltage cable 4 mm ² , 4-core	m	600		
9.3.16	E05.9 (a)	Supply and delivery of low-voltage cable 2,5 mm ² , 4-core	m	600		
9.3.17	E06.17 (h)	Installation of low-voltage cable 2. mm ² , 4-core	m	600		
9.3.17	E06.17 (h)	Install 2,5 mm ² , 4-core	m	600		
9.3.18	E05.9 (a)	Supply 1.5 mm ² , 12-core	m	150		
9.3.19	E06.17 (h)	Install 1.5 mm ² , 12-core	m	150		
CARRIED FORWARD						
Signature of person authorised to sign the tender:						Signature

ITEM	PAYMENT REFERENCE	DESCRIPTION	UNIT	QTY	RATE (R)	AMOUNT (R)
9.4	E06.17 (g)	SECTION 9.4:TERMINATION OF MV CABLE				
		Termination of MV cable As specified in the Specification - Section 12				
9.4.1		CU 95mm2 3C XLPE TYPE A 6.35/11KV Testing and re-terminating of existing cables on MV motor (Clean Water pumps)	no.	3		
TOTAL CARRIED FORWARD TO SUMMARY OF BILL OF QUANTITIES						R -

Signature of person authorised to sign the tender:	Date

ITEM	PAYMENT REFERENCE	DESCRIPTION	UNIT	QTY	RATE (R)	AMOUNT (R)
9.5	E11.6	SECTION 9.5: EARTHING As specified in the Specification Earthing				
9.5.1	E11.6 (d)	Earthing of MCC (Purification MCC works)	no.	2		
9.5.2	E11.6 (d)	Earthing of MCC (Extraction MCC works)	no.	2		
9.5.3	E11.6 (e)	Supply and lay earth continuity conductors	m	200		
9.5.4	E11.6 (f)	Terminating of earth continuity conductors	No	15		
9.5.5	E11.6 (g)	Extra over for the supply and installation of additional earth spikes of specified length including clamps for the connection of earth conductor	No	8		
9.5.6	E11.6 (i)	Provide an instrument earthing system	Sum	1		
TOTAL CARRIED FORWARD TO SUMMARY OF BILL OF QUANTITIES						

Signature of person authorised to sign the tender:	Signature

ITEM	PAYMENT REFERENCE	DESCRIPTION	UNIT	QTY	RATE (R)	AMOUNT (R)
9.6		SECTION 9.6: INSTRUMENTATION As specified in the Specification Supply installation and commission				
9.6.1	C3.4.7 section 4.7 (c)	(TURBINE FLOW METER TYPE 1) 700 mm diameter Turbine Flow Meters	no.	1		
9.6.2	C3.4.7 section 4.7 (c)	(TURBINE FLOW METER TYPE 2) Chlorine 32 mm diameter Turbine	no.	4		
9.6.3	C3.4.7 section 4.7 (c)	(TURBINE FLOW METER TYPE 3) Lime- 15 mm diameter Turbine Flow	no.	4		
9.6.4	C3.4.7 section 4.7 (c)	(MAGNETIC FLOW METER TYPE 4) Backwash- 150 mm diameter Mag	no.	2		
9.6.5	C3.4.7 section 4.7 (c)	(MAGNETIC FLOW METER TYPE 4) Clean Water 700 mm diameter Mag	no.	2		
9.6.6	C3.4.7 section 4.7 (c)	(OPEN CHANNEL FLOW METER) Ultrasonic open channel flow	no.	3		
9.6.7	C3.4.7 section 4.4 (b)	(MOTORISED VALVE 1) 600 mm diameter motorised valve, knife-gate	no.	10		
9.6.8	C3.4.7 section 4.4 (b)	(MOTORISED VALVE 2) 300 mm diameter motorised valve, knife-gate	no.	30		
9.6.9	C3.4.7 section 4.4 (b)	(MOTORISED VALVE 3) 200 mm diameter motorised valve, knife-gate	no.	10		
9.6.10	C3.4.7 section 4.4 (b)	(MOTORISED VALVE 4) 100 mm diameter motorised valve, knife-gate	no.	10		
9.6.11	C3.4.7 section 4.4 (b)	(MOTORISED VALVE 5) 60 mm diame	no.	5		
9.6.12	C3.4.7 section 4.6 (b)	(LEVEL TRASMITTER) 4-20mA water le	no.	4		
9.6.13	C3.4.7 section 4.5 (b)	(TURBIDITY TRASMITTER) Turbidity tr	no.	3		
TOTAL CARRIED FORWARD TO SUMMARY OF BILL OF QUANTITIES						R -

Signature of person authorised to sign the tender:	Signature

ITEM	PAYMENT REFERENCE	DESCRIPTION	UNIT	QTY	RATE (R)	AMOUNT (R)
9.7	C3.4.7 Section 4.8, 4.9	SECTION 9.7: PLC (Refer drawing RAL-BRK-09-ECI-006 As specified in the Specification Detailed design, supply installation				
9.7.1	C3.4.7 section 4.8 (g)	Hardware (servers, PC's, screens, etc)	sum	1		
9.7.2	C3.4.7 section 4.8 (b)	Interposing Relay (IR) (for Purification MCC)	sum	1		
9.7.3	C3.4.7 section 4.8 (b)	Control Room PLC panel	sum	1		
9.7.4	C3.4.7 section 4.8 (b)	Programing and commissioning of the entire system	sum	1		
9.7.5	C3.4.7	Windows laptop with preloaded	sum	1		
TOTAL CARRIED FORWARD TO SUMMARY OF BILL OF QUANTITIES						

Signature of person authorised to sign the tender:	

SUMMARY OF PRICING SCHEDULE

SECTION	DESCRIPTION	AMOUNT
SERIES 0	GENERAL	
0.1	General Requirements and Charges	
0.2	Engineers Accommodation	
	CIVIL ENGINEERING WORKS	
SERIES 1	ANCILLARY WORK	
1.1	Site Clearing and Grubbing	
SERIES 2	EARTHWORKS	
2.1	General	
2.2	Trenching	
SERIES 5	DRAINAGE AND EROSION PROTECTION	
5.6	Filter Sand	
SERIES 6	ROADS AND PARKING AREAS	
6.1	Gravel Pavement Layers	
6.4	Stabilization	
6.10	Concrete Paving	
SERIES 7	STRUCTURES	
7.1	Foundations for Structures	
7.2	Falsework, Formwork and Concrete Finish	
7.3	Reinforcement for Structures	
7.4	Concrete	
7.6	Joints in Structures	
8.0	MECHANICAL ENGINEERING WORKS	
8.1	Supply and Delivery of RAW WATER ABSTRACTION	
8.2	Supply and Delivery of INLET WORKS & CHEMICAL DOSING	
8.3	Supply and Delivery of CLEAN WATER PUMPING	
8.4	Supply and Delivery of BACKWASH & RECIRCULATION	
8.5	Supply and Delivery of FLOTATION & AERATION SYSTEMS	
8.6	Supply and Delivery of FLOTATION & AERATION SYSTEMS	
8.7	Supply and Delivery of SETTLING & FILTRATION	
8.8	Supply and Delivery of LIME DOSING SYSTEM	
8.9	Supply and Delivery of LIFTING EQUIPMENT	

Signature of person authorised to sign the tender:	Date

SUMMARY OF PRICING SCHEDULE

SECTION	DESCRIPTION	AMOUNT
8.9	Supply and Delivery of LIFTING EQUIPMENT	
9.0	<i>ELECTRICAL, CONTROL & INSTRUMENTATION ENGINEERING WORKS</i>	
9.1	Distribution Board	
9.2	Switchboard and Motor Control Centres	
9.3	Low Voltage and Instrumentation	
9.4	Termination of MV cable	
9.5	Earthing	
9.6	Instrumentation	
9.7	PLC	
SUBTOTAL 1 (Total of Scheduled Prices)		
<u>CONTRACT SKILLS DEVELOPMENT PROGRAMME (CSDP)</u>		
<i>Refer to Section C3.4.1.29.</i>		
CSDP Amount calculated at 0.25% of SUBTOTAL 1		
SUBTOTAL 2 (SUBTOTAL 1 + CSDP Amount)		
Add 6% for Escalation		
SUBTOTAL 3 (SUBTOTAL 2 + Escalation)		
Add 10% for contingencies		
SUBTOTAL 4 (SUBTOTAL 3 + Contingencies)		
Add 15% VAT		
CONTRACT PRICE CARRIED FORWARD TO FORM OF OFFER		

Signature of person authorised to sign the tender:	Date

Contract No: WSBU 15-2025/26

Tender for the refurbishment of Bronkhorstspuit water treatment plant for a period of twenty-four (24) months from commencement date

Volume1: General Clauses, Tender Procedures, Contract Data, Schedule of Quantities and Scope of Work

Portion 2: Contract

Part C3: Scope of Work

**CITY OF TSHWANE
WATER AND SANITATION BUSINESS UNIT**

CONTRACT NO: WSBU 15-2025/26

**TENDER FOR THE REFURBISHMENT OF BRONKHORSTSPRUIT WATER
TREATMENT PLANT FOR A PERIOD OF TWENTY-FOUR (24) MONTHS FROM
COMMENCEMENT DATE**

PORTION 2: CONTRACT

PART C3 SCOPE OF WORKS

**CITY OF TSHWANE
WATER AND SANITATION BUSINESS UNIT**

CONTRACT NO: WSBU 15-2025/26

**TENDER FOR THE REFURBISHMENT OF BRONKHORSTSPRUIT WATER
TREATMENT PLANT FOR A PERIOD OF TWENTY-FOUR (24) MONTHS FROM
COMMENCEMENT DATE**

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**CITY OF TSHWANE
WATER AND SANITATION BUSINESS UNIT**

CONTRACT NO: WSBU 15-2025/26

**TENDER FOR THE REFURBISHMENT OF BRONKHORSTSPRUIT WATER
TREATMENT PLANT FOR A PERIOD OF TWENTY-FOUR (24) MONTHS FROM
COMMENCEMENT DATE**

C3.1 DESCRIPTION OF WORKS

C3.1. DESCRIPTION OF WORKS

C3.1.1 EMPLOYER'S OBJECTIVES

The primary objective of the project is to refurbish and upgrade the Bronkhorstspuit Water Treatment Plant (WTP) to:

1. Improve operational efficiency and capacity of the water treatment infrastructure to ensure it meets its full design output of 54 Ml/day at Bronkhorstspuit WTP.
2. Enhance the reliability and safety of water supply through infrastructure upgrades, improved process controls (SCADA and instrumentation), and backup systems.
3. Ensure compliance with SANS 241:2024 Drinking Water Quality standard.
4. Address maintenance and aging infrastructure issues at Bronkhorstspuit WTP to ensure long-term sustainability of water supply to Bronkhorstspuit, Zithobeni, Ekangala, Ekandustria, Rethabiseng, and parts of Thembisile Hani LM.

Bronkhorstspuit WTP

- Improve operational efficiency and restore the plant's design output of 54 ML/day.
- Upgrade civil, mechanical, electrical, control and instrumentation systems to modern standards.
- Ensure compliance with SANS 241 drinking water standards, particularly addressing high aluminum and E. coli levels in raw water.
- Enhance resilience and safety through redundancy, automation, and backup systems.

The project is executed through multidisciplinary refurbishments involving civil, mechanical, electrical, instrumentation, and process engineering components and is part of the City of Tshwane's broader water infrastructure upgrade strategy

The works to be performed under this contract consist of the comprehensive refurbishment and upgrade of the Bronkhorstspuit Water Treatment Plant (WTP) located in Region 7, Ward 102 of the City of Tshwane. The plant draws raw water from the Bronkhorstspuit Dam within the Olifants River Basin and serves approximately 225,000 residents in Bronkhorstspuit and surrounding areas including Zithobeni, Ekangala, Ekandustria, Rethabiseng, and Thembisile Hani Local Municipality.

This project involves multidisciplinary refurbishments to civil, mechanical, electrical, control, and instrumentation infrastructure aimed at restoring the plant's full treatment capacity of 54 ML/day, improving operational efficiency, and ensuring compliance with SANS 241 water quality standards..

C3.1.2 OVERVIEW OF THE WORKS

The Bronkhorstspuit Water Treatment Plant operates with two identical treatment modules (Module 1 and Module 2), each capable of independent operation. This modular design enables continued water supply during maintenance and refurbishment activities.

Project execution strategy: To maintain uninterrupted water supply during refurbishment of Bronkhorstspuit Water Treatment Plant, the works must be sequenced to complete one module before commencing major works on the second module. This approach ensures that at least one treatment train remains operational at all times, maintaining essential water supply to more than 225,000 residents served by the plant.

Sequencing of the works has been prescribed in the contract. Refer to **C.3.1.5 Sequence of the Works** for details. Contractual impacts of the prescribed sequencing is provided in the Contract Data.

C3.1.2.1 Bronkhorstspuit Water Treatment Works

The scope of the works includes:

- **Civil Engineering Works:**
 - Structural upgrades to the Raw Water Pump Station
 - Construction of new High-Rate Lamella Clarifiers
 - Modification of Clari-flocculators and filters
 - Desludging of the 2ML clear water reservoir and lagoons
 - Sanitation upgrades (additional septic tank)
 - New off-take point for water tankers
 - Access road upgrade to the intake station
- **Mechanical Engineering Works:**
 - Replacement/refurbishment of raw water and high-lift pumps
 - Rehabilitation of the lime plant and associated dosing systems
 - Mechanical systems for the new clarifiers (rake arms, scrapers, etc.)
- **Electrical Engineering Works:**
 - Replacement of existing Purification 400V LV MCCs with new
 - Relocating of Lime Plant MCC loads from existing loads to new Purification 400V LV MCC
 - Replacement of existing Extraction 400V LV MCC with new
 - Installation of VSDs, UPS, and distribution boards
 - Upgrades to lighting and power distribution systems
 - Recommissioning of all existing cables and replacing with new where required.
- **Control and Instrumentation:**
 - Installation of new Interface Relay Panel (IRP)
 - Installation of new PLC and SCADA systems in the Control Room
 - Instrumentation of new instruments (flow, level, pH, turbidity, chlorine sensors, etc)
 - Integration with historian and remote telemetry systems
- **Process Engineering**
 - Reactivation of lime dosing and Clari-flocculators
 - Filtration system rehabilitation
 - Installation of new high-rate clarifier
 - Optimization of DAF and SCADA for automation

The prescribed sequence affects only process treatment units between flocculation and filtration, i.e. Flocculation Basins, Dissolved Air Floatation (DAF) units and Filtration. At least one full treatment train of these units must be kept in operation at all times. Continued operation of the Works take at most priority above all project matters.

Priority 1 consists of the following process treatment units:

- Flocculation Basin of Module 1
- DAF Units of Module 1
- Filters for Module 1

Priority 2 works will only commence on completion and attainment of Priority 1 Sectional Completion Certificate. The units under Priority 2 are:

- Flocculation Basin of Module 2
- DAF Units of Module 2
- Filters for Module 2

All other Works shall commence as soon as practicable (contract commencement) as long as they do not completely disrupt the operational treatment train.

C3.1.3 LOCATION OF THE WORKS AND DESCRIPTION OF THE SITE

The Bronkhorstspuit WTP site is located in Region 7, Ward 102, within the City of Tshwane Metropolitan Municipality. It lies adjacent to the Bronkhorstspuit Dam and services a significant portion of the City's eastern regional communities. The project also includes interventions at the Raw Water Intake Station, located near the dam wall, and new offtake connections for water tanker supply to Zithobeni and nearby villages..

Refer to part C4 Site Information.

i) EXCEPTIONALLY ADVERSE CLIMATIC CONDITIONS

Extension of time resulting from abnormal rainfall in terms of sub-clause 5.12.5 of the General Conditions of Contract for Construction Works, Third Edition (2015) (GCC 2015) shall be determined by applying the formula below;

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

Where X = 20 (Y shall be adopted as 10)

Where:

V = Extension of time in calendar days for the calendar month under consideration

Nw = Actual number of days during the calendar month under consideration on which a rainfall of 10mm and more is recorded

Rw = Actual total rainfall in mm recorded during the calendar month under consideration

Nn = Average number of days, derived from rainfall records, on which a rainfall of 10mm and more was recorded during the relevant calendar month as per the data tabulated hereinafter

Rn = Average total rainfall in mm for the relevant calendar month, derived from rainfall records, as tabulated hereinafter

The values of Nn and Rn are obtained from the table below which is rainfall records received from the Boekenhoutkloof weather station location -25.4500; 28.4000.

MONTH	Nn (days)	Rn (mm)
January	3.3	121.2
February	2.8	102.6
March	2.7	91.5
April	1.7	32.2
May	1.0	19.8
June	0	0
July	0	0.7
August	0	0
September	1.0	9.1
October	1.7	38.4
November	3.0	71.1
December	3.5	89.1

TOTAL	20.6	575.6

Where the extension of time due to abnormal rainfall has to be calculated for portion of a calendar month, pro rata values shall be used. Should V be negative for any particular month, and should its absolute value exceed the corresponding value of N_n , then V shall be taken as being equal to minus N_n . The total extension of time to be granted shall be the algebraic sum of all the monthly extensions, provided that if this total is negative then the time for completion shall not be reduced due to subnormal rainfall.

Actual extensions of time due to exceptionally adverse climatic conditions shall be agreed between the Engineer's and Contractor's representatives on the site. The agreed whole days or parts thereof shall be recorded in the site diary and monthly site meetings. Adjustment of the contract period shall only be made at the end of the Contract when the Contractor may submit his claim for the agreed extension due as well as any additional payment resulting from the delay.

If approved extensions of time extend the completion date beyond the start of the Contractor's holiday in December, the holiday period shall not be considered as working days. Any remaining extension of time at this date shall be calculated from the first statutory working day in January the following year, provided that the Contractor has shown in his program that he intends to close during the traditional Christmas/New Year break.

C3.1.4 Labour-Intensive Construction

The construction of certain of the works has specifically been identified for labour-intensive construction. Where unskilled workers are required, the Contractor shall employ and, where necessary, train workers from the local community to execute certain labour-intensive tasks. The Employer shall facilitate the process of identifying possible individuals to be employed by the Contractor.

Several items in the Schedule of Quantities have been identified for labour-intensive construction and these have been marked LI in the pay item column. It is accepted that some of these tasks (e.g. plumbing) will have to be performed by skilled individuals sourced by the Contractor, in other words, not all items marked LI are to be executed by unskilled workers. Labour intensive construction is therefore to be interpreted in the broader sense as defined in the Guidelines for the implementation of labour-intensive infrastructure projects under the Expanded Public Works Programme (EPWP) appended under section C3.4.1 – "Labour-intensive: refers to methods of construction involving a mix of machines and labour, where labour, utilising hand tools and light plant and equipment, is preferred to the use of heavy machines, where technically and economically feasible."

The Contractor shall prepare a proposal with regards to the execution of the identified tasks stating (a) the number of unskilled local labour to be employed, (b) number of labourers to be trained, type of training and (c) methods of construction. The proposal shall also indicate the names and qualifications of the individuals assigned to supervise the work. The proposal shall be submitted and approved by the Engineer prior to commencing with the above tasks. Once approved, the Contractor shall be expected to perform in terms of the proposed targets.

C3.1.5 Sequence of the Works

C3.1.5.1 Overall Construction Sequencing

In accordance with Clause 5.6.1 of the General Conditions of Contract (GCC 2015), the Contractor shall, within the period stated in the Contract Data, submit for approval to the Employer's Agent a detailed programme showing the order, procedure, and method by which the Works shall be executed, including key milestones for progress measurement and sectional completion.

The Works shall be programmed to achieve **Sectional Practical Completion** for two principal components at Bronkhorstspuit:

- Section 1 – Priority 1 Treatment Train as outlined in C3.1.2
- Section 2 – Priority 2 Treatment Train.

Separate Certificates of Practical Completion (Sectional Practical Completion Certificates) shall be issued for each Section in accordance with Clause 5.14 of the GCC. The sequencing outlined below defines the minimum logical order of execution. The Contractor may optimise activity durations but shall not alter the overall logic or sectional dependencies.

C3.1.5.2 Section 1 Critical Sequencing Requirements

- Site establishment and all temporary works arrangements
- Module 1 treatment units completion and commissioning
- SCADA integration for Module 1
- Performance testing and handover
- Non-treatment infrastructure works may proceed in parallel.

- Site establishment and all temporary works arrangements:

In line with GCC contractual requirements, the Contractor shall establish the site and execute all necessary temporary works as stipulated in the Preliminaries section. The Contractor must ensure compliance with the Employer's specifications and obtain approval from the Employer's Agent prior to commencement. All temporary works must be maintained until completion of the project and comply with statutory safety and environmental regulations.

- Module 1 treatment units' completion and commissioning:

The completion and commissioning of Module 1 treatment units must be executed in strict accordance with the GCC sectional completion provisions, ensuring full compliance with both contractual and technical requirements. The process begins with the installation and assembly of all mechanical, civil, electrical, and instrumentation components as specified in the contract documents. Upon installation, the Contractor is required to undertake comprehensive pre-commissioning checks, including pressure testing of piping systems, verification of mechanical alignments, calibration of instrumentation, and functional testing of electrical panels and control systems.

Following successful pre-commissioning, the treatment units are subjected to a formal commissioning protocol under the supervision of the Employer's Agent. This protocol encompasses dynamic performance testing, simulation of process flows, and validation of system responses under various operational scenarios. All commissioning activities must be documented in accordance with the requirements set out in sections C3.4.5 (Mechanical Works), C3.4.4 (Civil Works), C3.4.6 (Electrical Works), and C3.4.7 (Instrumentation). This includes detailed test procedures—such as step-by-step commissioning checklists, acceptance criteria for system performance (e.g., flow rates, pressure levels, control response times), and comprehensive commissioning reports capturing test results and any deviations observed.

Once the performance criteria are met and verified, the Employer's Agent will conduct an independent review of the commissioning records and perform onsite inspections to certify Practical Completion. Any defects, anomalies, or non-conformances identified during this process must be recorded systematically and rectified in accordance with the Defects Liability terms stipulated in the contract. The Contractor is responsible for addressing such defects promptly, maintaining a log of corrective actions taken, and providing supporting evidence for defect closure prior to final acceptance.

Throughout the commissioning and handover phase, rigorous documentation is essential—including as-built drawings, operation and maintenance manuals, calibration certificates, and statutory compliance records. These documents must be submitted to the Employer for review and

approval, forming part of the official handover package that substantiates the readiness and compliance of Module 1 treatment units for operational use.

- SCADA integration for Module 1:

The Contractor shall coordinate the integration of SCADA systems for Module 1 as part of the Works, ensuring compliance with the technical requirements outlined in the contract documents. All integration activities must be scheduled and approved by the Employer's Agent, with testing and validation performed prior to Practical Completion certification.

- Performance testing and handover:

Performance testing shall be conducted in accordance with GCC protocols for testing and commissioning. Upon successful completion of performance tests, the Contractor shall hand over the completed Module 1 works to the Employer, supported by all required documentation and certification. The final handover shall only occur after the Employer's Agent confirms compliance with all contractual requirements.

- Non-process works executed concurrently

Construction activities that do not form part of the Priority 1 process treatment train (including but not limited to roadworks, fencing, earthworks, buildings, drainage, non-process pipelines, and ancillary structures) may be carried out in parallel with Module 1 treatment works, provided that:

- they do not interrupt or compromise the continuous operation of at least one complete treatment train,
- they do not interfere with access required for operation or for Priority 1 works, and
- all such concurrent activities are incorporated in the approved programme and have the prior written acceptance of the Employer's Agent.

C.3.1.5.3 Module 1 Sectional Completion and Guarantees

Sectional Practical Completion of Module 1 (Section 1) shall be implemented in accordance with the GCC sectional completion provisions, including the commencement of the Defects Liability Period for Section 1, but shall not in itself trigger any release or reduction of the performance guarantee or other security furnished in terms of Clause 6.2.

The Contractor remains liable for any defects, anomalies, or non-conformances identified within the Section 1 works during the Defects Liability Period, and shall address such issues promptly, maintaining clear records of corrective actions and submitting evidence of defect closure prior to final acceptance. All relevant guarantees, warranties, and statutory certificates relating to Section 1 shall be provided to the Employer as part of the Section 1 handover documentation package.

Any SCADA, electrical or other integration works associated with Section 1 shall be tested and validated before the Section 1 Certificate of Sectional Practical Completion is issued, to the satisfaction of the Employer's Agent. For the avoidance of doubt, the performance guarantee shall remain valid, at the value and for the duration stated in the Contract Data, until Practical Completion of Section 2 and issue of the Performance Certificate, as set out in the amended Clause 6.2 in the Contract Data.

C3.1.5.4 Section 2 Critical Dependencies

- Module 2 works cannot commence until Section 1 Practical Completion is achieved

A critical dependency in the contract sequencing stipulates that Module 2 works may only commence once the Employer has formally certified Practical Completion of Section 1. This requirement ensures a structured and risk-managed progression between project phases. Furthermore, comprehensive coordination of SCADA and electrical integration across Sections is essential, necessitating meticulous planning and robust inter-disciplinary collaboration to guarantee seamless project continuity and effective commissioning.

It is a requirement that effective coordination be established between SCADA systems and electrical integration. This coordination facilitates optimal monitoring and control of the electrical infrastructure, thereby reducing the risk of operational issues in accordance with formal tender procedures outlined by the GCC.

- SCADA systems and electrical integration as part of the Works

The Contractor shall ensure comprehensive and effective coordination between the SCADA systems and electrical integration as part of the Works. This coordination is essential to enable optimal monitoring, control, and management of the electrical infrastructure for the Bronkhorstspuit Water Treatment Plant. In accordance with the provisions and procedures set out under the GCC contract, the following requirements apply:

The Contractor is required to prepare a detailed integration plan, outlining the sequence and dependencies of SCADA and electrical works, and submit this plan for review and approval prior to commencement of integration activities.

Testing and validation of SCADA and electrical systems shall be completed to the satisfaction of the Employer's Agent before certification of Practical Completion for the relevant Section or Module.

Any operational issues or defects identified during commissioning or integration shall be rectified promptly by the Contractor in accordance with the Defects Liability provisions of the GCC contract.

These requirements are intended to ensure a risk-managed and seamless integration of SCADA and electrical systems, supporting the overall objectives of the project and safeguarding the operational integrity of the Water Treatment Plant. For the purposes of security and guarantees, Practical Completion of Section 2 shall be regarded as Practical Completion of the Works as a whole, in line with Clause 6.2 as amended in the Contract Data.

C3.1.5.5 General Sequencing Requirements

- The Contractor's detailed programme shall align with this sequencing and include all inter-disciplinary dependencies.
- The Bronkhorstspuit WTP must remain operational; planned shutdowns require Employer's Agent approval.
- Minor non-interfering activities may proceed concurrently if safety and access are not compromised.
- Deviations must be approved in writing by the Employer's Agent.
- Separate Certificates of Practical Completion shall be issued for each Section upon commissioning and successful performance testing, but the performance guarantee shall remain in force in accordance with Clause 6.2 of the Contract Data until Practical Completion of Section 2 and issue of the Performance Certificate.

**CITY OF TSHWANE
WATER AND SANITATION BUSINESS UNIT**

CONTRACT NO: WSBU 15-2025/26

**TENDER FOR THE APPOINTMENT OF A CONTRACTOR FOR THE
REFURBISHMENT OF BRONKHORSTSPRUIT WATER TREATMENT
PLANT**

C3.2 ENGINEERING

C3.2.1 ENGINEER'S DESIGN

Although the Engineer has specified the equipment to be provided for tendering purposes, the Contractor shall be responsible for the detail design of all propriety materials and plant in order to ensure these are appropriately selected, specified and installed to meet the particular installation conditions on Site. This requirement shall be specifically applicable to any/all items of a mechanical, electrical and control instrumentation in nature included in the contract. The Contractor interface with equipment vendors to ensure detailed design is aligned to the equipment to be procured. The electrical & instrumentation detail design includes but not limited to: motor control centre modification upgrades detailed design with vendor, Interface panel modification upgrades detailed design with vendor, new PLC and Scada system with specialist vendor, instrumentation, etc

With regards to site and interconnecting pipework, the Engineer has provided the proposed layout of the pipework on the Drawings for tendering purposes. However, the Contractor shall be responsible for all final measurements on site, final design, correct manufacturing and installation of all pipe items and specials to suit the installation. The Contractor shall also maintain suitable records of all such items in order for the Engineer to complete the as-built drawings at the completion of the works.

Similar to the site pipework, the Engineer has provided the proposed layouts of the sites for tendering purposes. All modifications on site shall be handled in terms of the relevant Specifications for the construction of sewers. The Contractor shall also maintain suitable records of all such items in order for the Engineer to complete the as-built drawings at the completion of the works.

All Civil related works including pipework shall be re-measurable and the civil component of the final contract price shall be determined by the product of the tendered rate and actual quantity of work completed and certified.

C3.2.2 ALTERNATIVE OFFERS

The Contractor shall complete the tender in terms of the information provided and requested in the tender document. Failure to complete the tender document, including the schedule of quantities, may lead to the rejection of the bid. Alternative offers will be considered at the discretion of the Employer.

C3.2.3 CONSTRUCTION PERIOD

The maximum construction period total construction period of the infrastructure (civil and mechanical/electrical works) shall be **24 months** from the Commencement, excluding the builder's holiday, of which 3 months will be a float period belonging to the Employer for purposes of accommodating unforeseen Employer's delays.

Alternative offers for a shorter construction period may be submitted (refer to section C1.2.4 – Data to be provided by the Contractor), which will be considered during the tender evaluation process. Any alternative offer must include the aforementioned 3 month period.

C3.2.4 DRAWINGS

The following drawings have been issued for tender purposes are also in in Part C4 (Volume 2):

DRAWING NUMBER	DESCRIPTION
01 - GENERAL ARRANGEMENT DRAWINGS	
General Arrangements	
RAL-BRK-01-Gen-001	Locality Plan
RAL-BRK-01-Gen-002	Site Plan - Water Treatment Plant - Sheet 1 of 2
RAL-BRK-01-Gen-003	Site Plan - Water Treatment Plant - Sheet 2 of 2
RAL-BRK-01-Gen-004	Overall Plant General Arrangement
RAL-BRK-01-Gen-005	Overall Plant Isometric View
02 - PROCESS ENGINEERING DRAWINGS	
Process Engineering	
Ral-Brk-02-Pro-01	Process Block Diagram (NOT ISSUED - NOT FOR TENDER)
Ral-Brk-02-Pro-02	Process Flow Diagram (NOT ISSUED - NOT FOR TENDER)
Mechanical - Schematics	
Ral-Brk-02-Mech-01	Sheet 1 - Raw Water Abstraction Pumps - Schematics
Ral-Brk-02-Mech-02	Sheet 2 - Inlet Works/Pretreatment and Mixing Tanks
Ral-Brk-05-Mech-03	Sheet 3 - Filtration Tanks
Ral-Brk-02-Mech-04	Sheet 4 - Aeration & Floatation Tanks
Ral-Brk-02-Mech-05	Sheet 5 - Clarifiers
Ral-Brk-05-Mech-06	Sheet 6 - Clean Water Pumps & Back Wash Pumps
Ral-Brk-02-Mech-07	Sheet 7 - Compressor Areas
Ral-Brk-02-Mech-08	Sheet 8 - Lime Circuit
03 - RAW WATER ABSTRACTION	
Civils	
Ral-Brk-03-Civ-01	Raw Water Pump Station Road
Mechanical	
Ral-Brk-03-Mech-01	Sheet 1 - Raw Water Abstraction Pumps
Ral-Brk-03-Mech-02	Sheet 2 - Raw Water Clean Water Pumps
04 - INLET WORKS	
Mechanical	
Ral-Brk-04-Mech-03	Inlet Works Pre-Treatment
05 - CLARI-FLOCCULATOR	

DRAWING NUMBER	DESCRIPTION
Civils	
Ral-Brk-05-Civ-01	Clari-Flocculator - Layout & Sections
Ral-Brk-05-Civ-02	Clari-Flocculator - Pipe Schedules
06 - HIGH-RATE CLARIFIER	
Civils	
Ral-Brk-06-Civ-01	High-Rate Clarifier, Layout, Sections & 3D Views
Ral-Brk-06-Str-01	High-Rate Clarifier, General Notes
Ral-Brk-06-Str-02	High-Rate Clarifier, Reinforcement Details
09 - ELECTRICAL, CONTROL & INSTRUMENTATION	
Ral-Brk-05-ECI-001	Schematic DOL
Ral-Brk-09-ECI-004	CS Block
Ral-Brk-09-ECI-005	Abstraction BCC SLD
Ral-Brk-09-ECI-006	Schematic SMP DOL
Ral-Brk-09-ECI-007	Schematic VSD
10 - HIGH LIFT PUMPS & CLEAR WATER RESERVOIR	
Mechanical	
Ral-Brk-10-Mech-01	High Lift Pumps (Sheet 1 of 2)
Ral-Brk-10-Mech-02	High Lift Pumps (Sheet 2 of 2)
11 - MISCELLANEOUS	
Civils	
Ral-Brk-11-Civ-01	Septic Tank - Layout and Section
Ral-Brk-11-Civ-02	Septic Tank - French Drain Details
Ral-Brk-11-Civ-03	Water Filling Station - Layout & Sections
Ral-Brk-11-Civ-04	Water Filling Station - Pipe Schedules

**CITY OF TSHWANE
WATER AND SANITATION BUSINESS UNIT**

CONTRACT NO: WSBU 15-2025/26

**TENDER FOR THE REFURBISHMENT OF BRONKHORSTSPRUIT WATER
TREATMENT PLANT FOR A PERIOD OF TWENTY-FOUR (24) MONTHS
FROM COMMENCEMENT DATE**

C3.3 PROCUREMENT

C3.3 PROCUREMENT

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

Stage 1: Administrative Compliance

Stage 2: Mandatory Requirements

Stage 3: Technical Evaluation

Stage 4: Preference Point System

REFERENTIAL PROCUREMENT PROCEDURES

The City of Tshwane promotes preferential procurement. The philosophy of the process and mechanisms of points scoring system are described in section T1, Clause F3.11.9 below. The tenderer is also referred to SANS 10396:2003 "Implementing Preferential Construction Procurement Policies Using Targeted Procurement Procedures" as a general guideline for the procurement of targeted labour and enterprises. The following schedules should be noted:

Paragraph 4.3	Engagement of Target Groups in Contracts
Sub-Paragraph 4.3.2	Targeting on a Geographical Basis
Paragraph 4.5	Subcontracting
Paragraph 4.6	Conditions for Employment of Labour
Paragraph 4.9	Engaging Marginalized Communities in Infrastructure Projects
Paragraph 4.10	Measuring the Participation of Targeted Enterprises and targeted Labour
Paragraph 5.2	Techniques and Mechanisms allocated with Targeted Procurement
Sub- Paragraph 5.3.5	Targeting Frameworks for Employment Intensive Projects
Annexure G:	Implementing employment-intensive infrastructure projects which target the increase of employment opportunities generated per unit of expenditure

C3.3.2 PREFERRED SUBCONTRACTORS/SUPPLIERS

Section 47 of the SCM Policy SUB-CONTRACTING

When subcontracting :

The City shall obligate main contractors or service providers to engage targeted enterprises in the performance of their contracts incorporating resource specifications.

- (1) The appointed service provider must source competent and capable service providers and where applicable be registered with the relevant body and submit a list of sub-contractors for approval to the City of Tshwane.
- (2) Sub-contracting entity should have at least equal B-BBEE level status and /or specific goals or higher than the main contractor.
- (3) Minimum of 30% will be sub-contracted for this tender.
- (4) Local economic participation should be given priority when making a list of potential subcontractors available

City of Tshwane Participants with specific attention for the region in which the contract is to be executed should be given first priority and the below competent and capable designated groups should be prioritized.

- An EME or QSE
- An EME or QSE which is at least 51% Black Owned
- An EME or QSE which is at least 51% Owned by Black youth
- An EME or QSE which is at least 51% Black Women Owned
- An EME or QSE which is at least 51% owned by black people with disabilities.
- An EME or QSE which is 51% owned by black people living in rural or underdeveloped areas or townships
- A cooperative which is at least 51% owned by black people
- An EME or QSE which is at least 51% owned by black people who are military veterans; or
- More than one of the categories referred to in paragraphs (a) to (h).

Should subcontractors within Tshwane not be identified, the appointed service provider can extend the list of subcontractors to:

- Gauteng Participants
- National participants

(5) In relation to a designated sector a contractor must not be allowed to sub-contract in such a manner that the local production and content of the overall value of the contract is reduced to below the stipulated minimum threshold if the appointed Service Provider scored points for Local Content and Production.

C3.3.3 SUBCONTRACTING PROCEDURES

The contractor shall advertise and call for competitive tenders in respect of each portion of the works that are required to be subcontracted in terms of the contract in accordance with the relevant provision of the latest edition of the CIDB Standard for Uniformity in Construction Procurement. The Contract Data in the associated procurement documents shall be based on the City of Tshwane standards and any other relevant documentation of subcontracting with minimal project-specific variations and amendments that do not change their intended usage.

The Employer together with the Contractor shall evaluate the tenders received in accordance with the provision of the Standard Conditions of tender. The evaluation panel shall comprise equal representatives from the Employer and from the Contractor.

The Contractor shall without delay enter into a contract with the successful tendering subcontractor based on their accepted tender submission. The Contractor shall remain responsible for providing the subcontracted portion of the works as if the work had not been subcontracted.

**CITY OF TSHWANE
WATER AND SANITATION BUSINESS UNIT**

CONTRACT NO: WSBU 15-2025/26

**TENDER FOR THE REFURBISHMENT OF BRONKHORSTSPRUIT WATER
TREATMENT PLANT FOR A PERIOD OF TWENTY-FOUR (24) MONTHS
FROM COMMENCEMENT DATE**

C3.4 CONSTRUCTION (SPECIFICATIONS)

C3.4 CONSTRUCTION (SPECIFICATIONS)

C3.4.1 GENERAL CLAUSES AND SPECIFICATION

C3.4.1.1 Built-up areas

The attention of the Contractor is drawn to the fact that the Works will partially be constructed within the existing wastewater treatment works. The Contractor shall exercise all necessary precautions and take all necessary steps to ensure the safety and convenience of the staff, including the prevention of unnecessary noise, dust or other nuisance. Where applicable, the Contractor shall provide access for traffic over and through the Works, all as described in the specifications.

Any rock or debris falling from trucks on the road in use by the Contractor shall be removed immediately. Precautions shall be taken to prevent fouling of roads and completed works by trucks transporting any material in the Works. The Engineer may order the Contractor to broom off and clean roads continuously where the mud tracking of vehicles or falling debris may constitute a danger to the travelling public.

Allowance should be made by the Contractor in his construction programme for delays that may result from foreseen and unforeseen actions that are required to ensure the safety and convenience of the Contractor and Employer's staff.

C3.4.1.2 Reinstatement of Fences

The Contractor shall give all on-site residents a minimum of 48 hours' notice of his intent to dismantle fences to properties, where indicated on the Drawings or so ordered by the Engineer. The Contractor shall note and take photos of all aspects relevant to the condition of existing fencing prior to dismantling, and shall acquire the signature of the owner/occupant agreeing to such conditions.

All private fences may not be dismantled for a period longer than two weeks and the Contractor must programme the schedule of work accordingly.

After reinstatement, both the Contractor and the owner/occupant shall sign the form confirming that the condition of the fence is at least equivalent to its condition before dismantling.

C3.4.1.3 Care of the Site

At all times during the construction of the Works and upon completion thereof, the Site of the Works shall be kept and left in a clean and orderly condition. The Contractor shall store all materials and equipment for which he is responsible in an orderly manner, and shall keep the Site free from debris and obstructions. The site is classified as a high-risk area and it is the responsibility for the Contractor to secure the Works for the duration of the contract (refer to Clause 3.4.1.11). The Contractor must ensure the construction of the new fenceline is completed prior to any materials or equipment is delivered to or installed on site.

C3.4.1.4 Control of Water

The Contractor shall at all times and in all respects be responsible for the handling of stormwater at the Works, and for the handling of any sub-surface water that may affect the Works. No separate payment shall be made in this regard, as all costs related thereto shall be deemed to be included in the rates tendered for the various items of work that are included in the Schedule of Quantities.

C3.4.1.5 Existing Services and Structures

The site may be traversed by existing services such as sewer pipes, water pipes, power lines/cables and telephone cables, the exact position of which are generally unknown. Where positions of such services are known, these are shown on the layout plans or information in this regard will be made available by the Engineer prior to construction commencing in an area. The contractor will be required

to schedule and programme his work that when work is disrupted due to the influence of unexpected services encountered, construction can continue in other portions of the works to allow the situation to be remedied by re-routing of new or repairing of existing services.

The Contractor shall protect all known existing services as well as all work being carried out and structures being erected on the Site by other contractors or public authorities. The Contractor must familiarize himself with the various standard regulations of the relevant public authorities and act accordingly. Any damage caused to these services or structures or any obstructions or hindrance caused to other contractors or public authorities by the Contractor and all claims arising from such damage, obstruction or hindrance will be the sole responsibility of the Contractor.

All repair work shall be carried out at the Contractor's expense to the satisfaction of the Engineer or the appropriate public authority. The same obligations shall be imposed on the Employer and on other contractors employed by the Employer in respect of the Works being executed under this Contract.

The Contractor shall conduct the necessary search for unknown services as required by the Standard Specifications. After searching, all services shall be deemed as known.

Working space will be restricted on certain portions of the Works. The Contractor should note that all measurement and payment will be in accordance with the specified cross-sections and dimensions irrespective of the method used and that the rates and prices tendered for the Works will be deemed to include full compensation for difficulties encountered while working within restricted areas. No extra payment nor any claim for payment due to these difficulties will be considered.

C3.4.1.6 Open trenches

Trenches may not be left open during the builder's holidays and shall be safeguarded at all times from danger to the public. Safe trench-crossings shall be provided at all intersections with accesses to properties and with public roads and paths. The length of the trench left open at any one time may be restricted by the Engineer, should he consider such restriction to be in the interest of public safety.

C3.4.1.7 Spoil material

No indiscriminate spoiling of materials will be permitted. Surplus or unsuitable materials shall be spoiled at sites identified by the Contractor and approved by the Engineer for this purpose. All spoiling shall comply with the applicable statutory and municipal regulations of the local or rural authority in whose area it is located.

C3.4.1.8 Quality control

The onus to produce work that conforms in quality and accuracy of detail to the requirements of the specifications and the drawings rests with the Contractor, and the Contractor shall, at his own expense and in accordance with the Conditions of Contract, institute a quality assurance system and provide experienced engineers, foremen, surveyors, materials technicians, other technicians and technical staff, together with all transport, instruments and equipment to ensure adequate supervision and positive control of the quality of the Works at all stages of the Contract. The cost of the Contractor's supervision and process control, including all testing carried out by the Contractor, shall be deemed to be included in the various amounts tendered.

Within two weeks after the Commencement Date, and before the commencement of design, manufacturing of plant and materials, the Contractor shall submit a comprehensive proposal for a quality assurance plan to the Engineer for consideration. The Engineer will then issue his requirements for quality control which shall be based on the Contractor's proposals, provided these are adequate.

The Contractor and nominated sub-contractors shall work to defined quality assurance programmes compliant with ISO 9001. The Contractor shall list approvals held on his own behalf and for its main sub-contractors.

The Contractor shall undertake, in respect of sub-contractors, where no such acceptable information is available or where the sub-contractor has not been subject to an acceptable external quality audit in accordance with the Contractor's QA procedures, to carry out a quality audit of that sub-contractor to ensure that completion of the work shall be compliant with the Contract requirements.

Nominated sub-contractor(s) may be subject to quality audit by the Contractor in which the Engineer or nominated representative may participate.

The Contractor shall identify work packages that shall be sub-contracted, together with major items, for which quality plans (inspection and test plans) shall be submitted. The Contractor shall assist local Emerging sub-contractors which is deemed included in the contract. The Contractor shall name their representative that will be authorised as having responsibility for resolving or obtaining resolution, of any problems arising in respect of the acceptability of raw materials, components, assemblies and the installation thereof.

The Contractor shall establish and maintain a document inspection system capable of producing objective evidence that major components comply with the quality requirements of the Contract.

General information on the type of system in use by the Contractor shall be provided with the technical proposal.

The Contractor shall include in his orders to major sub-contractors a note advising that materials and equipment may be subject to inspection as determined by the Quality Plan.

The Contractor shall advise the Engineer, or his nominated representative, of the readiness of inspection at least ten (10) working days prior to a nominated witness or hold point unless an alternative period is agreed upon between Engineer and Contractors and then minuted at the first site meeting. Work shall not proceed beyond a hold point without the written agreement of the Engineer or his nominated representative.

The Contractor shall keep the Engineer informed in advance of the time of starting and of the progress of the work in its various stages so that arrangements can be made for inspection and for the test.

The inspection and tests by the Engineer of any components, or lost thereof, does not relieve the Contractor of any responsibility whatever regarding defects or other failures, which may be found before the end of the defects liability period.

C3.4.1.9 Contractor's Representative and superintendence

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

C3.4.1.10 Site meetings

The Engineer will conduct site meetings, prepare and circulate minutes, as determined by him in consultation with the Employer. The Contractor shall attend these meetings and shall ensure that when necessary, all required sub-contractors are represented. The Contractor shall submit monthly progress reports as required in the Conditions of Contract.

C3.4.1.11 Security of the Site

The attention of the Contractor is drawn to the necessity of securing the complete Site of the works and equipment, in particular his construction camp(s) and depot and the Engineer offices and facilities. The Contractor shall allow at all times for the necessary security and watching to prevent theft or damage to materials, plant and contractor's equipment, and to ensure the safety of both the Contractor's personnel, Employer's personnel and the Engineer's personnel.

The Contractor shall not be reimbursed by the Client for the loss or damage of any materials, vehicles and machinery whatsoever through theft or robbery (armed or unarmed) from the site of the works or his construction camp. Neither will a claim for extension of time be considered for the time lost due to the loss or damage caused by such theft or robbery.

The contract makes provision for the supply and installation new security system and control room, also included in the contract will be the operation of the system by a specialist security contractor appointed under the contract for the duration of the contract. The security contract will operate the system and secure the site as a trial operation and the system will be handed over to the client at the end of the contract with the rest of the treatment works. This scope of the work is subject to the concurrent security tender advertised by the City and therefore, they withhold the right to remove it from the Contract should the aforementioned contract be awarded before this contract.

It is in the interest of the Contractor to establish and maintain healthy community liaison and employment structures throughout the duration of the Contract, as healthy structures will serve to elicit the support of affected communities in detecting and prosecuting criminal activity.

It must be noted that there are high incidents of theft of electrical cables and damage to motor control centres on site. The Contractor may need to consider making provision for armed guards on site for the duration of the contract until completion certificates have been issued. It may also be in the Contractor's interest that the work be programmed so that the electrical equipment be installed and energised then directly placed into operation where possible.

C3.4.1.12 Survey and setting out

It is the responsibility of the Contractor to verify the accuracy of co-ordinates and heights (x, y & z) of survey beacons.

C3.4.1.13 Drawings

All information in the possession of the Contractor that is required by the Engineer's Representative in order to complete the As-Built drawings and to prepare a completion report for the Employer must be submitted to the Engineer's Representative before a Taking Over Certificate is issued for the Works. Similarly, the Contractor will be required to submit full details of all pipes, valves, meters and specials in a suitable loose bound format, including any special operational and maintenance procedures related thereto, for incorporation in the overall operation and maintenance manual for the Scheme prior to the issue of a Taking Over Certificate for the Works.

Only figured dimensions on the Drawings may be used in the interpretation thereof, and the Drawings shall not be scaled unless the Contractor is so instructed by the Engineer in writing. The Engineer will upon written request provide any dimensions that may have been omitted from the Drawings.

Pipe item schedules have been prepared by the Engineer for tender purposes. The Contractor shall number the items for manufacturing and drawing purposes in accordance with the Engineer's numbering system, and shall submit detailed as-built pipe item (including specials such as valves, meters etc) schedules prior to the issuance of the Taking-Over Certificate similar to the Engineer's pipe item schedule format. Should modifications to pipe items and/or additions to the schedule be required by the Contractor, such items shall be modified on the Engineer's pipe item schedules by the Contractor and submitted to the Engineer for approval.

C3.4.1.14 Operations and Maintenance manuals

Draft operating and maintenance manuals are a prerequisite to commencing with the Tests on Completion and the tendered amounts for the commissioning shall include for the compilation and provision of these manuals.

The Contractor shall hand over to the Engineer three (3 No) final copies of the Operation and Maintenance Manual before a Taking-Over certificate will be issued for the Works.

The manuals shall be printed on 90gsm thick paper and be securely bound in A4 size hard backed plastic/waterproof ring binders with clear pockets on the spine and front cover for insertion of title slips giving contract number, scheme description and equipment supplied. An electronic copy in pdf format must be also supplied on a memory stick.

The manual shall contain sections separated by plastic binders clearly and visibly marked to match the index and shall be set out as follows:

- a) Title page
- b) Index
- c) Final acceptance certificate relating to tests carried out.

The final Operation and Maintenance Manual will consist of two parts:

PART ONE

The first part will contain sections on:

- (a) Brief description of the plant.
- (b) Operating instructions for individual components of the plant, including final settings, available range and control philosophy. The instructions should be clear, concise and easy to follow and must include where applicable pre-start, safety, shut down and manual operating procedures.
- (c) Routine maintenance instructions i.e. list of tasks and recommended frequency of inspections and/or item maintenance or replacement.
- (d) Precautionary measures, elementary fault location, rectifying measures, emergency actions and safety procedures.

PART TWO

The second part will contain sections on:

- (a) Detailed information on equipment including equipment brochures and supplier's operation and maintenance requirements.
- (b) Lists of spare parts including names and contact details of suppliers.
- (c) All relevant technical information of the installations and components.
- (d) Details and ratings of motors.
- (e) All information pertaining to pump installations including test curves, test certificates and commissioning testing information.
- (f) Detail mechanical drawings, P&ID diagrams and final pipe items schedules.

C3.4.1.15 Information Required at Tender Stage

It is a specific requirement of the tender that full information of all the equipment offered must be supplied at the time of tendering in order for the Engineer to evaluate the Tenderer's submission. The information required is listed below and the tenderer is required to complete all Technical Schedules included under Section T2: Returnable Documents. **Failure to complete these schedules and supply required information will render the tender incomplete and will result in disqualification.**

Such information will include at least the following:

- (a) The country of origin.
- (b) Make and description of equipment.
- (c) Capacity of the units.
- (d) Material of the components.
- (e) Working pressures.
- (f) General arrangement drawings of all units.
- (g) Spares to be carried by the Client.
- (h) Full details of all pipework and valves including internal protection.
- (i) Pump curves

Manufacturer's pamphlets and catalogues shall be included, but edited and clearly marked so as to describe the particular equipment offered.

SUMMARY OF REQUIRED RETURNABLES DOCUMENTS:

No.	Description	Page
RD.A	Returnable Documents required for Tender Evaluation Purposes	T2.1-1
RD.B	Returnable Documents required for Preferential Procurement Evaluation Purposes	T2.1-1
RD.C	Additional Returnable Documents required for Tender Evaluation Purposes	T2.1-2
RD.D	Additional Returnable Documents that will be incorporated into the Contract	T2.1-3
RD.E	Other Documents that will be incorporated into the Contract	T2.1-3
T2.3	Technical Schedule required for Technical Evaluation Purposes	T2.3-1
T2.3.1	Electrical & Electronic Schedules to be completed	T2.3.1-1

C3.4.1.16 Contractor's Equipment

The Contractor's Equipment for construction and erection of the Works shall be adequate for the purpose required, of modern design and in good condition to carry out the Works expeditiously. Should the Engineer be of the opinion that the Contractor's Equipment is in anyway unsuitable for carrying out the Works in a manner or at a rate commensurate with the requirements of the Contract, he shall have the right to instruct the Contractor at any time during the Contract to provide additional or improved plant, tools and equipment, at the Contractor's expense, in order to meet the specified requirements.

C3.4.1.17 Testing of Equipment

The Contractor shall execute and submit to the Engineer all test results in accordance with of the General Conditions of Contract in order to prove that the works completed under the Contract conform in all respects to the Specifications. In particular, successful execution of the following testing is required in respect of completion of the Works:

a) Dry testing prior to commissioning

- Visual checking of general installation and appearance
- Fixing of equipment, pipes, brackets, anchors, etc.
- Written proof of alignment tests on pumps and motors

- Directional testing of rotating elements
- Checking and testing of all actuators and valve settings
- Water testing of chemical dosing equipment, pipes, joints
- Water tightness tests on all water retaining structures
- Pressure tests on all pipelines
- General safety of installations

b) Wet commissioning milestones

- Performance testing of all equipment at specified duties and efficiencies for at least 24 hours continuously
- Monitoring of levels at maximum conditions
- Power consumption
- Temperatures of all bearings
- Vibration of rotating elements
- Calibration of dosing equipment
- Water tightness tests of installations at full load

c) Trial Operation Period and Milestones

Once wet commissioning of all plant components have been completed to the satisfaction of the Engineer, the Contractor shall operate the completed plant successfully for a period as specified in C1.2.4 continuously, with interruptions only to alter plant settings, affect final settings and optimization, test auto-functionality and train the Operator in the detail functioning of the plant. The Engineer shall confirm in writing the date on which the trial operation period commenced. Any failure during the trial operation period will cause the trial to cease, and restart after the failed components have been repaired.

If the components fail again, then the components are not suitable for the duty, and the contractor shall rectify the situation at his cost. He shall then again prove that the equipment is suitable for the duty specified.

During the Trial Operation Period, the Contractor shall record all data and at its completion, submit to the Engineer a report confirming final settings, calibration, auto control functions, approved tests and successful training of the Operator to the satisfaction of the Employer before a Taking-Over Certificate will be issued for the Works in terms of clause 10.1 of the General Conditions of Contract.

d) Defects Notification Period

All equipment supplied under this contract shall be re-tested by the Operator in conjunction with the Contractor at the end of the 12-month Defects Notification Period, to prove that it continues to comply with the specified requirements.

C3.4.1.18 Sub-contracting

Should the Tenderer wish to employ Sub-contractors for part of the works, this is to be clearly indicated and the schedule in Volume 1 is to be completed to indicate the full names and addresses of all proposed Sub-contractors for which approval of the Employer (or the Engineer acting on his behalf) is sought, stating the section of the works that each will be handling.

C3.4.1.19 Labor Intensive Construction Methods (SPWP)

All items on the Bill of quantities marked “LI” is earmarked for the general labor of the affected ward and should be so executed. This includes, but not limited to:

- The preparation of the bedding in pipe trenches.
- Backfilling and compaction of the pipe trenches and around valve chambers.
- Trenching
- The installation of the security fence.

C3.4.1.20 Local Emerging Contractors (LECs)

All items on the bill of quantities marked “SC” is earmarked for the upliftment of the Local Emerging Contractors within the affected ward/s and if such skills are not within the affected ward these items will be subcontracted to LECs within the City of Tshwane.

The Contractor is encouraged to use LECs on any part of the works, over and above the above stated items, that he deems could be sub-contracted for the upliftment of the community and development of local economy and skills base. In areas where required by the Engineer the Contractor will be required to make use of local emerging contractors to execute dedicated portions of the work. Only approved tendered rates will apply for work executed and the Contractor must ensure that the Local Emerging Contractors are paid a market related price for work done. The Contractor will be compensated for the additional site supervision, management of Local Emerging Contractors, material management, training and personal protective clothing that may be required for the Local Emerging Contractors as a percentage value of the work done by the Sub-contractor.

The City of Tshwane has a mandate and responsibility to fight poverty, build clean, healthy, safe and sustainable communities). To achieve this, the City adopted an Integrated Poverty Reduction and Community Development Strategy which requires all departments to cooperate and contribute towards poverty reduction through indigent exit programs and projects. Therefore, Water and Sanitation is committed to utilize indigents that are registered on the City EPWP Database on all projects. The aim is to ensure commitment by each contractor on a project to utilize at least 95% of its personnel of the indigents list provided by the City in order to enhance poverty alleviation and the uplifting of indigents.

The Contractor appointed will have to make use of the provided beneficiary list in each area that will be provided by the City. The idea is to place indigents in the correct or appropriate project roles/occupations to help them achieve income capacity and/or to equip them through skills development. The Contractor must provide data about the number of indigents required, qualifications, type of placement/occupation and gender before the project starts. The Contractor appointed must accommodate students that are in need of practical training or in service training.

The Contractor will adopt the following structure for the selecting, training and appointing of Local Emerging Contractor(s) for this project:

- a) The project steering committee (PSC) under the leadership of the ward councilor(s) will compile a list of all the Local Emerging Contractors in the ward(s) where the project will be executed.
- b) Immediately after the approval of the appointment of the Contractor on the project, the PSC under the leadership of the ward councilor(s) will invite all the Local Emerging Contractors in the ward(s) where the project will be executed as captured on the abovementioned list to apply for possible inclusion on the list of candidates to be appointed as Local Emerging Contractor(s) by the principal contractor on the project.

- c) The applicants will then be evaluated and a short list will be compiled by the PSC together with the appointed construction and materials manager and the appointed Contractor.
- d) The successful candidates will then be trained by the appointed NQF accredited EPWP training provider on all the predetermined unit standards.
- e) The successful candidate(s) will then enter into a written agreement/contract with the Contractor.
- f) The Contractor can hold the Local Emerging Contractor(s) responsible for the quality and quantity of work done by them through their agreement/contract, but will be ultimately responsible and liable for the work done being the Contractor and mentor to the Local Emerging Contractor(s).
- g) The Contractor and Employer's agent responsible for the site supervision will submit a performance evaluation report to the Employer, the City, and to the CIDB for their records should the Local Emerging Contractor(s) being registered with the CIDB, in the process of registering or planning to register with the CIDB after the completion of the construction works on the project.
- h) A register of all the trained, appointed local emerging contractor(s) and experienced emerging contractors per ward will be kept at the Water and Sanitation Division on the Manage System.
- i) Ensure that each Local Emerging Contractor(s) Health and Safety Management Plan is implemented and maintained on their portion of the Works.
- j) A monthly progress report including an annexure of the performance of Local Emerging Contractors will be submitted on a monthly basis.

The above structure will ensure that Local Emerging Contractors with potential to be trained and given the opportunity to be appointed as Local Emerging Contractor(s) and to gain valuable experience under the mentorship of a construction and materials contractors manager.

C3.4.1.21 Scope of Mandatory Sub-Contract Work

In areas where required by engineer the Contractor will be required to make use of Local Emerging Contractors.

C3.4.1.22 Preferred Sub-contractors/Suppliers

Local Emerging Contractors must be Black Enterprises. A Black enterprise (BE) is defined as a company or economic activity that is owned by Black persons and where there is substantial management control by Black people. Ownership refers to economic interest, whilst management refers to the membership of any board or similar governing body of the enterprise. The Broad-Based Black Economic Empowerment Act No. 53 of 2003, principles must apply to BE's.

Enterprises must comply with the following:

- Business must be registered within the City boundaries,
- Owners must reside within the City.

C3.4.1.23 Sub-Contracting Procedures

The Contractor shall advertise and call for competitive tenders in respect of each portion of the works that are required to be Sub-contracted in terms of the contract in accordance with the relevant provision of the latest edition of the CIDB Standard for Uniformity in Construction Procurement. The Contract

Data in the associated procurement documents shall be based on the GCC 2015 form of Sub-Contracting with minimal project specific variations and amendments that do not change their intended usage.

The Employer together with the Contractor shall evaluate the tenders received in accordance with the provision of the Standard Conditions of tender. The evaluation panel shall comprise equal representatives from the Employer and from the Contractor.

The Contractor shall without delay enter into contract with the successful tendering Sub-contractor based on their accepted tender submission. The Contractor shall remain responsible for providing the Sub-contracted portion of the works as if the work had not been subcontracted.

C3.4.1.24 Contractor's Employees

C3.4.1.24.1 Minimum Employment Conditions for Conventional Construction Works

Contractors shall comply with the Basic Conditions of Employment Act (Act No 75 of 1997).

As a determination has not been made in terms of the aforesaid Act for the building sector, the minimum employment conditions which will apply to this Contract shall be guided by the Amendment of Sectoral Determination 2: Civil Engineering Sector published in the Government Gazette dated 4 September 2012, as and when amended from time to time.

The following minimum conditions shall apply to this Contract and Contractors shall include such conditions in employment contracts.

Employment contracts

The Contractor shall enter into an employment contract with every one of his/her employees, including short-term contracts i.e. contracts in which employment commencement and employment termination dates are specified. Short-term employment contracts will also apply an employee employed for only one day.

Normal working hours

Normal working hours are from 07:00 to 17:00 from Monday to Friday. A tea break is taken from 09:00 to 09:15 and lunch from 12:30 to 13:00.

Actual hours to work and be paid for is 9 hours per day. If a lunch break of one (1) hour is taken then the normal working day will be as follow:

Morning work sessions from 07:00 to 12:00, lunch break from 12:00 to 13:00, and afternoon sessions from 13:00 to 17:00.

Minimum wages

Minimum wages shall be according to the Government Gazetted rates for the Civil Engineering Sector for Gauteng Province (Regulation Gazette No 9360 Vol. 542). For a full day's work the hourly rate shall be multiplied by 9. Normal 5-day week hours of work shall be 45 hours and the wage calculated according to the applicable hourly rate.

Overtime pay shall be 1,5 times the ordinary wage. An employee shall be paid fortnightly.

Wages should be increased by CPI excluding owners' equivalent rent (eoe) plus two percentage point for the second and third years of the determination. The CPI to be used is the one that is

published by StatsSA six weeks prior to the scheduled increment date. Below are the recommendations of the Department regarding new minimum wages levels:

Minimum wages per hour for all employees in the Civil Engineering Sector:

Short time (excluding short time due to inclement weather)

If for reasons, which may be ascribed to the employee, e.g. arriving late for work or taking an afternoon off, the hours not worked shall be deducted from the daily wage calculation.

Short time resulting from inclement weather

- i. If the Contractor informs his/her employees that no work will be done the following day due to inclement weather, no payment will be due to the employee for such a day.
- ii. If the Contractor has not informed his/her employees that no work will be done due to inclement weather and no work or less than four (4) hours of work is possible during a day, the Contractor must pay the employee for four (4) hours of work. If more than four (4) hours of work is done, the Contractor shall pay the employee for the number of hours worked.

Vacation leave

If an employee has been in full time employment for more than four (4) months, he/she shall be entitled to 1 day's paid leave for every seventeen (17) days the employee worked or was entitled to payment.

Family responsibility leave

If an employee has been in full time employment for more than four (4) months, he/she shall be entitled to three days paid leave in a leave cycle of thirty-six (36) months of employment:

- i. When the employee's child is born;
- ii. When the employee's child is sick;
- iii. In the death of the employee's spouse or life partner, parent, grandparent, child or grandchild.

The employee shall provide the required proof to the Contractor of the event, failing which the leave shall be unpaid leave

Maternity leave

At least four (4) months unpaid leave.

Sick leave

The employee shall be entitled to one (1) day's paid sick leave of normal wages for every twenty-six (26) days worked.

If an employee is absent for three (3) or more consecutive days, the employee shall provide a sick certificate from a registered medical practitioner to qualify for sick leave payment. If such certificate is not provided, no sick leave payment will be due to the employee.

Piece work

Irrespective of the quantity of work done under a piece work system during a working week, the employee shall be entitled to a minimum of a week's wages determined as if no piece work applied.

The Contractor or employee may terminate an employment contract by giving notice of termination of not less than:

- i. On short period contracts i.e. a contract which states from which date work employment commences and on which day employment terminates, the terms of the employment contract shall apply;
- ii. One week if employee has been employed for four (4) weeks or less, unless it is a short-term project;
- iii. Two (2) weeks if employee has been employed for more than four (4) weeks but not more than one (1) year;
- iv. Four (4) weeks if employee has been employed for more than one year.

C3.4.1.24.2 Employment Conditions For Labour Intensive Works and Construction

The Ministerial Determination, Special Public Works Programmes, issued in terms of the Basic Conditions of Employment Act of 1997 by the Minister of Labour in Government Notice No R347 of 4 May 2012, as reproduced below, shall apply to works described in scope of work as being labour intensive and which are undertaken by unskilled or semi-skilled workers.

This clause contains the standard terms and conditions for workers employed in elementary occupations on an Expanded Public Works Programme (EPWP). These terms and conditions do NOT apply to persons employed in the supervision and management of an EPWP.

Terminology

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

Terms of Work

- i. Workers on an EPWP are employed on a temporary basis.

Normal Hours of Work

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

Meal Breaks

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

Special Conditions for Security Guards

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

Daily Rest Period

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

Weekly Rest Period

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

Sick Leave

- i. Only workers who work four or more days per week have the right to claim sick-pay in terms of this clause.
- ii. A worker who is unable to work on account of illness or injury is entitled to claim one day's sick leave for every full month that the worker has worked in terms of a contract.
- iii. A worker may accumulate a maximum of twelve days' sick leave in a year.
- iv. Accumulated sick-leave may not be transferred from one contract to another contract.
- v. An employer must pay a task-rated worker the worker's daily task rate for a day's sick leave.
- vi. An employer must pay a time-rated worker the worker's daily rate for a day's sick leave.
- vii. An employer must pay a worker sick pay on the worker's usual payday.
- viii. Before paying sick-pay, an employer may require a worker to produce a certificate stating that the worker was unable to work on account of sickness or injury if the worker is –
 - a. absent from work for more than two consecutive days; or
 - b. absent from work on more than two occasions in any eight-week period.
- ix. A medical certificate must be issued and signed by a medical practitioner, a qualified nurse or a clinic staff member authorised to issue medical certificates indicating the duration and reason for incapacity.
- x. A worker is not entitled to paid sick-leave for a work-related injury or occupational disease for which the worker can claim compensation under the Compensation for Occupational Injuries and Disease Act.

Maternity Leave

- i. A worker may take up to four consecutive month's unpaid maternity leave.
- ii. A worker is not entitled to any payment or employment-related benefits during maternity leave.
- iii. A worker must give her employer reasonable notice of when she will start maternity leave and when she will return to work.
- iv. A worker is not required to take the full period of maternity leave. However, a worker may not work for four weeks before the expected date of birth of her child or for six weeks after the birth of her child, unless a medical practitioner, midwife or qualified nurse certifies that she is fit to do so.
- v. A worker may begin maternity leave –
 - a. four weeks before the expected date of birth; or
 - b. on an earlier date –
 - if a medical practitioner, midwife or certified nurse certifies that it is necessary for the health of the worker or that of her unborn child; or
 - if agreed to between employer and worker; or on a later date, if a medical practitioner, midwife or certified nurse has certified that the worker is able to continue to work without endangering her health.
- vi. A worker who has a miscarriage during the third trimester of pregnancy or bears a stillborn child may take maternity leave for up to six weeks after the miscarriage or stillbirth.
- vii. A worker who returns to work after maternity leave, has the right to start a new cycle of twenty-four months employment, unless the EPWP on which she was employed has ended.

Family Responsibility Leave

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

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

Statement of Conditions

- i. An employer must give a worker a statement containing the following details at the start of employment –
 - a. the employer's name and address and the name of the EPWP;
 - b. the tasks or job that the worker is to perform; and

- c. the period for which the worker is hired or, if this is not certain, the expected duration of the contract;
- d. the worker's rate of pay and how this is to be calculated;
- e. the training that the worker will receive during the EPWP.
- ii. An employer must ensure that these terms are explained in a suitable language to any employee who is unable to read the statement.
- iii. An employer must supply each worker with a copy of these conditions of employment.

Keeping Records

- i. Every employer must keep a written record of at least the following –
 - a. the worker's name and position;
 - b. in the case of a task-rated worker, the number of tasks completed by the worker;
 - c. in the case of a time-rated worker, the time worked by the worker;
 - d. payments made to each worker.
- ii. The employer must keep this record for a period of at least three years after the completion of the EPWP.

Payment

- i. An employer must pay all wages at least fortnightly in cash or by cheque or into a bank account.
- ii. A worker may not be paid less than the sectoral determination for Civil Engineering Works Task Grade 1.
- iii. A task-rated worker will only be paid for tasks that have been completed.
- iv. An employer must pay a task-rated worker within five weeks of the work being completed and the work having been approved by the manager or the contractor having submitted an invoice to the employer.
- v. A time-rated worker will be paid at the end of each month.
- vi. Payment must be made in cash, by cheque or by direct deposit into a bank account designated by the worker.
- vii. Payment in cash or by cheque must take place –
 - (a) at the workplace or at a place agreed to by the worker;
 - (b) during the worker's working hours or within fifteen minutes of the start or finish of work;
 - (c) in a sealed envelope which becomes the property of the worker.
- ii. An employer must give a worker the following information in writing –
 - (a) the period for which payment is made;
 - (b) the numbers of tasks completed or hours worked;
 - (c) the worker's earnings;
 - (d) any money deducted from the payment;
 - (e) the actual amount paid to the worker.
- iii. If the worker is paid in cash or by cheque, this information must be recorded on the envelope and the worker must acknowledge receipt of payment by signing for it.
- iv. If a worker's employment is terminated, the employer must pay all monies owing to that worker within one month of the termination of employment.

Deductions

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

- ii. An employer must deduct and pay to the SA Revenue Services any income tax that the worker is required to pay.
- iii. An employer who deducts money from a worker's pay for payment to another person must pay the money to that person within the time period and other requirements specified in the agreement law, court order or arbitration award concerned.
- iv. An employer may not require or allow a worker to –
 - a. repay any payment except an overpayment previously made by the employer by mistake;
 - b. state that the worker received a greater amount of money than the employer actually paid to the worker; or
 - c. pay the employer or any other person for having been employed.

Health and Safety

- i. Employers must take all reasonable steps to ensure that the working environment is healthy and safe.
- ii. A worker must –
 - a. work in a way that does not endanger his/her health and safety or that of any other person;
 - b. obey any health and safety instruction;
 - c. obey all health and safety rules of the EPWP;
 - d. use any personal protective equipment or clothing issued by the employer;
 - e. report any accident, near-miss incident or dangerous behaviour by another person to their employer or manager.

Compensation for Injuries and Diseases

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

Termination

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

Certificate of Service

On the termination of employment, a worker is entitled to a certificate stating:

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

C3.4.1.24.3 Employment of Unskilled and Semi-Skilled Workers in Labour-Intensive Works

Requirements for the Sourcing and Engagement of Labour

- i. Unskilled and semi-skilled labour require for the execution of all labour intensive works shall be engaged strictly in accordance with prevailing legislation and SANS 1914-5, Participation of Targeted Labour.
- ii. Tasks established by the contractor must such that:
 - (a) the average worker completes 5 tasks per week in 40 hours or less; and
 - (b) The weakest worker completes 5 tasks per week in 55 hours or less.
- iii. The contractor must revise the time taken to complete a task whenever it is established that the time taken to complete a weekly task is not within the requirements of 6.1.3.
- iv. The Contractor shall, through all available community structures, inform the local community of the labour intensive works and the employment opportunities presented thereby. Preference must be given to people with previous practical experience in construction and / or who come from households:
 - (a) where the head of the household has less than a primary school education;
 - (b) that have less than one full time person earning an income;
 - (c) where subsistence agriculture is the source of income;
 - (d) Those who are not in receipt of any social security pension income.
- v. The Contractor shall endeavour to ensure that the expenditure on the employment of temporary workers is in the following proportions:
 - (a) 60 % women;
 - (b) 20 % youth who are between the ages of 18 and 35; and
 - (c) 2 % on persons with disabilities.

Specific Provisions Pertaining to SANS 1914-5

- i. Definitions
Targeted labour: Unemployment persons who are employed as local labour on the project.
- ii. Contract participation goals
 - a. there is no specified contract participation goal for the contract. The contract participation goal shall be measured in the performance of the contract to enable the employment provided to targeted labour to be quantified.
 - b. The wages and allowances used to calculate the contract participation goal shall, with respect to both time-related and task rated workers, comprise all wages paid and any training allowance paid in respect of agreed training programmes.
- iii. Further to the provisions of clause 3.3.2 of SANS 1914-5, written contracts shall be entered into with targeted labour.
- iv. Variations to SANS 1914-5
 - a. The definition for net amount shall be amended as follows:
Financial value of the contract upon completion, exclusive of any value added tax or sales tax which the law requires the employer to pay the contractor.
 - b. The schedule referred to in 5.2 shall in addition reflect the status of targeted labour as women, youth and persons with disabilities and the number of formal training provided to targeted labour.

Training of Targeted Labour

- i. The contractor shall provide all the necessary CETA accredited training to targeted labour to enable such labour to master the basic work techniques required to undertake the work in accordance with the requirements of the contract in a manner that does not compromise worker health and safety.
- ii. The cost of the formal training of targeted labour, shall be measured and paid for in the schedule of quantities of this contract document.
- iii. The contractor shall do nothing to dissuade targeted labour from participating in training programmes and shall take all reasonable steps to ensure that each beneficiary is provided with formal training.
- iv. An allowance equal to 100 % of the task rate or daily rate shall be paid by the contractor to workers who attend formal training, in terms of (iii) above.
- v. This training should take place as close to the project site as practically possible. The City will ensure that training arrangements for participants are in place and appointment of the training provider facilitated in time.
- vi. Proof of compliance with the requirements of (ii) to (iv) must be provided by the Contractor to the Employer prior to submission of the final payment certificate.

C3.4.1.25 Community Liaison Officer

The successful tenderer shall enter into an agreement with the ward Councillor/ward committee whereby the ward Councillor shall provide to the Contractor the following if necessary: A Community Liaison Officer (CLO) for liaison with the recipient community

The CLO shall attend all site and other meetings concerning the project.

The agreement shall make provision for the payment by the Contractor to the CLO a maximum amount calculated as follows:

Wage per month = The City of Tshwane's minimum T5 notch (Prior to deductions).

Community Strategy: The CLO shall be available full time on site when contractor is active. Furthermore, it will be required of him to liaise any pertinent communication to the community. He shall attend all site and technical meetings as well as steering committee meetings as well as steering committee meetings happen after hours.

If the project spans over more than one Ward, the relevant Ward Councillors shall agree on one CLO to be appointed by the Contractor. Should no agreement be found as envisaged, the relevant Project Manager together with the Executive Director: Integrated Community Development, or their nominees, will interview prospective appointees and in their discretion appoint such CLO.

Notwithstanding the above, if the vastness of the project requires the use of more than one CLO, this will be permitted provided that the total monthly sum paid to all CLO's shall not exceed the amount allowed for in paragraph 5.3.

Should the Contractor experience any difficulties with the community, these difficulties shall immediately be brought to the attention of the Department/project manager who shall arrange a meeting with the relevant ward Councillor(s) and the CLO to resolve such difficulties.

The Contractor shall ensure that any Sub-contractor he may appoint shall adhere to these conditions but also subject to the provisos applicable to the duration of such sub-contract.

Should any of the above conditions be less favourable than any Bargaining Council Agreement or Act applicable to the Contractor, the more favourable condition will apply.

C3.4.1.26 SOCIO-ECONOMIC PLAN

The tenderer shall provide an economic plan which will include the job creation plan (i.e. skills required and the number for each skill). The job creation plan where applicable should include interns.

The tenderer shall provide details of all training to be provided, through on-site, accredited training and formal training for employees at all levels to ensure they enhance their competence, and able to provide the required operation and maintenance skills across the various process streams. This shall also include SHEQ training.

The tenderer shall also detail the capacity building and skills transfer initiatives to be implement so that the Employer can manage the facility on contract completion, in a seamless and sustainable manner.

C3.4.1.27 CONSTRUCTION MANAGEMENT SERVICE REQUIREMENTS

The Contractor shall appoint a Construction Manager whose duties will be to provide construction management and materials management services in line with the employer's objective, Description of Work.

C3.4.1.27.1 General

The construction manager shall, in order to achieve the employer's objectives, Description of Work,

- a) comply with agreements made with the employer and the local community, if any, monitor and report on project expenditure and costs and construction progress, and co-ordinate site activities,
- b) advise, assist and train the supported contractor on the job in terms of the contract between the employer and the supported contractor and, if so required in the specification data, arrange for the supply of certain items of equipment and the supply and delivery to site of materials,
- c) remain impartial in his dealings with the employer and the supported contractor,
- d) engage, on behalf of and with the approval of the employer, specialist contractors to execute parts of the works and coordinate the work of supported contractors and the specialist contractors,
- e) cooperate with other professional service providers appointed by the employer,
- f) visit the site at appropriate intervals during the various stages of construction in order to confirm that the supported contractor is making satisfactory progress, that he shows technical competence in the execution of all aspects of the works and generally fulfils all contractual obligations,
- g) provide continuous support to the supported contractor in order to ensure that the employer's objectives are achieved,
- h) operate within any structured framework developed by the employer to enable interim payments to be made to supported contractors within relatively short time frames,
- i) provide site facilities for the employer and his agents, as provided for in the specification data,
- j) ensure the economic and efficient use of all plant and, to this end, maintain adequate records of plant usage,
- k) maintain detailed records of all costs relating to the construction of the works including those relating to the provision of construction management services, and report to the employer at intervals not exceeding one month on the financial status of the contract, and
- l) assist supported contractors in registering with a public body, if required, in terms of the specification data.

C3.4.1.27.2 Construction stage requirements

General

Following the award of the contract to the supported contractor, the construction manager shall, as a minimum,

- a) attend site and coordination meetings conducted by the employer and his agents,
- b) arrange weekly or fortnightly site progress meetings with the supported contractor and record and distribute the minutes thereof,
- c) liaise with the employer at coordination meetings at regular, agreed intervals and keep him fully informed regarding all aspects of the supported contractors' contracts,
- d) confirm insurance arrangements, notify insurers of all claims and ensure that all insurance policies are maintained,
- e) bring to the attention of the employer without delay any deficiencies in materials or in work performed by the supported contractor and follow up corrective actions which might be prescribed,
- f) inspect all exposed services, report in writing any damage to the employer and, subject to the approval of the employer, take the necessary action to have the damage repaired,
- g) implement and monitor approved security arrangements and recommend and implement changes which might be necessary, where required by the employer in terms of the specification data, arrange for the supply and erection of suitable name boards,
- h) maintain and update the assets register,
- i) monitor the progress of the supported contractor and submit monthly progress reports to the employer which provide information relating to,
 - progress in relation to the programme,
 - costs incurred in respect of materials, labour, plant, transport, specialist contractors and construction management services,
 - the actual cash flow compared with the predicted cash flow,
 - expected savings or excess expenditure,
 - site meetings,
 - details of plant hired, including standing-time charges, breakdowns and reasons for the use thereof, and
 - details regarding the theft of materials issued to site,
- j) coordinate and monitor the activities of the supported contractor and others involved in the works,
- k) maintain all necessary site records and documentation including those pertaining to personnel on site, equipment, progress, deliveries of materials to supported contractors, variations to their respective contracts, quantities of work executed, etc.,
- l) ensure that the supported contractor implements a systematic testing programme,
- m) review and monitor the supported contractor's quality control systems,
- n) establish and maintain a list of defects and ensure that these are remedied,
- o) brief supported contractors on health and safety requirements, and
- p) verify claims for payment to supported contractors and other parties in accordance with the provisions of the contract.

Advice and assistance to the supported contractor

The construction manager shall, as a minimum,

- a) process and resolve supported contractors' queries regarding the interpretation of drawings, specifications and contractual matters pertaining to their respective contracts,
- b) motivate and guide supported contractors and, where necessary, recommend measures to expedite their progress,
- c) assist supported contractors with

- the preparation and updating of a realistic and achievable programme,
 - the setting out of the works,
 - the management, administration and employment of their work forces,
 - the performance of their contracts,
 - all registrations required in terms of legislation and all applicable taxes and levies,
 - the preparation of payment certificates,
 - the handing over of the works to the employer upon completion, and
 - liaison with external organizations and the local community with regard to the works, and
- d) advise the supported contractor on safety measures which shall be implemented in order to comply with safety legislation.

Training

The construction manager shall, as a minimum,

- a) teach the supported contractors how to assess and order materials required for incorporation into the works,
- b) train, advise and guide supported contractors both in-house and on the job with regard to the following aspects of the contract:
 - the basic work techniques required to perform the contract;
 - the need to develop communication skills;
 - what is expected of a supported contractor;
 - health and safety requirements;
 - the need to execute appropriate tasks correctly the first time;
 - how to submit claims for payments;
 - how to control and motivate their work-forces;
 - the necessity for planning;
 - how to prepare and use construction programmes;
 - the relationship between tender pricing, productivity and profit; and
 - payment procedures for payments required in terms of the law, including all applicable taxes and levies, and
- c) act generally as a mentor to the supported contractor and facilitate, when appropriate, training of the supported contractor by other organizations.

Tools and equipment

The construction manager shall, as a minimum,

- a) advise supported contractors regarding their hand-tool requirements and assist them with the procurement thereof,
- b) arrange for the timeous supply and cost-effective use of items of equipment and plant required for the execution of the works which supported contractors are not, in terms of their contracts, required to provide,
- c) arrange for the supply of calibrated testing equipment to supported contractors, as required, and ensure that tests are properly carried out and the results forwarded to the relevant parties that require such information, and
- d) arrange for the supply of all fuel and power required for the operation of power-driven equipment and tools.

Materials (where materials management services are provided to supported contractors)

The construction manager shall, where a materials manager has been appointed, as a minimum,

- a) provide the materials manager with a programme of materials requirements, based on the programmes of supported contractors, at the commencement of their respective contracts and update such programmes as necessary,

- b) review supported contractors' requests for materials, adjust quantities, if necessary, and forward orders timeously to the materials manager,
- c) arrange with the materials manager for the delivery of materials direct to the site, where necessary,
- d) where required, collect materials from the materials manager's store and deliver to the site,
- e) monitor and approve the overnight storage of unused materials on the site by supported contractors or, should such materials not be suitable for overnight storage on site, arrange for their return to the store,
- f) determine appropriate allowances for tolerances and wastage on items where such allowances are not laid down in the supported contractor's scope of work, and
- g) reconcile quantities of materials issued to supported contractors with quantities used in the works and issue a materials reconciliation certificate to supported contractors upon completion of the works.

Post-construction stage requirements

After the completion of the works associated with supported contractors' contracts, the construction manager shall, as a minimum,

- a) compile a completion report that includes:
 - the final cost of the works in respect of materials, labour, plant, transport, supervision and construction management services;
 - the time of completion relative to the programme;
 - the nature and extent of training received by the supported contractor;
 - details of damage to services and insurance claims;
 - details of the construction manager's staff and organizational structure, equipment purchased for the contract and establishment costs; and
 - details of actual expenditure compared with projected expenditure,
- b) monitor remedial work undertaken during the defects liability period and advise and assist the supported contractor as necessary, and
- c) return, if required, to the employer or dispose of in accordance with the employer's instructions, all items of equipment on the register of assets.

C3.4.1.28 MATERIALS MANAGEMENT SERVICE REQUIREMENTS

C3.4.1.28.1 General

The materials manager shall, in order to achieve the employer's objectives,

- a) procure, store and issue materials for incorporation into the works either to the construction manager, who will deliver such materials to the place of work or directly to the supported contractor,
- b) establish a stores facility which is capable, at short notice, of supplying all the materials required for the project in a reliable, efficient and cost-effective manner,
- c) establish and implement management procedures and systems for procuring, storing, issuing and accounting for materials that
 - take cognizance of specific storage requirements for individual materials,
 - comply with the employer's procurement policies and procedures,
 - provide for quality checks upon delivery,
 - provide for the processing and timeous payment of statements for materials supplied and the delivery of materials to site,
 - account for the quantities of materials that are procured, stored and issued to or on behalf of each individual supported contractor,
 - ensure that records are readily auditable and protect the employer against corruption and theft, and
 - allow the employer to be informed monthly as to the status of all aspects of the materials management,

- d) ensure that all possible trade and settlement discounts are obtained and that the most favourable prices are paid for materials, and
- e) ensure that all materials purchased and issued comply fully with the employer's specifications embodied in the scope of work of the supported contractors' contract or in the contract with the employer.

C3.4.1.29 CONTRACT SKILLS DEVELOPMENT AND TRAINING (as per the Construction Industry Development Board Act, 2000 (Act no. 38 of 2000) (the Act): Standard for Developing Skills)

C3.4.1.29.1 General Requirements

The Contractor shall:

- a) Plan, implement, manage, monitor and report on a Contract Skills Development Programme for the duration of the Contract.
- b) Ensure that the programme complies with:
 - CIDB Standard for Developing Skills through Infrastructure Contracts.
 - CIDB Practice Guides.
 - National Qualifications Framework (NQF).
 - Applicable legislation, including the Skills Development Act.
- c) Integrate skills development activities into the **construction programme** without compromising health, safety, quality or productivity.
- d) Provide meaningful workplace exposure aligned with the scope and sequencing of the Works.

C3.4.1.29.2 Contract Skills Development Methods

The Contractor shall implement one or more of the following four (4) CIDB-prescribed methods, as appropriate to the nature of the Works, to achieve the CSDG:

Method 1: Occupational Qualifications

Provision of workplace learning leading to a part or full occupational qualification registered on the National Qualification Framework (NQF), including:

- Structured on-the-job training.
- Supervised practical exposure.
- Assessment through an accredited assessment body.

Method 2: Trade Qualifications

Provision of training leading to a listed trade qualification as published in Government Gazette No. 35625 of 31 August 2012, including:

- Apprenticeships or learnerships.
- Workplace practical training aligned with trade requirements.
- Preparation for trade testing.

Method 3: National Diplomas

Provision of structured workplace learning leading to a National Diploma registered on the NQF, including:

- Practical workplace modules.
- Logbooks and mentoring aligned to diploma requirements.
- Coordination with accredited education institutions.

Method 4: Professional Registration

Provision of workplace experience and mentorship leading to registration in a professional category by a professional body listed in the CIDB Standard, including:

- Candidate registration support.
- Supervised professional experience.
- Structured mentorship and competency development

C3.4.1.29.3 Beneficiary Selection

The Contractor shall:

- a) Prioritise **previously disadvantaged individuals**, youth, women and persons with disabilities, where feasible.
- b) Ensure fair and transparent selection processes.
- c) Keep records of beneficiary details, enrolment and participation.

C3.4.1.29.4 Supervision, Mentorship and Quality Assurance

The Contractor shall:

- a) Appoint suitably qualified supervisors and mentors for all beneficiaries.
- b) Ensure that workplace learning is structured, supervised and relevant to the qualification outcomes.
- c) Maintain training records, logbooks and assessment evidence.

C3.4.1.29.5 Monitoring, Reporting and Verification

The Contractor shall:

- a) Submit **monthly progress reports** on skills development activities, including:
 - Number of beneficiaries.
 - Method applied.
 - Training progress and hours achieved.
 - Challenges and corrective actions.
- b) Submit quarterly CSDG performance reports aligned with CIDB reporting templates.
- c) Make all records available for audit, inspection and verification by the Employer, Engineer, CIDB or authorised entities.

**CITY OF TSHWANE
WATER AND SANITATION BUSINESS UNIT**

CONTRACT NO: WSBU 15-2025/26

**TENDER FOR THE APPOINTMENT OF A CONTRACTOR FOR THE
REFURBISHMENT OF BRONKHORSTSPRUIT WATER TREATMENT
PLANT**

C3.4.2 STANDARD SPECIFICATIONS (CIVIL)

C3.4.2 STANDARD SPECIFICATIONS (CIVIL)

C3.4.2.1 Standard Specifications

The applicable "Standard Specifications" shall be the document "Standard Specifications for Municipal Civil Engineering Works, Third Edition 2005", issued by the General Manager: Roads and Stormwater of the City of Tshwane, read together with the Variations and Additions thereto.

Tenderers, Contractors and Subcontractors shall obtain their own copies of the document "Standard Specifications for Municipal Civil Engineering Works, Third Edition 2005", for tendering purposes and for use for the duration of the Contract from the Procurement Advice Centre, Tshwane House, 320 Madiba Street

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

References from, and variations and additions to the Standard Specifications and Particular Specifications are included in section C3.4.3 to C3.4.8.

**CITY OF TSHWANE
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**C3.4.3 CORRECTIONS AND AMENDMENTS TO THE
STANDARD SPECIFICATIONS FOR MUNICIPAL CIVIL
ENGINEERING WORKS, THIRD EDITION 2005**

C3.4.3 CORRECTIONS AND AMENDMENTS TO THE STANDARD SPECIFICATIONS FOR MUNICIPAL CIVIL ENGINEERING WORKS, THIRD EDITION 2005

C3.4.3.1 SECTION 001: GENERAL REQUIREMENTS AND CHARGES

B001.05 Community Liaison Officer

Change the following:

"Item	Description	Unit
B001.05	Community Liaison Officer	per month

The tendered rate shall include full compensation for the appointment of a community liaison officer for the duration of the construction works.

Payments shall be made in monthly instalments for each month the community liaison officer is employed. Rate will be the City of Tshwane's minimum T5 monthly notch include a 10% mark-up fee for the contractor. Annual rate increase depends on annually approved City of Tshwane salary increase.

B001.05.01	Contractor's mark up on item B001.05 (limit to maximum of 10%)	Unit percentage

The unit of additional payment for charges and profit on item B001.05 shall be percentage as given in the bill of quantities, restricted to the maximum of 10%.

Item B001.06.01: Targeted Labour

Unit: Provisional Sum

Training of targeted labour

The contractor shall provide all the necessary on-the-job training to targeted labour to enable such labour to master the basic work techniques required to undertake the work in accordance with the requirements of the contract in a manner that does not compromise workers' health and safety.

The project manager, together with the consultant, shall be responsible for providing of the Construction education and training authority (CETA) accredited training providers.

The contractor shall be responsible for scheduling the training of workers and shall take all reasonable steps to ensure that each beneficiary is provided with a minimum of six (6) days of formal training if he/she is employed for 3 months or less and a minimum of ten (10) days if he/she is employed for 4 months or more.

The contractors shall do nothing to dissuade targeted labour from participating in the above-mentioned training programmes.

An allowance equal to 100% of the task rate or daily rate shall be paid by the contractor to workers who attend formal training, in terms of 1.3.4 above. Provision for allowances is included in the provisional sum.

Proof of compliance with the requirements of 1.3.2 to 1.3.6 must be provided by the Contractor to the Employer prior to submission of the final payment certificate.

All labourers on site must wear the necessary protective clothing including an overall. All labourers must also wear a bright reflected jacket over their overall. On the front of the overall the "City of Tshwane" name must appear with the CoT logo on the left-hand side and the EPWP sectorial logo must appear on the right. On the back, the letters "EPWP" must appear

Payment: Contractor to submit three (3) quotations from reputable accredited training service providers before commencement of any training. Payment shall be made paid upon receiving training certificates.

C3.4.3.3 SERIES 3: EARTHWORKS

C3.4.2.3.1 PIPE TRENCHES - Protection of Pipes During Backfilling

ADD THE FOLLOWING AMENDMENT:

5.1.3 Protection of Pipes During Backfilling

A minimum thickness of compacted selected fill blanket of 300mm is required over the top of any pipe (measured from pipe crown) before machine compaction equipment is permitted to operate in the trench.

Initial backfill up to 300mm above pipe crown shall be:

- Placed by hand or light equipment
- Selected material free from stones >50mm, organic matter, or deleterious material
- Compacted in layers not exceeding 150mm to minimum 90% Mod AASHTO density
- Special care taken at pipe joints to prevent displacement

Machine compaction equipment (rollers, vibrators, rammers) shall only operate above this 300mm protective blanket.

The Contractor shall submit a pipe protection and backfilling method statement for approval by the Engineer before commencing trench excavation.

Rationale: This requirement prevents pipe damage from compaction equipment, joint displacement, coating/lining damage, and PE pipe crushing or deformation.

C3.4.3.4 SERIES 4: CONCRETE

C3.4.2.4.1 Aggregates for Water Contact Structures

ADD THE FOLLOWING TO MATERIALS SECTION:

C3.4.1 Aggregates for Water and Wastewater Contact

Aggregates for all concrete structures in contact with raw water, treated water, or wastewater shall be of dolomitic origin.

This requirement applies to:

- Water treatment tanks (clarifiers, flocculators, filters)
- Clear water reservoirs
- Pump station wet wells
- Pipeline thrust blocks and anchor blocks
- Valve chambers with standing water
- Borehole pump houses and chambers

Testing:

The quantity of insoluble matter, determined according to SANS 677 Appendix C, shall not exceed 15% by mass.

Exemptions:

The following concrete works are exempted from the dolomitic aggregate requirement:

- Blinding concrete
- Mass concrete for foundation fill not in contact with water
- Concrete for bedding and encasing of pipes (unless specified otherwise)
- Structural concrete for buildings and roof slabs

The Contractor shall submit aggregate source test certificates confirming dolomitic origin and insoluble matter content before commencement of concrete works.

Rationale: Siliceous aggregates are susceptible to acid attack from sewage gases (H_2S) and certain water chemistry conditions. Dolomitic aggregates provide superior resistance to chemical attack.

C3.4.3.4.2 Concrete Testing Regime (6-Cube Sets)

AMEND TESTING DEFINITIONS AND REQUIREMENTS:

1. Concrete Sample Definition

A "sample" of concrete shall be the minimum volume of uncompacted freshly mixed concrete required for a designated test:

- For compressive strength testing: 32 dm³ (liters) minimum
- This volume produces 6 cubes of nominal side 150mm

2. Concrete Cube Set Definition

A "set" of concrete cubes shall consist of 6 cubes of nominal side 150mm:

- 3 cubes to be tested at 7 days after casting
- 3 cubes to be tested at 28 days after casting

3. Test Results and Compliance

3.1 Seven-Day Test Results:

The average compressive strength of the three 7-day cubes shall not be less than 65% of the specified 28-day characteristic strength.

If 7-day results are below 65% of specified strength:

- Immediately notify the Engineer
- Take additional samples from subsequent batches
- Investigate cause (cement quality, mix proportions, curing conditions)
- Engineer may order additional testing or rejection of affected concrete

3.2 Twenty-Eight-Day Test Results:

Compliance shall be determined per SANS 2001-CC1 Clause 4.3:

- Average strength of any 4 consecutive test results $\geq f_{cu} + 4 \text{ MPa}$
- Any individual test result $\geq f_{cu} - 4 \text{ MPa}$

Where f_{cu} = specified characteristic cube strength

4. Testing Frequency

Concrete samples for strength testing shall be taken at the following minimum frequencies:

- Not less than one sample per 50m³ of concrete placed
- Not less than one sample per day of concrete placing
- Not less than one sample per grade of concrete
- Additional samples at Engineer's instruction

Rationale: Early strength verification at 7 days allows early detection of problems while maintaining 28-day design strength verification. Provides better quality control with more data points.

C3.4.3.4.3 Storage and Age of Cement

ADD THE FOLLOWING:

3.2.3 Storage and Age of Cement

Cement shall not be kept in storage for longer than 6 weeks from the date of manufacture without the Engineer's permission.

Cement exceeding 6 weeks age:

- Shall be reported to the Engineer
- Engineer may order removal from site at Contractor's cost, OR
- Engineer may allow use in less critical concrete works such as:
 - Blinding layers
 - Mass concrete for foundation fill
 - Pipe bedding and encasement

Where cement over 6 weeks old is used with Engineer's permission, the concrete mix design may need to be modified (increased cement content) to achieve specified strength.

Cement bags shall be clearly marked with delivery date on arrival at site.

Rationale: Prevents use of degraded cement which affects strength, durability, and water-retaining properties.

C3.4.3.4.4 Formwork Requirements for Water-Retaining Structures

ADD THE FOLLOWING TO FORMWORK SPECIFICATIONS:

1. Corner Chamfers

All exposed external corners of water-retaining structures shall be chamfered.

Chamfer formation:

- Size: 20mm x 20mm (45° chamfer)
- Method: Fix timber or plastic chamfer strips into formwork corners
- Apply to: All edges, columns, beams, and corners exposed to water or weather

Chamfers shall be neat, uniform, and continuous. Damaged chamfers shall be repaired to match adjacent work.

2. Formwork Ties for Water-Retaining Structures

Ties used in formwork for water-retaining structures shall:

- Be suitable for grouting to depth of:
 - Minimum: concrete cover specified, OR
 - Minimum: 50mm,
 - Whichever is greater
- Be cone type (male/female) or equivalent
- Leave cones in concrete for grouting

- Not have metal bar passing through full thickness

After formwork removal:

- Remove outer cones
- Clean void to depth specified
- Pack with non-shrink cementitious grout (1:1 cement:sand with bonding admixture)
- Finish flush with concrete surface
- Apply waterproofing over grouted ties where specified

Details of ties to be used shall be submitted to Engineer for approval before ordering formwork materials.

C3.4.3.5 SERIES 5: PIPELINES

C3.4.3.5.1 Pipe Materials and Specifications

ADD THE FOLLOWING DETAILED PIPE MATERIAL SPECIFICATIONS:

PIPE MATERIALS AND SPECIFICATIONS

1. Steel Pipes

All steel pipes shall comply with SANS 719 Grade B with minimum wall thickness as follows:

Nominal Bore (mm)	Minimum Wall Thickness (mm)
200 - 375	4
400 - 550	5
600 - 700	6
750 - 900	8
950 - 1550	10
1800	14

2. Cast Iron Pipes

All cast iron pipes and fittings shall comply with BS 2035:

- Straight pipes: Class D quality
- Fittings: Class CD quality
- Material: SANS 1034 Grade 300 for Grey Iron Castings

3. HDPE Pipes

All HDPE pipes and fittings shall comply with SANS ISO 4427.

- Jointing: Butt-welding per SANS 10112
- Welding beads shall be removed on the inside only of all butt-welded joints

4. Stainless Steel Pipes

Stainless steel shall be ANSI Type 304L Schedule 10 unless otherwise specified.

Rationale: Detailed pipe material specifications with wall thickness schedules prevent under-specification, material failures, and disputes on quality requirements.

C3.4.3.5.2 Flanges and Bolted Connections

ADD THE FOLLOWING

1. Flange Standards

Unless otherwise specified, all flanges shall comply with SANS 1123:

- Table 16: for nominal diameters ≤150mm

- Table 10: for nominal diameters >150mm

Flanges shall be:

- Machined flat face (no raised joint face)
- Face finish suitable for jointing material specified
- Drilled holes in accordance with SANS 1123

Puddle flanges shall have same dimensions as standard flanges but shall be supplied undrilled.

2. Flange Face Protection

Faces of flanges which will be in contact with jointing gaskets shall receive a protective coating similar to the corrosion protection specified for the internal surface of pipes and fittings, of such thickness and consistency as will not impair the water/air tightness of the joint.

For stainless steel Grade 304 flanges and pipe connections:

- Flange faces shall be cleaned and passivated per ASTM A967 before assembly
- No additional coating is required on stainless steel flanges (passivation provides inherent corrosion protection)
- Flange face finish shall be suitable for gasket material (smooth, flat machined)
- Surface finish minimum Ra 1.6 micrometers for optimal gasket performance

3. Jointing Gaskets

Jointing gaskets shall:

- Comply with BS 3063 (unless otherwise specified)
- Be cut to full width of flange
- Be holed for bolts
- Material: EPDM rubber for water service, NBR for sewage

4. Bolts, Nuts, and Washers

All bolts, nuts, and washers shall:

- Be stainless steel grade 304 (A4-70 minimum per ISO 3506-1) for ALL applications
- Comply with SANS 1200 HA Clause 3.3.1 (Structural Steelwork) Minimum grade: Grade 8.8 for mild steel; Grade A4-70 for stainless steel NOT be mild steel in any application (including below-ground pipework)
- Include plastic sleeves and/or washers where stainless steel bolts connect to cast iron or other dissimilar metals to prevent galvanic corrosion
- Be coated with nickel-based anti-seize compound before adding nuts to facilitate future disassembly and prevent galling
- Conform to material specifications in Pipe Schedule Section C2.1 Clause 3.c

Plastic sleeves and/or washers shall be used for protection against bi-metallic corrosion where dissimilar metals are joined (e.g., C.I. flange to S.S. pipe).

All threaded bolts shall be coated with nickel-based anti-seize compound (e.g., Kopr-Kote, Never-Seez) before adding nuts. This facilitates future disassembly and prevents galling.

5. Assembly Requirements

Flanged connections shall be assembled with:

- Clean, dry flange faces
- Gasket centered and aligned
- Bolts inserted from same side (usually pump side or pressure side)
- Tightening in star pattern to specified torque
- Torque values per manufacturer recommendations or ASME PCC-1

ADDITION FOR STAINLESS STEEL FLANGE ASSEMBLIES:

For stainless steel Grade 304 flanged connections:

- All bolts shall be pre-coated with nickel-based anti-seize compound before assembly (prevents galling and seizing of stainless bolts)
- Tightening torque: Apply 70-80% of torque values recommended for mild steel
- Grade 8.8 bolts (stainless steel A4-70 has lower shear strength)
- Use calibrated torque wrench (do not use impact wrenches)
- Final tightening in 2-3 passes using star pattern to ensure even load distribution
- Verify all bolts remain tight after 24 hours and again after first pressurization test

The Contractor shall submit a flange assembly procedure for approval before commencing installation of flanged pipework.

C3.4.3.5.3 Corrosion Protection Requirements

ADD THE FOLLOWING CORROSION PROTECTION SPECIFICATION:

CORROSION PROTECTION REQUIREMENTS

1. Scope

All steelwork, pipework, and metal components shall be protected against corrosion using the coating systems specified herein.

2. Surface Preparation

All surfaces shall be blast cleaned to minimum Sa2½ (ISO 8501-1) unless otherwise specified.

- Surface profile: 50-100 microns (fine to medium grade)
- Dust quantity: Not greater than 2 (ISO 8502-3)
- Soluble salts: Not more than 100 mg/m² (Weber-Rielly Test)

3. Coating Systems

3.1 System 1 - Underwater Immersion (clarifiers, filters, tanks)

- Surface preparation: Sa3, profile 50-100µm
- Coating: 2-3 coats high-build epoxy
- Total DFT: 300-450 microns minimum
- Testing: Wet sponge EID test at 90V, 2 MΩ
- Use: All steelwork in continuous or intermittent water contact

3.2 System 2 - Solvent-Free Epoxy for Potable Water Contact

- Surface preparation: Sa3, profile 50-100µm
- Coating: 1-2 coats solvent-free epoxy (non-toxic, non-tainting certified)
- Total DFT: 300-500 microns
- Testing: Wet sponge EID test at 90V, 10 MΩ
- Use: Pipe linings, tank interiors for potable water

3.3 System 3 - Buried Pipework

- Surface preparation: Manual/mechanical cleaning to St2 minimum
- Primer: Manufacturer's specified prime
- Tape: Butyl rubber-modified bitumen with PE outer wrap
- Overlap: Minimum 25mm (up to 55mm in aggressive soils)
- Testing: High voltage holiday detection at 18kV minimum
- Use: All buried steel and CI pipework

4. Quality Control

- All coating work shall be subject to inspection by the Engineer or approved independent testing laboratory

- DFT measurements at frequency per ISO standards
- Holiday detection before burial/immersion
- Adhesion testing (pull-off or cross-hatch)
- Test certificates required before proceeding to next stage

C3.4.3.6 SERIES 6: ROADS AND PARKING AREAS

C3.4.3.6.1 Corrections to Series 6 Standard Specifications

CORRECT THE FOLLOWING:

CLAUSE / ITEM	CORRECTION
Series 6: Roads and Parking Areas Section 601: Gravel Pavement Layers 07 MEASUREMENT AND PAYMENT Item 601.06 Extra over Item 601.02 for borrow material from sources to be supplied by the Contractor 614.02.01 (Layer and type of material indicated) sources 614.02.02 Etc for other layers and type of material	Replace item No. with: 601.06.01 (Layer and type of material indicated) sources 601.06.02 Etc for other layers and type of material
Section 602: Crushed-stone Pavement Layers 08 MEASUREMENT AND PAYMENT Item 602.02 Crushed-stone subbase constructed with material from 602. Commercial sources 602.02.01.02 ~~G2 material compacted to 100% of apparent density~~	Replace item description with: G2 material compacted to 100% of modified AASHTO density

C3.4.3.7 ENGINEER'S OFFICE & MEETING ROOM FACILITIES

SCOPE

This section covers the provision of accommodation for the Engineer's resident staff, including:

- Three (3) offices for on-site Engineer representatives
- One (1) meeting room accommodating 20 persons
- One (1) kitchen facility for Engineer's staff
- One (1) dedicated ablution facility for Engineer's team and visitors

All facilities supplied under this section shall remain the property of the Employer upon completion of the Contract and shall be designed for permanent use on future projects.

DEFINITIONS

Engineer's resident staff shall include:

- Three (3) Employer's Agent Representatives (on-site full-time)
- Periodic visits by Employer's Agent (Team Lead), Electrical Engineer, Mechanical Engineer, Civil Engineer (off-site based)
- OHS and Environmental Representatives (periodic attendance at progress meetings)
- Employer and Contractor representatives (periodic attendance at meetings)

The Contractor shall erect the nameboards at locations indicated by the Engineer while establishing himself on site, but not later than fourteen (14) days after the start of the Contract. On completion of the Contract, the Contractor shall remove the boards.

OFFICE BUILDINGS

Engineer's Offices (3 No.)

The Contractor shall provide **three (3) prefabricated offices** for the Engineer's on-site representatives, each with the following minimum specifications:

Structural Requirements

- **Floor area:** Minimum 18 m² per office
- **Ceiling height:** Minimum 2.4 m clear
- **Construction:** Prefabricated modular construction suitable for permanent installation
- **Weatherproofing:** Insulated walls and roof, sealed against rain and wind
- **Foundation:** Raised timber or composite floor minimum 300 mm above surrounding ground level
- **Flooring finish:** Vinyl tile flooring or equivalent, easy to clean

Access and Security

Item	Specification
Doors	Steel security door with 3-lever lock and two (2) keys per office
Windows	Minimum glazed area 15% of floor area
Window opening	At least 50% of window area openable for ventilation
Security	Fitted with burglar bars (security mesh or steel bars)
Privacy	Fitted with venetian or roller blinds (opaque type) for privacy

Overall design	Designed to prevent unauthorized entry

Electrical and Lighting

Item	Specification
Lighting	Adequate fluorescent or LED lighting, minimum 400 lux at desk level
Power outlets	Four (4) × 15A power points per office, strategically placed
Distribution	Connected to main electrical distribution board with RCD protection

Climate Control

- **Air conditioning:** One (1) air conditioning unit per office
 - Minimum 2.2 kW capacity
 - Electrically operated compressor type (not evaporative cooling)
 - Suitable for continuous operation during business hours

Completion and Ready for Occupation

The offices shall be completed, furnished (as specified), and ready for occupation **not later than three (3) weeks after the Commencement Date of the Contract.**

Specification for Office Furniture and Equipment

All furniture and equipment shall be **new and of commercial office quality** suitable for a professional engineering environment.

Office Furniture (For Three Offices)

Item	Description	Qty	Specification
a)	Office desks	3	Surface area minimum 1.5 m ² , with lockable drawers and two (2) keys
b)	Steel stationery cabinets	3	Shelf area minimum 1.5 m ² , volume 0.70 m ³ , fitted with lock and two (2) keys
c)	Steel filing cabinets	3	Four-drawer, on runners, 1300 mm (H) × 460 mm (W) × 600 mm (D), with two (2) keys
d)	Laptops	3	Intel Core i7 (or equivalent), 16 GB RAM, 500 GB SSD, 15" display, Windows 11 Pro, security cable, carry case, wireless mouse
e)	Software licenses	3	Microsoft Office Professional Suite (Word, Excel, Outlook, PowerPoint); MS Project Professional; PDF editor; AutoCAD LT
f)	A4 Laser printers	3	Monochrome, with two (2) spare toner cartridges each
g)	Drawing racks	3	A0 size, Barhold-type hangers, ten (10) hangers per rack
h)	Office chairs	3	Ergonomic design, padded seat and backrest, height-adjustable
i)	Whiteboards	3	Minimum 1.5 m ² each, complete with set of six (6) dry-erase markers and eraser

j)	Venetian/Roller blinds	All windows	Opaque type, fitted to all three offices
k)	Waste bins	3	Plastic construction, suitable for office use

Meeting Room Furniture and Equipment

The meeting room shall be equipped with furniture suitable for professional meetings accommodating 20 persons (3 on-site reps + 4 off-site engineers + 2 OHS reps + 2 Environmental reps + 4 Employer reps + 4 Contractor reps).

Item	Description	Qty	Specification
l)	Boardroom table	1	Minimum 4.0 m (L) × 1.2 m (W), solid construction, suitable for 20 persons
m)	Meeting chairs	20	Stackable type, padded seat and backrest, suitable for all-day meetings
n)	Pinboard	1	2.7 m (L) × 0.9 m (H), suitable material (cork or fabric), wall-mounted
o)	Whiteboards	2	Minimum 2.0 m ² each, complete with sets of dry-erase markers and erasers
p)	LED Display Screen	1	55-inch, 4K resolution, wall-mounted or mobile stand, suitable for presentations and video conferencing
q)	Presentation Connectivity Panel	1	Wall-mounted or desk-mounted, providing HDMI, USB-C, and VGA inputs with cable management
r)	Cable runs	1	10 m cable runs from presentation panel to boardroom table for presenter connectivity
s)	Wireless screen mirroring	1	Miracast/AirPlay compatible for seamless presenter connectivity from laptops
t)	Power distribution	1	Minimum eight (8) × 15A power points: four (4) at table center, four (4) at periphery
u)	Audio system	1	Conference speakerphone or ceiling-mounted microphone array suitable for 20-person meetings, with speaker outputs
v)	Venetian/Roller blinds	All windows	Blackout/opaque type for presentation visibility

Engineer's Meeting Room

The Contractor shall provide **one (1) prefabricated meeting room** with the following minimum specifications:

Structural Requirements

- **Floor area:** Minimum 40 m² (approximately 5.0 m × 8.0 m, or equivalent) to accommodate 20 persons comfortably
- **Ceiling height:** Minimum 2.7 m clear
- **Construction:** Prefabricated modular construction suitable for permanent installation
- **Weatherproofing:** Insulated walls and roof, sealed against rain and wind

- **Foundation:** Raised timber or composite floor minimum 300 mm above surrounding ground level
- **Flooring finish:** Carpet tile flooring or vinyl for easy cleaning and acoustics

Access and Security

Item	Specification
Doors	Two (2) access doors (one at each end for emergency egress and convenience)
Door specification	Each door fitted with 3-lever lock and two (2) keys
Door width	Minimum door width 0.9 m for accessibility
Windows	Minimum glazed area 15% of floor area
Window opening	At least 50% of window area openable for ventilation
Security	Fitted with burglar bars
Presentation blinds	Fitted with blackout blinds (not venetian) to allow projection visibility

Electrical and Lighting

Item	Specification
Lighting	Adequate LED lighting, dimmable, minimum 500 lux standard level (reduced when presenting)
Power outlets	Minimum eight (8) × 15A power points as specified (t)

Climate Control

- **Air conditioning:** Two (2) air conditioning units, each minimum 3.5 kW capacity
 - Sized for room volume and 20-person occupancy
 - Electrically operated compressor type (not evaporative)
 - Suitable for continuous operation

Digital Infrastructure

The meeting room shall be equipped with presentation and communications capability:

- **Display screen:** 55-inch LED screen as specified
- **Connectivity:** HDMI, USB-C, VGA inputs as specified
- **Wireless mirroring:** Miracast/AirPlay compatible as specified
- **Audio system:** Conference speakerphone
- **Network:** Wi-Fi coverage throughout meeting room for video conferencing capability

Completion and Ready for Use

The meeting room shall be completed, furnished, equipped with all digital facilities, and ready for use **not later than three (3) weeks after the Commencement Date of the Contract.**

Ownership

This facility shall remain the property of the Employer at the end of the Contract.

KITCHEN FACILITY

Kitchen (Engineer's Staff Only)

The Contractor shall provide **one (1) prefabricated kitchen** for the sole use of the Engineer and his staff, with the following specifications:

Structural Requirements

Item	Specification
Floor area	Minimum 12 m ²
Ceiling height	Minimum 2.4 m clear
Construction	Prefabricated modular, weatherproof, suitable for permanent use
Foundation	Raised floor minimum 300 mm above ground level
Door	Steel security door with 3-lever lock and two (2) keys
Windows	As per office specification with burglar bars and blinds

Equipment (All New, Commercial Quality)

Item	Specification	Qty
Refrigerator	Minimum 200 litres capacity, commercially rated	1
Microwave oven	Minimum 1.0 kW capacity	1
Electric hot water cylinder	50 litres, suitable for staff handwashing and beverage preparation	1
Electric kettle	2.0 litres capacity	1
Kitchen sink	With drainboard, hot and cold water taps, stainless steel	1
Kitchen table	Minimum 1.8 m × 0.9 m, durable surface	1
Kitchen chairs	Minimum 6 No., sturdy construction	6
Coffee/tea/sugar holders	Wall-mounted storage	3
Crockery sets	Complete sets of cups, saucers, and plates for 15 persons	2
Cutlery	Full sets for 15 persons	2
Cleaning supplies	Initial provision of dishwashing liquid, cloths, and paper towels	As required

Services

Item	Specification
Water supply	Connected to potable water supply (hot and cold)
Waste disposal	Connected to existing on-site waste tank or new septic system
Electrical	Adequate fluorescent/LED lighting and four (4) × 15A power points

Monthly Consumables (Contractor Responsibility)

The Contractor shall provide monthly replenishment of:

- Dishwashing liquid
- Hand soap
- Paper towels
- Kitchen cloths
- Waste disposal liners

Ownership

This facility shall remain the property of the Employer at the end of the Contract.

ABLUTION FACILITIES

Ablution Facilities (Engineer's Team)

The Contractor shall provide **ablution facilities for the sole use of the Engineer's staff and visitors**, separate and distinct from Contractor's workforce ablutions, with the following minimum provisions:

Facilities Required

Item	Specification
Toilets	Two (2) flush toilets: one (1) male toilet, one (1) unisex/accessible toilet (SANS 10400-S compliant)
Wash basins	Two (2) wash basins with hot and cold running water, soap dispensers
Shower	One (1) shower facility (optional but recommended)

Construction Standards

- **Type:** Prefabricated modular ablution unit or brick-built structure suitable for permanent use
- **Weatherproofing:** Fully enclosed, insulated, weather-tight
- **Flooring:** Slip-resistant tiles or composite
- **Walls:** Tile finish or equivalent, easy to clean
- **Ceiling:** Finished, with adequate ventilation

Services

Item	Specification
Water supply	Connected to potable water supply (hot and cold)
Waste disposal	Connected to existing on-site waste tank or new septic system as detailed on Drawings
Electrical	Adequate lighting (minimum 300 lux), extraction fan in each cubicle

Accessibility Compliance

Designed and constructed to comply with SANS 10400-S (Accessibility standards):

- Accessible toilet with grab rails
 - Accessible wash basin height (maximum 800 mm to tap)
-

- Accessible shower with grab rails (if provided)

Completion

The ablution facilities shall be completed and operational **not later than three (3) weeks after the Commencement Date of the Contract**.

TESTING & ACCEPTANCE

All facilities shall be inspected and tested prior to occupation to verify:

- Structural integrity and weatherproofing
- All electrical circuits and power points functional with RCD protection verified
- Climate control systems operational and tested for temperature control
- All doors and security mechanisms functional
- All equipment new, undamaged, and operational
- Digital infrastructure and connectivity verified functional
- Plumbing and water services tested and pressure-tested where applicable
- Ablution facilities operational and connected

Acceptance Certificate shall be issued by the Engineer upon satisfactory completion and testing of all facilities.

OWNERSHIP & HANDOVER

Upon completion of the Contract, all facilities and equipment provided under this section shall become the property of the Employer and shall be retained on-site for future use.

The Contractor shall provide:

- Maintenance and operating manuals for all equipment
 - Warranty documentation for equipment supplied
 - Key sets for all locked items (two complete sets)
 - As-built drawings showing utility connections and equipment locations
-

SKILLS DEVELOPMENT PROGRAMME (refer to BoQ summary page)

ADD THE FOLLOWING

MEASUREMENT AND PAYMENT**Contract Skills Development Programme**

- **Unit:** Sum
- **Measurement:** The price for the programme shall be a 0.25% of the total items of the Bill of Quantity. Refer to C3.4.1.29.7
- **Payment:** Shall be in line with the provisions of CIDB BUILD programme; Refer to Table 3 (page 15 of the Standard for developing Skills Through Infrastructure Contracts_48491_April 28-2023

Type of Training Opportunity	Provision for stipends (Unemployed learners only)	Provisions for mentorship	Provisions for additional costs*	Total costs	
				Unemployed learners	Employed learners
Method 1					
Occupational qualification	R7 000	R0	R9 000	R16 000	R9 000
Method 2					
TVET College graduates	R14 000	R0	R9 000	R23 000	N/A
Apprenticeship	R14 000	R0	R12 000	R26 000	R12 000
Method 3					
P1 and P2 learners, or a 240 credits qualification	R24 000	R20 000	R4 500	R48 500	N/A
Method 4					
Candidates with a 360 credits qualification	R37 000	R20 000	R4 500	R61 500	R20 000
Candidates with 480 or more credits qualification	R47 000	R20 000	R4 500	R71 500	R20 000

Note: Learner stipends must be fair, reasonable and compliant with applicable SETA and labour legislation, and may not be less than the prescribed minimums in force at the time of training

**CITY OF TSHWANE
WATER AND SANITATION BUSINESS UNIT**

CONTRACT NO: WSBU 15 2025/26

**TENDER FOR THE REFURBISHMENT OF BRONKHORSTSPRUIT WATER
TREATMENT PLANT FOR A PERIOD OF TWENTY-FOUR (24) MONTHS FROM
COMMENCEMENT DATE**

C3.4.4 PARTICULAR SPECIFICATION: CIVIL WORKS

C3.4.4 PARTICULAR SPECIFICATION: CIVIL WORKS

C 3.4.4.1: REPLACEMENT OF FILTER MEDIA IN SAND FILTERS

SECTION B506: FILTER SAND

B01 SCOPE

This section covers the material requirements, placement, testing, and payment for **filter sand**, used as a filtration and drainage medium in subsurface drains, underdrain envelopes, drainage trenches, or as backfill around drainage pipe systems.

B02 MATERIALS

B02.01 General Requirements

Filter sand shall consist of clean, hard, durable, and uncoated quartz sand particles, free from organic matter, clay, loam, mica, and other deleterious substances.

B02.02 Grading Requirements

The filter sand shall conform to the grading envelope as specified in the table below:

Sieve Size (mm)	Passing (%)
9.5	100
4.75	95–100
2.00	80–100
0.425	25–60
0.075	<10

B02.03 Uniformity Criteria

- The **Uniformity Coefficient (UC)**, defined as D_{60} / D_{10} , shall not exceed **4**.
- If filter sand is used in geotextile-wrapped systems, compatibility must be ensured by the Engineer via filter retention criteria (e.g., Terzaghi or USBR rules).

B02.04 Moisture Content

The delivered moisture content shall not exceed 6% to facilitate placement and compaction.

B03 PLACING AND COMPACTION

B03.01 Placement

Filter sand shall be placed in layers not exceeding 200 mm in loose thickness. In trenches, sand shall be installed uniformly around pipes or structures, ensuring full encapsulation.

B03.02 Compaction and Protection

Where structural loads are not anticipated, light compaction (minimum 85% of Modified AASHTO dry density) shall be applied. Over-compaction shall be avoided to preserve permeability. Exposed sand shall be protected from contamination during storage and placement.

B03.03 Contamination Control

- Mixing of filter sand with base or trench materials shall not be permitted.
- Contaminated sand shall be removed and replaced at the Contractor's expense.

B04 TESTING

B04.01 Sampling and Testing Requirements

The Contractor shall perform the following tests at a frequency specified in the Project Specifications or as directed by the Engineer:

- **Sieve analysis:** one test per 50 m³
- **Moisture content:** daily
- **Bulk density:** as required to confirm placement quality

All laboratory work shall conform to **SANS 3001** methods.

B506.05 MEASUREMENT AND PAYMENT

Item B506.05.01: Supply of Filter Sand

- **Unit:** Cubic metre (m³)
- **Measurement:** Measured per volume placed in position, confirmed with the Engineer and based on cross-sectional dimensions or volumetric calculations.
- **Payment:** The rate shall include full compensation for sourcing, processing, stockpiling, hauling to site, moisture control, and contamination-free delivery at site.

Item B506.05.02: Placing and Compaction of Filter Sand

- **Unit:** Cubic meter (m³)
- **Measurement:** Measured as the compacted volume of sand placed in accordance with the Drawings and Specifications.
- **Payment:** The rate shall include full compensation for off-loading, spreading, light compaction, protection from contamination, and cleaning up.

Item B506.05.03: Testing of Filter Sand

- **Unit:** Provisional Sum
- **Measurement:** Payment will be made based on accepted certified invoices from the testing laboratory, including all SANS-compliant tests as authorized by the Engineer.
- **Payment:** The amount tendered shall allow for sieve analyses, moisture content determination and any additional testing required. A 10% mark-up shall apply if testing is arranged by the Contractor.

**CITY OF TSHWANE
WATER AND SANITATION BUSINESS UNIT**

CONTRACT NO: WSBU 15-2025/26

**TENDER FOR THE REFURBISHMENT OF BRONKHORSTSPRUIT WATER
TREATMENT PLANT FOR A PERIOD OF TWENTY-FOUR (24) MONTHS FROM
COMMENCEMENT DATE**

C3.4.5 PARTICULAR SPECIFICATIONS FOR MECHANICAL WORKS

C3.4.5: PARTICULAR SPECIFICATION FOR MECHANICAL WORKS

This section outlines the comprehensive mechanical specifications required for the successful execution of the Bronkhorstspuit Water Treatment Plant refurbishment project.

It details requirements for the selection, supply, delivery, offloading, installation, testing, and commissioning of all mechanical systems and equipment to be deployed at the project site.

All works must adhere to current mechanical engineering standards and best practices, ensuring that every component is robust, reliable, and designed for long-term operational efficiency.

The appointed contractor is responsible for coordinating all activities to guarantee seamless integration of new systems with existing infrastructure, minimising operational disruption and ensuring high plant availability.

Quality assurance and control are integral at every stage of the project, with thorough inspections and performance verifications required during installation and prior to commissioning.

Provisions for easy access, maintenance, and future upgrades must be incorporated into all equipment layouts and installation procedures.

The specified mechanical systems are critical to restoring the plant's intended design capacity, thereby improving water service reliability for the communities served.

All installations must be executed with professional diligence, prioritising safety, operational resilience, and energy efficiency to meet current and future facility demands.

C3.4.5.1: NEW VERTICAL PUMP

Technical overview

3 pump sets are installed at the site: two will be replaced, one is being procured for Bronkhorstspuit WTP, and the last is scheduled for refurbishment.

- Reference Drawing: Equipment Specification: Ral-Brk-03-Mech-01/ Ral-Brk-03-Mech-02/Ral-Brk-02-Mech-01
- Quantity Required: 2 Units
- Each vertical pump has a duty point of 44 metres at a flow rate of 360 litres per second.
- Each unit operates with an estimated rated power capacity of 280 kW.

C3.4.5.1:1 SUPPLY OF MECHANICAL PUMPS

The Contractor shall be contractually obligated to supply two (2) vertical centrifugal pumps, each with a duty point of 360 litres per second at a pumping head of 44 metres. Both pumps must be of the same make and model to ensure interchangeability and operational consistency. Each pump shall be provided complete with a high-efficiency 280 kW electric motor, precision-balanced impellers, and robust mechanical seals. All supplied equipment shall conform to the technical specifications and standards referenced in the contract documents.

1.1 Delivery to Site

The Contractor shall, at their sole cost and risk, be responsible for the secure packaging, handling, and transportation of all pumps and associated equipment—including matched electric motors, baseplates, interconnecting piping, vibration isolators, flexible couplings, and all required accessories—to the

Bronkhorstspuit Water Treatment Plant site. All items shall be delivered strictly in accordance with the project schedule as stipulated in the contract. Deliveries must be accompanied by packing lists, equipment data sheets, and all other documentation necessary for verification and contractual record-keeping upon arrival. Any damage or loss incurred prior to formal site handover shall be the Contractor's liability.

1.2 Installation

The Contractor is contractually required to position and install each pump unit on the designated existing foundation with both vertical and horizontal alignment in line with the manufacturers and contract requirements. Installation shall provide adequate clearance for inspection, operation, and future maintenance as per the specifications. All interconnecting pipework, valves, and accessories shall be installed securely, with vibration isolators and flexible couplings fitted in accordance with the contract drawings and standards. All equipment must be lifted using official lifting points and methods that comply with all relevant health, safety, and statutory regulations. Any non-conformance during installation shall be rectified at the Contractor's expense.

1.3 Electrical and Control Integration

The Contractor shall ensure that all pumps are electrically integrated as specified within the contract documentation, including wiring of high-efficiency motors and full configuration of control panels. The system shall permit both automatic and manual switching between units for parallel or alternating operation, to extend service life and optimize maintenance. The Contractor is responsible for the correct installation of all instrumentation—pressure gauges, flow meters, and alarm indicators—for real-time monitoring in compliance with all contract and regulatory requirements.

1.4 Testing and Commissioning

Following installation, the Contractor shall perform and document comprehensive mechanical and electrical testing, including but not limited to, alignment verification, secure mounting checks, and system functionality. Functional checks shall include verification of specified flow rates, pressure outputs, operational switching, and alarm and instrumentation response. All load and performance testing must meet the stipulated operational parameters in the contract. Any deficiencies discovered during testing shall be corrected by the Contractor prior to acceptance. Testing and commissioning records shall be provided as contractual deliverables.

1.5 Documentation and Handover

The Contractor shall supply comprehensive documentation—including installation records, operation manuals, maintenance protocols, certificates of conformity, and test results—for all equipment installed under this contract. Training sessions must be conducted by the Contractor for the facility's operational personnel, ensuring staff are fully capable of safe and effective system operation. Only upon satisfactory completion of all required testing, commissioning, and training, shall the formal contractual handover of the fully operational pump system occur. This process shall be evidenced by signed acceptance documents confirming that the installed works meet all performance, safety, and operational criteria specified in the contract, thereby supporting the long-term sustainability and resilience of the Bronkhorstspuit Water Treatment Plant.

C3.4.5.2: OVERHEAD CRADE

- Quantity: 1.0 Item
- Install a new 2-ton, 6 kW motorised hoist gantry crane on the existing structure.

- This task involves choosing a suitable 2-ton motorized hoist to replace the current manual hoist on the gantry crane. The selection must include all required accessories and guarantee compatibility with the existing structural framework.
- Beyond ensuring a 2-ton capacity, important factors such as duty cycle, lifting speed, power supply (e.g., voltage and phase), and control methods (such as pendant or wireless remote) should be evaluated. It's essential to confirm the gantry's load-bearing limits through engineering calculations and verify that the system meets relevant safety codes like SANS for overhead hoists. The chosen mounting style—either top-running or underhung—should fit the design of the structure, with any bracket or electrical connection changes clearly recorded. During installation, proper alignment, convenient maintenance access, and sufficient clearance for both the hoist and trolley are vital to ensure lasting performance and safe operation.
- The installation process includes positioning and securing the crane, integrating the electrical systems for safe operation, and performing necessary load testing and commissioning procedures. The upgraded gantry crane will enhance material handling efficiency and safety within the facility by providing reliable lifting capabilities on the established support structure.
- The overhead crane or motorized hoist system must be designed for safe lifting operations within a water treatment environment. Equipment shall include a 5-ton electric hoist, with robust gantry structure, safety limit switches, and clearly rated load capacity labels. Installation must comply with SANS 500 and OHSA lifting regulations.

C3.4.5. 3. INLET WORKS

- Reference Drawing: 1. Ral-Brk-04-Mech-03/Ral-Brk-04-Mech-04/Ral-Brk-02-Mech-02
- Quantity: 1.0 Item

3.1 Technical Overview

This project scope encompasses the detailed technical and mechanical supply, installation, testing, and commissioning of advanced chemical dosing piping systems for three essential chemical services: Poly, Chlorine, and Lime. Each system is meticulously designed to ensure durability, operational safety, and compliance with the latest South African National Standards (SANS).

Below are requirements of the chemical dosing parameters

- Pre-Chlorine: 18 l/hr
- Lime: 166,7 l/hr
- Poly : 18:00 l/hr

3.2 Poly Dosing System

- Piping and Materials: Utilizes 15 mm outside diameter (OD) PVC piping, conforming to SANS 966-1:2012 standards for high-pressure applications. Piping systems are factory-fabricated for dimensional accuracy and supplied in 20 m segments. All piping is joined using solvent-welded or mechanical fittings to ensure leak-free connections.
- Valves and Fittings: Incorporates sluice valves, ball valves, and actuated valves in compliance with SANS 664 for reliable flow control. Fittings include 16 elbows (for directional changes), 6 tees (for branch connections), 5 reducers (to accommodate varying sizes), and 10 flanges (for secure junctions and maintenance access).

- **Ancillary Equipment:** A 10,000-litre poly dosing tank is provided, constructed from chemical-resistant polyethylene mounted on a reinforced concrete plinth to ensure long-term stability. The tank includes level sensors, overflow protection, and accessible inspection hatches.
- **Installation:** Piping is securely fastened with corrosion-resistant clamps and supports, routed to minimize bends and facilitate maintenance. All connections are pressure-tested to verify integrity and prevent leaks.
- **Commissioning:** System undergoes hydrostatic pressure testing, functional checks of all valves, and calibration of dosing pumps. Comprehensive documentation and client staff training are provided upon completion.

3.3 Chlorine Dosing System

- **Piping and Materials:** Employs 32 mm OD PVC piping compliant with SANS 966-1:2012 for chlorine resistance and longevity. Sections are supplied in 20 m lengths, with connections made via solvent-weld or mechanical couplings.
- **Fittings and Accessories:** Includes 16 elbows, 6 tees, 5 reducers, and 10 flanges, all in chlorine-compatible PVC or CPVC materials to prevent corrosion. Actuated valves allow for automated flow control and integration with plant-wide safety systems.
- **Installation and Testing:** All joints are assembled according to manufacturer and SANS guidelines, with pipe runs clearly labelled and adequately supported. Chlorine dosing lines are flushed, pressure-tested, and inspected for leaks prior to commissioning.
- **Commissioning:** Includes detailed verification of valve operation, sensor responses, and integration with the SCADA (Supervisory Control and Data Acquisition) system. Staff are trained on emergency procedures and system maintenance.

3.4 Lime Dosing System

- **Piping and Materials:** Utilizes robust 32 to 110 mm OD HDPE piping, conforming to SANS 4427-1:2008. HDPE is selected for its high resistance to chemical attack and mechanical wear. Pipework is supplied in standard 20 m lengths and joined using butt-fusion welding or electrofusion couplers for maximum durability.
- **Fittings and Mechanical Equipment:** Incorporates 16 elbows, 6 tees, 5 reducers, and 10 flanges, all manufactured from chemical-resistant materials. The system is equipped with dosing pumps (variable speed for precise control), lime storage silos or hoppers, and motorized screw conveyors to deliver accurate, automated lime feed.
- **Electrical and Control Systems:** Includes control panels with motor starters, interlocks, and emergency stop features. Systems are integrated with plant automation for continuous monitoring and alarm notifications in case of malfunctions.
- **Installation and Commissioning:** All mechanical assemblies are aligned to minimize vibration and ensure longevity. Piping and equipment are anchored to concrete plinths or steel frames for stability. Each system is subjected to dry and wet commissioning phases, including functional testing of pumps, conveyors, and all safety features.

3.5 General Compliance and Handover

- All chemical dosing systems will be installed in strict accordance with SANS standards, the Occupational Health and Safety Act (OHSA), and manufacturer recommendations. Under the OHSA, a thorough risk assessment must be conducted prior to installation to identify potential hazards related

to chemical handling, pressurized piping, and electrical integration. Safety measures include the use of appropriate personal protective equipment (PPE), the implementation of safe work procedures, and regular safety briefings for all personnel involved.

- Technical compliance with OHSA requires that all pressure vessels, pumps, and mechanically actuated devices are installed by qualified professionals, with safety interlocks and emergency stop features tested during commissioning. Electrical connections must be carried out by licensed electricians, ensuring that control panels are equipped with lockout/tagout systems, circuit protection, and proper earthing, as specified in the Act.
- Clear, permanent labelling of all hazardous zones, emergency shut-off locations, and dosing lines is mandatory. Spill containment measures such as drip trays and bunded areas are to be provided at chemical storage and dosing points to mitigate environmental risks. Ventilation systems should comply with OHSA requirements to control exposure to airborne contaminants, and all staff must be trained in emergency response procedures, first aid, and the handling of hazardous substances.
- Detailed as-built documentation, safety datasheets, and scheduled maintenance instructions will be provided to the client, ensuring ongoing compliance with OHSA. Upon successful completion of commissioning, including verification of all safety features and system performance, the systems will be formally handed over to the client, accompanied by a comprehensive training program for operational and maintenance staff.

C3.4.5.4. CLEAN WATER PUMPS

4.1 Technical Overview

Five pump sets are installed at the site: three will be replaced, one is being procured for Bronkhorstspuit WTP, and the last is scheduled for refurbishment.

- Quantity: 3.0 Item
- Reference Drawing: Drawing No: Ral-Brk-10-Mech-01/Ral-Brk-10-Mech-02/Ral-Brk-02-Mech-08
- Reference Drawing: Equipment Specification: Pump and Motor
 - Pump duty points 212 metres at 170 litres per second (l/s)
 - Estimated Rated Power Requirement: 550 kilowatts (kW)

4.2 Scope of Work

- Equipment Supply: The contractor shall procure and supply all centrifugal pump systems and ancillary equipment, including high-efficiency pumps, electric drive motors, engineered baseplates, associated pipework, isolation and check valves, vibration isolators, and all required mounting hardware. All equipment must meet current SANS/SABS standards and conform precisely to the referenced technical documentation.
- Delivery and Offloading: All supplied equipment will be securely packed to prevent in-transit damage. Upon site delivery, certified personnel will offload components using appropriate lifting equipment (crane, forklift, etc.), verifying integrity and completeness against packing and shipping manifests.
- Site Preparation: The contractor shall construct reinforced concrete plinths in accordance with engineering drawings, ensuring all mounting surfaces are finished to tolerances suitable for precision alignment and secure anchoring of pumps and motors.

- **Mechanical Installation:** Installation specialists will set and grout pump and motor assemblies, torque all anchor bolts, connect all pipework using flanged or specified joints, install required valves, and implement vibration isolation as per manufacturer recommendations. All fasteners and wetted materials shall be corrosion-resistant and compatible with the process fluid.
- **Electrical Works:** All power and control wiring, panel terminations, and motor starter integrations will be executed by licensed electricians. This includes the integration of instrumentation (e.g., pressure switches, flow meters), connection of safety interlocks, emergency stop circuits, and implementation of lockout/tagout, circuit protection, and earthing measures consistent with OHSA and project requirements.
- **System Testing and Quality Verification:** Pipework shall undergo hydrostatic testing for leaks and pressure compliance. Motors will undergo insulation resistance and earth continuity testing before energization. Full system commissioning, with manufacturer oversight, will validate all critical parameters—flow, head, efficiency, and power draw—against the design specifications.
- **Commissioning and Performance Validation:** Commissioning includes systematic start-up protocols, calibration of process instrumentation, functional testing of emergency and safety systems, and verification of all safety interlocks. Performance data—vibration, noise, current load, operational stability—shall be measured and documented for compliance with technical datasheets. Any deviations must be resolved prior to final acceptance.
- **Training and Handover:** The contractor will deliver comprehensive training for operations and maintenance personnel, covering procedures for start-up, shut-down, troubleshooting, and emergency response. The final documentation shall include all as-built drawings, safety datasheets, maintenance schedules, and compliance certificates, ensuring proper knowledge transfer and operational readiness.
- **Health, Safety, and Environmental Compliance:** All work will adhere to SANS standards, the OHSA, and OEM guidelines. Contractors will conduct and document risk assessments, provide and enforce the use of personal protective equipment (PPE), and clearly demarcate hazardous and emergency zones. Spill containment (drip trays, bunds) will be installed at chemical handling points, and ventilation systems will be verified as compliant. Permanent, weatherproof labelling shall be affixed to all hazardous areas, shut-off points, and dosing lines.
- **Documentation and Quality Records:** A full set of as-built documentation, commissioning certificates, safety datasheets, and preventative maintenance schedules will be compiled and turned over to the client in both hard and soft copy formats, ensuring full traceability and regulatory adherence.
- All work must be carried out by certified professionals with demonstrable expertise in pump system installation and commissioning.
- The contractor is responsible for ensuring that all equipment and workmanship meet or exceed the specified technical and quality standards.
- The client reserves full rights to witness all inspections and commissioning activities, and to request independent third-party verification as needed.
- Any proposed deviations from contract specifications require documented client approval before implementation.
- Non-compliance with safety, technical, or contractual requirements may lead to penalties, rework, or termination of the contract.

C3.4.5.5. PUMP AND MOTOR REFURBISHMENT

- Quantity: Motor 1.0 Item
- Quantity: Pump 1.0 Item
- Reference Drawing: Drawing No: Ral-Brk-10-Mech-01/Ral-Brk-10-Mech-02/Ral-Brk-02-Mech-08

5.1 Scope of Work for Pump

Scope of Work – Pump

- Refurbish of the Sulzer SME200-200 Pump model

Pump refurbishment shall encompass the thorough disassembly of all equipment, detailed inspection for wear or damage, followed by repair or replacement of affected components. The process includes precise reassembly and comprehensive performance testing to ensure the restored unit meets or exceeds original operational standards. All activities will strictly adhere to relevant statutory and OEM requirements, with full compliance to technical specifications and safety protocols.

Complete disassembly

Examination of all major components (stator, rotor, bearings, windings) Electrical testing of windings for insulation resistance and identification of potential damage.

- Mechanical assessment for wear or misalignment of parts
- Replacement of bearings as required
- Cleaning and/or re-impregnation of the core if insulation is found compromised
- Execution of necessary repairs or replacement of faulty parts

Reassembly and Testing

- Reassemble the motor upon completion of maintenance activities
- Conduct comprehensive performance tests, including:
- Vibration analysis
- Load testing
- Measurement of current draw

Acceptance Criteria

- Ensure the overhauled pump meets original manufacturer specifications
- Submit the motor for final approval prior to return to service

5.2 Scope of Work

- Refurbishment of 550 kW Weg Motor

Complete disassembly

Examination of all major components (stator, rotor, bearings, windings) Electrical testing of windings for insulation resistance and identification of potential damage.

Below SANS Reference shall apply

- SANS 60034-1: Rotating electrical machines – Part 1: Rating and performance
- SANS 10142: The wiring of premises – Low-voltage electrical installations
- SANS 60079: Explosive atmospheres (if applicable to hazardous environments)
- SANS 60745: Hand-held motor-operated electric tools – Safety
- SANS 60529: Degrees of protection provided by enclosures (IP Code)
- Mechanical assessment for wear or misalignment of parts
- Replacement of bearings as required
- Cleaning and/or re-impregnation of the core if insulation is found compromised
- Execution of necessary repairs or replacement of faulty parts

Reassembly and Testing

- Reassemble the motor upon completion of maintenance activities
- Conduct comprehensive performance tests, including:
 - Vibration analysis
 - Load testing
 - Measurement of current draw

Acceptance Criteria

- Ensure the overhauled motor meets original manufacturer specifications
- Submit the motor for final approval prior to return to service

C3.4.5.6: BACK WASH WATER PUMPS

- Quantity: 6.0 Item
- Refer to drawing Ral-Brk-10-Mech-02/Ral-Brk-01-Pro-02-009

6.1 Technical Overview of Wash Water Pumps

Pumps Specifications:

- Pump duty is 24 m at flow Rate of: 20 L/s
- Estimated Power Output: 30 kW

6.2 Detailed Technical Requirements

All equipment and associated works specified herein shall conform to the latest industry standards, codes of practice, and the project's quality requirements. The Contractor shall be responsible for the complete provision, delivery, installation, and commissioning of all systems and components, in accordance with the manufacturer's recommendations and all relevant statutory regulations.

6.2.1 General Requirements

- All supplied pumps and mechanical units must be brand new, of robust industrial design, and suitable for continuous operation under the specified environmental and process conditions.

- Prior to installation, the Contractor shall submit detailed data sheets, catalogues, and certified drawings for all equipment, including but not limited to performance curves, materials of construction, and manufacturer's certifications.
- Packaging for transport shall safeguard all components from physical damage, moisture ingress, and corrosion, using shock-absorbing and weatherproof materials. The Contractor shall instruct logistics personnel in safe handling procedures, ensuring compliance with the project's health and safety protocols.

6.2.2 Offloading and Handling

- Offloading and movement of units at site shall be performed exclusively by qualified and trained personnel using certified lifting equipment, such as cranes or forklifts, rated for the load in question.
- All lifting operations must be risk-assessed prior to execution, with lifting plans submitted to the Engineer for approval.
- Damage or loss incurred during transit or offloading will be the sole responsibility of the Contractor, who must repair or replace affected items at no additional cost to the Employer.

6.2.3 Installation

- Installation works must be executed by specialist technicians who have demonstrable experience with similar equipment. The Contractor shall provide credentials and references upon request.
- All foundations, anchor bolts, and mounting arrangements must be prepared in accordance with manufacturer's tolerances and approved installation drawings.
- Alignment of pump and motor assemblies shall be performed using precision instruments. Horizontal and vertical alignment must be within tolerances specified by the equipment manufacturer.
- All connections—hydraulic, mechanical, and electrical—shall be made using approved materials and methods, ensuring longevity and compliance with local and international standards.

6.2.4 Testing and Commissioning

- Upon completion of installation, the Contractor shall conduct comprehensive pre-commissioning checks including but not limited to insulation resistance tests, verification of wiring terminations, and lubrication of moving parts.
- Full commissioning shall be performed in the presence of the Engineer, with all performance parameters—flow, head, power consumption, and noise/vibration levels—measured and recorded to demonstrate compliance with the specifications.
- Any deficiencies identified during testing must be rectified before the equipment can be accepted as complete.
- The Contractor shall submit detailed commissioning reports and performance certificates for each unit.

6.2.5 Documentation and Training

- The Contractor shall provide comprehensive Operation & Maintenance (O&M) manuals, as-built drawings, and warranty certificates for all supplied equipment.
- On-site training shall be provided to the Employer's staff, covering safe operation, routine maintenance, and troubleshooting procedures.

6.2.6 Safety and Quality

- All activities must conform to the site's safety management plan and prevailing health and safety legislation.
- Quality assurance and control procedures shall be demonstrated throughout all phases of the work, including material traceability, inspection reports, and compliance certificates.

C3.4.5.7. INSTANT MIXING AGITATORS

Mechanical agitators' drives must be supplied to ensure reliable mixing within tanks.

7.1 Technical Overview Refurbishment and add VSD Agitator motors

Mechanical agitator drives must replace for reliable tank mixing. Agitators should have VSDs, support continuous operation, and feature water-resistant bearings and chemical-resistant seals as needed.

- Power (kW): 7.5, Quantity: 2.0 Item
- Power (kW): 4, Quantity: 4.0 Item
- Refer to drawing Ral-Brk-02-Mech-03

7.2 Scope of works

All works shall adhere to the project's technical specifications and contractual obligations, ensuring compliance with applicable mechanical, electrical, and safety standards. The Contractor is responsible for the following scope of work:

Supply the agitator drive units complete with gearboxes and motors. Each supplied unit must include accompanying inspection and compliance documentation.

- Installation: Align all motors precisely with mechanical assembly gear box. Ensure secure anchoring of each unit and terminate all cables in strict accordance with local electrical codes and project drawings. Integrate all motors and variable speed drives (VSDs) into designated control panels and configure VSDs to meet specific operational requirements.
- Commissioning: Perform load performance checks, vibration analyses, and VSD functionality tests. Coordinate closely with automation and instrumentation teams to assure seamless integration and system optimization. Verify correct operation and system readiness prior to final commissioning.
- Safety and Documentation: All procedures shall be executed in compliance with the site's safety management plan and relevant health, safety, quality, and documentation standards. Detailed records of inspections, installations, test results, and commissioning activities must be maintained and submitted for approval.

All activities, from material handling through final system commissioning, shall be performed under a framework of quality assurance and risk mitigation, as specified in the contract documents and technical appendices.

C3.4.5.8. FLOATATION AND AERATION

8.1 Technical Specification for Supply and Installation

8.1.1 Scope of Works: Air Spargers, Pipes, Valves, Flanges, Compressors, and Pipe Supports

Refer to drawing Ral-Brk-02-Mech--4

The Contractor shall supply air spargers, pipes, valves, flanges, compressors, pipe supports, and all associated components in strict accordance with approved technical specifications, drawings, and data sheets. All mechanical equipment must meet or exceed the relevant SANS (South African National Standards) specifications. All items must:

- Be manufactured and tested to recognized industry standards (such as ASME, ASTM, ISO, and SANS where applicable).
- Be constructed from corrosion-resistant materials suitable for water treatment environments.
- Include valid quality assurance and quality control certificates, factory acceptance test results, and warranties as required.
- Pipes, valves, and flanges must be compatible in terms of material grade, diameter, and pressure rating as specified in the project design.
- Compressors must meet a minimum power specification of 80 kW, with capacity, pressure, and efficiency as outlined in the project technical requirements. Each compressor must feature vibration isolation and appropriate control interfaces.
- Pipe supports must be designed for anticipated operational loads, vibration, and environmental conditions, following engineering calculations and drawings.

8.1.2 Delivery to Site

All equipment and materials—including compressors (minimum 50 kW) and pipe supports—shall be delivered to the specified project location according to the approved project schedule and in compliance with handling and preservation technical guidelines. The Contractor must ensure the following:

- Safe and secure transport to prevent any damage, contamination, or deterioration during transit.
- All items are clearly labelled, stored under suitable conditions, and protected from adverse environmental effects at the site.
- A joint inspection upon delivery with the client to confirm compliance with technical specifications, quantity, and condition.
- Any discrepancies or damages are documented, reported, and resolved before installation, as per project procedures.

8.1.3 Installation – Technical Requirements

Installation of all supplied components shall be performed by certified personnel, following the most current and approved methods and technical procedures. It is required that all mechanical equipment complies with SANS specifications. The Contractor shall ensure:

- Mechanical and electrical assemblies are precisely aligned and securely anchored, meeting specified design tolerances.
- Pipes and supports are installed to maintain proper slope, clearances, and support intervals as detailed in engineering drawings.
- Valves and flanges are oriented and torqued to specified values to prevent leaks.
- Compressors (minimum 80 kW) are installed with appropriate mounting, vibration isolation, and electrical connections as detailed in technical manuals and schematics.
- All work is carried out in compliance with national and local codes (such as IEC for electrical, ASME for pressure systems, and SANS where applicable), as well as project safety management plans.

8.1.4 Commissioning – Technical Requirements

Commissioning activities must adhere strictly to the technical requirements set forth in project documentation and all relevant standards, including SANS specifications for mechanical equipment. These activities include:

- Hydrostatic and pneumatic pressure testing of pipes and valves to verify integrity and ensure leak-tightness.
- Functional testing of air spargers and compressors (minimum 50 kW), including calibration, pressure/flow verification, and system integration trials.
- Verification of pipe supports for mechanical stability under operational load and vibration.
- Recording all performance data, test results, and compliance certifications for submission to the client.
- Final acceptance and handover only after all technical criteria are satisfied and documentation is duly approved.

C3.4.5.9. FLOATATION AND AERATION DRIVES

Refurbishment of the flotation system and aeration scrubber drives involves overhauling key mechanical and electrical components to restore efficient operation. This process typically includes inspecting and replacing worn parts, updating control systems, ensuring compliance with current safety standards, and testing integrated performance to maximise reliability and output in industrial applications.

Power (kW):0.37, Quantity: 12.0 Item

Refer to drawing: Ral-Brk-02-Mech-04

- Refurbish, test, install, and commission electrical motor units per mechanical and project specifications.
- Conduct detailed inspections and overhauls on refurbished motors.
- Perform insulation resistance and functional tests according to IEEE protocols.

- Align motors with mechanical systems; ensure secure anchoring and cable terminations to local electrical codes.
- Commissioning includes load performance verification, vibration analysis, testing, and close coordination with automation and instrumentation teams.
- Ensure all procedures comply with project safety, quality, and documentation standards.

C3.4.5.10. SETTLING TANK

10.1 Refurbishment

- Settling Tank Agitator Motors Units: Rated Power (kW) - 4 (kW), Quantity : 2.0 Item
- Filtration Tank Motors Units: Rated Power (kW) – 0,37(kW), Quantity : 4.0 Item
- Refer to drawing: Ral-Brk-02-Mech-05/Ral-Brk-02-Mech-06

A comprehensive refurbishment will be carried out on all motor units, including the following technical steps:

- Disassembly and thorough inspection of all mechanical and electrical components for wear, corrosion, or operational defects.
- Replacement of defective parts such as bearings, seals, terminal boxes, and connections to restore original design tolerances.
- Cleansing of windings and rotor assemblies, ensuring the removal of contaminants and preservation of insulation integrity.
- Application of protective coatings as required to enhance resistance to process conditions and prolong service life.

10.2 Electrical Testing and Commissioning

All refurbished and newly supplied motor units shall undergo rigorous electrical and functional testing as follows:

- Insulation resistance testing in accordance with IEEE Std 43, documenting polarization index and absolute insulation values.
- Functional verification of windings and phase balance to confirm correct assembly and absence of shorted turns.
- Load performance verification during commissioning, including measurement of current draw, voltage, and temperature rise under normal and peak conditions.
- Vibration analysis utilizing digital equipment to assess alignment, bearing condition, and dynamic stability within manufacturer-prescribed limits.

10.3 Mechanical Alignment and Installation

Proper mechanical integration is essential for reliable operation:

- Precision alignment of motors to their respective pump or agitator shafts using laser or dial indicator methods.

- Securing all motor units on vibration-dampening mounts or anchor bolts as specified by engineering drawings and local code requirements.
- Termination of power and control cabling, with cable management and labelling in accordance with local electrical standards and project documentation protocols.

10.4 Documentation, Quality, and Safety Compliance

All works shall conform to the following standards:

- Compliance with project-specific safety standards, including lockout/tagout procedures during installation and commissioning.
- Preparation and submission of detailed test records, inspection reports, as-built drawings, and commissioning certificates.
- Adherence to project quality assurance protocols, with all work subject to inspection and approval by the project engineer or designated authority.

C3.4.5.11. REFURBISHMENT OF FILTRATION TANK

11.1 Refurbishment of Motor Units

- Filtration motor: Rated Power (kW): 1.1, Quantity : 4.0 Item
- Recirculation Pump and motor assemblies: Rated Power – 30 kW : 4.0 Item
- Refer to drawing: Ral-Brk-02-Mech-05/Ral-Brk-02-Mech-06

A comprehensive refurbishment will be carried out on all motor units, including the following technical steps:

- Disassembly and thorough inspection of all mechanical and electrical components for wear, corrosion, or operational defects.
- Replacement of defective parts such as bearings, seals, terminal boxes, and connections to restore original design tolerances.
- Cleansing of windings and rotor assemblies, ensuring the removal of contaminants and preservation of insulation integrity.
- Application of protective coatings as required to enhance resistance to process conditions and prolong service life.

11.2 Electrical Testing and Commissioning

All refurbished and newly supplied motor units shall undergo rigorous electrical and functional testing as follows:

- Insulation resistance testing in accordance with IEEE Std 43, documenting polarization index and absolute insulation values.
- Functional verification of windings and phase balance to confirm correct assembly and absence of shorted turns.
- Load performance verification during commissioning, including measurement of current draw, voltage, and temperature rise under normal and peak conditions.

- Vibration analysis utilizing digital equipment to assess alignment, bearing condition, and dynamic stability within manufacturer-prescribed limits.

11.3 Mechanical Alignment and Installation

Proper mechanical integration is essential for reliable operation:

- Precision alignment of motors to their respective pump or agitator shafts using laser or dial indicator methods.
- Securing all motor units on vibration-dampening mounts or anchor bolts as specified by engineering drawings and local code requirements.
- Termination of power and control cabling, with cable management and labelling in accordance with local electrical standards and project documentation protocols.

11.4 Documentation, Quality, and Safety Compliance

All works shall conform to the following standards:

- Compliance with project-specific safety standards, including lockout/tagout procedures during installation and commissioning.
- Preparation and submission of detailed test records, inspection reports, as-built drawings, and commissioning certificates.
- Adherence to project quality assurance protocols, with all work subject to inspection and approval by the project engineer or designated authority.

C3.4.5.12 LIME PUMPS AND DISLUDGE PUMPS

12.1 Scope of Work

This specification covers the requirements for the supply, delivery, installation, testing, and commissioning of Lime and Dislurge Pump units, including all associated mechanical works, to ensure reliable and efficient operation in accordance with the project's technical and quality standards.

12.2 Equipment Supply

Provide Lime Pumps (Qty: 3) and Dislurge Pumps (Qty: 2) as detailed in the equipment schedules. Refer to drawing: Ral-Brk-04-Mech-04/ Ral-Brk-02-Mech-09

Each pump unit shall conform to the following minimum specifications for the duty points

- Lime Pumps: Head: 46 m; Estimated Rated Power: 30 kW; Flow: 20 L/s
- Complete lime dosing system including tank, screw feeder, mixing tank, agitator, and pumps
- Dislurge Pumps: Head: 30 m; Estimated Rated Power: 25 kW; Flow: 15 L/s
- Pumps and motors must be new or comprehensively refurbished, complete with all necessary accessories and documentation.

All supplied equipment shall be certified in accordance with relevant international and local standards.

12.3 Delivery and Handling

Pump units and accessories shall be securely packaged and protected for transportation, minimizing risk of damage.

Delivery to the designated site shall comply with industry best practices and project delivery schedules.

Offloading at site must be performed using approved lifting equipment by trained personnel to ensure safety and integrity of all components.

12.4 Installation

Pumps and motors shall be installed at designated locations as shown in the project drawings.

Mechanical integration must include precise alignment of pumps to motors using laser or dial indicators.

All equipment shall be mounted on vibration-dampening bases or anchor bolts as per engineering requirements and local codes.

Power and control cables must be terminated, managed, and labelled according to electrical standards and documented protocols.

All installation works shall follow manufacturer's guidelines and be subject to approval by the project engineer or designated authority.

12.5 Testing and Commissioning

Comprehensive mechanical and electrical testing shall be conducted upon installation completion.

Operational testing to verify performance against design specifications for head, power, and flow rates.

Commissioning will include trial runs, vibration analysis, and monitoring for leaks and abnormal operation.

All test results will be documented and submitted for review.

Commissioning certificates, as-built drawings, inspection reports, and records of all testing shall be provided to the client.

12.6 Quality and Safety Compliance

All works to comply with project-specific safety standards, including lockout/tagout procedures during installation and commissioning phases.

Strict adherence to the project's quality assurance protocols is required; all activities are subject to inspection and approval.

Personnel involved must be qualified and trained for their respective roles.

12.7 Documentation

Detailed installation manuals, equipment certificates, and warranty documents shall be supplied with the pump units.

C3.4.5.13 TESTING, COMMISSIONING, QUALITY, DOCUMENTATION, AND SUPPORT

13.1 Operational Testing and Commissioning

- Operational testing shall be conducted to confirm pump performance aligns with design specifications for head, power, and flow rates.
- Commissioning procedures will include trial runs, vibration analysis, and close monitoring to detect leaks or abnormal operation.
- All test results shall be thoroughly documented and submitted for formal review.
- Commissioning certificates, as-built drawings, inspection reports, and all testing records shall be provided to the client upon completion.

13.2 Quality and Safety Compliance

- All works must comply with project-specific safety standards, including mandatory lockout/tagout procedures during installation and commissioning phases.
- Strict adherence to the project's quality assurance protocols is required; all activities are subject to inspection and approval.
- Only qualified and appropriately trained personnel shall be engaged in all project activities.

13.3 Documentation

- Detailed installation manuals, equipment certificates, and warranty documentation shall accompany all pump units supplied.
- Preparation and submission of test records, as-built drawings, commissioning certificates, and inspection reports are mandatory deliverables.

13.4 Warranty and Support

- All equipment and workmanship shall be covered by a warranty period defined in the contract documents.
- Following commissioning, comprehensive post-commissioning support, training, and maintenance services shall be provided as required.
- This specification establishes a consistent and comprehensive approach to the supply, installation, and commissioning of pump packages, ensuring safe, reliable, and fully compliant operation.
- Preparation and submission of test records, as-built drawings, commissioning certificates, and inspection reports are mandatory.
- 14.8 Warranty and Support
- All equipment and workmanship shall be warranted for a minimum period as specified in the contract documents.
- Post-commissioning support, training, and maintenance services shall be provided as required.
- This specification ensures a comprehensive approach to the supply, installation, and commissioning of pump packages, guaranteeing safe, reliable, and compliant operation.

C3.4.5.14 MEASUREMENT AND PAYMENT

14.1 GENERAL

Measurement and payment for Mechanical Works shall be in accordance with the Pricing Data (Volume 2), the Schedule of Quantities, and the provisions of this Section C3.4.5.

Rates and prices tendered shall be deemed to include full compensation for all obligations, risks, costs, and activities necessary to execute the Works in accordance with the Contract, whether or not such activities are expressly itemised.

No payment shall be made for work not measured, certified, and approved by the Engineer.

14.2 BASIS OF MEASUREMENT

Unless otherwise stated in the Schedule of Quantities, measurement shall be as follows:

- Supply items measured per Item (No.) or per unit (No), per metre (m), or as scheduled
- Installation items measured per Item (No.) or per unit (No), per metre (m), or per item
- Testing, commissioning, documentation, and training measured as part of Installation per Item (No.) or per unit (No)

Only completed, compliant, and accepted work shall be measured for payment.

14.5.1 DEFINITION OF SUPPLY

- Supply includes equipment design, constructability, and site integration to ensure compatibility and practicality. Design must be submitted and approved before any work begins.
- Manufacture, fabrication, and assembly of equipment
- Corrosion protection—including selection of suitable materials, protective coatings, and environmental provisions—must be considered in design, manufacture, and assembly, and be submitted for approval prior to commencement of work.
- Procurement of all materials, components, and consumables
- All factory labour, supervision, and workmanship
- Factory inspections, quality control, and quality assurance
- Factory testing where applicable
- Packaging suitable for handling, transport, and site conditions
- Transport to site, including loading and off-loading

- All on-site and off-site storage, preservation, and protection
- Insurance and risk associated with supply up to delivery
- Inspection upon delivery and verification of compliance
- Supply-related documentation, certificates, and data sheets

No separate payment shall be made for any activity, labour, or off-site storage cost deemed to be included under Supply.

14.5.2 DEFINITION OF INSTALLATION

Installation shall include, but shall not be limited to:

- Handling, positioning, erection, and fixing on site
- Mechanical assembly, alignment, grouting, and bolting
- Installation of pipework, valves, fittings, and accessories
- Electrical and control integration associated with mechanical equipment
- Site labour, supervision, tools, plant, and temporary works
- Testing, commissioning, and performance verification
- Rectification of defects identified prior commissioning

No separate payment shall be made for any activity, labour, on site storage cost deemed to be included under installation.

All testing, documentation, certification, and training shall be deemed included in the installation rates unless specifically scheduled otherwise. No separate payment shall be made for repeat testing resulting from non-compliance.

14.5.3 DEFINITION OF COMMISSINING

- Comprehensive functional and performance testing is carried out on all components and systems.
- Equipment is adjusted and calibrated to meet optimal performance and project requirements.
- Defects or non-conformances found during commissioning are documented and resolved.
- Commissioning test results and compliance certificates are submitted to relevant authorities.
- Operational and maintenance personnel receive thorough training for safe and effective equipment use.
- Detailed Operation and Maintenance Manuals, including as-built drawings, are prepared and delivered.

- Final system handover to the Employer includes all approvals and documentation, according to South African water sector standards.

All commissioning, documentation, certification, and training shall be deemed included in the Installation rates unless specifically scheduled otherwise. No separate payment shall be made for repeat testing resulting from non-compliance.

14.6 PAYMENT REFERENCE PER SECTION

14.6.1 NEW VERTICAL PUMPS

- a) Supply: Each pump unit, complete with motor and all equipment as specified in section C3.4.5.1, shall be measured per unit supplied. Pipework measured per metre supplied, valves and accessories to be measured per item.
- b) Installation: Measurement shall be per pump unit installed, tested, and compliant with applicable standards.
- c) Commissioning: Each pump unit shall be counted upon successful commissioning in accordance with prescribed procedures.

Full payment for installation will be made only after commissioning and formal acceptance by the relevant authority.

14.6.2 OVERHEAD CRANE / GANTRY HOIST

- a) Supply: Measured per complete hoist and gantry system supplied as specified in C3.4.5.2
- b) Installation: Measured per complete system installed, load tested, and certified
- c) Commissioning: Overhead Crane unit shall be counted upon successful commissioning in accordance with prescribed procedures.

No payment shall be made until statutory load testing and certification are completed.

14.6.3 INLET WORKS (CHEMICAL DOSING SYSTEMS)

- a) Supply: as specified in section C3.4.5.3
 - Dosing equipment, tanks, pumps, valves and Pipework to measure per item
- b) Installation rates include flushing, pressure testing, calibration, and safety labelling per item.
- c) Commissioning shall only be paid upon completion of all works and successful commissioning, subject to statutory requirements where applicable per item.

Full payment for installation will be made only after commissioning and formal acceptance by the Engineer and the City of Tshwane.

14.6.4 CLEAN WATER PUMPS

- a) Supply: Each pump unit, complete with motor and all equipment as specified in section C3.4.5.4, shall be measured per unit supplied. Pipework measured per metre supplied, valves and accessories to be measured per item.
- b) Installation: Measurement shall be per pump unit installed, tested, and compliant with applicable standards.
- c) Commissioning: Each pump unit shall be counted upon successful commissioning in accordance with prescribed procedures.

Full payment for installation will be made only after commissioning and formal acceptance by the Engineer and the City of Tshwane.

14.6.5 REFURBISHMENT OF PUMP AND MOTOR

The refurbishment of the pump and motor, as specified in section C3.4.5.5, must include all associated costs:

- a) The cost for the refurbishment of each pump and motor unit—including removal from site, factory testing after refurbishment, return to site, and all related activities—shall be measured per unit refurbished.
- b) Installation: Payment for installation will be made per pump unit that has been installed, tested, and is compliant with applicable standards. No payment shall be made for removal, return, or factory testing prior to installation.
- c) Commissioning: Final payment shall be made only after each refurbished pump unit has been successfully commissioned according to prescribed procedures and is formally accepted by the Engineer and the City of Tshwane.
- d) Full and final payment will be affected only after commissioning and official acceptance by the Engineer and the City of Tshwane.
- e) No partial payments will be made for work not yet meeting these milestones.

14.6.6 BACK WASH WATER PUMPS

- a) Supply: Each pump unit, complete with motor and all equipment as specified in section C3.4.5.6, shall be measured per unit supplied.
- b) Installation: Measurement shall be per pump unit installed, tested, and compliant with applicable standards.
- c) Commissioning: Each pump unit shall be counted upon successful commissioning in accordance with prescribed procedures.

Full payment for installation will be made only after commissioning and formal acceptance by the Engineer and the City of Tshwane.

14.6.7 INSTANT MIXING AGITATOR MOTORS

- a) Supply: Measured per agitator motor, or VSD unit supplied or refurbished as specified in section C3.4.5.7
- b) Installation: Measured per unit installed, programmed, tested, and compliant with applicable standards.
- c) Commissioning: Each motor or VSD unit shall be counted upon successful commissioning in accordance with prescribed procedures.

Full payment for installation will be made only after commissioning and formal acceptance by the Engineer and the City of Tshwane.

14.6.8 FLOATATION AND AERATION

- a) Supply as specified in section C3.4.5.8
 - Compressors measured per unit
 - Pipes measured per metre
 - Valves, flanges, fine-bubble disc diffusers and Special Items measured per item supplied
 - Motors including Gear Box for Scrubbers measured per item supplied
- b) Installation:
 - Compressors measured per unit
 - Pipes measured per metre installed
 - Valves, flanges, fine-bubble disc diffusers and Special Items measured per item supplied
 - Equipment measured per unit installed and tested, and compliant with applicable standards.
- c) Commissioning: Floatation and Aeration unit shall be counted upon successful commissioning in accordance with prescribed procedures.

Full payment for installation will be made only after commissioning and formal acceptance by the Engineer and the City of Tshwane.

14.6.9 FLOATATION AND AERATION DRIVES

The refurbishment of drives including gear boxes, as specified in section C3.4.5.9, must include all associated costs:

- a) The cost for the refurbishment of each drive including gear boxes unit—including removal from site, factory testing after refurbishment, return to site, and all related activities—shall be measured per unit refurbished.
- b) Installation: Payment for installation will be made per drive unit that has been installed, tested, and is compliant with applicable standards. No payment shall be made for removal, return, or factory testing prior to installation.
- c) Commissioning: Final payment shall be made only after each refurbished drive unit has been successfully commissioned according to prescribed procedures and is formally accepted by the Engineer and the City of Tshwane.

Full payment for installation will be made only after commissioning and formal acceptance by the Engineer and the City of Tshwane

14.6.10 SETTLING TANK DRIVES

The refurbishment of drives including gear boxes, as specified in section C3.4.5.10, must include all associated costs:

- a) The cost for the refurbishment of each drive including gear boxes unit—including removal from site, factory testing after refurbishment, return to site, and all related activities—shall be measured per unit refurbished.
- b) Installation: Payment for installation will be made per drive unit that has been installed, tested, and is compliant with applicable standards. No payment shall be made for removal, return, or factory testing prior to installation.
- c) Commissioning: Final payment shall be made only after each refurbished drive unit has been successfully commissioned according to prescribed procedures and is formally accepted by the Engineer and the City of Tshwane.

Full payment for installation will be made only after commissioning and formal acceptance by the Engineer and the City of Tshwane

14.6.11 REFURBISHMENT OF FILTRATION TANK

The refurbishment of drives including gear boxes, as specified in section C3.4.5.11, must include all associated costs:

- d) The cost for the refurbishment of each drive including gear boxes unit—including removal from site, factory testing after refurbishment, return to site, and all related activities—shall be measured per unit refurbished.
- e) Installation: Payment for installation will be made per drive unit that has been installed, tested, and is compliant with applicable standards. No payment shall be made for removal, return, or factory testing prior to installation.
- f) Commissioning: Final payment shall be made only after each refurbished drive unit has been successfully commissioned according to prescribed procedures and is formally accepted by the Engineer and the City of Tshwane.

Full payment for installation will be made only after commissioning and formal acceptance by the Engineer and the City of Tshwane

14.6.12 LIME PUMPS AND SLUDGE PUMPS

- a) Supply: Each pump Lime and Sludge pump unit, complete with motor and all equipment as specified in section C3.4.5.12, shall be measured per unit supplied.
- b) Installation: Measurement shall be per pump unit installed, tested, and compliant with applicable standards.
- c) Commissioning: Each pump unit shall be counted upon successful commissioning in accordance with prescribed procedures.

Contract No: WSBU 15-2025/26

Tender for the refurbishment of Bronkhorstspuit water treatment plant for a period of twenty-four (24) months from commencement date

Volume 2: Pricing Data, Schedule of Quantities and Scope of works

Part C3: Scope of Work

C3.4.5: Particular specifications for Mechanical works

Full payment for installation will be made only after commissioning and formal acceptance by the Engineer and the City of Tshwane.

**CITY OF TSHWANE
WATER AND SANITATION BUSINESS UNIT**

CONTRACT NO: WSBU 15-2025/26

**TENDER FOR THE REFURBISHMENT OF BRONKHORSTSPRUIT WATER TREATMENT
PLANT FOR A PERIOD OF TWENTY-FOUR (24) MONTHS FROM COMMENCEMENT
DATE**

C3.4.6 ELECTRICAL SPECIFICATIONS

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1. BACKGROUND

Ralema Consulting Engineers were appointed as for the design and supervision for the REFURSHMENT OF BRONKHORSPRUIT WATER TREATMENT PLANT.

The project focuses on upgrading the Bronkhorstspuit Water Treatment Plant to address current challenges and ensure compliance with standards. The refurbishment aims to enhance operational efficiency, address maintenance issues, and ensure the sustainability of the water supply system.

This report provided a general electrical system design of the Bronkhorstspuit water treatment plant.

2. INTRODUCTION

This specification is for the supply, delivery to site, off loading, storing on site, erection, testing and commissioning of electrical and instrumentation equipment associated with upgrading the Bronkhorstspuit Water Treatment Plant project.

The specification prescribes the basic minimum requirements and principles for the electrical design, selection, and protection of electrical equipment, materials and installation of electrical facilities relevant to the Refurbishment of the Bronkhorstspuit Water Treatment Plant Project. The Works shall ensure safety to personnel and equipment during operation and maintenance and, in particular, safe starting, safe operation and safe shutdown of units under all conditions.

The electrical facilities shall include power distribution, motor starts, lighting, earthing & lightning protection as well as various electrical field equipment.

Vendors are invited to make recommendations with justification, any options, additional accessories, fabrication methods or operational methods available that can be beneficial in considering cost performance, maintainability and quality. Where applicable, such options shall be jointly considered by Ralema Consulting Engineers and the City of Tshwane in the evaluation of suitability and benefits offered.

All work shall be carried out in accordance with this document and all relevant standard specifications and codes of practice.

3. OVERVIEW OF WORK

3.1. General

The scope of work shall include for the furnishing of all plant, materials, tools, consumables, supervision, labour, transportation, technical and professional services necessary for the construction, installation, testing and commissioning of all electrical equipment as detailed within the body of this specification, attached drawings and relevant contract documentation.

The tenderer shall acquaint himself with requirements of this documentation and any conditions that may exist on site. All items supplied and installed shall be complete, assembled, installed, tested and commissioned. The Contractor shall be responsible for the functional testing of the installation.

Built in items shall not be covered before inspection by the Engineer or his authorised representative.

In all cases where reference is made to the Engineer it shall be read to include the Engineer's authorised representative.

4. ELECTRICAL EQUIPMENT SPECIFICATION

4.1. Motor Control Centre (MCC) LV Switchgear

- The existing Raw Water Extraction Motor Control Centre (MCC) shall be decommissioned and replaced with a new assembly. The new MCC shall be designed to cater for new mechanical equipment and facilitate full automation integration with the new PLC SCADA system. The MCC shall be fully equipped with Variable Speed Drives (VSDs) to allow for variable extraction rates in accordance with end-user requirements. The MCC shall be equipped with a local Programmable Logic Controller (PLC). VSDs

and associated local field instruments shall be hardwired or networked to this local PLC. The PLC shall be fitted with a fibre optic communications module for upstream SCADA integration

- The Purification Works shall be decommissioned and replaced with a new assembly to cater for existing and new loads. The Contractor shall perform detailed inspection with as-built drawing of the existing MCC to evaluate the kW size of each cubicle and location. The new MCC cubicle arrangement shall be the same as existing to ensure outgoing supply cables are re-instated in the same location on the new MCC. The new design of the Purification MCC shall cater for Lime handling loads (about 6) such that all motors in the existing Lime Handling MCC are supplied from the extended Purification MCC. The existing Lime Handling MCC shall not be decommissioned as lighting and small power is still fed from this panel. The new MCC cubicle shall be DOL starters, VSD (with adequate ventilation), and Static feeders in line with existing configuration.
- In general, switchgear / MCC's shall generally be in accordance with the requirements of IEC/SANS 60529 and IEC/SANS 60947.
- The switchboard shall incorporate outgoing units for motor starters, distribution board feeders and feeders to individual consumers. Motor starters shall be equipped with intelligent motors relay with profinet communication protocol.
- Motor starter feeder circuits shall comply to Type 2 coordination as per IEC60947 requirements.
- Outgoing static feeder circuits shall be of the breaker type, not necessarily incorporating intelligent relays, except for earth leakage relays as appropriate to circuit duties.
- All contactor controlled outgoing units shall have facilities for remote control and monitoring by the substation SCADA system.
- Motor switching shall be enabled from two locations: local hand station and remote SCADA system.
- The new switchgear shall consist of grouped assemblies of free-standing, vertical, metal clad enclosures containing single main busbar systems, removable circuit breakers / switching devices, necessary auxiliary control devices, instrument transformers, relays and metering equipment.
- Switchgear assemblies for installation in substations with controlled environments shall be of the indoor industrial type.
- Switchgear assemblies for installation outdoors shall have weatherproof, vermin-proof, fully gasketed enclosures and may be provided with space heaters to prevent internal condensation.
- As far as possible the existing LV switchgear philosophy including but not limited to component make, configuration, etc. shall be retained for ease of maintenance and spare interchangeability.
- The incomer section shall be equipped with withdrawable air circuit breakers (ACB's).
- Each incomer as well as bus section (where provided) shall be provided with a robust bolt-on facility to accommodate a supply side earthing arrangement (e.g. octopus) that is applied during maintenance. Vendors shall propose the optimal placement of the earthing arrangement.
- The earthing arrangement including the flexible cable and all connections between the phases and the earth bar shall be constructed in such a manner that it shall withstand the thermal and dynamic forces associated with the rated short time withstand current of the assembly for 1s. The OEM shall produce the relevant type test certification for this assembly.
- The earthing arrangement shall be visible whilst in service.
- The incomer section of LV boards shall be fitted with one PT per incoming supply and one PT per busbar section – depending on relay selected.
- All LV incomer and bus tie circuit breakers shall be equipped with two trip coils (main & backup) and one closing coil, capable of operating on 220V AC from UPS supply. Trip coils shall be fed from separate DC MCB's residing in the LV cubicle.
- Particular Specification E04 provides detailed specifications of the Electrical Low Voltage switchboards and Motor Control Centre

4.2. Uninterrupted Power Supply (UPS) Unit

- To support new instrument loads, a new UPS shall be designed supplied and installed in the substation. The UPS sized to 10kVA, 400V 3phase IN / 400V 3phase OUT Uninterrupted Power Supply, complete with 30min Back-up time NiCads Battery Bank. The output of the UPS shall be fed to a UPS distribution board.
- Particular Specification E16 provides detailed specifications of the UPS unit

4.3. 400/231 V AC UPS Distribution Board

- The out of the new UPS shall feed the 400/231V Distribution board. The new UPS Distribution board shall feed all instruments in the field and PLC / Scada system in the Control room.

- Particular Specification E18 provides detailed specifications of the Distribution Board

4.4. Motor control station / Isolator push buttons

- Particular Specification E04 provides detailed specifications of the Electrical Low Voltage switchboards and Motor Control Centre

4.5. Variable Speed Drives (VSD's)

- VSD's requirements are stated in Electrical load list.
- Particular Specification E17 provides detailed specifications of the VSDs

5. GENERAL TECHNICAL SPECIFICATION FOR ELECTRICAL INSTALLATION

5.1. Scope

This specification covers the general technical requirements for the installation, testing and commissioning of electrical installations including the equipment and materials used therein. It forms part of the enquiry document and shall be read in conjunction with any Project Specification and drawings that may be included with the Tender Documents.

All the work described in this specification shall be included for in the Tenderers quotation and carried out by the Successful Tenderer (hereinafter called the Electrical Contractor) as part of the contract, insofar as it is relevant to the specific project identified

The electrical installation shall comply fully with the requirements of this specification. Should any contradictions or discrepancies exist between this specification and any Project Specification and drawings that may be included in the Tender Document, then the latter shall take precedence.

5.1. Specification

Where reference is made to a specification, standard or code, the reference shall be taken to indicate the latest edition of such specification, standard or code, including addenda, supplements and revisions thereto, current at the date of award of contract. The following lists of specifications standards, as well as all associated references, shall be applied on this project as the basis of design, manufacture and construction, as appropriate.

1. Should any conflict arise between the various specifications listed below and those cited elsewhere in this document, the precedence from a design perspective, shall be as follows: South African Legislation and Legal requirements;
2. SANS and IEC standards;
3. This specification;
4. Client Specifications or preference;

5.2. Standards and Code of Practice

Number	Title
ISO 9001	Quality Management Systems - Requirements
IEC / SANS 60099	Surge Arrestors
IEC / SANS 60269	Low-voltage fuses
IEC / SANS 60289	Convertor Transformers and Reactors.
IEC / SANS 60305	Insulators for overhead lines with a nominal voltage above 1 000 V
IEC / SANS 60309	Plugs, socket-outlets and couplers for industrial purposes

IEC / SANS 60439	Low-Voltage Switchgear and Control gear assemblies Parts 1 & 2
IEC / SANS 60529	Degrees of protection provided by enclosures (IP Code)
IEC / SANS 60598	Luminaires
IEC / SANS 60720	Characteristics of line post insulators
IEC / SANS 60934	Circuit-breakers for equipment (CBE)
IEC / SANS 60947	Low Voltage Switchgear and Control gear
IEC / SANS 61000	Electromagnetic compatibility (EMC) – All parts
IEC / SANS 61140	Protection against electric shock - Common aspects for installation and equipment
IEC / SANS 61386	Conduit systems for cable management
IEC / SANS 62305	Protection of structures against lightning
SANS 1019	Standard voltages, currents and insulation levels for electricity supply
SANS 1063	Earth rods and couplers
SANS 1091	National Color Standard
SANS 1213	Mechanical cable glands
SANS 1239	Plugs, socket-outlets and couplers for industrial purposes
SANS 1339	Electric cables - Cross linked polyethylene (XPLE) insulated cables for rated voltages 3.8/6.6 kV to 19/33 kV
SANS 1411	Materials of insulated electric cables and flexible cords – Part 1, 6, 7
SANS 1474	Uninterruptable Power Systems

Number	Title
SANS 1507	Electric cables with extruded solid dielectric insulation for fixed installations (300/500V to 1900/3300V) – Part 3
SANS 1973	Low-Voltage Switchgear and Control Gear Assemblies - Part 1
SANS 1885	Metal-clad switchgear for a.c. voltage above 1 kV up to and including 36 kV - General requirements and methods of test
SANS 10114	Interior Lighting
SANS 10142-1	The wiring of premises Part 1: Low-voltage installations
SANS 10142-2	The wiring of premises Part 1:
SANS 10198	The selection, handling and installation of electric power cables of rating not exceeding 33 kV
SANS 10199	The Design and Installation of an Earth Electrode

SANS 10280	Overhead power lines for conditions prevailing in South Africa – Part 1
SANS 10292	Earthing of Low Voltage (LV) Distribution Systems
SANS 10313	Protection against lightning - Physical damage to structures and life hazard
SANS 10389	Exterior Lighting

5.3. Quality Assurance

- The installation work, materials, and equipment supplied for this contract, shall comply fully with the latest revision of the relevant SANS Specification. Where no SANS specification exists, the relevant IEC or BS Specification shall be used. Should the Electrical Contractor wish to use equipment not displaying any "Mark of Approval" he shall first obtain the approval of the Engineer in writing.
- Where a certain manufacturer's material or equipment is called for in this specification or on the drawings these shall be supplied as specified.
- Where the Tenderer is unable to offer the equipment specified, he may offer an alternative, provided attention is drawn to the fact in the relevant section of the tender documents.
- All materials and equipment shall be new, of the best of their kind and adequate for the purpose specified. Any materials or equipment found to be substandard or unsuitable for the purpose for which they are intended shall be removed and replaced at the Electrical Contractor's expense.
- Workmanship shall be of the highest standard throughout, and follow the best modern engineering practice. All work shall be performed by personnel, or under the direct supervision of personnel fully qualified in work of this nature. Any substandard work shall be dismantled and replaced at the Electrical Contractor's expense.
- Equipment and components of a similar class or purpose, such as wiring accessories, switch-disconnectors, etc, shall be of the same make and pattern throughout the Contract. Luminaires shall be sourced via a single manufacturer, unless agreed in writing with the Engineer.
- If in the opinion of the Electrical Contractor any method described in the specification may be improved upon, the Electrical Contractor shall first obtain the approval of the Engineer.
- The Engineer will inspect the installation work periodically during the progress of the contract, but the Electrical Contractor shall notify the Engineer timeously whenever important stages are reached, so that the Engineer may schedule his inspections in the interests of all parties. Any discrepancy between the installation and the requirements of this specification shall be remedied at the Electrical Contractor's expense. Under no circumstances shall these inspections relieve the Electrical Contractor of his obligations in terms of the contract.
- The Electrical Contractor may be required to submit for approval, drawings or samples of materials or equipment which he proposes to use on the contract. Such samples may also be called for during the Tender period or during the Tender adjudication period.
- Note: A request for submission of samples or drawings does not necessary imply that the Tenderer's quotation will be accepted
- Drawings shall be clearly marked "WORKING DRAWINGS FOR APPROVAL". Samples shall be forwarded to and, if necessary, remain in the possession of the Engineer until the completion and handover of the Contract. With the approval of the Engineer the samples may be used in the completion of the installation. Any expenses incurred in the supply and return of drawings and samples shall be borne by the Tenderer or Electrical Contractor, as the case may be.
- The Electrical Contractor shall supply all materials, consumables, equipment and labour necessary for the completion of this contract whether specifically mentioned or not.

6. Cable Condition assessment

- The contractor shall test all existing cables prior to procurement of new cables. The cable condition assessment shall be conducted on all existing loads which have not been switched on for an extended period.
- Particular Specification E01 provides detailed specifications of the Cable condition assessment

7. Medium voltage and Low voltage cables

- Where new loads or equipment are required, the contractor shall supply and install required power and control cables.
- The Electrical Contractor shall supply, install, connect and test all the cables called for in the schedules and where shown on the drawings. Cables shall be 600/1,000 volt grade, or 1,900/3,300 volt as appropriate, PVC insulated, steelwire armoured and PVC sheathed, with stranded copper conductors or as called for in the cable schedules, constructed in accordance with SANS1507. The armouring of any armoured cable is not acceptable as an earth conductor. Single core cables shall be unarmoured and run in trefoil formation.
- All PVC/SWA/PVC or PVC/PVC cable terminations shall be effected in non-corrodible metal compression glands similar. Waterproof or flameproof glands shall be provided where necessary. Glands shall be complete with earthing ferrules, locknuts, bushes and shrouds.
- Conductors shall be terminated onto equipment using compression lugs of the correct size and suitable for the application. Manual crimping shall be done with the Maker's special tools which will not release until the full crimping pressure has been achieved, the ends of conductors of 50 mm' cross-sectional area and greater shall be crimped by hydraulic machine.
- Each and every run of cable shall be a single length without joints, save that where a run exceeds the standard drum length or where the length of cable is increased after installation, a through box will be permitted.
- Cable joints shall be made by using kits approved by the cable manufacturer, and by personnel trained in the use of these kits. Tenderers shall specify in the appropriate schedule the type of cable joint to be used.
- If epoxy resin filled boxes are to be used, preference will be given to transparent resin types. The type of joint used shall not impair the mechanical and electrical properties of the cables. All conductor and armouring wires shall be carried through the joint, and adequately crimped ferrules and lugs shall be used. The Engineer reserves the right to cut open any made joint to ensure the integrity of the joint, and should such an inspection reveal inadequate jointing procedures, the right to insist the re-jointing of all cables at the Electrical Contractor's expense. This applies to joints in all types of cable. Adequate measures shall be taken to prevent the ingress of moisture into any joint.
- Drums of cable shall be delivered to site with their end seals intact and shall be off-loaded and stored in an approved manner. Any damaged cable shall be removed from site and replaced with undamaged cable at the Electrical Contractor's expense.
- Cable drums shall be supported on an axle and supporting jacks and, when the cable is unreeled, the direction of rotation indicated on the drum flanges shall be observed. Rolling of drums along the ground is not permitted.
- Particular Specification E05 provides detailed specifications of the Low Voltage cables
- Particular Specification E12 provides detailed specifications of the Medium Voltage cables

8. Installation of Cables - Racks

- Except where otherwise specified, cable racks shall imply cable tray or cable ladder, Multiple runs of cables shall be fixed to cable racks, and all cables shall be numbered at either end in accordance with the schedules.
- Where cables are run along walls or structural members, they shall be supported throughout their length on cable racks fixed securely to the building structure and level. Cables shall be fixed to the racks at intervals not exceeding 1000 mm, for racks in a vertical orientation and at 2 metres for those in horizontal orientation.
- Cables shall be fixed by means of UV stabilised PVC cable ties, , standard ties for cables up to and including 50 mm' cross-sectional area, and heavy-duty cable ties for cables of 70 mm' cross-sectional area and larger. Cable ties shall also be provided within 75 mm of each end of any set in the cable, Cables shall be secured in such a fashion that any cable may be removed without affecting other cables in the run.
- Cable through-joint boxes shall be positioned for easy access for maintenance and repair.
- Cables shall be installed adjacent and parallel to each other on the cable racks with all bends and sets concentric and presenting a neat appearance. The radius of any bend or set in cables shall comply with the requirements of the cable manufacturer or the appropriate SANS Code of Practice. Under no circumstances shall cables be bunched.
- Where cables leave cable racks to feed motors or other equipment they shall be adequately supported on channel, angle iron or other approved support. Cables fixed to conveyors or other steelwork on which excessive vibration may occur, shall be fixed with stainless steel "Band-it" strap. Cables fixed directly to concrete or steelwork shall be adequately secured with saddles, except where damage to the cables could occur, in which case the cables shall be protected by a steel conduit or sleeve.

- Cables for different services, i.e. communication and power shall not be run on the same cable rack.
- Particular Specification E02 provides detailed specifications of the Cables racks

9. Installation of Cables - Underground

- Except where otherwise stated the Electrical Contractor shall provide all cable trenches where called for on the drawings. Cables shall follow the routes where indicated on the drawings, where no routes are indicated, the Electrical Contractor may select routes to his reasonable preference, but shall first obtain the approval of the Engineer before any excavation or installation commences. During the course of the contract, drawings indicating cable routes shall be kept in the site office for reference purposes. "As Installed" drawings indicating the routes of all cables shall be provided by the Electrical Contractor, and handed to the Engineer on completion of the contract.
- Cable trenches shall be excavated to a minimum depth of 600 mm below finished ground level. The bottom of the trench shall be level and clear of any sharp rocks and stones or any other debris likely to cause damage to cables. Cables shall be bedded on a 150 mm layer of clean dry sand or sifted soil.
- Where more than one multi-core cable is laid in a trench, they shall be spaced at a minimum of 150 mm apart throughout their length. Single core cables shall be laid in trefoil formation and bound together at intervals of 500 mm, using heavy duty cable ties.
- The Electrical Contractor shall provided special cable markers to locate them. In addition a non-corrosive strap with the cable number embossed upon it shall be provided on either side of the cable joint.
- Prior to backfilling, the cables shall be inspected by the Engineer for any damage caused during cable laying procedures. Damaged cables shall be repaired in accordance with the cable manufacturers instructions.
- Cables shall be covered completely with a 150 mm layer of clean dry sand or sifted soil, and the trenches then backfilled in layers of 300 mm, each layer being well compacted and consolidated, with sufficient allowance made for settlement. The first 300 mm layer shall be free of all stones, rocks or other debris, and shall have laid above it a cable marker tape. This tape shall be a minimum of 0.1 mm thick, yellow with the inscription "DANGER: ELECTRIC CABLE" continuously along its length.
- Cable sleeves shall be provided wherever cables cross under roadways, railway lines, or wherever necessitated by site conditions. Sleeves shall preferably be of twin walled corrugated sandwich construction, manufactured from Polyethylene
- Where unsleeved cables cross other services, they shall be taken at least 500 mm under such services and interlocking concrete cable tiles shall be laid 300 mm above the cables extending 900 mm on either side of the crossing point.
- Where cable trenches and sleeves are provided by others, the Electrical Contractor shall liaise with the other party regarding trench size and depth, sleeve sizes, positions, radii, etc., and moreover, shall be in attendance to ensure correct backfilling procedures and positioning of the marker tape and cable route markers.
- The Electrical Contractor shall ensure that all sleeves are sound, clean and free of any snags, before drawing in any cables. Only one cable shall be drawn into a sleeve, except where there are insufficient sleeves, and with the approval of the Engineer, more than one cable of small diameter may then be drawn into
- The same sleeve. After the drawing in of cables, each end of the sleeve shall be plugged with weak cement mix or similar compound. Spare sleeves shall be provided with galvanised steel draw wires and closure caps, after clearing away any soil or debris.
- Cable markers shall be provided on all underground cable routes, at intervals not exceeding 30 metres on straight runs, and at every change of direction. They shall also be provided at each end of every cable sleeve and at the outer end of every cable sleeve entering a building. The type of cable marker proposed shall be submitted to the Engineer for his approval. The information required to be inscribed on the cable marker shall be obtained from the Engineer.
- Particular Specification E06 provides detailed specifications of the Electrical Medium and Low Voltage cables

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10. Installation of Cables - Cables in Concrete Lined Trenches or Tunnels

- Generally all cables shall be supported on cable racks fixed vertically to the sides of concrete lined trenches or tunnels,
- In trenches beneath switchgear and main low voltage distribution boards, cables shall be fixed to

horizontally mounted cable ladder. The cable ladder shall be supported on adequately sized cantilever arms, fixed in turn to concrete anchor channels

- The width of this cable ladder shall not exceed 500 mm, and the distance between each cable ladder in multiple runs shall not be less than 300 mm. The largest cables shall be fixed to the lowest cable rack in the trench so as to obtain the bending radii required and the smallest cables shall be on the topmost cable rack.
- 70 mm² cross-sectional area and larger shall be fixed to the rungs by means of cable clamps. Cables of 50 mm² cross-section area and below, shall be fixed by means of heavy duty cable ties, as appropriate for the cable being secured.
- Particular Specification E06 provides detailed specifications of the Electrical Medium and Low Voltage cables

11. Cable Racks

- The Electrical Contractor shall supply and install all cable racking as required by the cable routes. This shall be cable tray, cable ladder or wire mesh cable tray, as called for in the Project Specification or on the drawings, and shall include all the necessary supports, clamps, hangers, fixing materials, risers, droppers, bends, reducers, etc., and all that is necessary for a complete installation.
- Generally all cable racking shall be manufactured from mild steel, hot-dipped galvanised after manufacture. Where cutting, drilling or welding, or other work, is carried out on site and which causes damage to the finish, the Electrical Contractor shall restore the corrosion resisting properties of the material with the appropriate treatment.
- Particular Specification E06 provides detailed specifications of the Electrical Medium and Low Voltage cables

12. Termination of Cables

- The Electrical Contractor shall test re-terminate all existing MV motors. The Contractor shall provide all necessary labor, supervision, tools, consumable materials, and testing equipment required to prepare, install, and test MV cable terminations. The work must strictly adhere to the manufacturer's installation instructions and relevant international/local standards (SANS 10142-2, IEC 60502).
- Particular Specification E06 provides detailed specifications of the Electrical Medium and Low Voltage cables

13. Installation of Cable Racks

- Wherever possible all cable racks shall be installed in a vertical orientation to prevent accumulation of spillage and dust. Adequate space being provided behind the rack for the fixing of nuts and cable ties, etc.
- Cable racks shall be fixed to the building structure by means of stand-off supports at approximately two-metre intervals, supports being provided in any case at the end of each fabricated length. Supports shall be galvanised after fabrication.
- Where cable racks are to be installed in concrete lined tunnels or trenches they shall be fixed to concrete anchor channels. The top of the channel shall be 75 mm below the lip of the trench and the bottom, 75 mm above the floor of the tunnel or trench. The anchor channels shall be supplied and installed by the Electrical Contractor in close co-operation with the Civil or Building Contractor.
- Cable racks shall be sized to allow the future addition of cables equal to 25% of the present number installed.
- Cable racks shall be installed parallel to any major structural members and where there are multiple runs they shall be parallel with all bends concentric.
- Fixing of cable racks to structural elements shall be by means of galvanised steel bolts, all bolts holes shall be painted with cold galvanising paint.
- Cable racks shall be adequately supported for the cables that they carry. No twisting or sagging will be allowed on unsupported lengths.
- The radius of any bend shall be such that the cable manufacturer's recommended minimum bending radii are complied with.
- Each run of cable rack shall be bonded across all sections and be electrically continuous throughout. Where the electrical continuity cannot be guaranteed, a continuous bare copper conductor shall be

provided for each run of cable tray and each section shall be bonded to this conductor. This shall be done in any case in outdoor locations and coastal areas. In addition all cable racks shall be bonded to the switchboard to which the cables it carries are connected.

- Particular Specification E02 provides detailed specifications of the Cables racks

14. Cable Trunking (Wiring Trunking)

- Cable trunking shall be of rolled or folded sheet steel or aluminium construction forming a rigid and robust enclosure, complete with hinged, screwed or snap-on metal covers providing full and continuous access to the interiors. The material shall not be less than 1 mm thickness. If screws are used to secure the covers they shall be captive in the covers and shall have blunt ends.
- Only radiused elbows, tees and cross-overs shall be used. 90 degree elbows, tees and cross overs will not be accepted.
- Trunking shall be fixed rigidly to the building structure, with supports at intervals not exceeding 1,5 metres. Supports shall in any case be provided at joints between sections of trunking and any bend or cross-over. Where columns or stanchions stand proud of walls the trunking shall be aligned with the column faces and stand-off supports provided between the columns. Adequate provision shall be made for expansion and contraction.
- All trunking routes shall follow those indicated on the drawings or as directed by the Engineer. They shall be laid to fall for drainage purposes, and all runs shall be kept 150 mm clear of and below any hot water or steam piping.
- All joints in trunking shall be bonded so that the system is electrically continuous throughout. A continuous bare copper earth conductor shall be provided throughout the system, and each section of trunking shall be bonded to this conductor. This earth conductor shall have a cross-sectional area not less than half that of the largest current carrying conductor, but shall not be less than 4 mm², and need not be greater than 70 mm², cross-sectional area. The resistance, as measured between the earth electrode and any point in the system, shall not exceed that specified in SANS 10142-1.
- Where trunking pass through walls, floors or ceilings, their covers shall be permanently fixed and shall project 150 mm, on either side of walls or partitions and 500 mm, on either side of floors or ceilings. In addition, purpose made metal sleeves shall be provided where trunking passes through floor slabs or walls to protect the trunking from any mechanical damage.
- Where trunking passes through floors or partitions intended as fire barriers the trunking shall be equipped with barriers designed for a minimum fire retardation rating of 4 hours.
- Conduit entries into trunking shall be effected by means of couplings and brass male bushes. Vibration proof hardened steel washers shall be placed on either side of the trunking with the bush then being pulled up tight against the trunking. Holes shall be formed in the trunking using chassis punches of the correct size, and arranged to avoid undue setting of conduits.
- Where terminations from the trunking are to be made to items of plant with inherent vibration or movement, a length of flexible conduit shall be used for final connections.
- Trunking installed in boiler rooms and or on exterior surfaces, shall be fixed to stand-off supports having a minimum clearance of 6 mm from the surface.
- Trunking installed in exterior locations, shall be fully weather-proofed with covers fitted with neoprene gaskets. All trunking and supports shall be galvanized.
- Particular Specification E08 provides detailed specifications of the low voltage wiring

15. Conduits

- All conduits shall be heavy duty solid drawn or welded, black enamel or galvanised, complying fully with the requirements of SANS requirements. All conduits shall be sized to comply with the requirements of SANS 10142-1, but no conduit having a diameter smaller than 20 mm shall be used.
- All conduit fittings shall comply fully with the requirements of SANS requirements. Conduit bushes shall be of brass or nylon, with the outlet smoothly rounded, the threads shall be undercut to ensure that the bushes may be screwed fully home. Other conduit fittings shall be of malleable cast iron with screwed entries, and finished hot dip galvanised, sheradized or black enamelled according to the nature of the conduit run.
- No manufactured elbows, tee-pieces, inspection or solid bends shall be used, except where approved in writing by the Engineer.
- Where conduit is to be used for final connections to motors or other vibrating equipment, or for connections to thermostats, sensors, stoves, etc., only flexible metal conduits shall be used complying with BS 731, which shall be sheradized or hot dip galvanised and PVC sheathed overall.
- The conduit shall terminate in adaptors or glands, of brass, zinc or cadmium plated mild steel. A copper

earth conductor of not less than 2,5 mm², connecting the adaptors or glands, shall be spiralled around and fixed to the flexible conduit with cable ties.

- As an alternative to screwed conduit the Electrical Contractor may also use, if preferred and with the approval in writing of the Engineer, the plain-ended (threadless) steel conduit system. Where this system is used the minimum wall thickness of the material shall be 1,2 mm. Plain-ended conduit shall not be used in the following circumstances:
 - In flameproof installations
 - As load bearing conduit, or
 - For the suspension of luminaires
- The Electrical Contractor shall agree all conduit runs with the Engineer, where these are not clearly defined on the drawings.
- Particular Specification E08 provides detailed specifications of the low voltage wiring

16. Installation of Conduits

- Conduit threads shall be cut clean and be of just sufficient length to enable the conduits to be butted together at joints, exposed threads shall be kept to the absolute minimum. The ends of all conduits shall be reamed and free of burrs and sharp edges. After each joint is finished all oil shall be removed and the exposed threads shall be painted with black enamel or zinc paint, according to the nature of the conduit. Running couplers with long threads shall be kept to a minimum, but where unavoidable they shall be secured by lock-nuts at each end of the coupler to ensure a strong mechanical joint and the exposed threads shall be painted as above.
- All conduits showing roughness, cracks, kinks, obstructions in the bore or any other damage, shall be rejected. All open ends of partially completed conduit runs shall be plugged to prevent ingress of dirt and moisture.
- Every conduit run shall have complete electrical and mechanical continuity and shall be securely bonded to earth.
- Conduits shall not be installed closer than 150 mm to pipes containing steam, hot water, gas or other substances which may cause damage to conduits or the conductors therein. In order to prevent electrolytic corrosion conduits shall not be in contact with the pipes of other services. Where this cannot be avoided, cathodic protection shall be provided.
- All conduit runs shall be completely erected, fixed and inspected by the Engineer before any conductors are drawn into the system. The Electrical Contractor shall give the Engineer adequate notice for these inspections.
- All conduits shall terminate in distribution boards, power skirting, accessory, loop-in, draw boxes, etc. with a brass or nylon female bush and two locknuts. The conduit shall only protrude far enough through the entry hole to accommodate the bush and
- locknut. If there is insufficient space in the box to accommodate the locknut then a coupling with a brass or nylon male bush and external locknut may be used.
- Where outlet boxes are equipped with spouted connections the conduits shall be screwed tightly home with no threads being visible.
- The free ends of all conduits for future extensions shall be galvanised and sealed by
- means of conduit couplings and brass plugs. The conduit shall be coated with a
- suitable paint to prevent corrosion.
- Bends or sets shall be made cold without alteration to the section. The inner radius shall not be less than 3 times the external diameter of the conduit, cognisance also being taken of bending radius of the conductors within the conduit.
- Where plain-ended conduit is used, bends and sets shall be made with the manufacturer's special bending tools. Damaged conduit resulting from incorrect bending procedures shall be removed and replaced at the Electrical Contractors expense.
- In general all conduit and accessory fixings shall be secured with roundhead screws. Wood plugs are not acceptable, nor shall plugs be installed in the mortar joints between bricks in walls.
- Earth conductors shall be connected to conduits by means of copper clamps with non-corrodible bolts. The contact surfaces shall be thoroughly cleaned and after the clamp has been tightened the conduit repainted to correct colour. Bush nuts shall not be used for the connection of earth conductors to conduits.
- Particular Specification E08 provides detailed specifications of the low voltage wiring

17. Power Skirting

- The Electrical Contractor shall supply and install power skirting in the positions shown on the drawings. It shall be manufactured from folded sheet steel having two or three compartments as called for on the drawings, with separate covers for each compartment and be complete with all necessary corner pieces, end closers, splices, etc. The colour shall be as specified.
- The Electrical Contractor shall provide the necessary feeder, spare and interconnecting conduits for each service (electrical, telephone, other). Where a section of power skirting is interrupted by a doorway, bridging conduits shall be provided to connect the two sections. Where these conduits are not indicated on the drawing a minimum of one 32 mm diameter conduit shall be provided for each service catered for in the power skirting.
- Where power skirting is fixed to brick or concrete walls, conduit entries into each compartment shall be via a bushed entry from conduit boxes recessed into the wall behind the power skirting. Where fixed to steel curtain walling or similar, conduit boxes shall be cast or chased into the floor with the bushed entries terminating in their respective compartments.
- The bushed entries to the upper compartments shall be positioned towards the rear of the lower compartments to allow adequate space for wiring to pass.
- The positioning and number of switched socket outlets in power skirting shall be as shown on the drawings.
- Power skirting in laboratories and workshops shall, unless otherwise specified, be of the single compartment type and be run along the bench tops.
- A green PVC-insulated copper earth conductor shall be provided throughout the power skirting system, bonded to each metal section and connected to the earth bar in the distribution board. A separate BCEW shall be connected between the earth terminals of the switched socket outlets and the earth bar in the distribution board.
- Prior to the fitting of the covers the power skirting shall be thoroughly cleaned to remove all dust and debris. The Electrical Contractor shall make good any damage or blemishes in paintwork, using paint from manufacturer's original batch to ensure accurate colour matching
- Particular Specification E09 provides detailed specifications of the building installation wiring

18. Lighting and Small Power

- All loads defined as lighting and small power end-users are 230V AC, 50Hz, single phase loads.
- Lighting and small power shall be distributed via a 400/230V, 50Hz, 3-phase, 4-wire solidly earthed distribution system.
- In general, the design and installation of lighting and small power shall comply to SAN10142-1 requirements.
- Lighting shall be provided for all operating areas, plant, substation and all other areas requiring lighting as required by the City of Tshwane.
- As far as practically possible, all new light fitting shall be of LED technology.
- Distribution boards and light fittings shall be installed in such a manner that they will not impair or obstruct the normal clearance of passageways for personnel or equipment.
- Luminaries shall be mounted such that routine operations and reasonable maintenance can be conducted with safety and without the use of temporary scaffolding.
- All new lighting steel pole shall be fitted with mid-hinged facility for ease of maintenance.
- A combination of timers and photo-electric switches shall control all outdoor and building lighting.
- Branch lighting circuits shall be protected by suitably rated circuit breakers.
- Emergency lighting shall be achieved by battery backed up light fitting located in specific areas
- Lighting fixtures shall be mounted on steel poles or unistrut fixing arrangements when provided for general area lighting.
- New light fitting required at Bronkhorstspuit plant shall comprise of bulk head light fitting type with LED lamps or similar. Where required, existing light fittings will be modified and fitted with LED plate.
- High mast lighting will be utilized around outdoor plant area. LED flood lights will be utilized.
- The illumination levels for normal lighting in workplaces shall conform to SANS10114 and SANS10389 requirements.
- These illumination levels shall be used for design purposes as the minimum maintained levels and shall be increased by a factor of 1,43 when used in design calculations for establishing initial luminance in outdoor areas (i.e. lighting designs shall allow for a maintenance-ageing factor of 0,7).
- The illumination levels shall be measured at the elevations listed above grade or floor level and between two adjacent lighting fixtures.
- At Bronkhorstspuit plant, convenience sockets shall be provided on the basis of adequate plant coverage assuming the use of 15m extension leads. Socket outlets shall be suitable for outdoor application.

- Convenience sockets shall also be provided at the Workshops and various buildings.
- All socket outlet circuits shall have earth leakage protection with a sensitivity rating of 30mA or less.
- The entire installation shall comply with SANS 10142-1.
- Particular Specification E09 provides detailed specifications of the building installation wiring
- Particular Specification E08 provides detailed specifications of the low voltage wiring

19. Earthing

- The Electrical Contractor shall supply and install the main earth and lightning protection systems, where called for, in accordance with the requirements of SANS 10142-1 and SANS 10313.
- The Electrical Contractor shall also supply and install all the materials required for the earthing and bonding of all electrical apparatus, equipment, outlets, circuits, structures, etc., whether specifically mentioned or not.
- A green PVC-insulated stranded copper earth conductor shall be provided between the earth bar of the main LV switchboard and the earth bar of each sub-distribution board and or motor control centre. They shall be run with and tied to the main feeder cables. The sizes shall be as given on the drawings or in the schedules. Where a single-phase supply is required for a sub-distribution board, a three-core feeder cables shall be used, the third core being used for the earth conductor. Where multi-core cables are run in parallel there shall be one earth conductor per cable and where single core cables are run in trefoil there shall be one earth conductor per trefoil formation.
- In all three-phase 400 volt installations, such as to electric motors, the fourth core of a four-core PVC cable shall be used as an earth conductor and shall terminate at each end to either the appliance metalwork or the switchboard earth.
- All conduits, sheaths of lead cables, screens of screened cables and armouring of armoured cables shall be bonded to the metalwork of its terminating gear.
- All external water pipes, drain pipes, down pipes, corrugated iron walls and roofs, and metal guttering shall be securely bonded to earth. All contact surfaces shall be thoroughly cleaned and the connections made by means of copper clamps with non-corrodible bolts or by soldering. These earth conductors shall be copper tape, perforated or solid, not less than 12 mm wide and 1,2 mm thick.
- All non-current carrying metallic parts and enclosures of electrical equipment and metallic structures used for mounting electrical equipment will be effectively bonded to earth throughout the plant so as to ensure that all exposed conductive parts are at substantially equal potential during normal operation and under fault conditions.
- All exposed conductive parts of equipment, piping, vessels and structural items will be effectively bonded so as to prevent the accumulation of static charge.
- Metal sheaths and steel armouring of cables shall be earthed in the switchgear and at the load end. Care must be taken to ensure that the metal sheaths and armouring are interconnected at cable branches or joints.
- To bridge the insulating effect of the anti-vibration mountings on mechanical packages, bonding conductors will be used to connect the insulated equipment to the adjacent structural steel.
- Particular Specification E11 provides detailed specifications of the earthing and lightning protection

20. Labelling

- The Electrical Contractor shall supply and install labels for all equipment, distribution boards, control panels, etc. corresponding with the designations shown on the drawings and or schedules.
- All labels shall be of plastic "sandwich board" material, the legends being engraved through the front plastic layer to the contrasting inner layer.
- The lettering shall be not less than 6 mm high, in sans-serif capitals. Black lettering on a white background shall be selected to ensure maximum legibility.
- All labels shall be secured with at least two screws or rivets and shall be accurately level and central over their subjects. The Electrical Contractor may propose alternative methods of labelling which he considers superior to that specified, but shall use the specified method without extra charge, if required to do so by the Engineer.

21. Testing and Commissioning

- The Contractor shall carry out all the necessary testing and commissioning of all equipment and systems, including the earthing system, function testing, etc.
- The Contractor is responsible to conduct a complete internal Factory Acceptance Test (FAT) and

- approve all equipment before releasing to the Principal Representative and the Client, for inspection.
- The contractor being responsible for the performance of all inspection and testing activities associated with equipment installed by Contractor as well as full system checks.
- As a minimum, the following quality control checks are required:
- Megger tests and record sheets for all cables within the contractor's scope,
- Issuing of Certificate of Compliance (COC) for all relevant systems within the Contractor's scope,
- Visual inspections and final checkout of all installations.
- The creation of a 'Hand Over File' for each electrical item of equipment, which shall include copies of all relevant 'As-Built', marked up drawings and approved Quality Control Certificates.
- Field Instrumentation Calibration and Testing : The contractor being responsible for the performance of all calibration, inspection and testing activities associated with equipment installed by Contractor as well as full system checks.
- The creation of a 'Hand Over File' for each electrical item of equipment, which shall include copies of all relevant 'As-Built', marked up drawings and approved Quality Control Certificates.
- Certificate of Compliance: The Sum Price for this item shall include, but not be limited to:
- Issuing of Certificate of Compliance (COC) for all relevant systems within the Contractor's scope.

22. Particular Specifications

- Particular Specifications Attached

REFERENCE	PARTICULAR SPECIFICATION
E01	CONDITION ASSESSMENT
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 CABLES
E06	ELECTRICAL MEDIUM AND LOW VOLTAGE CABLE INSTALLATION
E08	ELECTRICAL WIRING
E09	ELECTRICAL BUILDING INSTALLATION
E11	GENERAL ELECTRICAL EARTHING AND LIGHTNING PROTECTION
E12	ELECTRICAL MEDIUM VOLTAGE CABLES (underground installation)
E16	ELECTRICAL UNINTERRUPTIBLE POWER SUPPLY UNIT
E17	VARIABLE SPEED DRIVE (VSD) UNITS
E18	DISTRIBUTION BOARDS

PARTICULAR SPECIFICATION

E01: CONDITION ASSESSMENT

PARTICULAR SPECIFICATION : VOLUME E01 : ELECTRICAL LOW VOLTAGE POWER AND CONTROL CABLES

E01.1 SCOPE

This specification covers the technical requirements for the condition assessment of Medium Voltage (MV) and Low Voltage (LV) power cables. This document defines the testing protocols required to evaluate insulation integrity, detect aging mechanisms (such as water treeing), and determine the remaining service life of the cable asset.

E01.1.1 Statutory Documents and Standards

The testing and evaluation shall be performed in accordance with the latest revisions of:

IEEE 400.2 : Guide for Field Testing of Shielded Power Cable Systems Using Very Low Frequency (VLF).

IEEE 400.3 : Guide for Partial Discharge Testing of Shielded Power Cable Systems in a Field Environment.

IEC 60502 : Power cables with extruded insulation.

SANS 10198 : The selection, handling, and installation of electric power cables of rated voltage not exceeding 33 kV (relevant for South African installations).

IEC 60540 : Test methods for insulations and sheathes of electric cables and cords

SANS 1507 : Electrical cables with extruded solid dielectric insulation for fixed installations

SANS 1411 : Materials of insulated electric cables and flexible cords

SANS 10142-1 : The Wiring of Premises Part 1 – Low Voltage Installations

IEC 173 : Flexible cords

IEC 245 : Rubber insulated cables

IEC 287 : Current rating calculations

IEC 540 : Insulation tests

VDE 0250 : Standard for insulated wires and flexible cables

The Occupational Health and Safety Act (Act No. 85 of 1993)

E01.2 INSPECTION & TEST METHODOLOGY

E01.2.1 Inspection

Route Inspection: Verify cable route markers, trench integrity, and support structures (for rack-mounted cables). Check for signs of mechanical damage, cable stress, etc.

Termination Inspection (Thermography): Infrared scanning of cable terminations at switchgear and transformers to detect high-resistance joints.

Online Partial Discharge (PD) Screening: Use of Transient Earth Voltage (TEV) and High-Frequency Current Transformers (HFCT) clamped around earth straps to detect PD activity in terminations and joints without switching off.

Testing

Requires the cable to be de-energized and isolated at both ends.

Dielectric Insulation Resistance (IR) & Polarization Index (PI)

- Method: Apply DC voltage (1kV for LV, 5kV for MV) for 1 minute (IR) and 10 minutes (PI).
- Objective: To identify gross contamination or moisture ingress.
- **Acceptance Criteria:**
 - For low-voltage cables (under 1kV) an insulation resistance (IR) test result of 1 MΩ or higher is the absolute minimum acceptable value aligned with SANS10142-1
 - MV Cables: > 100 MΩ (minimum), typically > 1 GΩ for healthy XLPE.
 - PI Ratio (10min/1min): > 2.0 indicates good insulation condition.

E01.3 MEASUREMENT AND PAYMENT

Measurement and payment will distinguish between inspection and testing of cables.

<u>Item</u>	<u>Unit</u>
a) Condition assessment and report - Inspection	No
The rate unit shall include a route inspection as specified in E01.2.1 above and reporting. The report should include condition of route and infrared results on panels.	
<u>Item</u>	<u>Unit</u>
b) Condition assessment and report - Testing.....	No
The rate unit shall include a detailed condition assessment report indicating all cables tested with results of visual assessment and insulation resistance test. At minimum, the report shall state assessment outcome if the cable has passed or failed. The report shall include cable size, length, connection source and destination load	

PARTICULAR SPECIFICATION

E02: ELECTRICAL CABLE RACKS

PARTICULAR SPECIFICATION : VOLUME E02 : ELECTRICAL CABLE RACKS

E02.1 SCOPE

This specification covers the supply, delivery and installation of cable ladders for industrial installations. Only cable ladders are to be supplied. Cable trays shall not be acceptable. Cable ladders are not recommended for large cables and open ground as they expose the cable to theft.

E02.1.1 Statutory Documents and Standards

Cable ladders shall be manufactured in accordance with the requirements of the latest editions of the following standards:

- ☐ SANS 10044 : Welding
- ☐ SANS 10064 : Preparation of steel surfaces for coating
- ☐ SANS 10158 : Glossary of terms for quality assurance and quality control
- ☐ SANS 10214 : The design, fabrication and inspection of articles for hot-dip galvanising
- ☐ SANS 1274 : Coatings applied by the powder process
- ☐ SANS 10044 : Welding Part 3: The fusion of steel (including stainless steel): Tests for the approval welding procedures and production welds
- ☐ SANS 10044 : Welding Part 4: The fusion of steel (including stainless steel): Tests for the approval of welders working to approved welding procedures
- ☐ SANS 10044 : Welding Part 5: The fusion of steel (including stainless steel): Tests for approval of welders where weld procedure approval is not required
- ☐ SANS 10162-1 : The structural use of steel Part 1: Limit-states design of hot-rolled steelwork
- ☐ SANS 10162-2 : The structural use of steel Part 2: Limit-states design of cold-formed steelwork
- ☐ SANS 10162-4 : The structural use of steel Part 4: The design of cold-formed stainless steel structural members
- ☐ SANS 10142-1 : The wiring of premises Part 1 – Low voltage Installations

E02.1.2 Particular Specifications to be read in conjunction with this specifications

This specification shall be read in conjunction with the following specifications:-

G01: PARTICULAR SPECIFICATION FOR COLOUR CODES

G02: PARTICULAR SPECIFICATION FOR CORROSION PROTECTION

E06: ELECTRICAL MEDIUM AND LOW VOLTAGE CABLE INSTALLATION

E02.2 CABLE LADDER MATERIAL

All cable ladders shall, unless otherwise specified, be heavy-duty cable ladder standard pattern. Metal cable ladders shall be manufactured from corrosion resistant galvanized Steel. For severe corrosion areas GRP material should be used.

All metal cable ladders shall consist of a 76 mm high side rail. The minimum sheet thickness of the material that the cable rack is to be manufactured from shall at least be 2mm. Cross rungs shall be spaced at maximum interval of 250 mm. Where cables of 10mm² or smaller are installed on cable ladders, the spacing of the cross rungs shall be a maximum of 125 mm.

E02.3 CABLE LADDER ACCESSORIES

E02.3.1 General

Cable ladder accessories shall be considered to be horizontal bends, vertical bends, internal bends, external bends, Tee-pieces, cross-pieces, reducers (transition pieces), support struts and fasteners. The accessories shall have dimensions that correspond to the dimensions of the linear sections to which they are connected. The radii of all bends shall be 1 m minimum.

The inside dimensions of horizontal angles or connections shall be large enough to ensure that the allowable bending radius of the cables is not exceeded. Sharp angles shall be 45° metered.

E02.4 INSTALLATION

Cable ladders shall be installed within accessible civil constructed cable ducts. These ducts may form part of the scope of works or may be existing.

Cable ladders are required to be installed within the cable ducts in the motor control centre rooms, on site electrical reticulation, and on access platforms to the mechanical equipment.

Cable ladders shall be installed within accessible cable ducts and shall be supported by a unistrut section securely fixed to the wall. The corrosion protection shall be of the same system as that of the cable ladder.

Cable ladders shall be supported with the struts, channels, brackets, clamps, cantilever arms and nuts/bolts/washers.

The platform mounted cable ladder reticulation shall be installed at minimum of 150 mm from the supporting concrete structure.

Crevice corrosion of the metal elements in contact with concrete surface shall be eliminated by means of a suitable layer of non-shrink grouting.

Unless otherwise agreed, all screws, bolts and nuts shall be hexagonal to ISO Metric commercial standards. All bolts, nuts, springwashers, etc shall be stainless steel 316.

E02.5 EARTH BONDING OF CABLE RACKING

All joints must be continuously electrically bonded with earth bonding. The ends of the racking must be connected to a network earth using bare earthwire conductor.

E02.6 CORROSION PROTECTION

All cable ladders and the cable ladder accessories shall be coated as specified below.

The preparation of the metal surfaces of the cable ladders and cable ladder accessories shall be in accordance with the latest edition of SANS 10064, prior to the application of protective coating.

Corrosion protection shall conform to the coating system stated below:

E02.6.1 Powder Coating Systems

E02.6.1.1 Paint System 1: Powder Coating, seven (7) stage zinc phosphate treatment, pure epoxy primer, polyester finishing coat, thickness 140 µm.

Paint System	Host Material	Preparation	Primer Coat	Finishing Coat	Dry film Thickness
			(70 µm)	(70 µm)	(µm)
No 1	304 L SS	7 stage zinc phosphate pre-treatment	Epoxy	Epoxy	140

E02.6.1.2 Upon the completion of the corrosion protection specified, the Contractor shall be required to perform the following quality control testing procedures:-

- ☐ Impact testing in accordance with SANS 10400
- ☐ Cross hatch adhesion test
- ☐ Bend test

E02.6.1.3 The corrosion protection shall form part of the quality control system as approved by the Engineer
C3.4.6-23

and the Tenderer shall submit a certificate of compliance upon the delivery of all cable cable rack protected.

E02.6.1.4

Epoxy Powder Coat Products

Item	Product type	Powder – Lak
1	Epoxy primer	23-007
2	Pure Epoxy / Polyester finishing coat	Series 3000

E02.7

MEASUREMENT AND PAYMENT

Item **Unit**

a) Supply and deliver cable ladder m

The unit of measurement shall be per linear length in meter of cable ladder supplied and delivered. Separate items shall be scheduled to include for each size of cable ladder required under the Contract. The unit shall include all mounting accessories

The tendered rates shall include for the manufacture, supply, delivery, handling and inspection of the complete cable ladder.

Item **Unit**

b) Install cable ladder.....m

The unit of measurement shall be per linear meter of cable ladder installed. Separate items will be scheduled in the Schedule of Quantities differentiating each size of cable ladder installed under the Contract.

The tendered rates shall include for all labour, handling, the cutting at points of change in direction, jointing, etc, for the complete installation and inspection of the cable ladders installed under the Contract.

Item **Unit**

c) Supply and deliver horizontal bends..... No

The unit of measurement shall be the number of horizontal bends supplied and delivered. Separate items shall be scheduled to include for each size of horizontal bend required under the Contract.

The tendered rates shall include for the manufacture, supply, delivery, handling and inspection of the complete horizontal bends.

Item **Unit**

d) Install deliver horizontal bends No

The unit of measurement shall be the number of horizontal bends installed. Separate items will be scheduled in the Schedule of Quantities differentiating each size horizontal bend installed under the Contract.

The tendered rates shall include for all labour, handling, the cutting at points of change in direction, jointing, etc, for the complete installation and inspection of the horizontal bends installed under the Contract.

Item **Unit**

e) Supply and deliver vertical bends No

The unit of measurement shall be the number of vertical bends supplied and delivered. Separate items shall be scheduled to include for each size of vertical bend required under the Contract.

The tendered rates shall include for the manufacture, supply, delivery, handling and inspection of the complete vertical bends.

Item **Unit**

f) Install deliver vertical bends No

The unit of measurement shall be the number of vertical bends installed. Separate items will be scheduled in the Schedule of Quantities differentiating each size of vertical bend installed under

the Contract.

The tendered rates shall include for all labour, handling, the cutting at points of change in direction, jointing, etc, for the complete installation and inspection of the vertical bends installed under the Contract.

<u>Item</u>	<u>Unit</u>
g) Supply and deliver internal bends	No

The unit of measurement shall be the number of internal bends supplied and delivered. Separate items shall be scheduled to include for each size of internal bend required under the Contract.

The tendered rates shall include for the manufacture, supply, delivery, handling and inspection of the complete internal bends.

<u>Item</u>	<u>Unit</u>
h) Install deliver internal bends	No

The unit of measurement shall be the number of internal bends installed. Separate items will be scheduled in the Schedule of Quantities differentiating each size of internal bend installed under the Contract.

The tendered rates shall include for all labour, handling, the cutting at points of change in direction, jointing, etc, for the complete installation and inspection of the internal bends installed under the Contract.

<u>Item</u>	<u>Unit</u>
i) Supply and deliver external bends	No

The unit of measurement shall be the number of external bends supplied and delivered. Separate items shall be scheduled to include for each size of external bend required under the Contract.

The tendered rates shall include for the manufacture, supply, delivery, handling and inspection of the complete external bends.

<u>Item</u>	<u>Unit</u>
j) Install deliver external bends	No

The unit of measurement shall be the number of external bends installed. Separate items will be scheduled in the Schedule of Quantities differentiating each size of external bend installed under the Contract.

The tendered rates shall include for all labour, handling, the cutting at points of change in direction, jointing, etc, for the complete installation and inspection of the external bends installed under the Contract.

<u>Item</u>	<u>Unit</u>
k) Supply and deliver Tee-pieces	No

The unit of measurement shall be the number of Tee-pieces supplied and delivered. Separate items shall be scheduled to include for each size of Tee-piece required under the Contract.

The tendered rates shall include for the manufacture, supply, delivery, handling and inspection of the complete Tee-pieces.

<u>Item</u>	<u>Unit</u>
l) Install deliver Tee-pieces	No

The unit of measurement shall be the number of Tee-pieces installed. Separate items will be scheduled in the Schedule of Quantities differentiating each size of Tee-pieces installed under the Contract.

The tendered rates shall include for all labour, handling, the cutting at points of change in direction, jointing, etc, for the complete installation and inspection of the Tee-pieces installed under the Contract.

<u>Item</u>	<u>Unit</u>
m) Supply and deliver cross-pieces	No

The unit of measurement shall be the number of cross-pieces supplied and delivered. Separate items shall be scheduled to include for each size of cross-piece required under the Contract.

The tendered rates shall include for the manufacture, supply, delivery, handling and inspection of the complete cross-pieces.

<u>Item</u>	<u>Unit</u>
n) Install deliver cross-pieces	No

The unit of measurement shall be the number of cross-pieces installed. Separate items will be scheduled in the Schedule of Quantities differentiating each size of cross-pieces installed under the Contract.

The tendered rates shall include for all labour, handling, the cutting at points of change in direction, jointing, etc, for the complete installation and inspection of the cross-pieces installed under the Contract.

<u>Item</u>	<u>Unit</u>
o) Supply and deliver reducers (transition-pieces)	No

The unit of measurement shall be the number of transition pieces supplied and delivered. Separate items shall be scheduled to include for each size of transition-piece required under the Contract.

The tendered rates shall include for the manufacture, supply, delivery, handling and inspection of the complete transition-pieces.

<u>Item</u>	<u>Unit</u>
p) Install deliver transition-pieces	No

The unit of measurement shall be the number of transition-pieces installed. Separate items will be scheduled in the Schedule of Quantities differentiating each size of transition-pieces installed under the Contract.

The tendered rates shall include for all labour, handling, the cutting at points of change in direction, jointing, etc, for the complete installation and inspection of the transition-pieces installed under the Contract.

PARTICULAR SPECIFICATION

E03: ELECTRICAL ISOLATOR PUSHBUTTON STATION (LOCAL START/STOP) EQUIPMENT

PARTICULAR SPECIFICATION : VOLUME E03 : ELECTRICAL ISOLATOR PUSHBUTTON STATION (LOCAL START/STOP) EQUIPMENT

E03.1 SCOPE

This section covers the requirements for local isolator/start/stop pushbutton stations. Local isolator/start/stop pushbutton stations shall be supplied, delivered, installed and commissioned for each mechanical equipment driven by a motor.

E03.2 STANDARDS

The latest edition, including all amendments up to date of tender of the following particular national specifications, publications and codes of practice shall be read in conjunction with this specification and shall be deemed to form part thereof:

(a)	SANS 62262	Enclosures for electrical equipment classified by IP code
(b)	SANS 10142-1	The Wring of Premises Part 1 – Low-voltage Installations
(c)	SANS 60439	Low-voltage Switchgear and Control gear Assemblies
(d)	IEC 60529	Degrees of Protection of Enclosures for Low Voltage Switchgear and Control gear
(e)	BSCP 1014	Protection of Electrical Power Equipment against Climatic Conditions
(f)	SANS 60947	Low-voltage Switchgear and Control gear:
	Pt 1	General rules
	Pt 2	Circuit breakers
	Pt 3	Switches/Isolators/Switch Isolators and Combination Fuse Switch Units
(g)	BSS 3858	Binding/Identification Sleeves for Cables and Wires
(h)	BSS 152	Electric Power Switchgear and Associated Apparatus
(i)	BSS 158	Marking and Arrangement for Switchgear Busbars Main Connections of Auxiliary Wiring
(j)	SANS 1091	National Colour Standards for Paint
(k)	BSS1767	Grommets
(l)	Occupational Health and Safety Act 85 of 1993 (as amended)	

E03.3 GENERAL REQUIREMENTS

E03.3.1 Particular specifications to be read in conjunction with this specification

This specification shall be read in conjunction with the following specifications:-

G01: PARTICULAR SPECIFICATION FOR COLOUR CODES

G02: PARTICULAR SPECIFICATION FOR CORROSION PROTECTION

E08: WIRING

E03.3.2 General Requirements

- (a) The enclosure shall be of a 3CR12 material equipped with a motor isolator to match each motor rating as specified in the motor equipment schedules. Where the station is to be placed in highly corrosive areas, a tougher material like GRP is preferred.
- (b) The Start/Stop pushbutton or control station shall be mounted adjacent to the motor which it shall control. and shall be located at a radius of 1000mm at the most from the equipment it controls.
- (c) The station shall be pedestal mounted at least 1100mm above floor level. The pedestal design shall be approved by the Engineer.
- (d) The pedestal base plate shall be installed on 10mm of epoxy grout to prevent crack

corrosion.

- (e) The pedestal material shall be mild steel and have minimum thickness of 6mm. The pedestal shall be painted, B26 electric orange.
- (f) All START pushbuttons shall be GREEN and flush mounted with the bezel.
- (g) A mushroom head latching push button suitable to serve as an EMERGENCY STOP shall be fitted to each of the enclosure provided under the contract.
- (h) The EMERGENCY STOP button shall be a “twist to release” type.
- (i) The EMERGENCY STOP button shall be lockable for added protection for maintenance staff.
- (j) The station enclosure shall be designed to provide adequate space for the following:
 - The required switches, indicating lights and their respective labels.
 - A single multi-core control cable (including glanding) shall be installed from the MCC to the station, from where the required signals shall be individually wired, as per the cable schedule.
 - Power cable/s (including glanding) shall be installed from the MCC to the station, providing power to the individual motor, as per the cable schedule, terminated at an isolator in the panel. The isolator shall be rated for off-load conditions.

E03.4 DIMENSION FOR ISOLATOR STATION

The start/stop isolator pushbutton station shall be of IP65 rating to SANS 1222 and shall be fitted with a canopy. The minimum dimensions of the start/stop isolator pushbutton stations shall be 300 mm (L) x 250 mm (H) x 200 mm (D).

The junction box including the canopy and the support stand shall be painted B26 – Electric Orange.

E03.5 FASTENERS

All fasteners in concrete shall be 316 SS and pedestal bases shall be sealed against the ingress of any crevice corrosion by means of a suitable non shrink cementitious grout and approved by the Engineer.

E03.6 MEASUREMENT AND PAYMENT

<u>Item</u>	<u>Unit</u>

a) Supply and delivery of local start/stop isolator pushbutton stations	No

The unit of measure shall be the number of stations supplied and delivered.

The tendered rate shall include all costs related to the manufacture, supply and delivery of the local start/stop isolator pushbutton or control stations (as detailed in the schedule of quantities), including support pedestal in accordance with this specification and the additional requirements detailed in the detail specification complete with all mounting brackets.

Separate items will be scheduled in the schedule of quantities for different types and sizes, defined by the kW rating of the driven equipment, of pushbutton / control stations.

<u>Item</u>	<u>Unit</u>

b) Install and commission local start/stop isolator pushbutton stations	No

The unit of measure shall be the number of stations installed.

The tendered rate shall include full compensation for installing, testing and commissioning of the local start/stop isolator or control stations as specified. The rate shall further include for pedestal support securing and sealing preventing crevice corrosion.

Separate items will be scheduled in the schedule of quantities for different types of pushbutton / control stations.

Separate items will be scheduled in the schedule of quantities for different types and sizes, defined by the kW rating of the driven equipment, of pushbutton / control stations.

PARTICULAR SPECIFICATION

E04: ELECTRICAL LOW VOLTAGE SWITCHBOARDS AND MOTOR CONTROL CENTRES

PARTICULAR SPECIFICATION : VOLUME E04 : ELECTRICAL LOW VOLTAGE SWITCHBOARDS AND MOTOR CONTROL CENTRES

E04.1 INTRODUCTION

This specification is for the supply of low voltage (380V) distribution switchgear.

All equipment and services shall comply with the mandatory requirements of the Occupational Health and Safety Act 85 of 1993 and regulations (as amended).

E04.2 SCOPE

E04.2.1 General

The scope of work includes the furnishing of all labour, material and services for the design, supply, manufacture, testing and inspection at works, delivery to site, off loading and rectification of defects developing during the warranty period for equipment as specified below.

E04.2.2 Work to be Included

The work includes, but shall not be limited to the items listed below.-

- (a) All work in E04.2.1 above.
- (b) Documentation, as called for in the vendor QA and document requirement list and drawings and data.
- (c) The supply of one complete set of any special tools required per Motor control centre that will be required for operation or maintenance purposes, including three spare sets of each type of fuse.
- (d) Recommended spares for one year's operating period and prices of same.
- (e) Technical assistance if requested during checking for operational readiness.

E04.3 STANDARDS

In general work and materials shall be in accordance with the latest practice and in particular in accordance with the latest revision of the following specifications, and any amendments thereto, the SANS specification taking precedence:

SANS 10142-1	The Wiring of Premises Part 1 – Low-voltage Installations
SANS 60439	Low-voltage Switchgear and Control gear Assemblies
SANS 1973-1	Low-voltage Switchgear and Control gear Assemblies
IEC 60529	Degrees of Protection of Enclosures for Low Voltage Switchgear and Control gear
BSCP 1014	Protection of Electrical Power Equipment against Climatic Conditions
SANS 60947	Low-voltage Switchgear and Control gear: Pt 1 General rules Pt 2 Circuit breakers Pt 3 Switches/Isolators/Switch Isolators and Combination Fuse Switch Units Pt 4 Contactors Pt 5 Relays
IEC 60337	Low Voltage Control Switches
IEC 60228/BSS 159	Busbars, Main Connections and Small Wiring for Switchgear
BSS 3858	Binding/Identification Sleeves for Cables and Wires

SANS 1507	Electric Cables with Extruded Solid Dielectric Insulation For Fixed Installations (300/500V to 1900/3300V)
SANS 1574	Electric Cables – Flexible Cords and Flexible Cables
SANS 1619	Small Power Distribution Units (Ready Boards) for Single-phase 230V Service Connections
SANS 61643	Surge Protective Devices Connected to Low-voltage Power Distribution Systems
SANS 61238-1	Compression and Mechanical Connectors for Power Cables with Copper or Aluminium Conductors, Part 1: Test Methods and Requirements
IEC 60730-2-7	Timer Switches
SANS 61036	Alternating Current Static Watt-hour Meters for Active Energy (Classes 1 and 2)
BSS 1322	Aminoplastic Moulding Materials
BSS 152	Electric Power Switchgear and Associated Apparatus
BSS 158	Marking and Arrangement for Switchgear Busbars Main Connections of Auxiliary Wiring
SANS 60076/BSS 3535	Transformers
SANS 1091	National Colour Standards for Paint
IEC 60185/BSS 3938	Current Transformers
IEC 60186/BSS 3941	Voltage Transformers
IEC 6043/BSS 37	Meters
IEC 6051/BSS 89	Indicating Instruments
BSS 142	Protective Relays
SANS 156	MCB's and MCCB's
SANS 1195	Busbars
BSS 1767	Grommets

E04.3.1 Particular specifications to read in conjunction with this specification

This specification shall be read in conjunction with the following specifications:-

G01: PARTICULAR SPECIFICATION FOR COLOUR CODES

G02: PARTICULAR SPECIFICATION FOR CORROSION PROTECTION

E06: ELECTRICAL MEDIUM AND LOW VOLTAGE CABLE INSTALLATION

E08: WIRING

E04.4 CODES

All equipment and services shall comply with the mandatory requirements of:

- (a) Mine Health and Safety Act 29 of 1996 and Regulations (as amended).
- (b) Occupational Health and Safety Act 85 of 1993 (as amended).
- (c) Road Traffic Act, Act No 29 of 1989 (as amended).
- (d) The SANS Standard and Regulations for the wiring of premises (SANS 10142-1) (as amended).
- (e) The South African Minerals Act 50 of 1991 (as amended).

E04.5 DESIGN CRITERIA AND MATERIAL OF CONSTRUCTION

E04.5.1 System Details

Busbar voltage 380V $\pm$ 10% (or 400V $\pm$ 10%) as per system voltage.

Phases 3

Frequency 50 Hz

Phase rotation R-Y-B-R

Note:

The fault levels as indicated on drawings shall be deemed to be the maximum current occurring

at the Motor control centres under symmetrical short circuit conditions on the line side of the final limiting device in a circuit. The duration of the maximum short circuit currents shall be deemed to be a minimum of one second. Evidence (in the form of Certificates from testing authorities recognised by City of Tshwane) of the ability of the 380V distribution switchgear boards offered to withstand satisfactorily the prospective fault conditions shall be furnished with the tender.

E04.6

MANUFACTURING AND CONSTRUCTION DETAILS

E04.6.1

Mechanical Construction - General

- (a) The Motor control centres shall be fixed pattern, comprising one or more fully interchangeable modular, rigid, free standing sections, bolted together to form an extensible, composite, rigid, free standing and vermin proof Motor control centre of uniform appearance. Each section shall be divided vertically into panels. Each panel shall be divided into one or two cubicles one above the other.
- (b) The overall height of the panel may not be more than 2400mm including the channel iron frame.
- (c) A channel iron frame (minimum 100mm x 50mm) shall be provided under each completed section of transportable length which shall be so constructed that it can be used for lifting the transportable section without distortion taking place. The maximum length of the transportable sections shall not exceed 3000mm.
- (d) All completed sections shall be provided with lifting lugs and shall have sufficient strength to withstand all stresses occurring during transportation, installation and operation without distortion or damage.
- (e) The Motor control centre shall be compartmentalised to segregate busbar, cable, circuit-breaker and instrument zones, in such a manner that prospective damage resulting from electrical faults will be minimised and confined to the zone cubicle or compartments in which the fault occurs. Power busbars shall be completely separated from any other compartment by means of suitably earthed metallic barriers.
- (f) Separate compartments shall be provided for each moulded case circuit breaker and instrument section.
- (g) Access to all power busbar compartments shall be by removable bolted covers. Removable covers shall be provided with captive screws.
- (h) Incoming feeder, outgoing feeder, relay, control transformer and metering and instrumentation cubicles shall have doors suitably constructed to ensure rigidity. Doors shall be fitted with robust steel or brass hinges with at least two 6mm square recessed quick close/open latches.

Hinges shall be provided at 500mm intervals per door with a minimum of two hinges per door. Each door shall be fitted with an equal number of hinges and latches. At least one of these latches shall be padlockable.

Doors and covers shall be provided with a high density neoprene gasket to form a firm seal. The neoprene seal shall be a nominal 5mm thick compressed to 3mm on closing of the door. The entire switchboard shall be effectively dust and splash proof to IP 54.
- (i) All hinged doors shall be fitted with a robust mechanism to latch and hold the door in the wide-open position, to minimise inadvertent contact with live parts during maintenance operations.
- (j) All hinged doors shall open to a minimum of 135° from the closed position, to facilitate easy access for maintenance.
- (k) Under no circumstances should rear doors have a width exceeding 750mm.
- (l) Attention shall be given to ventilation to prevent the accumulation of ionised gases. Suitable drip proof, fine mesh screened, vermin proof openings shall be provided to facilitate air movement by convection. These openings shall be arranged such that the hot gasses or other materials cannot be discharged in a manner injurious to operating personnel.
- (m) Sectionalised removable gland plates shall be fitted and shall be fixed by means of captive nuts or screws and so located that ample space is available for the satisfactory entry and termination of cables. Cable entry shall be at the bottom of the board. All gland plates are

to be connected to the main panel earth bar via suitably sized copper conductors and unused sections shall be left blank. Gland plates for three-core cable of cross-sectional area 70mm² and above shall be minimum 5mm plate.

Gland plates shall be galvanised. Where single core cables are used, gland plates are to be of non-magnetic material or slit to mitigate effect of eddy currents. The cable gland compartments shall have removable covers attached with standard 6mm square recessed quick close/open latches.

- (n) Suitable termination points shall be provided to enable any multiple three-core cables to be terminated without cross-overs of different phases and with minimum lengths of cable "tails". All cable termination points and associated connections shall be suitably braced to withstand the available fault currents without damage. If necessary cable support clamps shall be provided for the individual cores after glanding off.

In addition to any support/bracing required by the electrical conditions, the busbars shall also have sufficient support to prevent stresses being transmitted to the circuit breakers or any components by cable terminations. Particular attention must be paid to the termination arrangements of any multiple incoming three-core cables to ensure adequate glanding space.

- (o) Flash barriers shall be furnished to increase creepage distance between phases and shall be furnished on all circuit breaker cradles between the phases on the busbar riser section.
- (p) Spare compartments shall be equipped generally as detailed on the single line diagram, and shall include all circuit breakers, busbars, wiring, instruments, etc, with the exception that, in the case of withdrawable circuit breakers, only the breaker cradle shall be furnished.
- (q) The general structure of the board shall be designed and fabricated to ensure that no excessive vibration caused by the operation of any component is transmitted to any other components, thereby causing spurious tripping of any device.
- (r) Unless otherwise agreed or stated in this Specification, all screws, bolts and nuts shall be hexagonal to ISO metric commercial standards and shall be rustproof. Loose 'bolts and nuts' shall **not** be used on steelwork. Blind threaded fastening system bushings or equivalent shall be used for thread sizes M5 and above. Studs projecting from the exterior surfaces of the board shall have chrome or cadmium plated dome nuts. Self-tapping screws shall not be utilised for any purpose on any equipment.
- (s) The switchboard steelwork shall be a minimum of 2mm thick, irrespective of the type of steel used.
- (t) Each cubicle/compartment door shall be labelled with the reference letter(s) of that compartment, using durable designation label with 30mm high black letters on a white background. The labels shall have two designation letters, the first being the tier, numbered from A, left to right and the second the cubicle, numbered from A top to bottom.
- (u) Every door and/or removable cover giving access to a cubicle shall bear a durable designation label suitably inscribed with the description and the equipment number where applicable, using engraved black characters at least 6mm high on white background. Incomers shall be labelled as indicated on the single line diagrams.
- (v) The Motor control centre shall be provided with an identity label, engraved with 30mm high black on white characters and shall be mounted on top of the switchgear.
- (w) All removable covers/doors protecting live equipment shall be fitted with warning labels. Warning labels shall be engraved red characters 6mm high on a white background.

Each circuit shall be provided with a blank white/black white traffolyte type label (or engraved in accordance with designations on drawings).

All electrical components/equipment shall be labelled ((with designations corresponding to those of the Purchaser's schematic diagrams) to facilitate recognition. Engraving shall be left to the discretion of the manufacturer but shall be legible and durable. The component labels shall be affixed adjacent the component they refer to.

All labels and label brackets shall be affixed by machine screws. Adhesive labels are not acceptable.

- (x) Incomers shall be labelled "Incomer from" and the standby bus coupler

(where applicable) shall be labelled "Standby Bus Coupler".

- (y) Over and above labelling requirements of this specification, the labelling requirements of SANS 10142-1 must also be met.
- (z) Doors to compartments shall be so arranged that normally they cannot be opened whilst the apparatus contained is live, unless this apparatus is fully shrouded or screened to IP20 to prevent inadvertent contact. Doors shall be designed to ensure rigidity and shall be a neat fit in the framework and around the circuit breaker escutcheon plate.
- (aa) Circuit breakers shall be interlocked with the panel door to prevent opening of the door when the circuit breaker is in the "ON" position.

A non-apparent interlock defeat shall be provided for the opening of the door with the circuit breaker in the "ON" position for testing and maintenance. In addition there shall be provision for the attaching of three padlocks to each operating handle in the "OFF" position, which prevent the circuit breaker from being operated.

All access doors are to be effectively and permanently earthed to the main panel enclosure of the switchgear, by means of a suitable braided copper earth strap, not less than 16mm², crimped with lugs and bolted at each end to the door and enclosure.

E04.6.2 Mechanical Construction - Busbar Ducts (where required)

- (a) Busbar ducts shall be furnished for the interconnection of the standby bus between the various Motor control centres.
- (b) The bus ducting shall have suitable sealing at each end, between the bus duct and switchgear, and shall be constructed so as to ensure that any fire or other fault cannot spread between the various sections.
- (c) Busbar ducts shall utilise copper complying with this Specification and shall be designed for a maximum current density of 1.6A/mm². The bus ducts shall be metal enclosed, non-segregated phase type, suitable for indoor use and positively vermin proof. Ventilation slots if any shall be suitably screened with a fine mesh.
- (d) If necessary, provision shall be made for expansion or contraction of the busbars and the housing due to loadings, temperature changes and short circuit conditions.
- (e) Busbars, insulators and supports shall be braced so as to withstand the mechanical and thermal effects of the fault current.
- (f) Bus duct housing shall have bolted covers for access to busbars, insulators and joints.
- (g) Insulators shall be mounted on their supports in such a way that they can be easily removed and replaced.

E04.6.3 Electrical Construction

The electrical requirements for each Motor control centre shall be as detailed in the drawings.

E04.6.3.1 Cooling

Artificial cooling of any component will not be acceptable. All design and construction shall be based on natural cooling by convection or radiation. Forced cooling will only be acceptable where power electronic components are contained.

E04.6.3.2 Busbars and Connections

Busbars and connections shall generally comply with BS 158, BS 159 and BS 162 for air clearances. Notwithstanding the contents of the above-mentioned specifications, all solid copperwork shall be made of hard drawn high conductivity copper of constant cross-section throughout their lengths with a maximum design current density of 1,66A/mm².

Notwithstanding the requirements of BS 159, the following minimum air clearances shall be observed for busbars and other current carrying or live parts:

- ☐ Phase – Earth : 30mm
- ☐ Phase – Phase : 45mm

Where these clearances cannot be attained, suitable insulating barriers shall be employed.

In addition, all copperwork (including connections to, from and between equipment) shall have

applied solid insulation suitable for the rated voltages. Heat shrink insulation shall be used wherever possible.

Main busbars shall be rated for 2000 amps. Busbar droppers shall be manufactured from solid copper bar and rated for the maximum possible current (determined by the breaker frame size) in that section with a minimum rating of 1000 amps.

The use of flexible conductors as droppers from the main busbars to circuit breakers shall not be permitted.

Note:

- ☐ Busbars and droppers shall be housed in separate metal enclosures.
- ☐ All busbar joints shall be silver plated or tinplated. High pressure bolted lap joints shall be used and all bolts shall be of the high tensile type.
- ☐ All busbars and droppers shall be securely supported by heavy, high di-electric, non hygroscopic material with bracing to withstand stresses due to short circuits of one second duration and at least equal to the interrupting rating of the circuit breaker protecting the busbars.
- ☐ All insulation used on electrical conductors/connections and wiring shall be flame retardant types, constructed of low toxicity materials.
- ☐ Power wiring on the "live" side of the circuit breakers (busbar dropper to circuit breaker) shall be **as short as** possible, sized to carry the maximum current continuously of the frame size of the respective breakers and shall be a flexible conductor. The flexible connection shall be provided on all such connections and shall be designed so as to prevent the transmission of any forces that may arise between the busbar droppers and the circuit breaker. In terms of SANS 60439, this connection is deemed to be a fault free zone and the design and use of the flexibles shall in no manner compromise this zone.
- ☐ This connection may be by way of insulated stranded conductor, laminated, insulated conductor or multistrand braid.

Notwithstanding the foregoing the minimum power wiring size shall be 25mm². Power wiring terminations shall use an appropriate crimped accessory. The pressed tubular type of accessories is preferred. **Stamped, folded, split-barrel** type accessories are **not** acceptable.

In addition, hexagonal die type hydraulic crimping shall be used for all wiring greater than 16mm².

E04.6.3.3 Earth Bar

A continuous copper main earth bar or minimum cross sectional area 70mm² shall extend the whole length of each Motor control centre. This earth bar shall, at least, be bolted to the switchgear housing at each vertical section. Crimp type terminals for 70mm² stranded copper shall be provided at both ends of the earth bar for connection of City of Tshwane earthing.

E04.6.3.4 Wiring

Each Motor control centre shall be equipped and completely wired at the factory and, only after satisfactory testing, be split, if necessary, for transport.

Control and instrumentation wiring shall be Silicone insulated throughout and of flexible, stranded, annealed, untinned copper construction. All wiring shall comply with the table below. Conductors shall comply with SANS 1411, Part 1, Table 4, Class 5.

CT Wiring	2.5mm ² phase coloured, common return black insulated, earth link.
General Control Wiring	(AC) 2.5mm ² red (DC) 2.5mm ² (positive – red, negative – black)
LED's and PLC Inputs	(AC) 0.75mm ² red (DC) 0.75mm ² (positive – red, negative – black)
Control Neutral	(AC) 2.5mm ² black
Terminal Links	2.5mm ² yellow

Notwithstanding the above mentioned requirements, the vendor shall ensure wire size used is amply rated for the applicable current, under ambient conditions. Each end of every wire shall be marked with a wire number by means of plastic cable ferrules (black lettering on a white or yellow

base). Control and instrumentation shall not be coloured yellow or blue, yellow or blue being restricted for use as bridge wires and interlocking wires respectively.

All control/instrument panel wiring shall terminate by means of suitably sized compression crimp lugs unless terminals of the pressure pad type are employed. The minimum voltage rating of the control wiring shall be 600/1000V grade to SANS 1507 and SANS 1411 Pt I and III.

All wiring shall be of the stranded type. Wiring shall be run in plastic trunking. Only where a space problem exists will loomed wiring be acceptable.

Note: Stick on harness holders are **not** acceptable.

E04.6.3.5

Wire Numbering

Cable/wire marking ferrules shall be to the codes laid down in BSS 158 and shall correlate to the appropriate schematic or wiring diagrams.

Split or open type marking ferrules shall not be used.

E04.6.3.6

Terminals

Minimum rating for terminal blocks shall be 40A. Terminal strips/blocks shall be marked with designations corresponding with the suppliers/buyers drawings. Generally terminal numbers shall be the same as the relevant wire number. No more than two wires may be connected to any one side of a terminal. 10% additional spare terminals shall be furnished.

Terminals are to be provided for all door mounted components, diodes, etc.

E04.6.3.7

Circuit Breakers

Circuit breakers shall be either fixed pattern moulded case circuit breakers or withdrawable pattern air circuit breakers complying with the following requirements:

(a) Air Circuit Breakers (ACBs)

- ☐ ACBs shall be of the withdrawable type with self aligning disconnecting devices with the disconnecting fingers preferably mounted on the breaker for ease of maintenance. The draw out mechanism shall hold the circuit breaker rigidly in the fully connected, test and fully disconnected positions.
Safety shutters shall be provided to shield the fixed part automatically when the draw out parts removed preventing access to the conductors (main and auxiliary circuits). These shutters shall be clearly labelled indicating busbar and cable sections and in addition "live" section shall be labelled "380V – LIVE/LEWENDIG". ACBs shall be equipped with inter-phase barriers.
- ☐ Each bus section ACB shall be equipped with three appropriate direct acting non-adjustable over-current trip devices.
- ☐ Each incoming ACB from a transformer shall be equipped with three direct acting, thermal inverse time over-current trip devices with adjustable current set point and three direct acting magnetic short time delay over-current trip devices with adjustable current set point and short time delay.
- ☐ The City of Tshwane Project Engineer shall take particular care to ensure that the ACB protection is correctly co-ordinated with the upstream and down stream protective devices.
- ☐ Where current and time delay set points on ACBs are adjustable these shall be accessible from the front of the ACB without removing the ACB from its cradle and shall only be adjustable when the cubicle door is open.
- ☐ Interlocks shall be provided to ensure the following:
 - that the main circuit breaker cannot be removed from or to the fully connected position unless the ACB is open.
 - that the compartment doors cannot be opened should any accessible portion of the ACB frame be energised.
 - that the breaker cannot be closed unless in the fully connected, test or fully disconnected positions.
- ☐ Mechanical deterrents shall be provided to inhibit mismatch of ACBs of different ratings.
- ☐ Provision shall be made for the padlocking of any ACB in any one of the fully connected,

test or fully open positions. In addition all ACBs shall have padlocking facility to prevent the close push button being operated when padlocked.

- ☐ ACBs employed as incomers and bus-section switches shall incorporate mechanical interlocks to prevent paralleling of incoming supplies.
- ☐ The ACBs supplied shall be three pole, magnetic operated. The mechanism shall be of the stored energy type having hand charged spring with mechanical and electrical releases for closing.
- ☐ The ACB control/protection unit shall be fitted with a transparent cover that can be sealed in the closed position to prevent tampering with the settings.

(b) Moulded Case Circuit Breakers (MCCBs)

- ☐ MCCBs shall be of the manually operated trip free type with thermal and instantaneous magnetic trips in each pole. Trip functions shall be resettable via the MCCB toggle. Generally these MCCBs will be used for the incoming circuit breakers and outgoing feeders up to a maximum rating of 800 amps.
- ☐ Each MCCB shall be fitted with a varidepth type operating handle.
- ☐ The thermal trip elements of each MCCB shall be calibrated for the maximum ambient temperature at 40°C
- ☐ Current ratings of MCCBs shall be detailed in the drawings.
- ☐ MCCBs shall be selected according to rating and fault level.
- ☐ The name of the manufacturer shall be furnished by the tenderer at tender stage.
- ☐ Each MCCB shall be provided with suitable insulation between the terminals of the MCCB and the back plate/chassis onto which the MCCB is mounted, such that any loose nut, screw, etc, which may fall between the MCCB terminals and back plate cannot cause a short circuit.
- ☐ Where interlocking is called for between the MCCBs this shall be effected using captive keys in the breaker or Lowe & Fletcher type keys.
- ☐ Miniature circuit breakers (MCBs) shall be confined to auxiliary circuits such as control and indication in which the prospective let through fault current will not exceed 2,5kA. They shall be of the thermal and magnetic trip free type.
- ☐ All outgoing circuits shall be equipped with individual core balance earth leakage units arranged to shunt trip each respective outgoing circuit.
- ☐ Outgoing circuits rated 125A and above shall have IDMT 375 mA earth leakage units. Outgoing circuits rated 100A and below shall have instantaneous 250 mA earth leakage units. All earth leakages must be of the manual reset type.
- ☐ All circuit breakers, except bus couplers and incomers, shall be connected with the switched side to the load, i.e. with reference to power flow incoming to "LINE" and outgoing to "LOAD".
- ☐ **The incoming terminals/shutters of all 380V circuit breakers shall be effectively shrouded and marked "380V LIVE - LEWENDIG" with white characters on a red ground.**

(c) 380V Power Connections

Power connections on any equipment shall **not** use "Philips"/Star type screw/socket heads. Allen type socket heads are preferred.

(d) Insulation Materials

Any insulation, filling putty, etc, used shall be selected such that it can withstand without injurious effect (mechanically or electrically), all temperatures encountered within the switchboard. All ACB boards shall have an surge arrestor fitted to the incoming ACB. This surge arrestor shall be fitted to the LIVE side of the breaker.

(e) Instruments and Meters

In general voltmeters and ammeters are a minimum requirement and shall be included as follows:

Incoming Feeders shall be equipped with a single 96mm x 96mm 5A secondary, combined

maximum demand and instantaneous ammeter. The maximum demand portion shall have a thermal movement with 15 minute time lag and drag pointer having a reset facility. It shall have a built-in saturation transformer for increased overload capacity to 90 times rated current for one second.

In addition incoming feeders shall have a 96mm x 96mm voltmeter connected to measure phase to phase voltage and phase to neutral voltage via a multi-position selector switch and a set of fuses suitably rated for voltage and short circuit current.

Outgoing feeders shall be equipped with a suitably sized 5A CT operated 96mm x 96mm 90° movement suppressed maximum demand ammeter having an overload rating of 40 x rated current for one second.

CTs shall be rated as follows:

<u>MCCB Current Rating</u>	<u>Ratio</u>
800	800/5
700	700/5
600	600/5
500	500/5
400	400/5
300	300/5
250	250/5
225	250/5
200	200/5
150	150/5
100	100/5
75	75/5
60	60/5
40	40/5
30	30/5

All current transformers shall conform to BS 3938 and IEC 285. For protection purposes class 10P CTs are to be used: for indicating purposes class 1 CTs are to be used and for metering purposes class 0,5 CTs are to be used. In general current transformer mechanical and thermal ratings shall be co-ordinated with the short circuit ratings of the equipment.

Each MCC shall be equipped with an energy meter capable of providing multiple parameters of the connection including kWh, kVAh, kW, kVA, PF, MD, etc and provide a pulsed output and Ethernet connectivity.

E04.6.4 Specific Notes

Fuses shall **not** be used for purposes other than voltmeter or kWh meter protection, unless specifically authorised. All short circuit protection shall be provided by means of circuit breakers and fast blow fuses for protecting the incoming side of the devices. In cases where the fault current level is excessively high, HRC fuses in conjunction with CB's should be considered to reduce the fault level and afford better protection for electrical personnel.

Fuse protection shall be used in cases where capacitive loads are switched i.e. Power factor correction or static capacitors panels.

E04.6.5 Labelling 5mm²

All components shall be clearly labelled with suitable inscriptions indicating their function. All labels shall be affixed by screws and have black lettering on a white ground, except danger labels which shall be white on a red ground.

To prevent confusion, identification labelling must be placed on all removable panels as well as the fixed portion of the respective enclosures.

Only safety related labelling must be fixed to removable panels.

E04.6.6 Types of motor starting

The following are the types of motor starters that available on the market:

- ☐ Direct-on-line (DOL) type motor starting
- ☐ Star/Delta (S/D) type motor starting
- ☐ Soft starting (SS) type motor starting
- ☐ Variable Frequency(Speed) Drive (VFD/VFD) type motor starting

The type of motor starting required shall be project specific and shall be indicated in the motor control centre schedule/s to be issued by the Engineer.

E04.6.7 Mechanical equipment protection devices

All the protection devices, i.e. overloads, circuit breakers, motor thermistors, motor heaters, gearbox oil flow switches etc on mechanical equipment shall be accommodated onto the individual motor starter circuits.

E04.6.8 Limit Switches

Limit switches shall be metal encapsulated precision switches with robust and compact explosion-proof structures.

Cables shall be equipped with a strain-relief device and safely cast into the enclosure. Switches shall have bottom, side or lateral cable outlets as per the requirement of the application. The integrated basic switch shall have a single-pole changeover contact with a high switching accuracy and a precise repeatability of the switching point.

It shall have high vibration resistance and long mechanical life. It shall have a high protection class that would allow the switch to be used in all processes.

The limit switch shall meet the following minimum requirements:

Operating ambient temperature

- ☐ -20 °C to +90 °C

Equipotential bonding

- ☐ External Ex terminals

Switching capacity

- ☐ 6.5 A at 250V AC
- ☐ 0.16 A at 230 V DC

Mechanical data

Switching point tolerance

- ☐ +/-0.5 mm depending on the actuator

Switching force tolerance

- ☐ +/-1 N

Repeat accuracy

- ☐ +/-1 mm

Protection class

- ☐ IP 67 according to DIN 40050

Mechanical life

10⁶ switching cycles

Vibration resistance

10 g at 10 to 2 000 Hz

Shock resistance/shock stability

50 g at a shock duration of 6 ms

E04.7**QA REQUIREMENTS**

The vendor / contractor will be responsible for the following.

TABLE OF CONTENTS			
SECTION	DESCRIPTION	REQUIRED (YES OR NO)	WHEN REQUIRED
DRAWINGS & DESIGN (2 SETS OF EACH)	DESIGN CALCULATIONS		
	GA DRAWINGS	YES	ORDER + 3 WEEKS
	DETAIL DRAWINGS	YES	CONSTRUCTION
	AS BUILT DRAWINGS	YES	COMPLETION
	BROCHURES	YES	CONSTRUCTION
	SKETCHES		
	SCHEMATIC DIAGRAMS	YES	ORDER + 3 WEEKS
	RISK ASSESSMENT BY VENDOR	YES	CONSTRUCTION
	DATA SHEETS	YES	TENDER
	DESIGN CRITERIA	YES	CONSTRUCTION
QUALITY CONTROL DOCUMENTS (2 SETS OF EACH)	QUALITY CONTROL PLAN	YES	ORDER + 3 WEEKS
	MANUFACTURING PROGRAM	YES	ORDER + 3 WEEKS
MATERIAL CERTIFICATES		YES	MANUFACTURE
CERTIFICATES OF INSPECTION TESTING AND ACCEPTANCE	PRESSURE TEST CERTIFICATE	YES	DATA BOOK
	ELECTRICAL HAZARD CERTIFICATE		
	ELECTRICAL TEST CERTIFICATES	YES	DATA BOOK
	INSTRUMENT CALIBRATION CERTS.		
	VENDORS CERTIFICATE OF CONFORMANCE	YES	COMMISSIONING
	NON-CONFORMITY / CONCESSION REPORTS	YES	COMMISSIONING
MANUALS (5 SETS OF EACH)	OPERATING / MAINTENANCE MANUAL	YES	COMPLETION
	DATA BOOK	YES	DELIVERY – 1 WEEK
	DRAWINGS	YES	COMPLETION
	WARRANTY/GUARANTEES CERTIFICATES	YES	COMPLETION

E04.8**DRAWINGS AND DATA**

The vendor / contractor will supply 5 copies of the equipment data book including all items as specified in the Vendor QA and document requirement list.

- (a) All drawings and documentation shall be in accordance with City of Tshwane specifications.
- (b) Data books will be supplied to City of Tshwane within 7 days from delivery of equipment, City of Tshwane will review the data books within 14 days from issue and notify the Vendor of its acceptance or rejection of same.

E04.9 PAINTING AND PROTECTIVE COATING

All chassis plates shall be painted white.

Specific external colours will be provided by City of Tshwane. All

gland plates shall be galvanised for improved cable earthing.

All panel doors on emergency supply must be painted to be RED and those on normal supply Electric Orange.

E04.10 PERFORMANCE AND GUARANTEE

The performance of the items supplied in terms of this specification, as defined by the order, shall be warranted by the Vendor and, if specified, be tested in accordance therewith.

The vendor shall not be specifically required to conduct a performance test on site.

A minimum guarantee period of 12 months is required.

E04.11 INSPECTION AND TESTING

The City of Tshwane Representative shall have access, at all reasonable times, to those parts of the manufacturing facilities engaged in the manufacture of items in terms of this specification. He is authorised to witness any stage of manufacture, tests and inspect documentation.

The City of Tshwane Representative is authorised to reject any items not manufactured to the requirements of the specification.

All equipment shall be inspected at the vendor's works prior to delivery, to ensure compliance with the specification.

No unit shall be considered complete until acceptance by City of Tshwane. The

minimum testing / pre delivery check list shall be as follows:

- ☐ The City of Tshwane representative must carry out a clause by clause check of each MCC or switchboard, prior to delivery.
- ☐ This DB checklist is intended to assist this process but does not relieve him/her of the responsibility described above.

All panels must be thermal imaged a minimum of 1 week after being put on service. The image must be taken in normal operating conditions. The image must be analysed for hot spots and must be part of the Operations and Maintenance Manuals presented at the end of the project.

DETAILED INSPECTION ROUTINE

Order No. : _____

Supplier/Vendor : _____

Project : _____

Motor control centre Designation : _____

Inspected by : _____

Date : _____

	Comments
Overall Appearance	

☐	
☐	Paint work : Compliance with Annexure A5
☐	Paint thickness
☐	Door fittings good
☐	Dust sealing effective (neoprene seals)
☐	Board fully assembled
☐	Overall height less than specified height
☐	Channel iron base frame (less than 3000m)
☐	Lifting lugs provided
☐	Equipment supplied in accordance with specification (contractors, overloads, circuit breakers, relays, etc.)
Busbars	
☐	Correct cross-section
☐	Correct phasing with incomer/outgoers
☐	Rigidly supported/braced
☐	Properly insulated
☐	Joints tightened
☐	Transport section joints supplied (fishplates, nuts and bolts, control wiring and terminals, etc.)
☐	Droppers from main bars to circuit breakers adequately rated, braced, insulated
☐	Nothing unnecessary mounted on bus bars
☐	Main earth bar, min 70mm ²
☐	Control busbars generally as above, separate from power busbars
☐	Air clearances adequate throughout
Single Line Diagram Check	
☐	As per approved single line diagram
Outgoing Circuit	
☐	Correct size/rating for MCCB's
☐	Correct size/rating for ACB's
☐	Correct earth leakage relays
☐	Correct current transformer and associated ammeters
☐	Correct overload relays
☐	Correct setting on overload relays
☐	Reasonable provision for cable termination power and control mounting of equipment
☐	Correct conductor sizing, power and control, and correct colouring
☐	Correct indicator lights and colours
☐	Air clearances correct throughout
Comments	
Incoming Circuits	
☐	Correct size/rating of ACB's
☐	Correct metering and proper mounting
☐	Connection of power factor meter
☐	Fuses on volt meter, where applicable
☐	Reasonable provision for termination of incoming cable/gland plate
☐	Air clearances correct throughout
☐	Incomer status signal to PLC

Interlocks	
Pressure and Injection Tests	
☐ 2kV pressure test on all 550 volt parts of the board, with contactors de-energised and circuit breakers closed, excluding control supply	
☐ Primary injection test for correct operation of all protection and overload relays	
Operational Test	
☐ Mechanical operation of all circuit breakers, preferably with doors closed	
☐ Shunt trip of all circuit breakers	
☐ Operation of overload relay	
☐ Correct operation of all interlocks	
☐ Correct operation of indicator lights	
☐ Correct operation of earth fault/overload alarm system, including general alarm panel	
Correct signals to PLC terminals	
Correct interlocks	
Door interlocks	
General Checks	
☐ Marking of control wires and power conductors	
☐ Main Motor control centre label	
☐ Cubicle labels fitted – designation and cubicle number	
☐ Component labels fitted	
☐ Warning labels on all removable covers giving access to live 400V conductors	
☐ Labels for indicator lights, pushbuttons, etc.	
☐ Terminal strip labels	
☐ Incoming side of circuit breakers label	
☐ Incoming circuit label – “FROM _____”	
☐ No ‘Philips’ (star) screws	
☐ No self-tapping screws	
☐ Grommets fitted on all open holes	
☐ Correct paint specification	
☐ All documentation submitted	
☐ Arc venting arrangements satisfactory	
☐ Door latches fitted	

Specific testing and inspection requirements relating to switchgear boards are as follows:

- ☐ Prior to shipment the switchgear boards shall be completely assembled, wired, adjusted and tested by the supplier in the presence of the engineer and the client representative.
- ☐ Testing shall include primary injection tests of all current transformers, pressure tests to prove quality of insulation, functional tests of all mechanical and electrical components and electrical circuitry and any other tests required to ensure compliance with this specification.
- ☐ The supplier shall give one week's notice of readiness for final tests to the City of Tshwane representative. The vendor shall ensure that the equipment is ready for final testing before requesting the presence of the City of Tshwane representative at such a test. Repeat inspections necessitated by the lack of readiness of the equipment may be charged to the vendor at the discretion of the City of Tshwane representative.

E04.12 PAINTING AND PROTECTIVE COATING

Powder Coating Systems

Paint system 1: Powder Coating, 7 Stage zinc, Phosphate pre-treatment, Pure epoxy primer, Polyester finishing coat, Thickness 140 µm.

Paint System	Host Material	Preparation	Primer (70µm)	Finishing Coat (70µm)	Thickness µm
No 1	Mild Steel	7 stage phosphate pre-treatment	Epoxy	Epoxy	140

On completion of the paint job, the powder manufacturer must carry out the following tests on the test panels:

- ☐ SAN10400 impact test
- ☐ Cross hatch adhesion test
- ☐ Bend test

The powder manufacturer must issue a Certificate of Compliance for each paint job, which should be included in the contract documentation.

The preferred corrosion protection systems are applied onto cold rolled mild steel plate with a thickness of 2.0mm.

Epoxy Powder Coat Products

Item	Product Type	Powder - Lak
1	Epoxy Primer	23-007
2	Pure Epoxy / Polyester Finishing Coat.	Series 3000

E04.13

MEASUREMENT AND PAYMENT

E04.13.1

Item

Unit

a) Supply and deliver Switchboards or Motor Control Centres..... No

The unit of measurement shall be the number of MCC's or boards supplied and delivered.

The tendered rate shall include full compensation for the manufacture, supply, testing and delivery of the boards as specified in the detailed specification.

E04.13.2

Item

Unit

b) Install Switchboards or Motor Control Centres No

The unit of measurement shall be the number of MCC's or boards installed.

The tendered rates shall include full compensation for the installation of the specified boards, including all required installation material to install the MCC or board in the required position including a heavy duty strut, mounted 400mm below the gland plate. All incoming and outgoing cables shall be attached to this strut by means of K-Clamps or approved equivalent clamps. The tendered rates shall include full compensation for the site testing and commissioning of the specified boards including the keeping of all commissioning records in triplicate, including all material, test equipment and labour required for the testing and commissioning.

E04.13.4

Item

Unit

c) Supply and install extra circuits on Switchboards and Motor Control Centres No

The unit of measurement shall be the number of circuits supplied and installed.

The tendered rate shall include full compensation for the manufacture, supply, testing and installing of extra circuits in switchboards or motor control centres (spare space being available on the board).

E04.13.5

Item

Unit

d) Supply and deliver level control equipment No

The unit of measure shall be the number of level control systems supplied and delivered.

The tendered rate shall include full compensation for the supply, manufacturing, testing and delivery of all the material required for the level control system, including all float level switches,

will the required length of cable attached to them, mounting brackets, terminal box and mounting equipment together will all material to facilitate a complete level control system.

Separate items will be measured for systems with different numbers of level switches.

E04.13.6	<u>Item</u>	<u>Unit</u>
	e) Install level control equipment	No

The unit of measure shall be the number of level control systems installed.

The tendered rate shall include full compensation for installing, testing and commissioning of the level control system including the required brackets, junction boxes, cables etc for a complete working system.

E04.13.7	<u>Item</u>	<u>Unit</u>
	f) Modify existing motor starter panels	No

The unit of measure shall be the number of motor starters to be modified.

The tendered rate shall include full compensation for the supply and delivery of all material and labour required to modify the motor starter panel as detailed in the detail specification.

E04.13.8	<u>Item</u>	<u>Unit</u>
	g) Supply and install PLC/Scada alarm and status signals	No

The unit of measure shall be the number of MCC's for which a siren and alarm light has been installed.

The tendered rate shall include for the full compensation for the supply, delivery, installation and commissioning of the specified siren and alarm light including all required installation material including cables required to render a fully operational system.

PARTICULAR SPECIFICATION

E05: ELECTRICAL LOW VOLTAGE POWER AND CONTROL CABLES

PARTICULAR SPECIFICATION : VOLUME E05 : ELECTRICAL LOW VOLTAGE POWER AND CONTROL CABLES

E05.1 SCOPE

This specification covers the requirements with regards to the manufacture, supply, delivery, installation, testing and commissioning of power and control cables rated up to 600/1000V. The term cable shall indicate electrical conductors or carriers manufactured for the purpose of supplying power for the control and supervision of multipurpose loads.

E05.1.1 Statutory Documents and Standards

Cables shall be strictly manufactured in accordance with the requirements of the latest editions of the following standards:

SANS 1507	:	Electrical cables with extruded solid dielectric insulation for fixed installations
SANS 1411	:	Materials of insulated electric cables and flexible cords
SANS 1520	:	Flexible electrical cables for use in mines
SANS 10142-1	:	The Wiring of Premises Part 1 – Low Voltage Installations
IEC 173	:	Flexible cords
IEC 245	:	Rubber insulated cables
IEC 287	:	Current rating calculations
IEC 540	:	Insulation tests
VDE 0250	:	Standard for insulated wires and flexible cables

The Occupational Health and Safety Act (Act No. 85 of 1993)

E05.1.2 Definitions and Terminology

In general, the following definitions and terminology shall apply:

Armouring	A layer or layers of galvanized steel wires applied to the cable to provide mechanical protection or earth continuity, or both.
Bedding	A layer of extruded compound applied to the cable beneath the armouring.
Cable	A length of core or more cores assembled together, that may or may not be provided with an overall mechanical covering.
Core	A single insulated conductor without protective covering.
Direction of lay	The lateral direction of inclination to the axis (either left or right) of the receding helix formed by wire or core in a cable or flexible cord.
P.V.C.	Polyvinyl chloride
Sheath	A solid extruded protective covering applied as the exterior of a cable or a flexible cord.

E05.1.3 Particular Specifications to read in Conjunction with this Specification

This specification shall be read in conjunction with the following specifications:-

E06: ELECTRICAL MEDIUM AND LOW VOLTAGE CABLE INSTALLATION

E05.2 GENERAL SCOPE

E05.2.1 Design and Supply

(a) Conductor sizes

The minimum conductor size for control cables shall be 2.5mm².

(b) The minimum conductor size for instrument supply shall be 1.5mm² and the outer sheath of the cable shall be electric orange, to distinguish it from other supplies.

(c) Conductor material

Aluminium conductor cables are not acceptable unless agreed upon in writing by the

Engineer.

E05.3 CONSTRUCTION

The cable shall be constructed as follows:

E05.3.1 Conductor Material

The copper conductors shall be of plain annealed or hard draw wire in accordance with the requirements of the latest edition of SANS 1411.

E05.3.2 Insulation

The insulation material shall comprise of PVC in accordance with the requirements of the latest edition of SANS 1411.

E05.3.3 Core Colour Identification

The cable cores colour shall be in accordance with the requirements of the latest edition of SANS 1507

E05.3.4 Bedding

The bedding shall consist of a continuous P.V.C. extruded sheath.

E05.3.5 Armour

The armouring shall consist of one layer of round galvanised steel wire in accordance with the requirements of the latest edition of SANS 1411.

E05.3.6 Sheath

The outer sheathing shall be an impermeable, halogen free, reduced smoke emission, flame retardant PVC in accordance with the latest edition of SANS 1411.

E05.3.7 Cable for Industrial Control Circuit Wiring

For general purposes this shall be a flexible P.V.C. insulated cable with a minimum of 21 finely stranded copper conductors having minimum cross sectional area of 2.5mm² and a rated insulation voltage of 600/1000V, manufactured to SANS 1507 or equivalent specifications.

E05.4 CABLE MARKINGS

The cables shall be legibly marked in accordance with the requirements of the latest edition of SANS 1507, and shall also include the following:

- (a) Conductor size in square millimetres
- (b) Number of cores
- (c) Conductor material (copper)
- (d) The specification number (SANS 1507) to which the cable has been manufactured.
- (e) The year of manufacture.

E05.5 PARKAGING

Cables shall be packed on reeled drums. The moisture content of wooden cable drums shall not exceed 20%.

Each end of the cable shall before being secured to the reeled drum, be sealed by an acceptable method approved by the Engineer. The outer end shall be secured to the reel drum and the inner end shall be protected in a manner against mechanical damage.

The cable reeled drums shall be capable of taking a round spindle and be lagged with strong, closely fitted battens, at the inner and outer circumference so as to prevent damage to the cables. The spindle bearing plates shall be steel. The dimensions of the drum shall not exceed 1 100 mm width, 2 000 mm diameter and the spindle bearing plate shall not be less than 9 mm thick. Each drum shall be clearly marked on both sides in accordance with the latest edition of SANS 1507.

The ends of the PVC sheathed cable shall be sealed to avoid penetration of moisture. Each cable

drum shall be numbered.

E05.6 CABLE SIZING AND DE-RATING

The cables shall be sized and de-rated in accordance with the requirements of the latest edition of SANS 10142.

E05.7 TESTING OF CABLES

The cables shall be tested in accordance with the requirements of the latest edition of SANS 1507. Routine test certificates shall be supplied for each drum of cable supplied under the Contract.

E05.8 QUALITY ASSURANCE

All the cables supplied under the Scope of Works of this project shall be designed and manufactured under a quality control system, typically to SANS ISO 9000 series.

E05.9 MEASUREMENT AND PAYMENT

Measurement and payment will distinguish between supply/delivery and installation/commissioning of the cabling lengths required.

<u>Item</u>	<u>Unit</u>
a) Supply and delivery of low-voltage cable	metre
The unit of measurement shall be the length of low-voltage cable supplied. It is the responsibility of the Contractor to verify the lengths of cables required on site. The Contractor shall only supply the required length of cables required. The final quantity of installed cable lengths shall determine the final quantity to be paid of the supplied cable lengths.	
The tendered rate shall include for the design, manufacture, supply and delivery of the specified cable to the site.	
Separate items shall be scheduled under this payment item for each size and type of cable.	

<u>Item</u>	<u>Unit</u>
b) Provision for additional low voltage cables as required.....	Prov sum
The provisional sum provided shall include for any additional low voltage cables which may be specified by the Engineer after the acceptance of the contract.	
The Contractor shall submit a written quotation to the Engineer when requested to by the Engineer and shall not commence with the installation of any additional low voltage cables without the written instruction of the Engineer.	

PARTICULAR SPECIFICATION

E06 : ELECTRICAL MEDIUM AND LOW VOLTAGE CABLE INSTALLATION

PARTICULAR SPECIFICATION : VOLUME E06 : ELECTRICAL MEDIUM AND LOW VOLTAGE CABLE
INSTALLATION

E06.1 SCOPE

This section covers the procurement and installation of cables for the distribution of electrical power to be installed in soil trenches, electrical cable ducts, buildings and structures for system voltages up to 11 kV at 50 Hz.

E06.2 PARTICULAR SPECIFICATIONS

This specification shall be read in conjunction with the following specifications:-

SANS 1507 : Electrical cables with extruded solid dielectric insulation for fixed installations

SANS 10142-1 : The wiring of premises Part 1 – Low Voltage installations

SANS 1213: Mechanical Cable Glands

VDE 0278 : Electric cables - Accessories - Material characterization

G01: PARTICULAR SPECIFICATION FOR COLOUR CODES

G02: PARTICULAR SPECIFICATION FOR CORROSION PROTECTION

E02: ELECTRICAL CABLE RACKS

E03: ISOLATOR PUSHBUTTON STATIONS

E04: MOTOR CONTROL CENTRES

E05: ELECTRICAL LOW VOLTAGE POWER AND CONTROL CABLES

E07: ELECTRICAL INDUSTRIAL WELDING PLUGS, COUPLERS AND SOCKET OUTLETS

E08: WIRING

E06.3 COMPETENCE OF PERSONNEL

It is a definite requirement that the Contractor shall only employ personnel fully conversant with the cable manufacturer's recommendations to lay, joint and terminate cables. When contractors are working on medium voltage equipment they shall be conversant with the medium voltage regulations and operating procedures. There shall be direct supervision at all times when working in the HT substations. Only competent persons who have the relevant qualifications and experience to work with 6.6 & 11 kV systems shall be allowed to work on the MV network.

Cables, cable jointings, cable terminations and cable accessories shall be installed in accordance with the manufacturer's installation instructions by competent personnel. Where cables are installed but not terminated onto equipment, the cable end shall be fitted with end-caps to prevent the ingress of moisture or other undesirable elements into the cables.

E06.4 MATERIALS

E06.4.1 Medium Voltage Cable Joints and Terminations

The medium voltage cable joints and terminations shall be of the heat shrink type.

E06.4.2 Low Voltage Cable Joints and Terminations

Low voltage joints shall be of the epoxy-resin type.

Cable glands shall be of the adjustable type gland suitable for indoor use and shall be suitable for use with PVC PVC SWA PVC cables complying with the latest edition of SANS 1507. All glands shall be installed with non-deteriorating neoprene shrouds.

Outdoor use cable glands shall be similar to the indoor use cable glands with an additional feature

of a nipple gasket and an inner seal kit, rendering the gland suitable for type "EXe" equipment (increased safety equipment).

In high corrosive areas, such as chlorination, chemical dosing and inlet works areas, the cable gland shall offer a minimum degree of protection according to SANS 1222 of IP 66, shall be suitable for type " EXe " equipment, shall be corrosion proof and shall have a positive seal internal to the cable gland that seals over the cable outer sheath. For these applications no shrouds are required.

For all gland installations on armoured cable, the outer sheath of the cable shall be cut back in accordance with the gland manufacturers' recommendations, so that a minimum of armouring is exposed between the gland and the outer sheath after gland installation. The shroud shall seal on the outer sheath of the cable.

Bi-metallic aluminium-copper lugs, shall be used according to the manufacturer's specifications, where solid aluminium conductors are terminated onto copper busbars.

E06.4.3 Cable Glands

All cable glands for indoor and outdoor use shall be Ex rated as per SANS 1213 and have corrosion proof guard. It shall have a minimum IP rating of 68. The cable glands shall be suitable for use in hazardous areas classified for zone 1,2,21 and 22.

E06.4.4 Earth Continuity Conductors

Earth continuity conductors shall comprise of stranded copper conductors of cross-section indicated in the detailed specification. Alternative materials or combination of materials can be considered for running of earth continuity conductors to reduce risk of cable theft.

A single earth conductor may be used where two or more cables run together, providing the earth conductor cross-sectional area is based on the largest size cable in the run.

E06.4.5 Cable Route Markers

Cable route markers shall be constructed of reinforced concrete and shall be of dimensions to be approved by the engineer.

E06.4.6 Cable Warning Tape

The plastic cable warning tape shall consist of a strip of polyethylene of thickness 0,04 mm and of nominal width 230 mm, completely impregnated with a pigment such that the colour of the tape is yellow, colour No B49 of SANS 1091, and having printed at intervals not exceeding 1 metre along its length, a black-triangle and an electric flash symbol and the words "Danger, Gevaar, Ingozi".

The plastic warning tape shall be installed on all cable routes (LV and MV) at 200 mm above the top cable layer. Where a cable route exceeds 600 mm in width multiple warning tapes shall be run in such a way that the space between adjacent warning tapes does not exceed 185 mm.

E06.4.7 Concrete Protective Slabs

Concrete protective slabs shall have the following dimensions:

Length 1 000 mm

Width 350 mm

Thickness 50 mm

The slabs shall be constructed of 20 MPa concrete and each slab shall be reinforced with one longitudinal and three transverse mild steel rod of minimum diameter 8 mm. The slabs shall be manufactured in such a way that the slabs interlock with each other thus avoiding shifting of the slabs after installation.

E06.4.8 Cable Sleeves

Cable sleeves shall be installed where necessary. The sizes of the sleeves to be installed shall as detailed in the specifications. Where the sleeves are used at road crossings, where there is possibility of heavy trucks crossing or heavy structures may be placed, the sleeves shall be of a minimum 6kPa pressure handling capacity.

E06.5 EXCAVATIONS

E06.5.1 General

The Contractor shall preserve the site as far as possible. Only the minimum of trees, shrubs, rocks, etc shall be removed and cleared for the cable route.

Where surplus material has to be disposed of the Contractor shall dump the material in the area provided by him.

The Contractor shall load and transport to the above-mentioned site all surplus material, unsuitable material for backfilling etc.

E06.5.2 Trench Routes

The cable trench shall be excavated along the routes indicated on the relevant drawings. The routing should preferably traverse through the lowest theft risk areas as much as is possible.

The trench shall be absolutely straight and shall comply with all requirements. The Engineer shall determine the length of the trench to be excavated, which shall not exceed 400 m, before the cable is installed and the trench backfilled.

If any obstacle or interference should be encountered which may require alterations to the trench or routes, such alterations shall receive prior written approval of the engineer.

E06.5.3 Cable Trench

The trench shall be excavated to a depth indicated on the drawings for the different cables. Where depths are not indicated on the drawings, the following shall apply:

For MV cables 1, 0 m and for all LV cables the trench shall be deep enough so that the top layer of LV cables is buried a minimum of 500 mm below final ground levels.

The Contractor shall excavate by hand where he cannot excavate by means of machines due to limited access and the proximity of other services.

The bottom of the trench shall be level and shall follow the contours of the final ground level. Where the excavation is in excess of the required depth, the excavation shall be backfilled and compacted with suitable material to the required depth.

The Contractor shall trim the trenches and clean up the bottom of the trenches after he has completed the required excavation. Bedding and cables shall not be laid until the trench has been approved by the engineer. Where bedding has already been laid the Engineer may instruct the Contractor to demonstrate that the minimum thickness of bedding has been provided for before authorising cable laying to proceed.

The Contractor shall remove all sharp projections, which could damage the cable where the trench is excavated through rocky formations, and shall remove all loose rocks, material, etc from the bottom of the trench. A bedding of soft sand shall be laid below the cable. Where this material is not available the contractor shall import suitable material for such purposes. The contractor must ensure that all backfill material is free from sharp objects and rocks and is soft material. Where this material is not available, the contractor should import suitable material for such use.

E06.5.4 Excavation of Jointing Chambers

Jointing pits shall be excavated to a depth of 1,2 m and shall be rectangular in shape and large enough for the cable jointers to work comfortably and in an efficient manner. Where more than one joint is to be made in the same position the joint pit shall be large and long enough to allow staggered joints to be made. The minimum size of a joint pit shall be as follows:

- ☐ one joint : 2,5 m long x 1,25 m wide
- ☐ two joints : 3,0 m long x 1,5 m wide

E06.5.5 Excavated Material

No excavated material shall be left closer than 300 mm from the side of the excavation. The excavated material which is considered by the Engineer to be suitable for bedding material for the cable shall be placed separately on one side of the trench so that it is available when required. The excavated material shall take up as small an area as possible with the safety of the workmen and Works taken into consideration.

E06.5.6 Inspection and Measurement of Excavations

Once the excavations for cable trenches and joint pits have been completed, the Contractor shall give the Engineer 24 hours notice to inspect the trench and to be present when the measurements are made. No inspections shall be undertaken on Saturdays, Sundays and public holidays.

Full detail of the cable trench dimensions and classification of the type of excavation shall be recorded and signed by the Contractors representative and the engineers representative as the final quantities for such excavations.

Inspections and recordings shall be completed before the installation of any bedding or backfilling. The Contractor shall be responsible to keep all records as proof of progress and as basis for claims for payment.

E06.5.7 Maintenance of Excavations

The Contractor shall maintain the excavation in a good condition, free of water, mud, loose ground, rocks, stones, gravel and other strange material until the cables are installed and the excavation is backfilled and compacted.

E06.6 CABLE TERMINATIONS

E06.6.1 General

Connection of cables to switchgear shall always be effected in such a way that the various phases, seen from the front of the switchgear will be in the following positions where practically possible:-

- ☐ conductor no 1 : left (red)
- ☐ conductor no 2 : centre (white)
- ☐ conductor no 3 : right (blue)

Exposed armouring is not acceptable. Glands will be properly fitted with shrouds so as to cover any bare armouring.

All cable ends shall be supplied with the necessary earth connection.

A P4000 channel or other approved means of support shall be provided to remove mechanical stress from the glands.

Cable cores shall be marked with heat-shrunk sleeves where necessary to identify the phases. Refer to clause 5.2.1 (d) of SANS 10142.

The current-carrying capacity and breakdown voltage of the cable end shall be the same as for the complete cable.

Cables shall be terminated in accordance with the recommendations laid down by the manufacturers of the cables and glands employed.

E06.6.2 Cable Terminations with Heat-Shrinkable Materials

The complete kit shall be packed in a container that is marked for the type of cable insulation and construction as well as the voltage range for which the materials are suitable.

An illustrated set of instructions for the installation of the materials shall accompany every kit.

The terminations shall make minimal, if any, use of insulating or stress relieving tapes. The use of electrical stress control and insulating tubing that is heat-shrunk on to the terminations is preferred above other methods.

The kits shall include suitable boots for the covering of the terminal studs on the Equipment. The ends shall be terminated strictly in accordance with the termination manufacturer's specification and shall withstand the same test voltage as the rest of the cable.

The materials shall comply with VDE 0278 and the supplier shall be called upon to confirm this aspect before acceptance of the materials or installation.

The heat-shrinkable and other materials used for the terminations shall be of a high quality and shall retain their electrical and mechanical properties without deterioration.

Terminations shall be made of a material that gives lasting protection against ultra-violet radiation.

The cores of all cables terminated outdoors and the cores of 3,3 kV and higher voltage cables terminated indoors, shall be completely covered with a shrunk-on protective layer against surface

tracking, ultra-violet radiation and weathering.

Outdoor terminations shall be designed to prevent flash-over under wet or contaminated conditions and to ensure additional mechanical strength. This shall be achieved with shrunk- on insulating spacers and rain sheds.

Heat shrinkable termination kits shall be used for all high voltage (above 1 kV) terminations and shall be applied strictly in accordance with the manufacturer's recommendations.

E06.7 CONNECTION OF CABLE CONDUCTORS

When cutting away insulation from cable conductors to fit into lugs, care shall be taken that no strands are left exposed. Under no circumstances may any of the conductor strands be cut away to fit into lugs.

Cables that are connected to clamp type terminals where the clamping screws are not in direct contact with the conductors, need not be lugged, but the correct size terminals shall be used.

Ferrules shall be used where cable conductors are connected directly to Equipment with screws against the conductor strands.

Suitable lugs shall be used and shall preferably be solidly sweated to cable conductor ends. Lugs may be crimped using mechanical, hydraulic or pneumatic tools specifically designed for this purpose, on condition that evidence is submitted that the system used complies with the performance requirements of BS 4579, Part 1, "Compression joints in copper".

Lugs crimped to cable with a cross-sectional area of more than 16mm² shall entail the use of either pneumatic or hydraulic crimping tools. Under no circumstances may a lug be crimped by means of a hammer and/or punch.

Lugs crimped to aluminium shall be subjected to thorough inspection with relation to the material and quality of crimping by the Engineer.

Contact surfaces shall be thoroughly cleaned and smoothed and fixing bolts shall match the hole size of the lug and shall be manufactured of cadmium plated high tensile steel.

E06.8 CABLE JOINTS INSTALLATION

E06.8.1 General

Joints in cable runs will not be allowed unless authorized by the Engineer.

Jointing shall only be carried out by personnel competent in jointing the types of cable used and shall be carried out strictly in accordance with the manufacturer's instructions.

The Contractor shall notify the Engineer timeously of the day on which jointing is to be carried out in order that an inspection may be arranged if so required. Any cable joint not inspected by the Engineer because of insufficient notice being given, shall be opened for inspection and redone at the discretion of the Engineer at the cost of the Contractor.

During outdoor jointing operations, the joint bays shall be adequately covered by tents of waterproof material suitable supported. When necessary, a trench shall be excavated around the bay to prevent the ingress of moisture. The sides of the hole shall be draped with small tarpaulin or plastic sheeting to prevent loose earth from falling in during jointing operations.

Joints shall be fully waterproof and airtight and shall be free of voids and airpockets.

The joint shall not impair the anti-electrolysis characteristics of the cable.

The crossing of cores in joints shall not be permitted under any circumstances.

The electrical continuity of all the conductors, screens and armouring shall not be impaired by the joints and the earth continuity shall be accomplished within the joints, i.e. no external earth continuity conductor that will be subject to corrosion, is acceptable. The joints shall be completely covered by a watertight sheath to prevent corrosion.

In the case of joints in cables with an outer PVC anti-electrolysis sheath, the joints shall be subject to the same electrical insulation test as the outer sheath of the cable.

Low voltage cable joints shall be of the epoxy resin type.

High voltage cable joints shall be of the heat shrinkable type.

E06.8.2 Cable Joints with Heat Shrinkable Materials

The complete joint kit shall be packed in a container that is marked for the type of cable insulation and construction as well as the voltage range for which the materials are suitable.

An illustrated set of instructions for the installation of the materials shall accompany every kit.

The joints shall make minimal, if any, use of insulating or stress relieving tapes. The use of electrical stress control and insulating tubing that is heat-shrunk on to the joint, is preferred above other methods.

The materials shall comply with VDE 0278 and the supplier shall be called upon to confirm this aspect before acceptance of the materials or installation.

The heat-shrinkable and other materials used for joints shall be of a high quality and shall retain their electrical and mechanical properties without deterioration.

Heat-shrinkable joints kits shall be used for all high voltage (above 1 kV) joints.

Where cable joints are required to be made in the course of a cable run, a joint hole shall be excavated of sufficient size to enable the cable joiner to work efficiently and unimpeded.

E06.9 **CABLE AND CABLE ROUTE IDENTIFICATION**

Cables shall be identified at all terminations (both ends). The identification of MV cables installed in cable ladders, ducts or to structures shall be to SANS 10142, Clause 7.1.3(c).

Both ends of the cable shall be marked with the cable number in accordance with the cable schedule. The cable tag shall comprise of a punched stainless steel strap which shall be tied onto the cable by means of a thin stainless steel tape

The use of PVC tape with punched characters or punched metallic bands or tabs is not acceptable.

The identification number of cables shall be shown on the "as built" drawings of the installation.

Cable route markers shall be constructed of reinforced concrete and shall be of dimensions as specified and approved by the engineer.

Aluminium plates shall be cast into the top of the blocks in such a manner that they cannot be pried loose. The wording "ELECTRICAL CABLE" shall be stamped on the plates as well as direction arrows and the cable voltage rating. Additional information may be required on the plate to assist in cable location and identification.

Cable markers shall be installed on the surface along all the underground routes and shall project 1000 mm above normal ground level unless the projected markers could be a hazard to pedestrian or other traffic in which case they shall be installed flush with the surface.

Cable markers shall be installed at the beginning and ending of a cable run (e.g. where a cable enters a substation or building), at all changes of direction, above all Joints, above cable sleeve entries and exits and at intervals not exceeding 50 m along the cable route.. The position of cable markers shall be indicated on the "as built" drawings.

Where the cable runs across around, minimum 6kPa pressure sleeves shall be used and a 20MPa concrete slab laid on top. The cable shall be protected by means of 20MPa concrete where it runs across paving.

E06.10 **GENERAL INSTALLATION OF CABLES**

E06.10.1 Cable theft prevention

Consideration must be given at design stage for the risk posed by cable theft. The routing of cables on site must be so that there is minimum risk of cable theft. This can be effected by avoiding use of bare earth copper cables, burying cables where possible, covering with secured covers, using a concrete paving over a cable route and any other approaches that will reduce probability of cable theft. As each and every site has different exposure to the risk of cable thefts, the user plant personnel must be involved in a risk assessment exercise to determine measures that may be applied on a site by site basis.

E06.10.2 Sand Bed for Cables

A sand bed layer of soft soil shall be installed and levelled at the bottom of each trench after the

trench has been approved by the engineer, and prior to cable laying.

The minimum thickness of the sand bed layer is 50 mm.

If the material that has been excavated is not suitable for the sand bed layer then suitable soil shall be imported for this purpose. The cost thereof shall be included in the unit price for the excavation unless otherwise specified.

An adequate quantity of soil similar to the sand bed material shall be available next to the excavation for the sand bed cover before an inspection of the cables is called for. The sand bed cover for MV cables shall be a minimum of 150 mm thick and for LV cables shall be 100 mm thick and shall be placed directly after the cable(s) has been inspected.

If the soil for the sand bed and sand cover has to be sifted, a sieve with holes not larger than 6 mm shall be used.

E06.10.3

Laying of Cables

The cable shall, after the completion of the trench, be laid with the minimum of delay so that the trench can be backfilled. The Contractor shall, however, not backfill the trench until each length of cable has been inspected and approved by the engineer.

Only one cable shall be laid at a time and the Contractor shall take precautions that the cables which are already installed are not damaged.

The method to be used for laying cables shall be approved by the Engineer prior to the commencement of the laying of the cables.

Cable rollers shall be used when cables are drawn into trenches. The cable rollers shall be placed so that the cable does not touch the bottom or the sides of the trench. The rollers shall be of an approved construction without any sharp metal parts, which could damage the cables.

If the Contractor intends using a winch to draw the cable into the trench, a cable stocking shall be used or the draw wires shall be soldered to the cable so that the tension is exerted on all the cores, lead sheath and/or steel wire armouring at the same time.

The maximum tension on a cable during laying operations shall not exceed the value specified by the manufacturer.

Should the Engineer not be satisfied with the manner or method employed to lay the cable he shall have the authority to instruct the Contractor to lay the cable by hand or in accordance with approved standards.

Medium-voltage cables shall overlap by at least 1 m, but not more than 1,5 m at joints.

Sufficient lengths of cable shall be left at the beginning and end of the cable routes to allow for the termination of the cables. Where necessary the Engineer shall decide on what length of cable is to be left. The Contractor shall take the necessary precautions to protect the cable ends until they are terminated. The cable ends shall be sealed by means of lead or heatshrink sealing caps to ensure that the cable is waterproof.

Where cables are drawn through sleeves, care shall be taken that they are not kinked or excessively bent. No bend in a cable shall have a radius less than the minimum-bending radius specified by the cable manufacturer.

The Contractor shall keep accurate records of each length of cable laid. The following information shall be recorded:-

- ☐ Cable drum number
- ☐ Size of cable
- ☐ Laid from where to where
- ☐ Length of cable
- ☐ Date laid

The Contractor shall be liable for the repair of the cable due to the faulty manufacture of the cable, should this information not be recorded directly after the cable has been laid.

Every cable shall be marked by means of a aluminium label on which the size of cable and its source or destination and cable number is punched. The label shall be installed around the inner PVC sheath immediately above the cable gland.

E06.10.4

Verification of Cables

The Contractor shall be solely responsible for inspecting all cables before backfilling to ensure that the correct type and number of cables have been installed.

The engineer's representative shall inspect all cable trenches before backfilling to ensure that the laying of cables complies with the specification.

During this inspection the Contractor's and engineer's representative shall record the lengths for all cables and all such records shall be signed by both representatives as the final quantities. The Contractor shall be responsible to keep the records as proof of progress and as basis for claims for payment.

E06.10.5

Road Crossings

The cable sleeves shall be installed 1,5 m below ground level to avoid damage when the roads are constructed.

Unless otherwise specified, two additional sleeves shall be installed for future use at each road crossing.

Sleeves used for crossings shall be straight and undamaged. Bends shall not be allowed in road crossings.

After the installation of the sleeves, the sleeves shall be meticulously backfilled so that no air pockets are left. The trench shall thereafter be backfilled in layers of 150 mm and compacted with mechanical vibrators to 95% modified AASHTO density.

The Contractor shall lay and join the cable sleeves and compact the trench to the satisfaction of the engineer. After installation, the sleeves shall be cleaned and a galvanised steel draw wire installed in the sleeve prior to the sleeve ends being sealed by means of plastic plugs.

E06.10.6

Crossing of Other Services

Where a cable crosses over other services, the cable shall not be installed at a depth less than 800 mm below ground level and if this is not possible the cable shall be installed underneath the other service and shall be protected in the prescribed manner by means of concrete slabs. The depth of the cable shall be maintained for one metre on either side of the crossing.

If it is not possible to cross over or underneath a service in the prescribed manner, the matter shall be referred to the Engineer for a decision.

The following minimum clearances shall be maintained between electrical cables and other services:-

	Vertical	Horizontal
GPO Cables	0,3	0,3
Water pipes	0,3	0,3
Sewer pipes	0,3	0,8
Stormwater pipes	0,3	0,6
Other electrical cables	0,15	0,15 (other than LV cables in same route)
LV cables on same route	0,100	One cable diameter or larger cable

E06.10.7

Backfilling of Trenches

When the cable has been laid, inspected and approved and the sand bed cover as specified in the clause on "Sandbed for cables" has been installed, the trench shall be backfilled with soil containing not more than 40% rock or shale which shall be able to pass through a 100 mm sieve and which is approved by the engineer.

Where more than 40%, but less than 70% rock occurs, the Contractor shall replace the rock with imported soil. However, should more than 70% rock occur then all the backfilling material shall be imported.

- (a) The Contractor may import further stone-free material to the site or sieve the excavated material for sand bedding and cover but payment shall only be compensated for the actual quantity of imported material required as determined by the engineer. The quantity of imported material required shall be calculated from the nominal trench width.
- (b) The excavated material shall be backfilled in layers of 150 mm and shall be well compacted

and consolidated to 90% MOD AASHTO. Where necessary the Engineer may require that a mechanical vibrator be used for compacting the trench.

- (c) The Contractor shall maintain the completed sections of the cable trench in a proper safe condition for the duration of the contract. The Contractor shall refill and compact the trench where subsidence occurs.
- (d) After completion of the work the route of the cable shall be neatly finished off and cleared. All stones bigger than 25 mm as well as all loose organic material and rubble shall be removed.

E06.11 INSTALLATION OF CABLES IN PURPOSE-BUILT TRENCHES (CABLE DUCTS)

E06.11.1 General

This paragraph covers the installation of cables in build-up trenches, service ducts, etc. the use of this method of cable routing should be avoided where possible as it exposes the cables to high risk of theft. Open channels shall not be used for cable routing on any site. The trenches, ducts, etc. inside buildings will be constructed and installed by others.

E06.11.2 Installation

Cables shall be installed in one of the following ways:-

- ☐ on horizontal cable trays;
- ☐ on horizontal metal supports with suitable clamps;
- ☐ on vertical cable trays or metal supports fixed to the side of the trench. Cables shall be clamped in position.

Cables shall not be bunched and laid on the floor of purpose built trenches.

Cable runs outside of buildings must be buried. Where cables need to cross, rise onto structures, enter buildings or link structures, cable ladders may be used. In such cases cable racks must be covered to prevent access. The cover may be bolted, welded in such a way that it is secure and may not be easily removed by simple tools.

E06.11.3 Covers

The covering of concrete trenches shall as a rule fall outside the scope of the electrical installation. The Contractor shall, however, be responsible for the cutting or drilling and smoothing of holes for cables through chequer plates, concrete or other coverings as required.

Cables shall enter and exit the trench through sleeves protruding 300 mm beyond the covering. The sleeves shall be permanently secured in position and the open space between the cable and sleeves shall be sealed with a non-hardening, watertight compound.

E06.11.4 Filled Trenches

Where specified herein, floor trenches shall be filled with sand.

If a sand filling is specified, the cables shall be fixed to non-corroding supports.

Sand-filled trenches other than in substations shall be covered in one of the following ways:-

- ☐ Reinforced concrete covers;
- ☐ 100mm of 20MPa concrete;
- ☐ Removable chequer plates. However this will not be acceptable in open spaces.

Reinforced concrete covers shall be used where vehicular traffic may be encountered over trenches. Unless otherwise specified herein, allowance for a mass of 2 tons shall be made.

E06.12 INSTALLATION OF CABLE LADDERS

Cable ladders shall be installed within accessible civil constructed cable ducts. These ducts may form part of the scope of works or may be existing.

Cable ladders are required to be installed within the motor control centre station, on site reticulation, and on access platforms to the mechanical equipment.

Cable ladders shall be installed within accessible cable duct and shall be supported by a 50mm high strut section securely fixed to the wall. The corrosion protection of the strut shall be of the same system as that of the cable ladder.

Cable ladders shall be supported with the struts, channels, brackets, clamps, cantilever arms and nuts/bolts/washers.

The platform mounted cable ladder reticulation shall be installed at minimum of 150 mm from the supporting concrete structure.

Crevice corrosion of the metal elements in contact with concrete surface shall be eliminated by means of a suitable layer of non-shrink grouting.

In highly corrosive environments such as chemical dosing stations, the use of GRP material is preferred.

Unless otherwise agreed, all screws, bolts and nuts shall be hexagonal to ISO Metric commercial standards. All bolts, nuts, springwashers, etc shall be stainless steel 316.

To minimise cable theft, long cable runs on cable ladders should be avoided. Wherever cable ladder is used, a securely welded or bolted boxing cover should be used to protect the cables.

E06.13 INSTALLATION OF CABLES ON LADDERS AND STRUCTURES

E06.13.1 Installation

Cables may be installed in one of the following ways:-

- ☐ on horizontal cable ladders with stainless steel strapping;
- ☐ against vertical cable ladders with stainless steel strapping;
- ☐ against horizontal or vertical metal supports or brackets with stainless steel strapping;
- ☐ with stainless steel strapping when fixed to structures.

E06.13.2 Spacing of Supports

E06.13.2.1 General

The most generally known method of supporting cables is the restrained installation where the distance between supports is small enough to prevent any noticeable sag in the cable. Unless otherwise specified herein, this method shall apply to all cable installations.

E06.13.2.2 Spacing of Supports of Restrained Cables

The maximum spacing between cleats (clamps) to which cables are fixed in horizontal and vertical cable routes shall be determined from Table 1 below. Additional cleats shall be installed at each bend or off-set in the cable run. The maximum distance between supports or cleats for multi-core control cables shall be 20 times the outside diameter of the cable with a maximum spacing of 500 mm for unarmoured cables and 30 times the outside diameter of the cable with a maximum spacing of 1 m for armoured cables. A minimum of 20 mm ventilation clearance shall be maintained between cables and the wall to which they are cleated. Spacing of supports for cables for high voltage lighting shall be in accordance with Table 8 of SANS 10142.

Table 1: Maximum Spacing of Supports (Cleats) (mm)

FOR RESTRAINED CABLE				
Cross-sectional area of Cable conductors (mm²)	Wire Armoured Cables		Other than Wire Armoured Cables and Unarmoured Cables	
	Horizontal Cable Routes	Vertical Cable Routes	Horizontal Cable Routes	Vertical Cable Routes
1,5	500	750	300	400

FOR RESTRAINED CABLE				
Cross-sectional area of Cable	Wire Armoured Cables		Other than Wire Armoured Cables and Unarmoured Cables	
2,5	500	750	300	400
4,0	600	750	300	400
6,0	600	750	300	400
10,0	750	900	400	500

16,0	750	1 000	400	500
25,0	900	1 000	400	500
35,0	900	1 000	400	500
Above 35,0	900	1 000	400	500

E06.13.3

Grouping and Spacing of Cables

Cables with a cross-sectional area of more than 16 mm² shall, as a rule, be spaced two outside cable diameters apart, for which no grouping correction factor need be applied.

Where parallel cable runs are installed at different levels (e.g. on parallel cable trays), and where the spacing of the layers is not specified, a minimum spacing of 300 mm shall be maintained.

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

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

E06.14

INSTALLATION OF MCC'S

Unless otherwise stated, each MCC shall be installed on a cable duct within an MCC room. Purpose made MCC supports shall be manufactured and installed to support the MCC. The contractor shall design and submit the details of the supports to Engineer for approval prior to the manufacturing of the MCC supports.

E06.15

TESTING

Each cable shall be tested after installation in accordance with SANS 150 (up to 1 kV), SANS 97 and SANS 1339 (up to 11 kV), as well as the requirements of the Local and Supply Authorities.

The Contractor shall make all arrangements, pay all fees and provide all equipment for these tests.

The Contractor shall notify the Engineer timeously so that he may witness the tests.

LV cables shall be tested by means of a suitable megger at 1 kV and the insulation resistance shall be tabulated and certified.

HT cables shall be pressure-tested in accordance with Table 2 and the exact leakage current shall be tabulated and certified.

Table 2

Cable Rating (kV)	TEST VOLTAGE (kV applied for 15 minutes)				
	Paper-insulated Cables				XLPE-insulated Cables
	Between Conductors		Conductors to Sheath		Conductors to Screen
	AC (rms)	DC	AC (rms)	DC	DC
6,6	12	18	12	18	11
11	20	30	20	30	18

On completion of the tests on any cable, the Contractor shall without delay, submit 3 copies of the certified test reports to the Engineer.

E06.16

COMPLETION

The Engineer reserves the right to inspect the installation at any stage during the course of

construction. Such inspections will, however, not deem the portions inspected as being complete or accepted and the Contractor shall remain responsible to complete the installation fully in accordance with this specification.

The Contractor shall carry out a final "as built" survey of the cable routes and present to the Engineer "as built" route plans of the complete installation.

The following information shall be reflected on the plans or submitted as separate schedules with the plans:-

- ☐ overall length of each cable.
- ☐ locations of all joints (if any) in relation to permanent reference points. Dimensions shall be shown and the method of triangulation i.e. two dimensions to each joint, shall be used.
- ☐ the location of all cable markers in relation to permanent reference points.
- ☐ identification numbers of all cables.

The Works will be deemed to be incomplete until all tests have been conducted and certified successfully and all "as built" drawings and schedules have been handed to the Engineer.

E06.17 MEASUREMENT AND PAYMENT

Excavation

<u>Item</u>	<u>Unit</u>
a) Excavate in all materials for trenches, backfill, compact and dispose of surplus material ...	m ³

This rate shall apply to all the excavations.

The unit of measurement shall be the cubic metre of material excavated in trenches, classified according to the depth and width specified listed. The width classification shall be in accordance with the authorised dimensions and the depth classification in accordance with the total depth of the trench and not with the depth range in which the material is situated before excavation. The depth of excavation shall be measured to the underside of the bedding.

The tendered rate shall include full compensation for clearing and grubbing the trench areas and the temporary removal of improvements from the line of the trench, for excavating the trench, preparing the bottom of the trench, separating material unsuitable for backfill, keeping the excavations safe, dealing with any surface or subsurface water, measuring, classification and keeping of all records and for separating topsoil and selected backfill material where necessary.

The rate shall furthermore cover the costs of installing the sand bed and sand cover, backfilling, compacting and disposing of the surplus material.

<u>Item</u>	<u>Unit</u>
b) Extra over for excavating in hard material	m ³

The unit of measurement shall be the cubic metre of material excavated and classified as hard, in accordance with the classification set out hereunder.

The tendered rate shall be paid over and above the rate tendered for excavation in full compensation for the additional cost of excavating in hard material instead of soft.

The tendered rate shall include full compensation for any overbreak as well as the additional backfilling required, reinstating the trench bottom, and for any other incidentals resulting from overbreak.

The materials excavated shall be classified as follows for payment purposes:

Hard Material

Material which cannot be excavated efficiently except with the use of pneumatic tools, blasting or wedging and splitting, and shall include boulders exceeding 0,15 m³ in volume.

Soft Material

All material not classified as hard material.

Notwithstanding the above classification, all material excavated from previously constructed fills, embankments, pavement layers and from above existing services shall be classified as soft material.

The decision of the Engineer as to the classification of the material shall be final and binding and any objection as to the classification shall be made before the excavation has been backfilled.

<u>Item</u>	<u>Unit</u>

c) Extra over for excavating by hand in all materials	m ³

The unit of measurement shall be the cubic metre of trench material excavated by means of hand tools as instructed or authorised in writing by the Engineer where the use of conventional excavating equipment is either impractical or likely to cause damage to services, trees or property or where the electrical Contractor has to excavate by hand where he cannot excavate by machine.

The volumes of the trench excavation will be computed from the length and the depth to the bottom of the specified bedding layer and the minimum base widths specified in the drawings. The rate shall cover the cost of complying with the safety and protection requirements specified except where particular items are scheduled to cover particular costs for the excavation.

The tendered rate shall be paid extra over the rates in full compensation for the additional expense of excavating by means of hand labour instead of conventional trenching equipment.

<u>Item</u>	<u>Unit</u>

d) Extra over for using backfill material obtained from:

(i) borrow areas	m ³

(ii) sources provided by the Contractor	m ³

The unit of measurement shall be the cubic metre of imported backfill material.

The tendered rate for paid extra over and shall be in full compensation for the additional cost of excavating and selecting of suitable material and the moving of the material to the backfilling site.

The above items will not be measured for payment unless importation has been ordered in writing. The volume will be computed from the trench width and the depth from ground level to the top of the sand bed cover as shown on the tender drawings. The rate for material from designated borrow pits shall cover the cost of excavation and selection of suitable material, the moving of the material to the backfilling site, and the disposal of the material that becomes surplus as a result of the importation, all within 0,5km.

The tendered rate for sources provided by the Contract paid extra over jointing and termination of MV cable shall cover the cost of the acquisition of the material and of the disposal of the surplus material resulting from the importation together with all the costs of transporting the material to the site regardless of distance.

<u>Item</u>	<u>Unit</u>

e) Backfill inverted culvert cable trench	m ³

The tendered rate shall be the cubic meter of cable trench backfilled.

The tendered rate shall include full compensation for importing and separating material suitable for backfilling, providing the bedding material, keeping the cable trench safe, dealing with any surface of subsurface water, measuring classification and keeping of all records.

The rate shall furthermore cover the cost of installing the sand bed and sand cover, backfilling and installing covers of the trench route. The covers will be provided by others.

<u>Item</u>	<u>Unit</u>

f) Lay MV cable	m

The unit of measurement shall be the linear length in meter of MV cable installed.

The tendered rate shall include full compensation for the handling, inspection, laying, cutting and testing the cable. Cables will be measured linearly over all lengths laid. No extra will be allowed for jointing, overlaps and termination.

<u>Item</u>	<u>Unit</u>

g) Termination of MV cable	No

The unit of measurement shall be the number of MV cable joints or terminations.

The tendered rate shall include full compensation for the cost of providing the kits, complete with

compound, ferrules and cable lugs, the cost of cutting the cable, handling and fitting the kits and the cost of testing the joints and terminations.

<u>Item</u>	<u>Unit</u>

h) Installation of LV cable	m

The unit of measurement shall be the linear length in meter of LV cable installed.

The tendered rate shall include full compensation for the handling, inspecting, laying, cutting and testing the cable. Cables shall be measured linearly over all lengths laid. Separate items shall be scheduled for each size and each type of cable laid.

<u>Item</u>	<u>Unit</u>

i) Install LV and MV cable on cable ladder	m

The unit of measurement shall be the length of LV and MV cable installed on cable ladder.

The tendered rate shall include full compensation for the handling, inspection, laying, cutting and testing the cable. Cables shall be measured linearly over all lengths laid. Separate items shall be scheduled for each size and each type of cable laid.

<u>Item</u>	<u>Unit</u>

j) Termination of LV cables	No

The unit of measurement shall be the number of LV cable terminations.

The tendered rate shall include full compensation for providing the cable glands and shrouds, the cost of handling, fitting and cutting the cable. Separate items shall be scheduled for each size and type of cable.

<u>Item</u>	<u>Unit</u>

k) Jointing of low voltage cable.....	No

The unit of measurement shall be the number of LV cables joints.

The tendered rate shall include full compensation for the cost of providing the kits, the cost of cutting the cable, handling and fitting the kits and the cost of testing the joints.

<u>Item</u>	<u>Unit</u>

l) Supply earth continuity conductor	m

The unit of measurement shall be the length in meter of earth continuity conductor supplied. The tendered rate shall include full compensation for procuring, furnishing and laying the specified earth continuity conductor.

<u>Item</u>	<u>Unit</u>

m) Lay earth continuity conductor.....	m

The unit of measurement shall be the length in meter of earth continuity conductor installed.

The tendered rate shall include full compensation for procuring, furnishing and laying the specified earth continuity conductor.

<u>Item</u>	<u>Unit</u>

n) Terminate and connect earth continuity conductor.....	No

The unit of measurement shall be the number of earth continuity conductors terminated and connected.

The tendered rate shall include full compensation for supplying all the material required to terminate and connect the earth continuity conductors and the connecting thereof to the earth bars.

<u>Item</u>	<u>Unit</u>

o) Supply plastic warning tape.....	m

The unit of measurement shall be the length in meter of plastic warning tape supplied.

The tendered rate shall include full compensation for the supplying, handling and laying the plastic warning tape.

<u>Item</u>	<u>Unit</u>
p) Lay plastic warning tape	m

The unit of measurement shall be the length in meter of plastic warning tape installed.

The tendered rate shall include full compensation for the supplying, handling and laying the plastic warning tape.

<u>Item</u>	<u>Unit</u>
q) Cable record drawings.....	Sum

The unit of measurement shall be the sum.

The tendered rate shall cover the cost of preparing and furnishing the drawings as specified in sub-clause "Information regarding the completed network".

<u>Item</u>	<u>Unit</u>
r) Supply and construct plinths for the distribution or junction kiosks	No

The unit of measurement shall be the number of plinths supplied and constructed.

The tendered rate shall include full compensation for the supply and delivery of all material required for the plinth, the excavation of the foundation for the plinth and the construction of the plinth.

<u>Item</u>	<u>Unit</u>
s) Install distribution or junction kiosks	No

The unit of measurement shall be the number of distribution or junction kiosks installed.

The tendered rate shall include full compensation for the installing and fastening of the distribution or junction kiosk on the plinth and the casting of a 50 mm floor at the bottom of the plinth.

<u>Item</u>	<u>Unit</u>
t) Substation building accessories	Sum

The unit of measurement shall be the sum.

The tendered rate shall include full compensation for the supply and installing of the substation building accessories specified in the detailed specification.

<u>Item</u>	<u>Unit</u>
u) Removal of existing medium voltage cable from existing switchgear.....	No

The unit of measurement shall be the number of existing MV cable removed from existing switchgear.

The tendered rate shall include full compensation for the disconnection and removal of existing medium voltage cables from existing switchgear.

<u>Item</u>	<u>Unit</u>
v) Supply cable markers	No

The unit of measurement shall be the number of cable markers supplied.

The tendered rate shall include full compensation for the provision of the cable markers and the cost of handling and installing them.

<u>Item</u>	<u>Unit</u>
w) Erect cable markers.....	No

The unit of measurement shall be the number of cable markers installed.

The tendered rate shall include full compensation for the provision of the cable markers and the cost of handling and installing them.

<u>Item</u>	<u>Unit</u>

x) Supply cable slabs..... No

The unit of measurement shall be the number of cable slabs supplied.

The tendered rate shall include full compensation for the supplying, handling and installing of the concrete protective slabs where specified.

Item

Unit

y) Install cable slabs No

The unit of measurement shall be the number of cable slabs installed.

The tendered rate shall include full compensation for the supplying, handling and installing of the concrete protective slabs where specified.

Item

Unit

z) Expose, cut and relocate existing cable Sum

The unit of measurement shall be the sum to expose, cut and relocate existing cable.

The tendered sum shall include full compensation to expose the length of cable as specified in the detail specification by hand, taking all the necessary precautions not to damage the cable, cutting the cable and relocating the cable into the existing substation.

Item

Unit

aa) Install LV cable in protective sleeve pipes m

The unit of measurement shall be the length in meter of LV cable installed in sleeve pipes.

The tendered rate shall include full compensation for the installation of LV cable in protective sleeve pipes.

PARTICULAR SPECIFICATION

E08: ELECTRICAL WIRING

PARTICULAR SPECIFICATION: VOLUME E08: ELECTRICAL WIRING

E08.1 SCOPE

This specification covers the wiring requirements of electrical installations.

E08.2 STANDARDS

The latest edition, including all amendments to until the date of tender, of the following particular national and international specifications, publications and codes of practice shall be read in conjunction with this specification and shall be deemed to form part thereof:

- (a) SANS 10142-1 : The wiring of premises part 1 – Low Voltage Installations
- (b) SANS 1411-2 : Materials of insulated electric cables and flexible cords Part 2 – Polyvinyl Chloride
- (c) SANS 1507 : Electric Cables with extruded solid dielectric insulation for fixed installations

E08.3 GENERAL REQUIREMENTS

PVC insulated conductors for general wiring shall consist of high conductivity annealed copper wire strands with polyvinyl chloride insulation. The insulation shall be compounded and stabilised to comply with SANS 1411-2 as amended.

Conductors shall be finished in the required colours and shall be manufactured in accordance with SANS 1507 as amended.

Any special requirement regarding the type and size of wiring to be installed in a specific installation shall be specified.

E08.4 DRAWING OF CONDUCTORS

Wiring shall only be carried out after the wireway installation is completed, but before painting has commenced. No conductors shall be installed before the wireways have been cleaned of all debris and moisture. Wireways shall contain no sharp edges.

When conductors are drawn through conduit, care shall be taken that they are not kinked or twisted.

E08.5 WIRING METHOD

All wiring shall be carried out according to the loop-in system. When earth continuity conductors are looped between terminals of equipment, the looped conductor ends shall be twisted together and ferruled to ensure that earth continuity is maintained when the conductors are removed from a terminal.

When connecting more than one conductor in a terminal, the strands shall be securely twisted together. Under no circumstances shall strands be cut off.

E08.6 SIZE OF CONDUCTORS

The following minimum conductor sizes shall be used:

Bell circuits	=	1,5 mm ²
Clock circuits	=	1,5 mm ²
Lighting circuits	=	1,5 mm ²
Plug circuits	=	2.5 mm ²
All the above	=	2,5 mm ² earth conductor

Motor circuits = As specified

E08.7 DIFFERENT PHASES

With the exception of three-phase outlets, circuits connected to different phases shall not be present at light, switches or socket-outlet boxes.

E08.8 MEASUREMENT AND PAYMENT

<u>Item</u>	<u>Unit</u>

a) Supply and deliver LV conductors	m

The unit of measurement shall be the linear length of conductor supplied and delivered.

The tendered rate shall include full compensation for the supply and delivery to site of the specified conductors. Conductors will be measured linearly along the full length installed in the wireway and sufficient provision will be made in the quantities for conductor slack at outlet boxes and distribution board trays. No extra will be allowed for jointing, overlapping and wastage at connections.

Separate items shall be scheduled for each conductor size.

<u>Item</u>	<u>Unit</u>

b) Install LV conductors in conduit.....	m

The unit of measurement shall be the linear length of conductors installed in conduit.

The tendered rate shall include full compensation for the handling, inspection, pulling in conduit the specified number and sizes of conductors, cutting and testing of the conductors. Sufficient provision will be made for conductor slack at outlet boxes and distribution board trays to make the necessary connections to equipment.

Separate items shall be scheduled for each size of conductor.

<u>Item</u>	<u>Unit</u>

c) Install LV conductors in trunking.....	m

The unit of measurement shall be the linear length of conductors installed in trunking.

The tendered rate shall include full compensation for the handling, inspection, installing in trunking the specified number and sizes of conductors, the grouping of these conductors into circuits using plastic cable ties, cutting and testing of the conductors.

Separate items shall be scheduled for each size of trunking and for each size of conductor.

This rate shall furthermore include for the supply of all cable ties, clamps and other materials necessary to ensure that the wiring conforms to the specification.

<u>Item</u>	<u>Unit</u>

d) Install LV conductors in power skirting	m

The unit of measurement shall be the linear length of conductor installed in power skirting.

The tendered rate shall include full compensation for the handling, inspection, installing in power skirting the specified number and sizes of conductors, the grouping of these conductors into circuits using plastic cable ties, cutting and testing of the conductors. Sufficient provision will be made for conductor slack at power outlets.

Separate items shall be scheduled for each type of power skirting and for each size of conductor.

This rate shall furthermore include for the supply of all cable ties, PVC sleeving for earth conductors and other materials necessary to ensure that the wiring conforms to the specification.

<u>Item</u>	<u>Unit</u>

e) Install LV conductors in floor ducting	m

The unit of measurement shall be the linear length of conductors installed in floor ducting.

The tendered rate shall include full compensation for the handling, inspection, installing in floor ducting the specified number and sizes of conductors, the grouping of these conductors into

circuits using plastic cable ties, cutting and testing of the conductors. Sufficient provision will be made for conductor slack at power outlets. Were cables are exposed to the sun they shall be strapped, using stainless steel strapping.

Separate items shall be scheduled for each type of floor ducting and for each size of conductor.

This rate shall furthermore include for the supply of all cable ties, PVC sleeving for earth conductors and other materials necessary to ensure that the wiring conforms to specification.

<u>Item</u>	<u>Unit</u>
f) Supply conductor terminals	No

The unit of measurement shall be the number of conductor terminals supplied.

The tendered rate shall include full compensation for the supply and delivery to site of the specified terminals complete with mounting rail and all hardware required to fasten the terminals and mounting rail. Separate items shall be scheduled for each size of terminal.

<u>Item</u>	<u>Unit</u>
g) Install conductor terminals	No

The unit of measurement shall be the number of conductor terminals installed.

The tendered rate shall include full compensation for the handling, inspection and installation of the specified terminals and mounting rail. Separate items shall be scheduled for each size of terminal.

<u>Item</u>	<u>Unit</u>
h) Supply PVC insulated multicore cables	m

The unit of measurement shall be the linear length of cable installed.

The tendered rate shall include full compensation for the supply and delivery of the cables. Separate items shall be scheduled for the different types and sizes of cables.

<u>Item</u>	<u>Unit</u>
i) Install PVC insulated multi core cables	m

The unit of measurement shall be the linear length of cable installed.

The tendered rate shall include full compensation for the supply and delivery of the cables. Separate items shall be scheduled for the different types and sizes of cables.

<u>Item</u>	<u>Unit</u>
j) Supply and install the terminations for PVC multicore cables	No

The unit of measurement shall be the number of terminations installed.

The tendered rate shall include full compensation for the supply and installing of the terminations as specified.

PARTICULAR SPECIFICATION

E09: ELECTRICAL BUILDING INSTALLATION

PARTICULAR SPECIFICATION : VOLUME E09 : ELECTRICAL BUILDING INSTALLATION

E09.1 GENERAL

The Particular Specification shall be read in conjunction with the Detailed Technical Specification.

Where the Detailed Technical Specification is in contradiction with this Particular Specification, the former shall apply to this contract.

E09.2 STATUTORY DOCUMENTS AND STANDARDS

E09.2.1 Standards

The installation shall be erected and carried out in compliance with:

- (a) The SANS 10142-1 Code of Practice for the Wiring of Premises as amended;
- (b) The Machinery and Occupational Safety Act as amended;
- (c) The local Municipal & Supply Authority By-Laws and Regulations;
- (d) The local Fire Regulations;
- (e) The Regulations of Telkom;
- (f) The Standard Regulations of any Government Department of public service company where applicable;
- (g) The factory-built assemblies of low voltage switchgear and control gear IEC 439, as amended;
- (h) The degrees of protection of enclosures for low voltage switchgear and control gear IEC 144, as amended.
- (i) Occupational Healthy and Safety Act (1993)(Act 85 of 1993), as amended.
- (j) SANS 10400 National Building Regulations and Building Standards Act (Act 103 of 1977), as amended.

E09.2.2 Particular Specifications to be read in conjunction with this specification

This specification shall also be read in conjunction with the following specifications:-

G01: PARTICULAR SPECIFICATION FOR COLOUR CODES

G02: PARTICULAR SPECIFICATION FOR CORROSION PROTECTION

E02: ELECTRICAL CABLE RACKS

E06: ELECTRICAL MEDIUM AND LOW VOLTAGE CABLE INSTALLATION

E08: WIRING

In addition, the Sub-Contractor shall issue all notices and pay all the required fees in respect of the installation to the local authorities, and shall exempt the Employer from all losses, costs or expenditures which may arise as a result of the Sub-Contractor's negligence to comply with the requirements of the regulations enumerated in paragraph 9.2.

It shall be assumed that the Sub-Contractor is conversant with the above mentioned requirements. Should any requirements, by-law or regulation, which contradict the requirements of this document, apply or become applicable during erection of the installation, such requirement, by-law or regulation shall overrule this document and the Sub- Contractor shall immediately inform the Engineer of such a contradiction. Under no circumstances shall the Sub-Contractor carry out any variations to the installation in terms of such contradictions without obtaining the written permission to do so from the Engineer.

E09.3 ARRANGEMENTS WITH THE SUPPLY AUTHORITY

It shall be the responsibility of the Sub-Contractor to issue all notices and pay all monies that are due for the electrical builders / temporary supply connection, except where otherwise specified. If, according to the contract, these monies are reclaimable from the Employer, then these claims by the Sub-Contractor shall be substantiated with official receipts.

It shall be the responsibility of the Sub-Contractor to make the necessary arrangements at his own cost with the local supply authority and to supply the labour, equipment and means to inspect, test, commission and to hand over the installation.

The Sub-Contractor shall supply and install all signage, notices and warning signs that are required by the appropriate laws, regulations and/or by this document.

E09.4

FIXING AND SUPPORTING OF EQUIPMENT AND MATERIALS

- (a) It is the responsibility of the Sub-Contractor to position and securely fix conduits, ducts, cables and cable channels, switchboards, fittings and all other equipment or accessories as required for the installation. The Sub-Contractor shall provide and fix all supports, clamps, brackets, hangers and other fixing materials.
- (b) All supporting steelwork shall be wire-brushed and given one coat of rust resisting primer, followed by one coat of high quality enamel paint before any other equipment is fixed.
- (c) Supports, brackets, hangers, etc. may only be welded to steel structural members where prior permission has been obtained.
- (d) All methods of suspension or supports shall be submitted to the Engineer for approval and for reference to the Structural Engineers where necessary, prior to manufacture or installation.
- (e) Supporting of any rotating equipment shall incorporate anti-vibration mountings of the type and selection specified in the applicable clauses referring to equipment bases herein.
- (f) Supports shall preferably be proprietary products such as unistrut, or failing this, shall be of mild steel sections, purpose fabricated for their application. Under no circumstances whatsoever will sheet metal straps be accepted as a supporting method. All supports shall cradle the item to be supported; supports shall not be rivetted or welded to the equipment. Rod hangers shall not exceed 3000mm in length and be of minimum diameter 12mm. For longer suspensions use mild steel angles. Angle iron supports shall be of 38 x 5mm minimum section.
- (g) Rawbolt anchor bolts, or their equivalent, shall be used for fixing supports to the building structure, it not being permissible to utilise gunpowder shot- driven bolts for this purpose unless prior permission has been obtained.
- (h) Where holes in equipment exist, bolts and fixing screws as specified shall be used. Where sizes are not specified, the largest bolt or screw that will fit into the hole shall be used.
- (i) Where the fixing holes in brick or concrete walls are smaller than 10mm diameter and where the mass of the equipment is less than 15kg, wall plugs may be used to fix conduits, cables and other equipment. Aluminium, fibre or plastic plugs only may be used. Wooden plugs are not acceptable. Plugs installed in seams between bricks are not acceptable. A masonry drill of the correct size shall be used to drill holes for plugs. Round headed screws shall be used throughout.
- (j) Where the fixing holes are 10mm and larger or where the mass of the equipment is 15kg or more, equipment shall be fixed by means of expanding anchor bolts or by means of bolts cast into the concrete.
- (k) Brass screws, bolts and nuts shall be used to fix galvanised equipment.
- (l) Materials as sheet metal cable ducts or channels may be fixed against walls and concrete slabs by means of the shot-fired method designed for this purpose.
- (m) The Sub-Contractor shall ascertain whether this method of fixing will carry the weight of the material including conductors, cables and other items of equipment to be installed later.

Should it be found that the method of fixing is inadequate and joints tend to loosen, the Sub-Contractor will be required to fix the material by an alternative method to the satisfaction of the Engineer. Where the shot-fired method is used, warning signs shall be placed at all entrances leading to the area where this work is in progress. The Sub-Contractor shall take all reasonable precautions to prevent accidents. Only nails recommended by the manufacturer of the shot-fired equipment shall be used.

E09.5 ELECTRICAL CONDUIT INSTALLATION

E09.5.1 General

Where conduits are to be installed in concrete, this shall be done while the building work is still in progress. Surface mounted conduit shall only be installed after the concrete has cured sufficiently.

E09.5.2 Other Services

Conduits may not be installed closer than 150mm to pipes containing gas, steam, hot water or other materials which may damage the conduits. Conduits may not touch pipes or other service installations in order to prevent electrolytic corrosion. Where this is unavoidable, cathodic protection shall be provided. Where doubtful situations of this nature occur or where there are installation incompatibilities, the matter shall be reported to the Engineer without delay.

E09.5.3 Galvanised Conduit

Galvanised conduit and accessories shall be used in the following circumstances:

- (a) In damp areas and areas exposed to the weather
- (b) For all installations within 30 kilometres of the coast
- (c) For surface mounted conduit installations
- (d) In conduit used for future extensions where 'free ends' exist
- (e) For connections to galvanised equipment.

Conduit & accessories for the above applications shall be hot-dipped galvanised to SANS32 and SANS 121.

E09.5.4 Debris

Care shall be taken to prevent any debris or moisture from entering the conduit during and after installation of the conduits. All conduit ends shall be sealed by means of a solid plug which shall be screwed to the conduit end. All conduits shall be cleaned to remove all oil, moisture or other debris that may be present, before conductors are installed.

E09.5.5 Defects

Each length of conduit shall be inspected for defects and all burrs shall be removed. All conduits that are split, dented or otherwise damaged or any conduits with sharp internal edges shall be removed from site. The Sub-Contractor shall ensure that conduits are not blocked.

E09.5.6 Conduit Ends

Conduit ends shall be cut at right angles to ensure that ends butt squarely at joints. Threads shall not be visible at joints and connections except at running joints for steel conduits.

E09.5.7 Joints

All conduit ends shall be reamed and all joints tightly screwed. Only approved couplings shall be used. Running joints with long threads shall be kept to a minimum and locknuts shall be provided to ensure a strong mechanical and a continuous electrical joint for steel conduits.

E09.5.8 Finish (Steel)

All joints shall be painted with red lead to prevent them from rusting in damp areas, areas within 30km of the coast, and in cases where the installation is exposed to the weather for any length of time. Where the galvanising or black paint has been damaged, the area shall first be cleaned and a coat of zinc base paint applied subsequently. Additional coats of paint shall only be applied after the undercoat has been completed.

E09.5.9 Continuity (Steel)

Mechanical and electrical continuity shall be maintained throughout the conduit installation. Conduits may not be relied upon for earth continuity.

E09.5.10 Inspection Type Accessories

Inspection type couplings, elbows and tees shall not be used except with the written consent of the Engineer. All outlet boxes and draw boxes shall however be of the inspection type.

E09.5.11 Position of Outlets

All accessories such as socket outlets, switches, lights, etc., shall be accurately positioned. It is the responsibility of the Sub-Contractor to ensure that all accessories are installed level and square at the correct height from the floor, ceiling or roof level as specified. It shall be the responsibility of the Sub-Contractor to determine the correct final floor, ceiling and roof levels in conjunction with the Main Contractor. Draw boxes shall not be installed in positions where they will be inaccessible after completion of the installation. Draw boxes shall be installed in inconspicuous positions to the approval of the Engineer. All installed draw boxes shall be pointed out to the Engineer. The positions of all draw boxes shall be indicated on the 'as-built' drawings.

E09.5.12 Draw Wires

Galvanised steel draw wires shall be installed in all unwired conduits, e.g. conduits for future extensions, telephone installations and other services.

E09.5.13 Bends

A maximum of two 90° bends or the equivalent displacement will be allowed between outlets and/or draw boxes. Draw boxes shall be installed at maximum intervals of 12m in straight conduit runs. All bends shall be made without heating the conduit or without reducing the diameter of the conduit. The inside diameter of a bend shall not be less than three times the outside diameter of the conduit.

E09.5.14 Wall Sockets

Where more than one socket outlet is connected to the same circuit, the conduit shall be looped from one outlet box to the following on the same circuit. Where a metal channel is used, the conduit may be installed from the channel directly to the outlet box on condition that the conductors can be looped from one outlet to the next without the jointing of wires.

E09.5.15 Luminaires

Conduit end may not be used to solely support luminaires. Where luminaires are specified which are fixed directly to the pendant box, the pendant box shall be fixed independently of the conduit installation except where the pendant box is cast into concrete.

E09.5.16 Withdrawal of Conductors

To ensure that all electrical conductors shall be easily withdrawable from conduits, the Engineer reserves the right to have the conductors on any circuit removed at his discretion and replaced at the cost of the Sub-Contractor. If the conductors are damaged during removal, the damaged conductors shall be replaced and the cost of the replacement shall be borne by the Sub-Contractor.

E09.5.17 Temperature Differences

Should the conduit installation be subject to temperature gradients at the same time, an expansion joint shall be installed in a suitable position to accommodate expansion and contraction. The conduit at the higher temperature shall be insulated from the rest of the installation with a suitable material. The above conditions for example apply where conduits leave cold rooms.

E09.5.18 Flush Mounted Outlet Boxes

The edges of flush mounted outlet boxes shall not be deeper than 10mm from the final surface. Where this is not the case, an extension box which ends flush with the surface, shall be screwed to the outlet box. This method shall be used in partitions and clad surfaces.

E09.5.19 Excess Holes

All excess holes in draw boxes, distribution boxes, switchboards, cable ducts or trunking,

power skirting, etc., shall be securely blanked off to render the installation vermin proof.

E09.5.20 PVC Conduit

The use of PVC conduit is permitted in most cases and shall not be allowed, only if stated in the Detailed Technical Specification portion of the document.

E09.5.21 Terminations

E09.5.21.1 Switchboards, Power Skirting, Etc

A female bush and two lock nuts shall be installed where conduits terminate in pressed steel switchboards and distribution boxes, cable ducts, power skirting, etc. The conduit end shall only project far enough through the hole to accommodate the bush and lock nut.

E09.5.21.2 Draw Boxes

A female bush and lock nut shall be used to terminate conduits at draw boxes and outlet boxes without spouts.

E09.5.22 Open Roof Spaces

E09.5.22.1 Sequence of Work

Conduits and wiring in open roof spaces above ceilings other than ceilings of concrete, shall be installed before the ceilings and walls are painted and before removable ceiling tiles are installed. In roof spaces where access is limited after installation of the ceiling. It is the responsibility of the Sub-Contractor to ensure close liaison with the Main Contractor in connection with the work.

E09.5.22.2 Fixing

All conduits in open roof spaces shall be installed parallel and at right angles to the roof members and shall be fixed to the structures at intervals not exceeding 1 metre. Approved saddles shall be used throughout. Clout nails, clamps or wood screws shall be used to secure the saddles to wooden roof members. Saddles which comply with the requirements of this specification shall be used to secure conduits against concrete slabs. Written permission shall be obtained to secure conduits to steel beams in which case saddles shall be fixed by means of bolts, nuts and lock washers or purpose made saddles shall be used.

E09.5.22.3 Cross-Overs

Cross-Overs in conduit routes shall be minimised. Where cross-overs are unavoidable one conduit only shall be offset to cross the other conduit. Where several conduits enter the same draw box, they shall as far as possible be installed parallel to each other.

E09.5.22.4 Draw Boxes

Draw boxes with metal cover plates shall be installed where required. Draw boxes shall as far as possible be installed near gangplanks. Socket and switch boxes will not be accepted as draw boxes in open roof spaces.

E09.5.22.5 Positions of Accessories

In open roof spaces which afford access after completion of the building, conduit accessories shall be installed to allow wiring or inspection from above. In ceiling voids with less than 900mm clear space between the ceiling and the roof, conduits shall be installed to permit wiring and inspection from below. In the latter case, the shortest route may be followed i.e. conduits need not be installed parallel or perpendicular to roof members. Conduits shall be looped between outlet boxes.

E09.5.22.6 Incandescent Luminaires

Where luminaires are secured directly to draw boxes in false ceilings or where ceiling roses or special connections are used, flush mounted, rear entry round draw boxes which are independently fixed to roof beams, shall be provided.

E09.5.22.7 Conduit Ends

All conduit ends for lighting outlets in ceilings shall be securely supported.

E09.5.22.8 Fluorescent Luminaires

Draw boxes for fluorescent luminaires shall be installed as specified in the previous paragraph

but luminaires shall be installed as specified in paragraph 9.5.22.6.

E09.5.23 Installation in Concrete and Screeds

In order not to delay building operations, the Sub-Contractor shall ensure that all conduits and accessories which are to be cast in concrete are placed in position in good time. The Sub-Contractor or his representative shall be in attendance when the concrete is cast.

E09.5.23.1 Draw Boxes

Draw boxes, expansion joints and round ceiling boxes shall be installed where required and shall be neatly finished to match the finished slab and wall surfaces. Ceiling draw boxes shall be of the deep type. In hollow tile slabs, rear-entry draw boxes shall be used. In columns where flush mounted draw boxes are installed, the conduits shall be offset from the surface of the column immediately after leaving the draw box.

E09.5.23.2 Cover Plates

Draw boxes and/or inspection boxes shall, where possible, be grouped together under a common approved cover plate. The cover plate shall be secured by means of screws.

E09.5.23.3 Fixing to the Shuttering

All conduits, draw boxes etc., shall be securely fixed to the shuttering to prevent displacement when concrete is cast. Wire will not be accepted for securing boxes to the shuttering where off-shutter finishes are required. All draw boxes and outlet boxes shall be plugged with wet paper before they are secured to the shuttering.

E09.5.23.4 Concrete Floor Slabs

Conduits will not be allowed in concrete floor slabs of boiler rooms (or boiler houses), laundries or other damp areas. Equipment in damp areas shall only be supplied from above by means of multi-core PVC-insulated cables which shall either be installed in galvanised steel ducting or on galvanised cable trays. All socket outlets and three phase outlets in damp areas shall be supplied from above.

E09.5.23.5 Screeds

The installation of conduits in floor screeds shall be kept to a minimum. Where conduits are installed in screeds, the top of the conduit shall be at least 20mm below the surface of the screed. Where the screed is laid directly on the ground, galvanised conduits shall be used. This ruling will always be applicable to the lowest floor of a building. A minimum distance of twice the outside diameter of the conduit shall be left free between adjoining conduits. Conduits shall be secured to the concrete slab at intervals not exceeding 2.0m.

E09.5.23.6 Inspection

All draw boxes, conduits, etc., which are installed in concrete shall be cleaned with compressed air and provided with draw wires two days after removal of the shuttering. Errors that occur during the installation of the conduits, or any lost draw boxes, or blocked conduits, shall be immediately reported to the Engineer in order that an alternative route can be planned and approved by the Engineer before the additional concrete is cast. Any additional cost shall be to the Sub-Contractor's account.

E09.5.24 Surface Installation (steel)

Except where installed in ceiling spaces, the installation of conduit on the surface of walls and concrete slabs will only be allowed when authorised, in writing, by the Engineer. Where surface conduits are specified, saddles shall be of the hospital (spacer) type.

E09.5.24.1 Building Lines

All conduits shall be installed horizontally or vertically as determined by the route and the Sub-Contractor shall take all measures to ensure a neat installation. Where conduits are to be installed directly alongside door frames, beams, etc., that are not true, conduits shall be installed parallel to the frames, beams, etc. When in doubt, the Sub-Contractor shall consult the Engineer before installation is commenced.

E09.5.24.2 Saddles

Conduits shall be firmly secured by means of saddles spaced at maximum intervals of 2000mm. Saddles shall be submitted to the Engineer for approval prior to commencement of

installation. Where saddles are used to secure vertical lengths of conduit connected to surface mounted switch boxes or socket outlet boxes, the saddles shall be spaced so that the intervals between the box and the first saddle, between any two successive saddles and between the last saddle and the ceiling or roof are equidistant. Conduits shall be secured within 250mm before and after each 90° bend.

E09.5.24.3 Joints

Joints will not be allowed in conduit lengths not exceeding 3500mm when these conduits are installed on the surface of a wall. Threads shall not be visible at joints of completed installations, except where running joints are used. Running joints will be allowed only when absolutely necessary. All running joints shall be provided with lock nuts and shall be painted with red lead immediately after installation.

E09.5.24.4 Accessories

Inspection bends or tee pieces shall not be used. Non-inspection type bends may be used in the case of 40mm or 50mm diameter conduits. All draw boxes supporting luminaires or other equipment shall be fixed independently of the conduit installation.

E09.5.25 Flexible Conduits

In installations where the equipment has to be moved frequently to enable adjustment during normal operation, for the connection of motors or any other vibrating equipment, for the connection to thermostats and sensors on equipment, for stove connections and where otherwise required by the Engineer, flexible conduit shall be used for the final connection to the equipment.

The lengths of flexible conduit shall be as short as possible to comply with the requirements of the particular connection but shall not exceed 600mm, except when specified or approved by the Engineer.

Flexible conduit shall preferably be connected to the remainder of the installation by means of a draw box. The flexible conduit may be connected directly to the end of a conduit if an existing draw box is available within 2000mm of the junction and if the flexible conduit can easily be rewired.

Flexible conduit shall consist of metal-reinforced plastic conduit or PVC covered metal conduit with an internal diameter of at least 15mm, unless approved to the contrary. In false ceiling voids, flexible conduit of galvanised steel construction may be used. Connectors for coupling to the flexible conduit shall be of the gland or screw-in type, manufactured of either brass or cadmium or zinc plated mild steel. The requirements of paragraphs 9.5.9 are applicable.

Where the possibility exists that the conduit can come into contact with moisture, suitable covering and/or packing shall be installed to isolate the conduit from the moisture.

Flexible conduit connections shall be provided with an internal or external earth wire connection as required by the local Supply Authority, with preference given to internal earth wires where no specific local regulations apply.

E09.5.26 Expansion Joints

Where conduits cross expansion joints in the structure, approved type draw boxes which provide a flexible connection in the conduit installation shall be installed.

The draw box shall be installed adjacent to the expansion joint of the structure and a conduit sleeve, one size larger than that specified for the circuit, shall be provided on the side of the draw box nearest the joint. The one end of the sleeve shall terminate at the edge of the joint and the other shall be secured to the draw box by means of locknuts.

The circuit conduit passing through the sleeve shall be terminated 40mm inside the draw box. The gap between the sleeve and the conduit at the joint shall be sealed to prevent the ingress of wet cement.

The conduit boxes shall be drilled and tapped and the earth wire shall be bonded to the boxes by means of a 2,5mm² copper wire (minimum) with lugs and brass screws.

Draw boxes at the expansion joint shall be provided with a suitable steel cover plate fixed to the boxes by means of screws. The cover plates shall be installed before the ceilings are painted by others.

E09.5.27 Chases and Builder's Work

Except where otherwise specified, the Sub-Contractor shall be responsible for the builder's work connected with conduits, outlet boxes, switchboard trays, bonding trays and other wall outlet boxes as well as the necessary chasing and cutting of walls and the provision of openings in ceilings and floors for luminaires and other electrical outlets. The Sub- Contractor shall notify the Main Contractor of his requirements and the responsibility lies with the Sub-Contractor to ensure that these requirements are met.

Electrical materials to be built in must be supplied, placed and fixed in position by the Sub-Contractor when required by the Main Contractor. The Sub-Contractor shall also ensure that these materials are installed in the correct positions.

Where no Main Contractor is on site the Sub-Contractor is required to cover conduits installed in chases by a layer of 4 : 1 mixture of coarse sand and cement, finished 6mm below the face of the plaster and roughened. In all cases chases shall be deep enough to ensure that the top of conduits are at least 12mm below the finished plaster surface.

The Sub-Contractor is responsible for the cutting of chases and the building-in of conduits or other equipment. He will be held responsible for all damage as a result of this work and will be required to make good to the satisfaction of the Engineer. Chases shall be made by means of a cutting machine.

Under no circumstances shall face brick walls or finished surfaces be chased or cut without the written permission of the Engineer. Where it is necessary to cut or drill holes in the concrete structure, then prior permission of the Structural Engineer shall be obtained to ensure that the structure is not weakened.

The Sub-Contractor shall maintain close co-operation with the Main Contractor and all his Sub-Contractors throughout the course of the contract. Should the Sub-Contractor not comply with this requirements, any additional costs resulting from lack of his co-operation will be recovered from him.

E09.5.28 Connections to Switchboards

Wherever possible conduits connected to switchboards shall terminate in a common fabricated sheet steel draw box installed in the vicinity of the switchboard. In open roof spaces this draw box shall be placed in a roof space of not less than 900mm clearance. Lighting and plug circuits may be separately grouped in common conduits or metal ducts (trunking) from the distribution board to the draw box.

The draw box shall be of sheet steel with a minimum thickness of 1,6mm and shall be provided with a removable cover plate.

E09.5.28.1 Flush Mounted Switchboards

Where flush mounted switchboards are required, the recessed switchboard tray shall be built into the brick or concrete wall. All conduits from the floor or roof shall be fully recessed and shall be bonded directly to the tray.

E09.5.28.2 Surface Mounted Switchboards

Where surface mounted switchboards are specified but where the conduits can be fully recessed, the conduit shall be connected to a recessed connection box installed behind the switchboard. An opening with the same dimensions as the connection box shall be cut in the back of the switchboard and be provided with a suitable grommet.

E09.6 CABLE TRAYS AND LADDERS

E09.6.1 Responsibility of the Sub-Contractor

The Sub-Contractor shall supply and install all cable trays or ladders as specified or as required by the cable routes including the necessary supports, clamps, hangers, fixing materials, bends, angles, junctions, reducers, T-pieces, etc.

E09.6.2 Cable Trays

Metal cable trays shall be manufactured from perforated rolled steel or an approved steel wire mesh type. Only the following metal cable tray types may be used:

- (a) Less than 200mm wide 1,6mm minimum thickness with 12mm minimum return

- (b) 200mm and 350mm trays shall be manufactured from 2mm thick steel with folded over returns and a minimum up-stand of 50mm.
- (c) 350mm and wider 2,4mm minimum thickness with 76mm return as alternative to (b) above.

The return of trays shall not be perforated and the top of the return shall be smooth. The same cable tray type shall be used in long parallel tray runs.

E09.6.3 Cable Ladders

Metal cable ladders shall consist of 76mm high side rail of 2mm minimum thickness. Cross pieces consisting of channel sections shall be spaced at maximum intervals of 250mm. Where cables of 10mm dia. or smaller are installed on cable ladders, the spacing of the cross pieces shall be 125mm. Cables shall be clamped in position by means of purpose made cable clamps that fit into the cross pieces. Cross pieces consisting of slotted metal rails which accommodate plastic or metal cable binding bands, may be used in vertical cable runs against walls, etc, where the prior approval of the Engineer has been obtained. These cross pieces are not acceptable in horizontal cable runs.

E09.6.4 Plastic Cable Trays

Rigid PVC cable trays are acceptable. Only the following tray types may be used:

- (a) Less than 250mm wide 3,0mm minimum thickness and 40mm minimum return.
- (b) 250mm and wider 4,0mm minimum thickness and 60mm minimum return.

E09.6.5 Finishes

Metal cable trays and ladders shall be finished as follows:

- (a) In coastal areas hot-dip galvanised to SANS 32 and SANS 121 or epoxy power coated
- (b) False ceiling void electro-galvanised or epoxy power coated
- (c) Vertical building duct hot-dip galvanised to SANS 32 and SANS 121 or epoxy power coated
- (d) Plant rooms, substations, service tunnels, basements electro-galvanising or epoxy powder coated
- (e) Damp areas, exposed hot-dip galvanised to SANS 32 and SANS 121 or epoxy powder to weather coated
- (f) Undercover industrial hot-dip galvanised to SANS 32 and SANS 121 or epoxy powder application coated

The abovementioned finishes shall apply unless specified to the contrary in the Detailed Technical Specification. Hot-dipped galvanised or electro-galvanised trays and ladders shall be cold galvanised at all joints, sections that have been cut and at places where the galvanising has been damaged. Powder coated trays and ladders shall likewise be touched up at joints, cuts and damaged portions.

E09.6.6 Supports

Trays shall be supported at the following maximum intervals:

- (a) 1,6mm thick metal trays 1.5m maximum spacing
- (b) 2,4mm thick metal trays 1,5m spacing and 75mm return
- (c) Metal cable ladders 1,5m spacing
- (d) 3,0mm thick PVC trays, 1,5m maximum spacing with 40mm return
- (e) 4,0mm thick PVC trays, 1,5m maximum spacing with 60mm return

In addition, trays and ladders shall be supported at each bend, offset and T-junction.

E09.6.7 Joints

Joints shall be smooth without projections or rough edges that may damage the cables. The Sub-Contractor will be required to cover joints with rubber cement or other hardening rubberised or plastic compounds if in the opinion of the Engineer joints may damage cables.

Joints shall as far as possible be arranged to fall on supports.

Where joints do not coincide with supports, joints shall in the case of trays with single returns (items (a) and (c) of paragraph E09.6.2) be made by means of wrap-around splices of the same thickness as the tray and at least 450mm long.

The two cable tray ends shall butt tightly at the centre of the splice and the splice shall be bolted to each cable tray by means of at least 8 round head bolts, nuts and washers. Splices shall have the same finish as the rest of the tray. Where joints which do not coincide with supports occurring in trays with folded over returns, tight fitting metal guide pieces, at least 450mm long, shall be inserted in the folded returns to provide the necessary support to the two cable tray ends. Splices as described above shall be provided if trays sag.

E09.6.8 Fixing

Trays shall be bolted to supports by at least two hexagon headed bolts and nuts per support. Bolts shall be securely tightened to avoid cables being damaged during installation. The use of square nuts is not permitted.

E09.6.9 Fixing to the Structure

The supports for cable trays and ladders shall in all cases be securely fixed to the structure by means of heavy duty, expansion type anchor bolts. It is the responsibility of the Sub-Contractor to ensure that adequate fixing is provided since cable trays and ladders that work loose shall be rectified at his expense.

E09.6.10 Accessories

Horizontal and vertical bends, T-junctions and cross connections shall be supplied by the Sub-Contractor. The dimensions of these connections shall correspond to the dimensions of the linear sections to which they are connected. The radius of all bends shall be 450mm minimum. The inside dimensions of horizontal angles or connections shall be large enough to ensure that the allowable bending radius of the cables is not exceeded. Sharp angles shall have a 45° gusset.

All accessories shall be manufactured by the supplier of the ladder / tray, site fabricated accessories shall not be permitted unless prior written approval has been given by the Engineer.

E09.6.11 Installation of Cables

Cables shall be installed adjacent and parallel to each other on the trays with spacings as determined by the current ratings. Horizontal trays and ladders shall in general be installed 450mm below slabs, ceilings, etc, to facilitate access during installation.

E09.6.12 Earthing

Metal trays and ladders shall be bonded to the earth bar of the switchboard to which the cables are connected. Additional bare copper stranded conductors or copper tape shall be bolted to the tray or ladder where the electrical continuity cannot be guaranteed.

E09.7 **CABLE CHANNELS**

E09.7.1 Responsibility of the Sub-Contractor

The Sub-Contractor shall supply and install all cable channels as specified or as required by the cable and wiring installation including the necessary supports, hangers, fixing materials, bends, angles, junction T-pieces end caps, etc.

E09.7.2 Materials and Finishes

The ducts shall be rolled from 1,2mm minimum sheet steel and shall be finished as follows:

(a)	In coastal areas (under all circumstances)	Hot dipped galvanised to SANS 32 and SANS 121 or epoxy powder coated
(b)	Cast in concrete	Pre-galvanised
(c)	False ceiling voids	Pre-galvanised

(d)	Vertical building ducts	Hot-dipped galvanised to SANS 32 and SANS 121 or epoxy powder coated
(e)	Surface mounted in plant, rooms, substations, service tunnels, basements	Epoxy powder coated or electro-galvanised
(f)	Damp areas, exposed to weather, underground	Hot-dipped galvanised to SANS 32 and SANS 121 or epoxy powder coated.
(g)	Undercover industrial applications	Hot-dipped galvanised to SANS 32 and SANS 121 or epoxy powder coated.

The abovementioned finishes shall apply unless specifically to the contrary in the Detailed Technical Specification. Epoxy powder coats shall comply with paragraph EO9.12.9. Hot-dipped galvanised or electro-galvanised ducts shall be cold galvanised at all joints, sections that have been cut and at places where galvanising has been damaged. Powder coated ducts shall likewise be touched up at joints, cuts and damaged portions using spray canisters recommended by the manufacturers of the channels.

E09.7.3 Cover Plates

All channels shall have metal snap-in cover plates. Cover plates for wider channels shall be fixed by means of screws which shall permanently be tapped into the cover plates spaced at suitable intervals to prevent warping. The finish of the covers shall comply with paragraph EO9.7.2

E09.7.4 Connections

Adjoining lengths shall be correctly aligned and securely joined by means of fishplates and mushroom bolts, washers and nuts or connection pieces that are pop-riveted to both adjoining sections. All adjoining sections shall be rectangular and shall butt tightly. Covers shall fit tightly across the joint.

E09.7.5 Support for Conductors

All conductors in inverted cable channels shall be retained by means of metal clips or metal spacer bars at not less than 1m centres.

E09.7.6 Vermin Proofing

All cable channels shall be vermin proof after installation. Holes shall be covered by means of screwed metal plugs or by means of metal strips that are bolted or pop-riveted to the channel. Wooden or other plugs which are driven into holes or other temporary plugs or covers are not acceptable.

E09.7.7 Earth Continuity

Electrical and mechanical continuity shall be maintained throughout the channel installation. A tinned copper bonding strip shall be installed across each joint and secured to both adjoining channels by means of brass bolts, nuts and washers. The channel shall be bonded to the earth bar of the associated switchboard.

E09.7.8 Internal Finishes

All bends shall be of easy sweep design with 45° gussets. Burrs and sharp edges shall be removed and the inside edges of all joints shall be lined with rubber cement or other suitable rubberised or plastic compound to prevent conductor insulation laceration.

E09.7.9 Services

Multiple duct runs or internal metal partitions shall be used where conductors for power, control and other services are present.

E09.7.10 Vertical Installation

Where vertical duct lengths exceed 5m, conductors shall have intermediate fixings.

- E09.7.11 Number of Conductors
Channels shall be large enough to ensure that the combined total cross-sectional area (including insulation) of all conductors does not exceed 40% of the cross-sectional area of the channel.
- E09.7.12 Fixing
The Sub-Contractor shall supply and install all hangers, supports or fixings for the channels. Channels up to 75 x 75mm shall be supported at maximum intervals of 1m and larger channels at maximum intervals of 2m. Channel runs shall be carefully planned to avoid clashes with other services and to ensure that all covers can be removed after completion of the entire installation. The method of fixing the channels or supports to the structure shall comply with paragraph E09.4 with particular reference to paragraphs E09.4.f and E09.4.h. Purpose made cable clamps, hangers, etc shall be used as required.
- E09.7.13 Installation in Concrete
Where channels are cast into concrete, the reinforced type shall be used. Additional spacer blocks shall be used where necessary to prevent ducts from being bent while the concrete is cast. Channels shall be filled with polystyrene or other suitable fillers to prevent the ingress of cement and shall be securely fixed in position to the shuttering.
- E09.7.14 Fire Barrier
Where channels pass through walls, non-asbestos filling shall be installed around the conductors to serve as a fire barrier.
- E09.7.15 Conduit Connection
All conduit connections shall be terminated by means of two lock nuts and a brass female bush. All holes through which conductors pass shall be equipped with grommets.
- E09.8 INSTALLATION OF LUMINAIRES**
- E09.8.1 Positions
The mounting positions of luminaires shall be verified on site. All luminaires shall be placed symmetrically with respect to ceiling panels, battens, beams, columns or other architectural features of the space. The layout as shown in the documents shall generally be adhered to but any discrepancies or clashes with structural or other features must be referred to the Engineer before commencing erection of the installation. Should the Sub-Contractor neglect to refer such discrepancies to the Engineer, costs incurred as a result of subsequent alterations to suit the architectural features shall be to the Sub-Contractor's account.
- E09.8.2 Cover Plates
Cover plates shall be fitted over all draw boxes and outlets for luminaires that are not covered by the luminaire canopy, lamp-holder, ceiling rose or similar accessories.
- E09.8.3 Hanger and Supports
Where provision has not been made for the fixing of luminaires, the Sub-Contractor shall supply the necessary supports, hangers, conduit extensions, angle brackets or any fixing method approved by the Engineer.
- E09.8.4 Suspended Cable Channels
Luminaires (especially fluorescent luminaires) may also be suspended from ceilings by means of suspended metal channels. The channel may be supported by conduits or threaded rods.
Should metal rods be utilised, these shall be screwed to anchor bolts fixed in the roof slab.
Wiring shall either be installed in conduits fixed to the metal channel or in the metal channels. Purpose-made clamps shall be used to fix the fittings to the cable channel.
- E09.8.5 False Ceilings
In all cases where luminaires are fixed to false ceilings, the Sub-Contractor shall ensure that the ceiling is capable of carrying the weight of the luminaires before commencing installation.
Should any doubt exist in this regard, the matter shall be referred to the Engineer.

In cases where the mass of the luminaire is not carried by the ceiling but by a support or other suspension method, provision shall be made to prevent relative movement between the ceiling and luminaire, ceiling rose or connection point.

E09.8.6 Fluorescent Luminaires Fixed to Concrete Slabs

Fluorescent luminaires to be installed directly against concrete slabs or walls shall be fixed to the outlet box and at two additional points. The additional fixing can be effected by:

- (a) bolts built into the ceiling or wall,
- (b) screws and approved plugs, or
- (c) anchor bolts.

Shot-fired fixings are not acceptable. If specified or where approved by the Engineer, fluorescent fittings may be fixed to metal channels installed against concrete slabs or walls. The metal channel fixing may in this case be short-fired or fixed by any of the abovementioned methods. Purpose-made clamps shall be used to fix fittings to cable channels.

E09.8.7 Fluorescent Luminaires Fixed to False Ceilings

When fixing fluorescent luminaires to false ceilings, a gap shall not be visible, except where the ceiling tile is of non-fire resistant material, between the fitting and the ceiling. The luminaire shall be fixed directly to the ceiling beams by means of 40mm round-head wood screws and washer or alternatively be fixed to 50 x 76mm wooden supports that are fixed to the ceiling beams. In the case of tiled ceilings with exposed or concealed T-section supports, the luminaires shall be fixed to the metal supports by means of butterfly screws, pop-rivets or bolts with nuts and washers. Self-tapping screws may not be used.

E09.8.8 Continuous Rows of Luminaires

In cases where fluorescent luminaires are installed in tandem, only one connection outlet need be supplied per circuit. All luminaires shall be coupled to one another by means of nipples or brass bushes and lock nuts to ensure that wiring is not exposed and that earth continuity is maintained. Luminaires on the same circuit may be wired through the channel formed by the fitting canopies. In this case silicon-rubber insulated conductors shall be used

and internal connections shall be made at terminal blocks.

Screw connectors are not acceptable. The wiring for any other circuits or outlets, even though these may be in the same row may not be installed through the fitting canopies. The Sub-Contractor shall ensure that continuous rows are straight and parallel to the relevant building lines.

E09.8.9 Recessed Luminaires

Where recessed luminaires are required, the Sub-Contractor shall maintain close liaison with the Ceiling Contractor. In the case of tiled ceilings, the luminaires shall be installed while the metal supports are being installed and before the tiles are placed in position. The Sub-Contractor shall be responsible for the co-ordination of the cutting of ceiling tiles with the Main Contractor and the Ceiling Contractor concerned. All mounting rings and other accessories shall fit closely into cut-outs to ensure a proper finish.

E09.8.10 Special Ceilings

In cases where special ceilings e.g. aluminium strips, decorative glass, metal leaves, etc, are to be installed, the Sub-Contractor and the manufacturer of the ceiling shall agree upon the method of fixing of luminaires to the ceiling.

E09.8.11 Waterproof Luminaires

Waterproof and flameproof luminaires shall be screwed directly to the conduit end. Draw boxes that may be required must be approved by the Engineer beforehand.

E09.8.12 Bulkhead Luminaires

Surface mounted bulkhead luminaires shall not be screwed directly to conduit ends. The conduit shall terminate in a round draw box at the top or back of the fitting. The PVC- insulated conductors shall terminate in a porcelain terminal strip in the draw box. Asbestos or silicon-rubber insulated conductors shall be used from the terminal strip to the luminaire lamp-holder. Porcelain-screw connectors will also be allowed.

E09.9 INSTALLATION OF LIGHT SWITCHES

E09.9.1 Mounting

All light switches shall be installed 1400mm above the finished floor level unless specified to the contrary. Mounting heights given shall be measured from the finished floor level to the centre of the switch.

E09.9.2 Doors

Unless specified to the contrary, switches adjacent to doors shall be installed on the side containing the lock. If the position of the lock is not shown on the drawings, the position shall be verified before the switch box is installed. Switch boxes in brick or concrete walls, shall be installed 150mm from the door frame. Light switches installed in partitions or door frames shall be of the type designed for that purpose.

E09.9.3 Walls

Where the lower portion of a wall is face brick and the upper portion plastered, light switches shall be installed wholly in the plaster, provided that the lower edge of the plaster is not higher than 1600mm above the finished floor level. In general where different wall finishes are used in the same area, switches shall be installed within the same finish and not on the dividing lines between finishes.

E09.9.4 Switch Boxes

Switches shall be installed in standard rustproof (galvanised) pressed steel switch boxes with the necessary knock-outs for the proper termination of conduits. The installation of switch boxes shall comply with the requirements of paragraph E09.5 of this specification. Boxes shall be flush mounted or recessed as specified for the whole installation.

E09.9.5 Cover Plates

Cover plates which overlap the switchbox and which fit tightly against the wall finishes shall be installed in the case of flush mounted switch-boxes. All fixing screws in cover plates and switch grids shall be supplied and securely fitted.

E09.9.6 Escutcheon Plates

Where flush mounted switches are installed in special wall finishes, e.g. wood or board panels, acoustic tiles or other cladding, etc, and where the wall finishes have to be cut to accommodate the switch, it may be necessary to fix an escutcheon plate to the wall to cover the cut-outs. The escutcheon plate shall fit closely around the switch box and shall be fixed independently of the switch box and cover plate. Bevelled cover plates that overlap the switch boxes shall be used. Cover plates shall be fixed to the switch boxes and shall fit firmly against the escutcheon plate.

E09.9.7 Surface Mounted Switches

Surface mounted switches shall consist of a metal switch-box, cover plate and switch specially manufactured for the purpose. Switch boxes shall be fixed to the surface as described in paragraph E09.4 of this specification.

E09.9.8 Cutting of Cover Plates

Cover plates shall under no circumstances be cut unless specifically authorised in exceptional cases by the Engineer.

E09.9.9 Partitions

Light switches installed in partitions shall preferably be of the type designed for this purpose to be accommodated in the partition design. Switches installed in the metal support do not require switch boxes. Switches may not be flush mounted in partition walls without switch boxes.

E09.9.10 Waterproof Switches

Switches that are exposed to the atmosphere or are installed in damp areas, shall be of the waterproof type.

E09.9.11 Appearance

The sides of adjacent switches, plugs, push-buttons, etc, shall be parallel or perpendicular to each other and uniformly spaced. A common escutcheon plate shall be used for flush mounted outlets and accessories where the cover plates do not cover the cut-outs in the finishes.

E09.10 INSTALLATION OF SOCKET OUTLETS

E09.10.1 Mounting Heights

Unless otherwise specified outlets shall be installed at the following heights above finished floor level:

Flush mounted socket outlets in general	300mm
Surface mounted socket outlets in general	1200mm
Kitchens and prep area, surface or flush mounted	1200mm
Shops - surface or flush mounted	300mm
Offices - surface or flush mounted	300mm

All mounting heights shall be measured from finished floor level to the centre of the outlet box
Socket outlet boxes shall comply with paragraph E09.9.4.

E09.11 PROVISION FOR TELEPHONE INSTALLATION

E09.11.1 General

This specification covers only the supply and installation of outlet points and wiring channels and/or conduits for telephones in buildings. The telephone installation will be carried out by Telkom personnel or Specialist Contractor.

E09.11.2 Regulations

All provisions for telephones in buildings shall comply with the latest issue of "FACILITIES FOR TELECOMMUNICATION SERVICES IN BUILDINGS". In cases where the provision of this publication and the requirements of the Detail Technical Specification are in conflict, the latter shall take precedence.

E09.11.3 Sleeves for Main Cables

One or more asbestos-cement or PVC sleeves as specified, shall be installed from a point at the boundary of the stand, (position indicated by the Engineer), to the main telephone distribution board or the main telephone building duct , 600mm below ground level.

A manhole with steel cover (as specified in Part 2, Detail specification) shall be installed at each bend in the underground route or at intervals not exceeding 50m in straight sections.

The inner radius of bends shall not be less than 12 times the outside diameter of the sleeves.

All sleeves, manhole covers and accessories shall be supplied by the Sub-Contractor including the building work of the manhole, unless specified to the contrary.

E09.11.4 Separation of Services

Cables or conductors for telephone services shall be separated from all other services by:

- (a) Installation in separate metal channels or conduits, or
- (b) Installing the cables at a minimum distance of 300mm from all power cables, conductors and accessories, or
- (c) An earthed metal barrier installed to ensure that the minimum distance through free air space between the telephone cables and other services is at least 300mm.

Conduits or wiring channels installed for telephone services may not be used for any other purpose. Where non-metallic channels are used, the separation as stated in (b) above shall be maintained through the installation.

E09.11.5 Main Telephone Distribution Board

The size and position of the Main Telephone Distribution Board where required, shall be installed according to the requirements of the Detailed Technical Specification.

The board shall consist of a metal tray, architrave frame and hinged doors and shall be flush

mounted in the position shown on the drawings.

A 20mm thick wooden panel shall be installed in the main telephone distribution board and shall cover the entire back of the board.

The finish of the board shall comply with the requirements of paragraph E09.16.9.

All conduits to telephone outlets or sub-distribution boards in the building as well as the main incoming sleeves, shall terminate at the main distribution board as indicated on the drawing.

Where 100 x 100 x 50mm draw boxes are specified, the boxes shall be provided with a cover plate. A wooden panel need not be provided in these cases.

E09.11.6

Telephone Outlets

The Sub-Contractor shall make provision for outlets with blank cover plates only.

Telephone outlets in walls shall consist of flush mounted 100 x 50 x 50mm draw boxes with blank cover plates.

Telephone outlets in floors shall be of the same type as floor outlets for power sockets which may be specified in the Detailed Technical Specification.

These provisions also apply to underfloor ducting. If no floor outlets are specified, 100 x 100 x 50mm flush mounted draw boxes with blank cover plates shall be provided in the floor at the positions indicated on the drawings.

Where twin underfloor ducts are provided and where the one duct is intended for telephone cables, the separation between the ducts shall be maintained throughout the underfloor ducting installation, including power outlets and telephone outlets.

Where power skirting is specified for telephone installations, the Sub-Contractor need only install the skirting with covers since the telephone socket outlet will be fixed directly to the cover.

Where multiple power skirting is provided containing other services, no other cables may be installed in the section intended for telephone cables and the separation between the sections shall be maintained throughout the installation.

E09.11.7

Connection of Telephone Outlets

Telephone outlets shall be inter-connected and connected to the telephone distribution boards as shown on the drawings.

If the inter-connecting conduits are not specified, conduit sizes shall be 25mm diameter for a maximum of 10 outlets and 32mm diameter for 11 to a maximum of 20 outlets.

Metal channels or power skirting installed on the same floor level on opposite walls of the same area as well as parallel runs of underfloor ducting intended for the installation of telephone cables, shall be inter-connected at intervals of 8 metres. Conduits may be used for these inter-connections.

All conduit and all ducts or channels which do not have removable covers, shall be provided with galvanised steel draw wires.

Conduit connections to power skirting or surface mounted metal channels, shall be made by means of a 100 x 100 x 50mm draw box which is flush mounted immediately behind the duct or channel in which the telephone cables are to be installed. A hole shall be cut in the back of the duct or channel, immediately opposite the draw box. The edges of the hole shall be grommetted. The draw box shall be accessible from the front when the cover is removed.

Purpose-made accessories for the connection of conduits to underfloor ducts shall be used. Where these are not available a 100 x 100 x 50mm draw box shall be installed below the underfloor duct opposite a floor telephone outlet. A hole shall be cut in the back of the duct opposite the draw box. The draw box shall be accessible from the top via the floor outlet.

E09.12

SWITCHBOARDS AND DISTRIBUTION BOARDS

E09.12.1

Design and Construction of Free Standing Switchboards

Switchboards shall be factory built assemblies of switchgear and control gear (FBAs) of the multi-cubicle type and shall comply with IEC 439.

Switchboards shall be floor mounted with exterior panelling including doors and covers presenting a flush and uniform appearance. A channel section base-frame shall be provided.

- (a) Switchboard operation on cable access shall be as follows:
 - front operation with rear cable access
 - front operation with front cable access
 - back to back switchboards with front and rear operation and cable access
 - cable entry from above and below
- (b) Compartments shall be provided for:
 - main busbars
 - auxiliary busbars, if applicable
 - cabling
 - incoming and outgoing functional units
- (c) Segregation in the base-frame shall be provided to correspond with divisions in the switchboard sections when cable entry is from below. Access for sealing the cable slot with vermiculite cement shall be provided from the front or rear of the section to:
 - reduce the danger of fire spreading
 - prevent vermin entering

The base-frame shall be sealed with a cover plate when cable entry is from above.
- (d) Increase in depth of certain sections of switchboards for high current ratings shall be subject to the Engineer's approval.
- (e) Switchboards shall be designed to confine internal arcing faults and to direct arcs and gases arising from these away from the operator.

The arrangement of functional units and spacing between them shall be such that forced cooling is not necessary.
- (f) Conductors passing through holes in compartments shall be protected by means of neoprene grommets. Bevelling of sheet steel will not be accepted as a substitute.
- (g) Measures shall be taken to prevent electrolytic corrosion where dissimilar metals are in contact with each other.
- (h) Bolts shall be of the correct size for the holes provided and shall be fitted with matching sizes of washers and lock washers. Where removable covers are provided with bolt fastening, the nuts shall be either welded in position or securely fixed by means of a mechanical fixing device. Self-tapping screws, captive head nuts or cage nuts are not acceptable.
- (i) Switchboards shall be designed to permit the addition of identical sections.

E09.12.1.1 Barriers

Functional units other than fuse switches within their own enclosures, shall be located in their own compartments, separated from each other and the busbars. Barriers shall be provided to prevent accidental contact with live conducting parts of the circuit and to protect the unit from falling objects.

Fused switches, moulded case circuit breakers, etc, within their own enclosures, shall be barrier protected from falling objects and accidental contact with live conducting parts of the circuit and adjacent switches.

Barriers shall be robust with high impact strength and made of material which is self-extinguishing or resistant to flame propagation.

E09.12.1.2 Doors and Covers

Each functional unit compartment and cable compartment shall be provided with individual hinged doors for easy access except where flush mounted equipment prevents this. Power and control busbar compartments shall be provided with removable covers requiring the use of a tool for their removal.

Doors shall have adequate points of hinging and latching and shall be reinforced to prevent distortion when open. Non-ferrous fasteners shall be of the type detailed in Part 2 with four keys being supplied per switchboard. A release mechanism shall be provided on the cable compartment door hinges to allow the doors to be removed.

All removable doors and covers shall be identified to enable replacement in the correct position.

Doors shall have stops to prevent over swing of the door when opening and to avoid interference with adjacent compartments. Dust-proof seals shall be provided on all doors.

E09.12.1.3 Gland Plates

When cables enter a switchboard from below, a cable gland plate shall be provided at a minimum height of 300mm above the point of entry. In case of cables entering from above, the cable gland plate shall be mounted at the point of entry.

The gland plate shall be removable and shall be supported to prevent movement of the cables.

When cables enter a switchboard from below, adequate access shall be provided beneath the gland plate to ensure that once the cables have been installed, the floor slot can be sealed from above using vermiculite cement. The arrangement shall be such that once this slot is sealed level with the floor, each base frame sub-section shall be sealed from the adjacent base frame sub-section.

When cables enter from above, the gland plates shall effectively seal the switchboard opening.

E09.12.1.4 Degree of Protection

The switchboards shall be designed and manufactured to the degree of protection specified in Part 2 in accordance with IEC 144.

The minimum degree of protection shall apply when all functional units are connected. In the test, disconnected and removed positions, adequate protection shall be provided against contact with live parts.

E09.12.1.5 Busbars

Busbars shall be made of hard drawn copper of suitable dimensions and in accordance with IEC 439 with regard to temperature rise at the specified altitude and mechanical strength for the rated fault conditions. Busbars shall be housed in their own compartment. The neutral busbar shall have a current carrying capacity of half that of the phase busbar unless otherwise specified.

Busbars shall be rated in accordance with the requirements as previously detailed in this specification.

Small leads connected directly to the busbars, shall be provided with a 20 amp HBC fuse mounted at the busbar.

Conductors between the busbars and the supply side of a single functional unit shall be rated for the same fault level as the busbars. Where the conductors to the components included in the unit are phase segregated, braced and substantially fault free, they shall be capable of withstanding the let-through current of the protection device in the unit.

Busbars and connections shall be air insulated and shall be taped and/or shrouded on all sections where accidental contact is possible. Insulating materials shall be resistant to flame propagation, non-hygroscopic and resistant to tracking. Spaces between busbars and other parts must be such that there will be no materials, bolts and nuts, tools or other debris that can be trapped and reduce the clearances initially designed for.

Joints and tees in busbar connections shall be made with sherardised bolts, nuts and washers of not less than 12mm diameter. High tensile (black) bolts of not less than 10mm diameter and having a reference symbol 'R' for the tensile range in accordance with BS 970 will be accepted as an alternative.

Joints shall be made with at least two bolts and the overlap shall be sufficient to ensure ample mechanical strength and joint conductivity. Unless otherwise approved, the overlap shall not be less than six times the thickness or shall equal the width of the busbar material, whichever is the greater.

- E09.12.1.6 Identification of Busbars
- AC or DC busbars and functional unit conductors and connections shall be clearly marked to indicate the supply phase or pole they are connected to. The phases shall be coloured red, white and blue, with the neutral colour black and the protective conductor (earth bar) green and yellow. DC busbars shall be coloured red for positive and black for negative.
- E09.12.1.7 Protective Conductor (Earth Bar)
- A separate copper protective conductor to which all metal parts are connected shall be installed in the inside rear of each switchboard along the entire length. The bar shall be in an accessible position to allow for the earthing of cables.
- The protective conductor shall have a current carrying capacity sufficient to withstand the earth fault current that may occur in the switchboard. The cross-section shall be calculated with the aid of the formula in Appendix B of IEC 439 but shall not be less than 200mm².
- The neutral busbar shall be connected to the protective conductor by means of a removable bolted link on the cable side of each incoming functional unit. The link shall be easily accessible from the front of the switchboard for removal and testing.
- Non-current carrying parts, including relays, metres, etc, shall be effectively connected to the protective conductor by means of their mounting arrangement on the panel or by a separate earthing conductor connected to the protective conductor. This shall include the earth terminals provided on equipment.
- All parts of the protective circuit within the switchboard shall be designed to withstand the highest thermal and dynamic stresses that may occur.
- E09.12.2 Construction of Flush Mounted Switchboard
- E09.12.2.1 Bonding Tray
- Bonding trays for flush mounted switchboards shall be of rigidly constructed 1,6mm thick galvanised steel, braced and reinforced. Formed gussets shall be provided at the corners. All the tray joints shall be properly welded or securely bolted with a brass or cadmium plated steel earth connecting stud and nut.
- E09.12.2.2 Expanded Metal
- Where switchboards are to be built into 116mm thick walls, expanded metal shall be spot welded to the rear of the bonding trays. The expanded metal shall protrude at least 150mm on each side to prevent plaster from cracking.
- E09.12.2.3 Knock-Outs
- Ample knock-outs shall be provided in the top and bottom ends of each switchboard tray to allow for the installation of conduits for the specified and future circuits. Knock-outs shall be allowed for any size of specified conduit. Provision shall however be made for termination of at least 2 x 25mm diameter conduits at top and 2 x 25mm diameter conduits at the bottom of each tray.
- E09.12.2.4 Architrave Frame
- The architrave frame shall be of 2,0mm thick sheet steel with bevelled edges. The architrave frame shall accommodate the chassis, panels and doors. The architrave shall overlap the bonding tray by at least 25mm on each side. The architrave frame shall be fixed to the tray in such a fashion to allow for depth adjustment and irregularities of the wall.
- E09.12.2.5 Extension Frames
- Semi-flush mounted switchboards shall be equipped with extension frames. Generally the frame depths shall be 50mm but may be altered to suit each application.
- E09.12.2.6 Chassis
- The chassis for mounting of switchgear and equipment shall be of rigid construction and shall be fixed securely to the architrave frame or bonding tray by means of bolts screwed into tapped holes or bolts and nuts. Self-tapping screws are not acceptable. The chassis position shall be adjustable in the horizontal plane.
- E09.12.2.7 Panel (Faceplate)

A suitably stiffened panel manufactured of 2,0mm thick sheet steel shall be installed in the architrave frame for flush mounting of switchgear. The panels shall have machined punched slots for housing the specified and future switchgear, instruments, fuse holders, isolating switches, indicator lamps, etc. In exceptional cases contractors will be allowed to protrude through the panel. Blanking plates shall be provided in positions where future switchgear will be installed. The distance between the inside of the closed doors and the panels shall be not less than 40mm. No equipment may be mounted on the panel (faceplate) unless it is permanently hinged to the switchboard frame.

E09.12.2.8 Fixing of Panels

The panel for each switchboard shall be secured to the architrave frame by means of captive fasteners. Alternatively, the panel may be secured to the architrave frame by means of two pins at the bottom and a latch or lock at the top of the panel. Self-tapping screws or dome nuts will not be allowed. Where it is required that equipment be mounted on the panel, the panel shall be securely hinged to the switchboard frame.

E09.12.2.9 Panel Handles

Two chromium plated handles shall be provided on each front cover. The handles shall be mounted at the top and bottom of each panel.

E09.12.2.10 Hinged Panels

Where hinged panels are specified, the hinges shall be fixed to the architrave frame and the panel shall be secured by means of studs and hexagonal chromium plated nuts or by means of a suitable lock or latch which can be operated with a screwdriver. The panel shall be removable when it is in the open position.

E09.12.3 Construction of Surface Mounted Switchboards

NB This section refers to surface mounted sub-switchboards and not to floor standing main switchboards in substations or sub-main switchboards.

E09.12.3.1 Switchboard Tray

Surface mounted switchboards shall be equipped with a 1,6mm sheet steel reinforced tray. Securing lugs shall be provided to fix the tray to walls or any other structure. A solid brass or cadmium plated steel earth connection stud and nut shall be provided.

E09.12.3.2 Construction

All joints shall be welded or securely bolted. The tray shall be square and neatly finished without protrusions. The front tray sides shall be rounded with an edge of at least 20mm to accommodate flush doors.

The requirements for chassis, panels and doors shall be as specified for flush mounted switchboards. The doors shall be hinged and shall fit flush in the frame in the closed position. Knock-outs shall not be provided unless specifically called for.

E09.12.4 Power and Control Wiring

- (a) Power circuit wiring and connections in a switchboard shall be rated to the full rating of the associated equipment, i.e. fused switch, contactor, circuit-breaker, etc, and not to the circuit or fuse rating.
- (b) Neutral connections shall have the same rating as the phase connections unless otherwise approved.
- (c) Control circuits shall be wired using a minimum of 2,5mm² conductors. Current and voltage transformer circuits shall be wired using a minimum of 2.5mm².
- (d) Conductors shall be general purpose 600/1000V grade PVC-insulated wire to SANS 1507 and SANS 1574.
- (e) Wiring for circuits up to 50V shall be in 0,5mm² flexible 300/500V grade PVC-insulated wire in accordance with SANS 1507 and SANS 1574.
- (f) Single or solid conductor wire shall not be used.
- (g) Joints or splices in any wiring are not acceptable.

- (h) Panel and equipment terminals, labels, etc, shall be accessible after the wiring has been completed.
- (i) Terminals which are on the live side of fuses and isolating switches shall be completely shrouded to prevent accidental contact.
- (j) Aluminium conductors are not acceptable.

E09.12.4.1 Wiring Supports

Wiring shall present a neat appearance and shall be braced, clipped and/or laced to prevent vibration and to ensure that it shall not deform under fault conditions. Connections to equipment on swing doors shall be arranged so as to give a twisting motion and not a bending motion to the conductor.

E09.12.4.2 Wiring Identification

Power wires shall bear the colour along their entire length of the phase to which they are connected.

Control wire sheaths shall be coloured grey for AC circuits.

Control wiring leads shall be marked at both ends with an interlocking type of ferrule with permanent black letters impressed on a white background.

For all control wires without lug terminations the numbered ferrule must not fall off when disconnecting the wire and in this regard, the use of one strand of wire to retain the ferrule is acceptable.

E09.12.4.3 Wiring of Moulded-Case Circuit Breakers

Single pole and double pole moulded-case circuit breakers shall be wired in a way that the supply to the switchboard is equally balanced.

E09.12.4.4 Control Wiring and Cable Terminations

Stripping of insulation shall not result in damage to the conductors. The stripping tools used shall be of the type which permits the length of strip to be preset. Control wiring shall be terminated with pre-insulated, crimped or compression type lugs. Crimping tools shall be of the type which will not release the termination during normal operation until the conductor crimp has been correctly formed. Any damaged wiring will be rejected.

Lugs shall be of the hooked blade type when used in conjunction with screw clamp spring loaded insertion type terminals, ring tongue type when used with stud or direct screw mounted connections and wire pin when used with pinch screw type connections such as indicating lamp fittings.

Not more than two conductors shall be connected to any side of a terminal.

Each terminal strip shall be provided with not less than 10% spare terminals, with a minimum of two, unless otherwise approved.

E09.12.4.5 Power Wiring and Cable Terminations

Terminations for power wiring and cabling shall be provided with pressure type clamping connections or bolted connections capable of accepting crimped or compression type lugs on conductors.

An undrilled solid copper bar shall be provided for terminating all external power cables above 70mm, or where three or more cables in parallel are specified. The arrangement shall be suitable for accepting cable lugs of conductors up to 630mm².

E09.12.4.6 Cable Terminal Arrangements

Cables shall be made off directly onto circuit-breakers, switches, contractors, thermal-overloads, etc. Terminals or solid copper terminating conductors shall be provided where necessary. Provision shall be made for bracing and for fixing the cable leads to prevent vibration.

Where a large number of control terminals are mounted in close proximity, the terminals shall be in vertical rows with a minimum of 125mm below rows. Spare terminals shall be mounted at the bottom of the row unless the cabling drawing shows otherwise.

Terminals shall be provided for all cores of external control cable as indicated on the drawings whether internally connected or not.

E09.12.5

Testing

Electrical switch panels shall be inspected by the Engineer at their place of manufacture, prior to delivery to site. At such inspection and testing, the Sub-Contractor shall demonstrate the functioning of the switch panel to the Engineer. Any defects in materials, finishes and

operation of the switch panels shall be corrected at their place of manufacture prior to delivery to site.

Type and routine tests shall be carried out on either a complete switchboard or a representative portion thereof to verify its characteristics.

Type tests shall be performed in accordance with IEC 439:

- ☐ verification of temperature rise limits
- ☐ verification of dielectric properties
- ☐ verification of the short circuit strength
- ☐ verification of the effectiveness of the protective circuit
- ☐ verification of clearances and creepage distances
- ☐ verification of mechanical operation
- ☐ verification of degree of protection

If evidence is available of type tests already made on similar equipment, this may, subject to the Engineer's approval, be acceptable in lieu of these tests,

Copies of test certificates shall be submitted to the Engineer.

Routine test shall be performed in accordance with IEC 439:

- ☐ inspection of the switchboard including inspection of wiring and electrical operation tests
- ☐ dielectric test. This test shall have a duration of 60 seconds
- ☐ checking of protective measures and of the electrical continuity of the protective circuits.
- ☐ Thermal imaging of panels in operation (minimum 1 week operation) whilst on normal loading conditions. The results must be included in the Operations and Maintenance Manuals.

E09.12.6

Construction of LV Switch Cubicles (Kiosks)

Switch cubicles shall be of sufficient size to accommodate all the specified equipment. All equipment shall be installed as described in paragraph E09.12.7.

E09.12.6.1

Framework

Switch cubicles shall be manufactured of mild steel sheet metal with a minimum thickness of 2mm or cold rolled 3CR12 sheet metal with a minimum thickness of 1,6mm. Fibre re- inforced or other corrosion proof material (e.g. glass fibre) may also be used if adequately reinforced.

E09.12.6.2

Ventilation

Two ventilation slots or grilles, approximately 150 x 125mm and covered on the inside with copper mesh, shall be provided on opposite sides of the cubicle.

E09.12.6.3

Doors

Doors shall be provided in the front and back panels and shall swivel through 180°. Rigid padlocks and base plates for security latches shall be provided on the doors. Openings for security latches shall be blanked with chromed brass discs.

E09.12.6.4

Warning Sign

Warning & danger signs shall be mounted on each door in compliance with the requirements.

E09.12.6.5

Base

The kiosk shall be mounted on a well finished concrete base, with minimum height of 150mm above ground level in the case of mild steel and any of the other specified acceptable materials. The kiosk can be made for direct mounting into the ground in which case it shall be

equipped with a base, forming part of the structure, for this purpose. The switch cubicle shall protrude at least 10mm past the edges of the base to prevent water collecting on the base.

E09.12.6.6 Panel

All equipment shall be mounted flush behind a single front panel with the exception of metres and time switches. The panel shall be fixed by means of captive fasteners. Chromed handles shall be provided on the panel. Metres and time switches may be installed on the surface of the flush panels.

E09.12.7 Mounting of Equipment

E09.12.7.1 Clearance and Access

A minimum clearance of 50mm shall be maintained between items of equipment and the side of the compartment. Where extra equipment is specified after the design has been finalised, this clearance requirement may be altered subject to the Engineer's approval.

No piece of equipment shall be mounted in any position where it is not visible and accessible to a viewer looking into the compartment through the door opening.

E09.12.7.2 Mounting of Circuit Breakers

All moulded case circuit breakers shall be flush mounted with only toggles protruding. Miniature circuit breakers may be installed in clip-in trays mounted on the frame. Special provision shall be made for large main switches. Circuit breakers shall be installed so that the toggles are in the up position when "ON" and down when "OFF".

E09.12.7.3 Mounting of Contactors

Contactors shall only protrude through the panel in special cases. Plastic covers or other coverings will not be required.

E09.12.7.4 Instrumentation

All metering instruments shall be mounted flush in the front panel unless otherwise specified. In certain instances it may be required that instruments be mounted flush in the door. In these instances the back of metres shall be covered by removable covers of isolating material fixed to the door to protect the terminals of instruments and to prevent accidental contact. Equipment mounted normally on the surface, e.g. time switches and relays, shall be mounted behind the front panel. In these cases hinged access panels shall be provided in the front panel.

E09.12.7.5 Fuse-Links and Carriers

Fuses shall be of the high rupturing capacity type and shall be mounted on insulated draw-out carriers which shall hold the fuses positively and remain firmly fixed after withdrawal. In all cases the top terminal shall be the live terminal. This applies also for MCB's.

DC circuits shall have fuses in the positive and negative leads.

Fuses shall be so positioned that they are readily accessible to a person standing on the floor.

Fuses for instrumentation shall be mounted on the outside of the compartment door adjacent to or below the instrument.

Fuses shall be provided with labels giving their rating and duty.

Solid link holders shall be coloured white.

E09.12.7.6 Spare Fuses

One spare fuse of each type and size used in each board shall be fitted on clip holders on the inside of the front panel.

E09.12.7.7 Control Equipment

All equipment performing control functions, e.g. control relays, transducers, and time relays not requiring adjustment, shall be mounted behind the front panel.

E09.12.7.8 Current Transformers

Current transformers shall comply with SANS 3939.

Current transformers shall be accessible and easily removable.

Secondary windings of current transformers shall be earthed at one point only. Each group of current transformers, i.e. protection, metering, etc, shall be earthed directly to the protective conductor (earth bar).

Current transformers shall be naturally air-cooled, and shall be able to withstand the maximum fault current for the duration of time taken by the functional unit to clear, with protective devices set at the maximum time delay settings.

E09.12.7.9 Main Circuit Breakers

- (a) Rack-out type air circuit breakers shall be mounted in a separate compartment with the handle or operating mechanism only protruding. A positive device shall be provided to ensure that the circuit breaker is secured in the:

- connected position
- test position
- disconnected position

It shall be possible to remove the circuit breaker from its compartment. It shall not be possible to insert a circuit breaker into a circuit of higher rating.

Automatically-operated shutters shall be provided so that on racking out the circuit breaker, these shutters cover the isolating sockets to prevent inadvertent contact with live busbars and circuits. Busbar shutters shall be labelled with the word BUSBARS in letters of at least 50mm high.

Mechanical interlocks shall be provide to ensure that:

- the circuit breaker main contacts cannot be engaged and disengaged unless the circuit breaker contacts are fully open
- the circuit breaker cannot be closed unless it is in the connected, disconnected or test position
- the action of disengaging the circuit breaker from the connected, disconnected or test position shall automatically trip the circuit breaker.

Circuit breakers shall be capable of carrying continuously the load current stated in the drawings at site altitude when mounted within the compartment specified without forced ventilation.

- (b) If the main switch is a moulded case circuit breaker or isolator, it shall be installed flush in a separate compartment.

Contactors controlling the supply shall be installed behind separate front panels.

- (c) All metering, protection and indicating equipment shall be clearly visible from the front of the board. Where doors are specified the equipment shall be installed flush in the doors and covered as described in 'Instrumentation' above.
- (d) Fuses or control gear providing back-up protection for circuit breakers shall be installed behind separate front panels.

E09.12.7.10 Standby Supplies

- (a) Where standby power from a diesel-generator set or other source is available and has to be connected to some of the equipment on a switchboard, the switchboard shall be divided into electrically separate sections with sheet metal division plates to isolate power and mains power sections. The section doors must be appropriately colour coded to provide visual distinguishing.
- (b) A means shall be provided to isolate both the standby and mains power supplies simultaneously. For this purpose, either a 6-pole rotary switch or mechanically and electrically interlocked circuit breakers or contactors may be used. Electrical interlocking alone is not sufficient. Rotary switches may only be used on boards where the fault level does not exceed 10kA.
- (c) A separate 3-pole isolator, fuse switch or circuit breaker shall be provided as main switch for both the standby power section and the mains power section in addition to the isolator of (b) above.

Where a 6-pole rotary switch is used as isolator for the incoming supplies, this switch may be located in the standby section of the switchboard in which case the rotary switch can also serve as the isolator for the standby section. This arrangement is acceptable where the equipment on the mains power section of the switchboard can be turned off whenever it is necessary to work on the standby section of the switchboards.

- (d) The main switches to the standby and mains power sections shall be interlocked with the doors providing access to those sections to ensure that the door can only be opened when the switches are in the OFF position.

E09.12.8 General

E09.12.8.1 Size

All switchboards shall be of ample size to accommodate all the specified switchgear and provide space for future switchgear. For every 4 (or part of 4) circuit breakers of a kind on a switchboard, space for an additional circuit breaker of similar size shall be allowed unless future space requirements are clearly specified. The clearance between adjoining switchgear or switchgear openings shall be as specified in paragraph E09.12.7 of this specification.

E09.12.8.2 External Dimensions

All specified external dimensions for switchboards shall be strictly adhered to. If the clearances specified in paragraph E09.12.7 cannot be adhered to as a result of restricting external dimensions, the Sub-Contractor or Manufacturer shall obtain the opinion of the Engineer before manufacturing the switchboards.

E09.12.8.3 Positions

The Sub-Contractor shall ascertain the exact position of switchboards and shall arrange timeously for the installation of cable sleeves, openings in the structure, flush draw trays behind switchboards and supports over cable trenches.

E09.12.8.4 Mounting Heights

In general, flush and surface mounted switchboards shall be mounted 2000mm above finished floor level - measured to the top of the switchboard. The upper ends of switchboards may not be higher than 2,1m above finished floor level.

E09.12.8.5 Labels

In addition to paragraph E09.15 of this specification, the following labels shall be provided for switchboards:

- (a) Main labels: A white traffolite label shall be provided to clearly identify each switchboard and subsections of switchboards.

The fixing of main labels shall be done as per paragraph E09.15. Lettering shall be black with a maximum height of 20mm letters.

- (b) Compartment labels : Front panels shall be identified with white traffolite labels fixed to the doors or front panel respectively. The function of the equipment and circuits shall be clearly identified.

The fixing of compartment labels shall be done as per paragraph E09.15.

Lettering shall be black with a maximum height of 8mm letters.

- (c) Equipment labels : All equipment shall be identified with the necessary labels. The labels for equipment mounted on doors shall be identified with white traffolite labels having black lettering engraved on them, with a maximum height of 3mm letters.

The equipment labels shall be secured by means of high quality double sided tape.

The labels for all equipment, installed behind panels, shall be fixed to the chassis close to the equipment.

If this equipment is positioned too close to each other to accommodate descriptive engraved labels, the equipment may be identified by a code or number label which shall be fixed close to the equipment. The code or number shall be identified on a legend board which shall be installed on the switchboard behind a protective cover.

The types of labels for equipment behind the doors or covers shall be subject to the

Engineer's approval.

E09.12.8.6 Drawings

- (a) A set of three prints of the shop drawings for the switchboards shall be submitted to the Engineer for approval before the boards are manufactured. The following information shall be presented:
- (i) A complete wiring diagram of the equipment on the boards, and the internal wiring of such equipment.
 - (ii) A complete layout of the arrangement of the switchboards indicating all equipment dimensions and the construction of the boards. The positions and method of fixing of busbars shall be shown.
 - (iii) All labelling information on a separate sheet.
 - (iv) The make, catalogue number and capacity of all equipment such as isolators, circuit breakers, fuses, contractors, etc.

The approval of drawings shall not relieve the Sub-Contractor of his responsibility to the Employer to supply the switchboards according to the requirements of this specification or to the requirements of the Detailed Technical Specification.

- (b) A complete set of "Record" transparent drawings of all switchboards shall be submitted to the Engineer immediately after completion of the installation. The following information shall be presented:
- (i) Items (i) and (iv) of the previous paragraph.
 - (ii) Terminal strip numbers, numbers and colours of conductors connected to the terminal strips and numbers and colours of the conductors utilised for the internal wiring.
 - (iii) A separate schedule of all equipment.

Where such transparent drawings as called for above are modified during the execution of the contract, the Sub-Contractor shall at his own expense modify or replace such drawings. Accurate drawings of the equipment shall be forwarded to the Employer.

E09.12.9 Paint Finish

E09.12.9.1 Finish Required

Metal components of the framework, panels and chassis shall be finished with a high quality paint applied according to the best available method. Baked enamel, electrostatically applied powder coating or similar proven methods may be used. Care shall be taken to ensure that all edges and corners are properly covered. Whichever finishing method is employed, it shall be backed up by written certification that the quality of finish complies with the relevant SANS standard.

E09.12.9.2 Baked Enamel Finish

Prior to painting, all metal parts shall be thoroughly cleaned of rust, mill scale, grease and foreign matter to a continuous metallic finish. Sand or shot blasting, or acid pickling and washing may be employed for this purpose. Immediately after cleaning all surfaces shall be covered by an electrolytically applied rust inhibiting, tough, unbroken metal phosphate film and then thoroughly dried.

Within forty-eight (48) hours after phosphatising, a passivating layer consisting of a high quality zinc chromate primer shall be applied, followed by two (2) coats of high quality baked enamel to SANS 783 type 1. The minimum paint thickness after baking shall be 0.06mm. The paint shall have a shock resistance of 25kg / cm on 0,9mm soft steel plate and a scratch resistance of 2000 grams.

E09.12.9.3 Powder Coated Finish

Prior to painting, all metal parts shall be thoroughly cleaned of rust, mill scale, grease and foreign matter to a continuous metal finish. Sand or shot blasting, or acid pickling and washing may be employed for this purpose. The metal parts shall be pre-heated and then covered by a microstructured paint powder applied electrostatically. The paint shall be baked on and shall harden within 10 minutes at a temperature of 190°C. The minimum paint thickness after

baking shall be 0,5mm and shall have a shock resistance of 25kg / cm on 0,9mm soft steel plate and a scratch resistance of 2000 grams.

E09.12.9.4 Colour

The colour coding shall be as per the following specification:-

G01: PARTICULAR SPECIFICATION FOR COLOUR CODES

Before the installation is handed over, the Sub-Contractor shall ensure that all paint surfaces are clean and undamaged.

E09.13 NOISE AND VIBRATION

If in the opinion of the Engineer, any equipment operates with, or transmits from it, objectionable noise or vibration, it will be necessary to rectify or replace such plant in order that the system operates at conditions acceptable to the Engineer. Remedial measures taken to achieve satisfactory noise and vibration levels shall be at no additional cost to the Employer.

The following measures shall be taken where necessary, whether specifically stipulated in these documents or not, all to ensure quiet, vibration-free operation of the installations:

- (a) Equipment shall be mounted on vibration isolators of the correct type and selection, dependent upon deflection requirements versus vibrating frequency.
- (b) Pipework and ductwork shall be suspended or mounted using suitable supports with vibration isolators to prevent transmission of vibration from them to the structure to which they are attached.

E09.14 COMMISSIONING AND TESTING

The Sub-Contractor shall commission and test the entire installation at his own expense, including provision of all test equipment, such testing to be done in the presence of the Engineer, who shall have been notified of the dates and approximate duration of the tests sufficiently early to allow him to witness tests if necessary.

The Sub-Contractor shall properly test and call for inspection by the Engineer any work which is to be covered, concealed, built-in, otherwise closed up or rendered inaccessible, before such closing up takes place. The Engineer may require any work of this nature which he has not been called on to inspect before closing up, to be uncovered or made accessible to him entirely at the Sub-Contractor's expense, making good included.

It is in the interest of the Sub-Contractor to notify the Engineer when the installation reaches various stages of completion (e.g. before plastering, final finishes, before casting concrete, etc) in order that the Engineer may inspect the installation and point out discrepancies. These inspections shall be considered informal and under no circumstances will they, in part or in whole, invalidate the requirements of the document. Any costs incurred in correcting discrepancies shall be to the Sub-Contractor's account.

The Sub-Contractor shall keep full and proper written records of all tests conducted and commissioning information, such data to be properly indexed and submitted to the Engineer for his records.

The Sub-Contractor shall test electrical wiring for compliance with regulations and have the complete installation tested by the relevant authorities.

The Engineer reserves the right to inspect any item of equipment during manufacture or before delivery to site. The Sub-Contractor shall make available any item for such inspection. The Engineer shall also be furnished with manufacturer's test certificates whenever these are required by law or called for by the Engineer.

The Sub-Contractor shall commission the complete installation prior to inviting the Engineer to accept it, commissioning including inter alia the following services, as relevant:

- (a) The Sub-Contractor shall record all motor running currents and set overload protection devices to correct values.
- (b) The Sub-Contractor shall adjust and set all time clocks, time delay relays, automatic control devices and check their function for correctness and response.
- (c) The Sub-Contractor shall remedy any defects apparent on the installation prior to

calling upon the Engineer to accept the plants.

Thermal images of the panels and distribution board must be taken once the units are more than one week in operation. The images must be taken while in normal operating condition. The images should be reviewed and then presented as part of the Operations and maintenance manuals.

E09.15 LABELLING AND IDENTIFICATION

All equipment shall be labelled and identified using white traffolite labels having black lettering engraved on them; where two similar items exist, they shall additionally be numbered for clarity in identification.

Labels shall be secured by means of white rivets, slotted label holders or screwed on. Self-tapping screws will not be allowed.

All other equipment including metres, instruments, indicator lights, switches, push-buttons, circuit breakers, fuses, etc, shall be identified. The function of the equipment and circuits shall be clearly identified. Flush mounted equipment within doors or front panels shall be identified with labels fixed to the doors or front panels respectively.

E09.16 OPERATING AND MAINTENANCE MANUALS; “AS BUILT” OR “AS INSTALLED” RECORD DRAWINGS

Provide three hard copies and one disk of all operating and maintenance manuals and record drawings.

Provide a MSWORD for WINDOWS disk copy for any word processed elements of the operating and maintenance manuals. Employ a specialist to prepare manuals for the form and content of the operating and maintenance manuals.

Agree format and contents with the Employer Operating and maintenance manuals must include, but are not limited to the following:

- ☐ Index of Contents
- ☐ A full description of each of the systems installed, written to ensure that the Employer's staff fully understand the scope and facilities provided. Description to include data on general design parameters, normal associated operating conditions and manufacturers information concerning correct operation, etc, based on commissioning results.
- ☐ A description of the mode of operation of all systems.
- ☐ Diagrammic drawings to each system (including distribution boards) indicating principal items of plant, equipment, valves, etc.
- ☐ A photo-reduction of all record drawings, together with an index.
 - Size A4
 - Size A3
- ☐ Legend for all colour-coded services.
- ☐ Schedules (system by system) of plant, equipment, valves, etc, stating their locations within the building, duties and performance figures. Ensure each item has a unique code number cross-referenced to the record and diagrammatic drawings and schedules.
- ☐ The name, address and telephone number of the manufacturer of every item of plant and equipment together with catalogue list and order acknowledgement numbers.
- ☐ Manufacturer's technical literature for all items of plant and equipment, assembled specifically for the project, excluding irrelevant matter and including detailed drawings, electrical circuit details and operating and maintenance instructions.
- ☐ A copy for all Test Certificates, Certificates of Compliance, Inspection and Test Records, Commissioning and Performance Test Records (including, but not limited to, electrical circuit tests, corrosion tests, type tests, start and commissioning tests) for the installations and plant, equipment, valves, etc, used in the installations.
- ☐ A copy of all manufacturers' guarantees or warranties.
- ☐ Copies of Insurance and Inspecting Authority Certificates and Reports.
- ☐ Starting up, operating and shutting down instructions for all equipment and systems installed.

- ☐ Details of procedures to maintain plant in safe working conditions.
- ☐ Control sequences for all systems installed.
- ☐ Schedule of all fixed and variable equipment settings established during commissioning.
- ☐ Back-up copies of any system software.
- ☐ Documentation of the procedures for updating and/or modifying software operating systems and control programs.
- ☐ Instructions for the creation of Control procedure routines and Graphic diagrams
- ☐ Details of the software revision for all programs provided.
- ☐ Two back-up copies of all software items, as commissioned.
- ☐ Details of lubrication systems and lubrication schedules for all lubricated items.
- ☐ A list of normal consumable items.
- ☐ A list of recommended spares to be kept in stock by the Employer, being those items subject to wear or deterioration and which may involve the Employer in extended deliveries when replacements are required at some future date.
- ☐ A list of any special tools needed for maintenance cross referenced to the particular item for which required.
- ☐ Procedures for fault finding.
- ☐ Emergency procedures, including telephone numbers for emergency services.
- ☐ Copies of all items incorporated in the plantroom and switchroom schedules and schematics.
- ☐ Encase the Manuals in A4 size, plastic-covered, loose leaf, four ring binders with hard covers, each indexed, divided and appropriately cover-titled. Fold drawings larger than A4 and include in the binder so that they may be unfolded without being detached from the rings.
- ☐ Provide record drawings. Include the provision of relevant framed plasticised drawings in all electrical rooms.
- ☐ Three copies of all "AS BUILT" or "AS INSTALLED" record drawings, in print form, are required to be handed to the Engineer before completion of the project. There shall have been previously submitted to the Electrical Engineer for comment and approval. The Electrical Engineer also requires 2 copies of all record drawings to be made available on disk on CAD format. All "AS BUILT" or "AS INSTALLED" record drawings are to be prepared by the Electrical contractor in CAD format.

E09.17 MAINTENANCE INSTRUCTIONS AND GUARANTEES

Retain copies of all maintenance instructions and guarantees delivered with components and equipment (failing which, obtain), register with manufacturer as necessary and handover to the Employer on or before Practical Completion. Notify the Employer of telephone numbers for emergency services by Specialist Contractors and Suppliers after Practical Completion.

E09.18 MEASUREMENT AND PAYMENT

Item Unit

Supply and deliver distribution boards No

- a) The unit of measurement shall be the number of distribution boards supplied and installed. The tendered rate shall include full compensation for the supply and delivery of the distribution board as specified in the detail specification complete with all the electrical equipment specified.

Item Unit

b) Install, test and commission the distribution boards No

The unit of measurement shall be the number of distribution boards installed, tested and commissioned. The tendered rate shall include full compensation for the installing, testing and commissioning of the distribution boards complete with all the specified electrical equipment in the distribution board. The tendered rate shall furthermore include for the wiring of the distribution board.

Item **Unit**

c) Supply and deliver isolators No

The unit of measurement shall be the number of isolators supplied and delivered.

The tendered rate shall include full compensation for the supply and delivery of the isolators where the isolators are specified separately.

Item **Unit**

d) Install isolators No

The unit of measurement shall be the number of isolators installed.

The tendered rate shall include full compensation for the installing of the isolators where the isolators are specified separately.

Item **Unit**

e) Supply and deliver circuit breakers No

The unit of measurement shall be the number of circuit breakers supplied and delivered.

The tendered rate shall include full compensation for the supply and delivery of the circuit breakers where the circuit breakers are specified separately.

Item **Unit**

f) Install circuit breakers No

The unit of measurement shall be the number of circuit breakers installed.

The tendered rate shall include full compensation for the installing of the circuit breakers where the circuit breakers are specified separately.

Item **Unit**

g) Supply and deliver fuse switches No

The unit of measurement shall be the number of fuse switches supplied and delivered.

The tendered rate shall include full compensation for the supply and delivery of the fuse switches where the fuse switches are specified separately.

Item **Unit**

h) Install fuse switches No

The unit of measurement shall be the number of fuse switches installed.

The tendered rate shall include full compensation for the installing of the fuse switches where the fuse switches are specified separately.

Item **Unit**

i) Supply and deliver earth leakage units No

The unit of measurement shall be the number of earth leakage units supplied and delivered.

The tendered rate shall include full compensation for the supply and delivery of the circuit breaker earth leakage units where the earth leakage units are specified separately, e.g. (30 mA)

Item **Unit**

j) Install earth leakage units No

The unit of measurement shall be the number of earth leakage units installed.

The tendered rate shall include full compensation for the installing of the circuit breaker earth leakage units where the earth leakage units are specified separately, e.g. (30 mA)

Item **Unit**

k) Supply and deliver contactors No

The unit of measurement shall be the number of contactors supplied and delivered.

The tendered rate shall include full compensation for the supply and delivery of the contactors where the contactors are specified separately.

<u>Item</u>	<u>Unit</u>

l) Install contactors	No

The unit of measurement shall be the number of contactors installed.

The tendered rate shall include full compensation for the installing of the contactors where the contactors are specified separately.

<u>Item</u>	<u>Unit</u>

m) Supply and deliver light fittings	No

The tendered rate shall include full compensation for the supply and delivery to site of the specified light fitting, complete with lamp/s, wiring, control gear where applicable, diffusers, etc.

Separate items shall be scheduled for each type of light fitting required.

<u>Item</u>	<u>Unit</u>

n) Install light fittings.....	No

The tendered rate shall include full compensation for the handling, inspection, fastening, connecting and testing of the light fitting.

Separate items shall be scheduled for each type of light fitting. This rate shall furthermore include full compensation for the cost of providing and installing all hardware, timber backing, plugs, screws connector terminals and other materials required to install the light fitting in accordance with the specification.

<u>Item</u>	<u>Unit</u>

o) Supply and deliver switches	No

The tendered rate shall include full compensation for the supply and delivery to site of the specified switch complete with cover plate and fastening screws.

Separate items shall be scheduled for each type of switch.

<u>Item</u>	<u>Unit</u>

p) Install switches.....	No

The tendered rate shall include full compensation for the handling, inspection, fastening, connecting, fitting of cover plate and testing of the switch.

Separate items shall be scheduled for each type of switch.

This rate shall furthermore include full compensation for the cost of providing and installing all hardware screws and wall plugs in the case of surface mounted switches, required to install the switch in accordance with the specification.

<u>Item</u>	<u>Unit</u>

q) Supply and deliver photo-electric switch.....	No

The tendered rate shall include full compensation for the supply and delivery to site of the specified photo-electric daylight switch complete with mounting bracket and around bulkhead light enclosure.

<u>Item</u>	<u>Unit</u>

r) Install photo-electric switch	No

The tendered rate shall include full compensation for the handling, inspection, fastening of the bulkhead enclosure and photo electric switch, connecting and testing of the switch.

This rate shall furthermore include full compensation for the cost of providing and installing all hardware, screws, wall plugs and other material required to install the photo electric light switch in accordance with the specification.

Item **Unit**

s) Supply lighting track m

The unit of measurement shall be the linear metre of track supplied.

The tendered rate shall include the supply and delivery to site of the track as specified in the detail specification.

Item **Unit**

t) Install lighting track m

The unit of measurement shall be the linear metre of lighting track installed.

The tendered rate shall include full compensation for cutting to size and fixing to the ceiling or wall with appropriate fasteners of the lighting track and shall include the wiring connections of the supply circuit.

Item **Unit**

u) Supply and install lighting track accessories No

The unit of measurement shall be the number of splices, bends, elbows, connector units and end caps.

The tendered rate shall include full compensation for the supply, connecting, installation and fixing of accessories as detailed in the schedule of quantities.

Item **Unit**

v) Supply consumer distribution kiosks No

The unit of measurement shall be the number of distribution kiosk supplied.

The rate shall include full compensation for the supply of the distribution kiosks complete as specified.

Item **Unit**

w) Install consumer distribution kiosks No

The unit of measurement shall be the number of distribution kiosks installed.

The rate shall cover the cost of the sitting, handling, transporting, installing, painting, testing and commissioning of each kiosk.

Item **Unit**

x) Supply and erect concrete plinths for consumer distribution kiosks No

The unit of measurement shall be the number of plinths supplied and erected.

The rate shall include full compensation for the supply of precast plinths and bases and the erection thereof as specified.

Item **Unit**

y) Supply consumer distribution pillars No

The unit of measurement shall be the number of distribution pillars supplied.

The rate shall include full compensation for the supply of the distribution pillars fully equipped as specified.

Item **Unit**

z) Install consumer distribution pillars No

The unit of measurement shall be the number of distribution pillars installed.

The rate shall include full compensation for the installing of the distribution pillars and shall include for the excavation for the installing of the pillar and the backfilling, compacting and disposal of the surplus material once the pillar has been installed.

Item **Unit**

aa) Supply service connection cable m

The unit of measurement shall be the length in metres of service connection cables supplied.

The tendered rate shall include full compensation for the supply and delivery of the cable to site.

Item **Unit**

ab) Lay service connection cable m

The unit of measurement shall be the length in metres of service connection cable laid.

The tendered rate shall include full compensation for the handling, inspection, laying, cutting and testing the cable. Cables will be measured linearly over all lengths laid.

Item **Unit**

ac) Terminate service connection cable No

The unit of measurement shall be the number of service connection cable terminated.

The tendered rate shall include full compensation for the termination cable including all material and labour to render complete terminations of the cables.

Item **Unit**

ad) Supply socket outlets No

The unit of measurement shall be the number of socket outlets supplied.

The tendered rate shall include full compensation for the supply and delivery of single or double single phase, three pin socket outlets.

Separate items shall be scheduled for the following:

- (i) socket outlets flush mounted
- (ii) socket outlets surface mounted
- (iii) socket outlets to be installed in power skirting
- (iv) socket outlets to be installed in pedestals for floor ducting
- (v) socket outlets to be installed in recessed service outlets for floor ducting.

Separate items shall be scheduled for standard and dedicated switched socket outlets. All socket outlets shall be supplied complete with cover plates and boxes where required. The tendered rate shall therefore include for the supply of the cover plates and fixing screws where applicable.

Item **Unit**

ae) Install socket outlets No

The unit of measurement shall be the number of socket outlets installed.

The tendered rate shall include full compensation for the installing of the socket outlets. Separate items will be scheduled for the various type of socket outlets specified in item 6.6.8. The tendered rate shall furthermore include for the installing of the cover plates where applicable.

Item **Unit**

af) Supply plug tops for dedicated socket outlets No

The unit of measurement shall be the number of plug tops supplied.

The tendered rate shall include full compensation for the supply of plug tops for each of the dedicated socket outlets supplied and installed under this contract.

Item **Unit**

ag) Supply and deliver double pole isolator for geyser supply No

The unit of measurement shall be the number of double pole isolators supplied.

The tendered rate shall include full compensation for the supply and delivery of double pole isolators for the geyser supplies.

Item **Unit**

ah) Install double pole isolator for geyser supply No

The unit of measurement shall be the number of double pole isolators installed.

The tendered rate shall include full compensation for the installing of double pole isolators for the geyser supplies.

Item **Unit**

ai) Supply and install connections to heaters, stoves, fans and airconditioners units..... No

The unit of measurement shall be the number of connections made.

The tendered rate shall include full compensation for the installing of the connections to the heaters, stoves, fans and air conditioners and shall include for the supply and installing of the double pole isolator or control unit which ever is applicable.

Separate items shall be scheduled for each type of connections.

Item **Unit**

aj) Supply double pole isolators for power skirting No

The unit of measurement shall be the number of double pole isolators supplied for the power skirting.

The tendered rate shall include full compensation for the supply and delivery to site of the double pole isolators.

Item **Unit**

ak) Install double pole isolators for power skirting No

The unit of measurement shall be the number of double pole isolators installed.

The tendered rate shall include full compensation for the installation of the double pole isolators in the power skirting and shall include the connections of the conductors to the isolators.

Item **Unit**

al) Supply junction boxes No

The unit of measurement shall be the number of junction boxes supplied.

The tendered rate shall include full compensation for the supply and delivery to site of the junction boxes.

Separate items shall be scheduled for each type of junction box.

Item **Unit**

am) Install junction boxes..... No

The unit of measurement shall be the number of junction boxes installed.

The tendered rate shall include full compensation for the installation of the junction boxes as specified.

Separate items shall be scheduled for each type of junction box.

Item **Unit**

an) Supply and delivery of conduit m

The unit of measurement shall be the linear metre of conduit supplied and delivered.

The tendered rate shall include for full compensation for the supply and delivery of the specified conduit and shall include full compensation for the supply of the couplings to join the conducts. Separate items shall be scheduled for the different types of conduits specified.

Item **Unit**

ao) Installing of conduit m

The unit of measurement shall be the linear metre of conduit installed.

The tendered rate shall include for full compensation for the installing of the conduit including

jointing and bending the conduit and fixing the conduit using saddles as specified. Separate items shall be scheduled for the different types of conduit and for installing the conduit in concrete, fixing the conduit in brick work, including the chasing thereof, fixing the conduit on the surface of structures or installing the conduit in ceiling voids.

Item **Unit**

ap) Terminate conduit No

The unit of measurement shall be the number of terminations made.

The tendered rate shall include full compensation for terminating the conduit in draw boxes and outlet boxes and shall include for all locknuts and bushes.

Item **Unit**

aq) Supply and install draw boxes No

The unit of measurement shall be the number of draw boxes supplied and installed.

The tendered rate shall include full compensation for supplying and installing the draw boxes including the cover plates. Separate items shall be scheduled for installing the boxes in concrete, in brickwork including chasing, and on the surface of structures.

Item **Unit**

ar) Supply and install conduit outlet boxes No

The unit of measurement shall be the number of conduit outlet boxes supplied and installed.

The tendered rate shall include full compensation for supplying and installing conduit outlet boxes and shall include blank cover plates where no equipment is installed in the boxes. Separate items shall be scheduled for 1, 2, 3 and 4 way outlet boxes and for installing the boxes in concrete, in brick walls, including the chasing thereof, and surface on structures.

Item **Unit**

as) Supply power skirting m

The unit of measurement shall be the linear metre of power skirting supplied.

The tendered rate shall include full compensation for the specified power skirting including cover plates. Separate items shall be scheduled for one, two and three compartment power skirting.

Item **Unit**

at) Install power skirting m

The unit of measurement shall be the linear metre of power skirting installed.

The tendered rate shall include full compensation for installing the power skirting including all material required to install the power skirting.

Item **Unit**

au) Supply and install power skirting end caps, bends, conduit outlets & accessories No

The unit of measurement shall be the number of power skirting end caps, bends and conduit outlets supplied and installed.

The tendered rate shall include full compensation for the supply and installing of the power skirting end caps, internal and external bends and outlets and shall include for the supply of all material required to complete the installing thereof.

Item **Unit**

av) Supply under floor ducting m

The unit of measurement shall be the linear metre of under floor ducting supplied.

The tendered rate shall include full compensation for the supply of under floor ducting. Separate items shall be scheduled for the two and three compartment ducting.

Item **Unit**

aw) Supply under floor ducting accessories No

The unit of measurement shall be the number of accessories supplied.

The tendered rate shall include full compensation for the supply of the required accessories for the completion of the under floor installation. Separate rates shall be scheduled for cross-over, T-junction and right angle bend draw boxes and up-bends.

<u>Item</u>	<u>Unit</u>

ax) Supply pedestal units	No

The unit of measurement shall be the number of pedestals supplied.

The tendered rate shall include full compensation for the supply of the specified pedestal units.

<u>Item</u>	<u>Unit</u>

ay) Install under floor ducting	m

The unit of measurement shall be the linear metre of ducting installed.

The tendered rate shall include full compensation for the installation of the under floor ducting.

<u>Item</u>	<u>Unit</u>

az) Install under floor ducting accessories	No

The unit of measurement shall be the number of accessories installed.

The tendered rate shall include full compensation for the installation of the accessories. Separate items shall be scheduled for the cross-over, T-junction and right angle bend draw boxes and up-bends.

PARTICULAR SPECIFICATION

E11: GENERAL ELECTRICAL EARTHING AND LIGHTNING PROTECTION

PARTICULAR SPECIFICATION : VOLUME E11 : GENERAL ELECTRICAL GENERAL EARTHING AND LIGHTNING PROTECTION

E11.1 SCOPE

This specification covers the detail requirements of the general earthing and lightning protection to be installed under the contract. The purpose of an earthing and lightning protection system is to protect personnel from harmful touch voltages, and personnel, electrical network, equipment and structures from destruction by direct lightning strikes. The designed and installed system should aim at eliminating or reducing the effects during a lightning strike.

E11.2 STATUTORY DOCUMENTS AND STANDARDS

The latest edition, including all amendments up to date of tender of the following particular national and international specifications, publications and codes of practice shall be read in conjunction with this specification and shall be deemed to form part thereof:

E11.2.1 Standards

The earthing and lightning protection of all installations shall comply with the following standards and statutory requirements (as amended):

- a) SANS 10198 The selection, handling and installation of electric power cables of rating not exceeding 33 kV
- b) SANS 10313 The protection of structures against lightning
- c) SANS 62305 Series
- d) SANS 10142 Code of practice for the wiring of premises
- e) SANS 10199 The design and installation of an earth electrode
- f) Act 85/1993 Machinery and Occupational Safety Act

E11.2.2 Particular Specifications to be read in conjunction with this specifications

The following particular specifications shall be read in conjunction with the Project Specification:

- ☐ G01: PARTICULAR SPECIFICATION FOR COLOUR CODE
- ☐ G02: PARTICULAR SPECIFICATION FOR CORROSION PROTECTION
- ☐ E06: ELECTRICAL MEDIUM AND LOW VOLTAGE CABLE INSTALLATION
- ☐ E05: LOW VOLTAGE POWER AND CONTROL CABLE
- ☐ E08: WIRING

E11.3 CERTIFICATE OF COMPLIANCE

The Contractor shall appoint an earthing and lightning protection specialist to perform resistance measurements. The obtained measurement/values shall form part of a certificate of compliance issued by the specialist, who shall be a professional Engineer, which shall contain:

- ☐ An evaluation of the obtained results;
- ☐ A statement that the earth network and earth electrode resistances are in accordance with the standards and requirements listed in Clause 11.2.1; and, if necessary;
- ☐ Details of areas of non-conformance in this regard.

Two copies of this certificate shall be submitted to the Engineer before handing over of any repair, modification or new installation involving earthing or lightning protection systems.

E11.4 GENERAL EARTHING

E11.4.1 Earthing Philosophy

The earthing philosophy is based on two broad principles:

- ☐ **Common Earth:** The installation shall make use of only one earth system. Every earth shall be bonded to the main plant earth.
- ☐ **Bonding:** All Equipment likely to be subjected to surge currents shall be securely bonded together and to the earth network.

E11.4.2 Common Earth

Unless otherwise specified herein, the installation shall make use of only one earth system. This implies the following:

- ☐ Where an installation may typically consist of a main building or plant and one or more satellite subsystems, the various earth networks shall be interconnected to form one earth system.
- ☐ All main distribution boards and sub distribution boards shall be connected to an earth bar that is connected to the main earth conductor.
- ☐ Only in the rare instance of a subsystem being totally isolated, with no cables, pipes, fences or other conductive structures connecting it to the rest of the installation, may a system be provided with a separate earth network.
- ☐ Mains or "safety" earth networks and so called "clean" earth networks shall be connected to each other, preferably somewhere outside the "clean" area.

E11.4.3 Bonding

E11.4.3.1 General

Bonding leads shall be short and shall run in straight or smoothly contoured routes. Items such as fences, pipes, cables and conduit shall be earthed at both ends. The following items shall all be securely bonded, in an electrically continuous manner, to the earth network:

E11.4.3.2 Earth busbars

All metal parts (e.g. enclosures, lighting masts, frames, steel columns, gates fencing, pipes, cable ladders and trays, roofs and steel reinforcing).

E11.4.3.3 Cable armouring and glands, cable screens and steel conduit shall all be bonded to the main system earth network.

E11.4.3.4 Earthing Electrodes

E11.4.3.5 Bonding Conductors

Unless otherwise specified herein, bonding shall be done by means of 16 mm², green PVC insulated, hard drawn, stranded copper conductor and terminated using crimping lugs or ferrules. As an antitheft measure, preference shall be given to alternative materials of equivalent effectiveness and approved by the Engineer.

E11.4.3.6 Lugs

Where the earth network is connected to the electrical system or bonded to structures, the earth or bonding conductor ends shall be fitted with lugs. The lugs shall be secured by means of a hydraulic compression crimping tool with hexagonal dies or by means of *brazing* or *silver soldering*. **Dimple type indent crimping will not be acceptable.**

E11.4.3.7 Cable Armouring

At cable ends, the armouring shall be made off separately and be fitted with lugs. Armouring strands shall not be cut away to fit lugs. Cable armouring shall be bonded to the earth network at both ends of the cable.

E11.4.3.8 Cable Screens

Cable screens shall normally be bonded to the earth network at both ends of the cable. In cases where cable screens are used for signalling purposes (e.g. coaxial cables), the screens shall either not be earthed or earthed at one end only, depending on the application. If not specified, the screens shall be earthed at one end only. In addition, the cable shall either run inside earthed steel conduit or a separate earth conductor shall be installed alongside the cable.

Screens of 600/1000 V grade single core cables shall be earthed at one end only.

E11.4.3.9 Cable Ladders and Tray

Where there are breaks in the cable ladder or cable tray installation (e.g. at joints, bends or wall penetrations), the two sections shall be connected to each other. Both ends of cable ladder and cable tray runs shall be bonded to the earth network by means of 35 mm², stranded, bare copper conductor.

E11.4.3.10 Roofs

One 10 mm² bare copper conductor shall be installed over the full length of the ceiling void. This conductor shall be fixed to the top purlin and connected to the main earth conductor or earth bar of each distribution board. Conductive roof sections and gutters shall be connected to this conductor, at 15 m intervals, by means of 12 x 0, 8 mm copper strapping and galvanized bolts and nuts. Different roof levels and sections shall be bonded to each other.

E11.4.3.11 Non-conductive Wireways

Cables in PVC conduit or non-conductive sleeves shall be installed with stranded, bare copper earth conductors. These conductors shall be bonded to the earth network and other conductive items in the vicinity.

E11.4.4 Earthing of Substation Buildings

A substation copper earth bar, 50 mm x 6 mm x 600 mm, shall be fixed against the wall with cadmium bolts, in a suitably positioned cable duct, 200 mm above floor level. Ten holes of 10 mm diameter shall be provided in the earth bar.

All earth conductors shall be stranded copper conductors with crimped cable lugs. The following earth conductors shall be installed via the cable ducts:

- ☐ Two 70 mm² separate conductors, from the medium-voltage switchgear earth bar or earth bolt to the substation earth bar.
- ☐ One 70 mm conductor from every medium-voltage cable box and/or cable box stand.
- ☐ One 70 mm conductor from every low-voltage board/panel.

All double earth conductors shall be bound together neatly with plastic cable ties and be attached with the same bolt.

Only cadmium plated bolts and nuts shall be used for fixing earth conductors.

Final earthing shall be by means of three 70 mm² stranded copper conductors extending from the earth bar away from the substation, and installed in the ground in cable trenches, 900 mm deep and 50 m long and as close to 120° apart as possible. Furthermore, a 70 mm² bare copper earth conductor in a closed circuit around the substation building shall be installed at a depth of 900 mm and both ends shall be fixed together and to the earth bar.

After completion the subcontractor shall arrange for an earthing-resistance test to be carried out in the presence of the engineer. Any further earthing that may be required will be determined by the test results.

As an antitheft measure alternative materials to bare copper wire should be considered. Such alternatives must be proposed and approved by the engineer.

E11.4.5 Earthing of Miniature Substations and Transformers

The earth shall comprise of a 70 mm² bare copper earth conductor installed in a ring around the miniature substation base at a depth of 1 metre. 1,8 metre earth spikes shall be installed at each corner of the miniature substation and shall be connected to the earth installed around the miniature substation. Two further 70mm² bare copper earth conductors connected to the earth spike at each corner of the miniature substation shall be installed radially away from the miniature substation for a distance of six metres. A 1,8 metre earth spike shall be installed at the end of the radial earth conductors.

All earth conductors shall be terminated at the miniature substation, using crimped lugs securely bolted to the earth bar. The ends of the copper conductors shall be cleaned for a distance of 30 mm to obtain a good electrical contact with the lugs.

All earthing shall be done to the satisfaction of the engineer.

E11.4.6 Earth Continuity Conductors

Bare stranded copper earth continuity conductors shall be laid with all low-voltage cables from

the miniature substations or main distribution board to the distribution kiosks and distribution boards. Crimped lugs shall be used for the termination of the earth conductors.

E11.4.7 Instrument Earth

In each motor control centre a separate instrument earth shall be provided. The instrument earth shall consist of a 50 mm x 6 mm x 600 mm solid copper earth bar which shall be fixed against the wall of the substation (above the cable trench) with cadmium bolts. Ten holes of 8 mm diameter shall be provided in the earth bar.

All earth conductors shall be green PVC insulated stranded copper conductors with crimped cable lugs. The following earth conductors shall be installed via the cable ducts:

- ☐ One 16 mm conductor from every instrument marshalling panel.
- ☐ One 16 mm conductor from every controller on PLC.
- ☐ One removable link (bolted) between the instrument earth bar and the substation earth bar.

Final earthing shall be as for substation earthing with the exception that the earth conductor shall be PVC covered up to the outside of the building and that the conductor size shall be 16 mm. The final earthing may share the same trench on condition that the two earths be separated by at least 400 mm.

After completion the contractor shall arrange for an earthing-resistance test to be carried out in the presence of the engineer.

E11.4.8 Earthing of Distribution Boards

The earth bar or earth terminal of distribution boards and Equipment shall be connected to the earth bar of the supplying distribution board in accordance with SANS 10142-1. These connections shall consist of bare, stranded copper conductors, installed along the same routes as the supply cables. If the supply connections consist of conductors in conduit, the earth conductors shall be installed in the same conduit.

Each earth bar shall be connected to the earth network by means of M8 lugs, brass bolts, nuts and locknuts. Unless otherwise specified herein, these connections shall be effected by means of 16 mm² copper earth conductor. Each earth conductor shall be connected to the busbar with its own bolt and nut.

E11.4.9 Earth Resistivity Test

Where specified in the Projection Specification, earth resistivity tests shall be carried out prior to the installation of the earthing installation by a Specialist Contractor and the results shall be submitted to the Engineer.

E11.4.10 Tests to be Carried Out

After completion the Contractor shall arrange for an earthing-resistance test to be carried out in the presence of the Engineer by a Specialist Contractor. Any further earthing that may be required will be determined by the test results.

The following are the maximum acceptable earth electrode resistances:

- ☐ Main substations - 1 ohm
- ☐ Miniature substations and kiosks - 2 ohms
- ☐ Highmasts - 5 ohms.

E11.5 GENERAL LIGHTNING PROTECTION

E11.5.1 Lightning Protection Philosophy

The lightning protection philosophy is based on sound earthing and the creation of relatively surge free areas. These areas will be referred to as protected areas.

E11.5.2 Earthing

The installation shall be earthed as specified above.

E11.5.3 Protected Areas

Main installations and subsystems shall be established as so-called protected areas. Protected areas shall be surrounded by a ring earth and all Equipment shall be bonded to the earth network

as specified herein.

All cables crossing the barriers of the protected area into the unprotected environment shall be supplied with surge protection.

All conductive Equipment, such as pipes and fences, crossing the barriers of the protected area into the unprotected environment, shall be securely bonded to the earth network at the point of entry into the protected area.

E11.5.4 Surge Protection

Surge protection shall be provided to all power, data and communication cables entering or leaving the protected area.

All types of surge protection utilized shall have a serviceability indication facility.

E11.5.5 Main Distribution Board

Course protection in the form of a high capacity 100KA surge arrester shall be installed at the main low voltage distribution board of the installation. All three phases, as well as neutral, shall be connected to earth via the arrester.

The surge arrester shall be solidly bonded to the distribution board earth bar by means of 16 mm² green insulated copper conductor and shall be as accessible as circuit breakers and other distribution Equipment fitted to the distribution board.

E11.5.6 Other Distribution Boards

Distribution boards, other than the main low voltage distribution board, feeding loads outside the protected area or being fed from outside sources, shall be supplied with 15kA overvoltage arresters. These arresters shall be installed between each phase and earth, as well as between neutral and earth.

Distribution boards, other than the main low voltage distribution board not feeding loads outside the protected area or being fed from outside sources, shall be supplied with 6.5kA overvoltage arresters. These arresters shall be installed between each phase and earth, as well as between neutral and earth.

The overvoltage arrester units shall be solidly bonded to the distribution board earth bar by means of 4 mm² green insulated copper conductor and shall be as accessible as circuit breakers and other distribution Equipment fitted to the distribution board.

Where use is made of more than one set of busbars in the same distribution board, all the busbar sets shall be provided with overvoltage arresters as specified herein.

E11.5.7 Data and Communication Cables

Data and communication cables entering or leaving the protected area shall be provided with suitable surge protection. The Contractor shall timeously submit detailed proposals of all surge and over-voltage protection Equipment to the Engineer for approval. The Contractor shall only utilise devices which have levels of signal attenuation less than that specified as acceptable by the equipment manufacturer.

E11.5.8 Induced Surge

Cable sections between surge protection Equipment and the barrier of the protected area may induce surge currents in nearby cables and shall be regarded as being part of the unprotected environment. No other cables shall be installed in the same trench or wireways as these cables.

In addition, the following sets of cables, along parallel routes, shall not be installed closer than 500 mm from each other:

"Raw" power and UPS power cables.

Data/communication and mains power cables.

E11.5.9 Specific Surge Protection

The measures specified are aimed at generally limiting the impulse level to 1000 V. The Contractor shall ensure that all electrical and electronic Equipment will be suitable for continuous, reliable operation under these conditions and that all such Equipment is adequately protected in accordance with their own withstand levels, whether such protection has been specified or not.

E11.6**MEASUREMENT AND PAYMENT**

<u>Item</u>		<u>Unit</u>

c)	Earthing of substation building	Sum

The tendered rate shall include full compensation for the supply of all material required and the installing of the earthing system and shall include for the testing of the earthing installation by a specialist contract.

<u>Item</u>		<u>Unit</u>

d)	Earthing of MCCs	Rate

The tendered rate shall include full compensation for the supply of the copper conductor and lugs, the laying of the bare copper conductors, the termination of the conductors and the connection thereof to the earth bar.

<u>Item</u>		<u>Unit</u>

e)	Supply and lay earth continuity conductors	m

The tendered rate shall include full compensation for the supply and laying of the specified earth continuity conductors.

<u>Item</u>		<u>Unit</u>

f)	Terminating of earth continuity conductors.....	No

The tendered rate shall include full compensation for supplying all the material required to terminate and connect the earth continuity conductors and the connecting thereof to the earth bars in the miniature substations, switchboards, motor control centers, main distribution boards, distribution kiosks and distribution boards.

<u>Item</u>		<u>Unit</u>

g)	Extra over for the supply and installation of additional earth spikes of specified length including clamps for the connection of earth conductor	No

The tendered rate shall include full compensation for the supplying and installation of the earth spikes.

<u>Item</u>		<u>Unit</u>

h)	Provision for additional earthing as required	Prov sum

The provisional sum provided shall include for any additional earthing which may be specified by the Engineer after the acceptance of the contract.

The Contractor shall submit a written quotation to the Engineer when requested to by the Engineer and shall not commence with the installation of any additional earthing without the written instruction of the Engineer.

<u>Item</u>		<u>Unit</u>

i)	Provide an instrument earthing system	Sum

The tendered rate shall include full compensation for the supply of all material required and the installing of the instrument earthing system and shall include for the testing of the earthing by a specialist contractor.

<u>Item</u>		<u>Unit</u>

j)	Earth resistivity tests.....	No

The tendered rate shall include for the carrying out of the earth resistivity tests by a Specialist Contractor. The unit for measurement shall be per point where such tests have to be carried out.

<u>Item</u>		<u>Unit</u>

k)	Earth tests	No

The unit of measurement shall be the number of earth tests undertaken.

The tendered rate shall include full compensation for providing the equipment required to undertake the tests and the undertaking of the tests.

PARTICULAR SPECIFICATION

E12: ELECTRICAL MEDIUM VOLTAGE CABLES

PARTICULAR SPECIFICATION: VOLUME E12: ELECTRICAL MEDIUM VOLTAGE CABLES

CONTENTS

E12.1 INTRODUCTION

This specification covers the following:

- ☐ Medium Voltage (MV) cables for underground and surface installation.
- ☐ The type of MV cables that shall be used.
- ☐ The general requirements of the MV cables.
- ☐ The practice to be followed when storing, installing and testing the cables.

E12.2 SCOPE

E12.2.1 General

This specification details the requirements for single-core and three-core, MV cables. The preferred type of MV cables which is detailed in this specification is paper insulated lead covered steel wire armoured, electric cables with stranded annealed copper conductors, based on the requirements of SANS 97 and Cross-linked Poly-ethylene (XLPE) type A cable.

E12.2.2 Work to be included

The scope of work includes the supply, delivery, storage, laying and testing of MV cables prior to commissioning of plant and equipment.

The following is specifically included in the scope:

- (a) Description of the MV cables required for the work.
- (b) Marking and labelling of the cables and cable drums.
- (c) Pre commissioning tests to be carried out on the cables.

E12.2.3 Work to be excluded

The following work and items are specifically excluded from the scope of work:

- (a) All civil works

E12.3 STATUTORY DOCUMENTS AND STANDARDS

E12.3.1 Standards

The cables and their installation methods shall comply with the requirements of this specification including the relevant requirements of the following Acts, Codes of Practice and Standards:

a)	SANS 10142-1	Code of Practice for wiring of premises.
b)	BS 1433	Specification for copper for electrical purposes - Rod and bar
c)	SANS 97	Electric Cables – Impregnated paper-insulated metal-sheathed cables for rated voltages 3.3/3.3 kV to 19/33 kV.
d)	SANS 1339	Cross-linked Poly-ethylene (XLPE) insulated cables for rated voltages 3.8/6.6kV to 19/33kV
e)	SANS 1507	Electrical cables with extruded solid dielectric insulation for fixed installations
f)	SANS 1411	Materials of insulated electric cables and flexible cords
g)	SANS 1520	Flexible electrical cables for use in mines
h)	IEC 173	Flexible cords
i)	IEC 245	Rubber insulated cables
j)	IEC 287	Current rating calculations
k)	IEC 540	Insulation tests

- l) VDE 0250 Standard for insulated wires and flexible cables
- m) SANS 10198 The selection, handling and installation of electric power cables of rating not exceeding 33kV
- n) The Occupational Health and Safety Act (Act 85 of 1993)
- o) The Mines Health and Safety Act (Act 78 of 1973)
- p) The Minerals Act (Act 50 of 1991)

E12.3.2 Particular Specifications to be read in conjunction with this specifications

The following particular specifications shall be read in conjunction with the Project Specification:

- ☐ G01: PARTICULAR SPECIFICATION FOR COLOUR CODE
- ☐ G02: PARTICULAR SPECIFICATION FOR CORROSION PROTECTION
- ☐ E06: ELECTRICAL MEDIUM AND LOW VOLTAGE CABLE INSTALLATION

E12.4 **DEFINITIONS**

PILC Cable	Single-core and three-core, paper insulated lead covered (PILC) – insulated, electric cables
Armour	A layer or layers of galvanized steel wires applied to the cable to provide mechanical protection or earth continuity, or both.
Sheath	A solid extruded protective covering applied as the exterior of a cable or a flexible cord.
Bedding	A layer of extruded compound applied to the cable beneath the armouring.
Core	A single insulated conductor without protective covering.
XLPE	Cross-linked Poly-ethylene cable

E12.5 **CABLE REQUIREMENTS**

E12.5.1 General

PILC cables shall comply with the requirements of SANS 97.

XLPE cables shall comply with SANS 1339

The following cable operating voltages (line voltage) shall apply:

- ☐ 11kV

The cores of three-core cables shall be identified by the colours Red, White and Blue (R, W, B).

E12.5.2 Specific Requirements of MV Cables

E12.5.2.1 Voltage Frequency

The cable is needed for an underground, three phase, medium voltage, 50 hertz, alternating current distribution system.

E12.5.2.2 Core Screen

The core shall be individually screened. The core screen shall be strippable.

E12.5.2.3 Metal Sheath

The metal sheath shall comprise of pure lead for PILC. XLPE cables shall be PVC.

E12.5.2.4 Bedding

A bitumass impregnated fibrous bedding complying with SANS 97 shall be provided. XLPE cables must be PVC bedded.

E12.5.2.5 Armour

Double steel tape armouring in accordance with SANS 97. XLPE cables to have a steel or aluminium wire armour.

E12.5.2.6 Outer Sheath (Serving)

A PVC outer sheath will be required for XLPE, An impermeable black PVC sheath in accordance with SANS 97 shall be provided for PILC.

E12.5.2.7 Conductors

The standard conductor shall be copper with cross-sectional areas as specified in Table 1:

1	2	3
Construction	Rated voltage(kV)	
	6.6	11
	Area (mm ²)	
3-core	25	25
	35	35
	50	50
	70	70
	95	95
	120	120
	150	150
	185	185
	240	240
	300	300

E12.5.2.8 Cable Markings

Cables shall be legibly marked as specified in SANS 97, and shall also include the following:

- (a) Conductor size in square millimetres
- (b) Number of cores
- (c) Conductor material (copper)
- (d) The specification number (SANS 97) to which the cable has been manufactured.
- (e) The year of manufacture
- (f) A red stripe along the length of the outer sheath to indicate the relevant applications.

Typically marking – MAKE YEAR 6.6/11kV XXmm² x 3 Cu SANS 97

E12.6 MARKING, LABELLING AND PACKAGING

E12.6.1 Packaging

Cables shall be supplied on wooden drums.

Unless otherwise stated, standard drum lengths shall be 300m for all 3-core cables.

E12.6.2 Marking of drums

The marking of drums shall be in accordance with SANS 97.

The following information, in addition to that required in SANS 97, shall be provided:

- (a) The specification number SANS 97;
- (b) The type of armour;
- (c) The order number or contract number;
- (d) The outer sheath material.

E12.7 CABLE SIZING AND DE-RATING

For cable sizing and de-rating factors, refer to Annexure A, B and C.

E12.8 TESTING OF CABLES

The tests as specified in SANS 97 and SANS 1339, shall apply to all cables. Routine test certificates shall be supplied for each drum of cable supplied.

E12.9 QUALITY ASSURANCE

All cables supplied under the scope of works of this project shall be designed and manufactured under a quality control system, typically to SANS ISO 9000 series.

E12.10 MEASURE AND PAYMENT

All cables supplied under the scope of works of this project shall be designed and manufactured under a quality control system, typically to SANS ISO 9000 series.

<u>Item</u>	<u>Unit</u>
a) Supply and delivery of medium voltage paper insulated cable.....	m

The unit of measurement shall be the metre of cable supplied and installed.

The tendered rate shall include full compensation for the supply and delivery of the specified cable to the site.

ANNEX A

GENERAL DATA FOR PILC SWA 11kV COPPER CABLES TO SANS 97

Conductor Area (mm ²)	Approx OD (mm)	Approx Weight (kg/km)	Impedance (Ω/km)	Ampere Rating		
				Ground	Duct	Air
25	31.38	4890	0.8779	105	90	105
35	33.64	5710	0.6371	130	110	125
50	33.49	6020	0.4751	160	135	165
70	36.50	7080	0.3365	195	165	200
95	39.33	8260	0.2499	235	200	245
120	41.73	9440	0.2053	265	225	280
150	44.36	10770	0.1739	295	250	315
185	47.42	12290	0.1481	335	280	360
240	52.14	14480	0.1245	380	325	415
300	56.15	16940	0.1106	425	365	470

ANNEX B

DERATING FACTORS FOR PILC SWA 11kV COPPER CABLES TO SANS 97

Table B1: Depth of laying – multicore PILC SWA cables

Depth of laying (mm)	Direct in ground		In single way ducts	
	Up to 300mm ²	Above 300mm ²	Single core	Multicore
500	1.15	1.15	1.15	1.15

600	1.10	1.10	1.10	1.10
800	1.00	1.00	1.00	1.00
1000	0.98	0.97	0.98	0.99
1250	0.96	0.95	0.95	0.97
1500	0.95	0.94	0.93	0.96
2000	0.92	0.90	0.90	0.94

Table B2: Variations of thermal resistivity of soil – single and multicore cables

Conductor size mm ²	Direct in ground				In single way ducts			
	Soil restivity, K.m/W				Soil restivity, K.m/W			
	1.0	1.5	2.0	2.5	1.0	1.5	2.0	2.5
25	1.06	0.93	0.85	0.78	1.03	0.96	0.91	0.86
35	1.06	0.93	0.85	0.78	1.03	0.96	0.90	0.85
50	1.07	0.93	0.84	0.77	1.03	0.96	0.90	0.85
70	1.07	0.93	0.84	0.77	1.03	0.96	0.90	0.85
95	1.07	0.93	0.84	0.77	1.03	0.95	0.89	0.84
120	1.07	0.92	0.83	0.76	1.03	0.95	0.89	0.83
150	1.07	0.92	0.83	0.76	1.04	0.95	0.89	0.83
185	1.07	0.92	0.82	0.75	1.04	0.95	0.88	0.82
240	1.07	0.92	0.82	0.75	1.04	0.95	0.88	0.82
300	1.07	0.92	0.82	0.74	1.04	0.95	0.87	0.82
400	1.07	0.91	0.81	0.74	1.04	0.94	0.86	0.81
500	1.08	0.91	0.80	0.72	1.05	0.94	0.84	0.78
630	1.08	0.91	0.79	0.72	1.05	0.94	0.84	0.78
800	1.08	0.90	0.79	0.71	1.05	0.93	0.83	0.77
1000	1.08	0.90	0.79	0.71	1.05	0.93	0.83	0.76

Table B3: Derating factors for grouping of multicore cables in horizontal formation in ground or ducts

No. of cables in group	In ground - Axial spacing (mm)					In ducts - Axial spacing (mm)			
	Touching	150	300	450	600	Touching	300	450	600
2	0.80	0.85	0.89	0.90	0.92	0.88	0.91	0.93	0.94
3	0.69	0.75	0.80	0.84	0.86	0.80	0.84	0.87	0.89
4	0.63	0.70	0.77	0.80	0.84	0.75	0.81	0.84	0.87
5	0.57	0.66	0.73	0.78	0.81	0.71	0.77	0.82	0.85
6	0.55	0.63	0.71	0.76	0.80	0.69	0.75	0.80	0.84

Table B4 Ground temperature derating factors

Maximum Conductor Temperature	Ground Temperatures (°C)				
	25	30	35	40	45
70°C	1.00	0.95	0.90	0.85	0.80
80°C	1.00	0.96	0.92	0.88	0.83

Table B5 Air temperature derating factors

Maximum Conductor Temperature	Air Temperatures (°C)			
	30	35	40	45
70°C	1.00	0.94	0.87	0.79
80°C	1.00	0.95	0.89	0.79

ANNEX C

SHORT CIRCUIT RATINGS FOR PILC SWA 11kV COPPER CABLES TO SANS 97

Table C1: Earth fault ratings

Conductor		Suspended conductor inception temperature	
		70°C	80°C
		Copper	Copper
Maximum Permissible Conductor Temperature	160°C	0.115	0.107
	250°C	0.154	0.148

Item No.	Cable Size	Fault Rating (1s) @ 160°C	Fault Rating (1s) @ 160°C
1	25	2.88	2.68
2	35	4.03	3.75
3	50	5.75	5.35
4	70	8.05	7.49
5	95	10.93	10.17
6	120	13.80	12.84
7	150	17.25	16.05
8	185	21.28	19.80
9	240	27.60	25.68
10	300	34.50	32.10

Item No.	Cable Size	Fault Rating (1s) @ 250°C	Fault Rating (1s) @ 250°C
1	25	3.85	3.70
2	35	5.39	5.18
3	50	7.70	7.40
4	70	10.78	10.36
5	95	14.63	14.06
6	120	18.48	17.76
7	150	23.10	22.20
8	185	28.49	27.38
9	240	36.96	35.52
10	300	46.20	44.40

PARTICULAR SPECIFICATION

E16 : ELECTRICAL UNINTERRUPTIBLE POWER SUPPLY UNIT

PARTICULAR SPECIFICATION : VOLUME E16 : ELECTRICAL UNINTERRUPTIBLE POWER SUPPLY UNIT

E16.1 INTRODUCTION

This specification is for the supply and installation of Single Online Double Conversion Static Uninterrupted Power Supply Units for use in office and industrial environments.

The Uninterrupted Power Supply Unit will be used for backing up critical electrical loads, such as lighting, dedicated sockets, air conditioning in computer rooms etc.

The Uninterrupted Power Supply Unit will be installed via Normal Power or via a Diesel Standby Generator.

For drawings, technical information and returnable schedules refer to Annexure's of this specification.

E16.2 SCOPE

The scope of work includes the furnishing of all labour, material and services for the design, supply, manufacture, delivery to site, off load, install in position, fix on site, testing, commissioning and inspection of the equipment and installation works at the manufacturers premises and on site of an Uninterrupted Power Supply Unit and its installation. The units are to be used in both surface and underground applications.

Tenderer's to complete all required returnable schedules. Failure to comply with this request will lead to immediate disqualification.

Tenderer's will be responsible for connecting electrical cables to their own equipment that is supplied and installed under this contract. All cables will be properly glanded to the units.

E16.3 STATUTORY DOCUMENTS AND STANDARDS

E16.3.1 Standards

In addition to any client specifications and general operating procedures, the Uninterrupted Power Supply Units shall comply with the requirement of the following specifications, and any amendments thereto, the SANS specification taking preference:

The equipment offered and work performed, shall comply with the requirements of the governing occupational Health and Safety act, at time of tender.

The Uninterruptible power supply system shall comply with the requirements of SANS 1474 or an International standard such as BS or DIN, and shall be produced in a factory with ISO9000 rating and the applicable quality assurance standards.

a) SANS 60439	Low Voltage Switchgear and Control Gear Assemblies
b) SANS 60529/IEC 529	Degrees of Protection Provided by Enclosures (IP Code)
c) SANS 60947/IEC 947	Low Voltage Isolators
	Low Voltage Motor Starters
	Relays
d) SANS 60076	Power Transformers
e) SANS 780	Distribution Transformers
f) SANS 1473	Low Voltage Switchgear and Control Gear Assemblies
g) IEC 146-3	Semi-conductor Converters, Transformers and Reactors
h) IEC 747	Semi-conductor Devices (including Thyristors)
i) IEC 269-4	Fuse Links for Semi-conductor Devices
j) IEC 269-6	Application guide for the protection of semi-conductors against

- over current by fuses.
- k) BSCP 1014 Protection of Electrical Power Equipment against Climatic Conditions
- l) SANS 10142-1 Code of Practice for the Wiring of Premises. Part 1; Low Voltage Installations
- m) SANS 156 MCB's and MCCB's
- n) SANS 1195 Busbars
- o) SANS 61238 Compression and Mechanical Connectors for Power Cables with Copper or Aluminium Conductors

E16.3.2 Particular Specifications to be read in conjunction with this specifications

The following particular specifications shall be read in conjunction with the Project Specification:

- ☐ G01: PARTICULAR SPECIFICATION FOR COLOUR CODE
- ☐ G02: PARTICULAR SPECIFICATION FOR CORROSION PROTECTION
- ☐ E06: ELECTRICAL MEDIUM AND LOW VOLTAGE CABLE INSTALLATION
- ☐ E05: LOW VOLTAGE POWER AND CONTROL CABLE
- ☐ E08: WIRING
- ☐ E11: GENERAL EARTHING AND LIGHTNING PROTECTION

E16.4 GENERAL TECHNICAL SPECIFICATION

E16.4.1 General

All Single Online Double Conversion Static Uninterrupted Power Supply Units will be continuous duty single or three phase units. The UPS module shall consist of the following main components:

- ☐ Transformer - choke input stage,
- ☐ Rectifier/Charger and DC link,
- ☐ Static Inverter,
- ☐ Static Bypass Switch and Manual Bypass Switch,
- ☐ Control Panel and Mimic Panel with LCD Display,
- ☐ Output Isolation Transformer,

The following items must also be part of the UPS unit and comply to:

- ☐ Cabinets,
- ☐ Batteries and Management System,
- ☐ Standards

E16.4.2 Module Modes of Operation

The uninterrupted power supply unit will operate as an online, fully automatic system in the following modes:-

- (a) Normal: - The inverter shall continuously supply the critical load.
- (b) The Rectifier/Charger shall derive power from the commercial AC source and shall supply DC power to the Inverter while simultaneously float-charging the batteries.
- (c) Batteries: Upon failure of the commercial AC power, the critical load shall continue to be supplied by the Inverter, which shall obtain power from the batteries without any operator intervention. There shall be no interruption to the critical load upon failure or restoration of the commercial AC source.
- (d) Recharge: Upon restoration of the AC source, the Rectifier/Charger shall recharge the batteries and simultaneously provide power to the Inverter.
- (e) This shall be an automatic function and shall cause no interruption to the critical load.
- (f) Bypass: No-break transfer to and from Bypass mode shall be capable of being initiated manually, without operation of the static switch.

E16.4.3 Environmental Conditions

The UPS shall withstand any combination of the following external environmental conditions without operational degradation.

- ☐ Operating Temperature -4 degrees C to +40 degrees C without de-rating (excluding batteries).
- ☐ Storage Temperature -20 degrees C to +70 degrees C.
- ☐ Relative Humidity 90% maximum non-condensing (Above Ground)
- ☐ Relative Humidity 100% maximum non-condensing (Below Ground).
- ☐ Altitude 0 to 2000m AMSL

Acoustical Noise: Noise generated by the UPS under normal operation shall be 65 dbA at one meter from any operator surface, measured at 25 degrees C and full load.

Efficiency: The typical UPS efficiency shall be 90% at full unity power factor load and nominal input voltage.

E16.4.4 Reliability and Maintainability

E16.4.4.1 Reliability

Transformer choke input stage

The UPS module shall utilize high-reliability wiring and connectors. All power cable connections to power transformers and chokes shall be secured with crimped lugs that require no maintenance or periodic re-torque.

The inverter controls, rectifier/charger controls, bypass controls and monitoring/communication controls in the UPS module shall be contained, in their totality, on a maximum of ten control printed circuit boards.

E16.4.5 Uninterrupted Power Supply System Standard Features: The

UPS shall be available with the following characteristics:

UPS Module Configuration

- ☐ Each UPS module shall feature a power processing unit comprised of a rectifier, DC link and inverter.
- ☐ Each UPS module shall feature an internal emergency bypass circuit consisting of a static switch
- ☐ Each UPS shall Feature a wrap around service bypass

E16.4.6 Uninterrupted Power Supply Module Standard Components:

The UPS modules shall consist of the following standard components:

- (a) Rectifier/Charger: The Rectifier/Charger shall convert incoming AC power to regulated DC output for supplying the Inverter and for charging the batteries. The Rectifier/Charger shall be of a six-pulse, phase-controlled, solid-state design. The modular design of the UPS module shall permit easy removal of the Rectifier/Charger without removal of any other assembly.
- (b) Inverter: The Inverter shall feature insulated gate bi-polar transistors (IGBTs) in a three-leg, pulse-width-modulation (PWM) design. The Inverter shall also have the following features:
 - The Inverter shall be capable of providing the specified quality output power while operating from any DC source voltage (rectifier or battery) within the specified DC operating range.
 - The modular design of the UPS module shall permit easy removal of each phase of the Inverter and DC electrolytic capacitors without removal of any other assembly.
 - Uninterrupted manual transfers shall be initiated from the control panel. Uninterrupted manual transfers to Bypass and from Bypass shall be possible with the Inverter logic. During manual transfers to Bypass mode, the Inverter must verify proper Bypass operation before transferring the critical load to the Bypass.
 - The Inverter shall feature protection circuitry that prevents the IGBTs from sourcing current in excess of their published ratings.

- (c) Bypass: The Bypass shall serve as an alternate source of power for the critical load when performing maintenance on the UPS module or when a failure prevents operation in Normal mode. The Bypass shall consist of a naturally-commutated static switch, for high-speed transfers. The static switch shall only be necessary for controlling emergency make before break transfers. The Bypass shall feature the following transfer and operational characteristics:
 - Uninterrupted transfers to Bypass shall be automatically initiated for the following conditions:
 - Output overload period expired.
 - Output voltage out of limits.
 - Over temperature period expired.
 - Total battery discharge.
 - UPS module failure.
- (d) Monitoring and Control Components: The following components shall provide monitor and control capability:
 - Monitor Panel with status indicators Alarm and metering display
 - Mimic panel graphical display of power flow through the ups
 - RS-232 communication port
- (e) Output Isolation Transformer: The UPS module shall contain an output isolation transformer (Class H). This transformer shall provide galvanic isolation between the output of the UPS and the critical load.

E16.4.7

Uninterrupted Power Supply Module Protection

Rectifier/Charger protection shall be provided by a D-type Circuit Breaker.

Bypass protection shall be provided through individual fusing of each phase.

A three pole fused isolator breaking the positive twice shall be the norm and shall provide battery protection for an external battery bank.

Output protection shall be provided by electronic current limit circuitry and fuses in the Inverter circuit.

Input wiring to the Rectifier/Charger input and Bypass input shall be monitored for phase rotation. If wiring is installed out of sequence, the UPS module shall detect and enunciate this condition (on the Monitor Panel) when power is supplied to the inputs. The UPS module shall not allow operation in Normal mode until the wiring error is corrected.

Inverter circuitry shall be provided which automatically inhibits the Inverter IGBT switching currents should they exceed normal operating parameters.

Manual transfers between Normal mode and Bypass mode shall be possible.

Adequate surge suppression on all electronic system components must be installed.

Uninterrupted Power Supply Units to be provided with phase monitoring equipment.

Over and Under Voltage power line surge suppression.

Adequate Surge Protection "Class 2&3".

Radio frequency suppression and immunity.

E16.4.8

Cabinets/Enclosures

The Uninterrupted Power Supply Unit and the back-up batteries must each be supplied and installed in a freestanding double front steel metal cabinet/enclosure (safety shield behind doors) on adjustable/levelling feet, all pre-powder coated. The cabinets/enclosures shall be designed for industrial and computer room applications in accordance with the environment requirements. The cabinets will have a minimum standard Ingress Protection of 20 (IP20) in office environments and a minimum Ingress Protection of 23 (IP23) in above or underground dusty conditions.

Cabinets will be provided with lockable removable doors/panels and seal protection as required. These doors/panels will be cut to accommodate the control panel displays and metering as required. Cabinets must be provided with forced air-cooling ventilation fans. Should the fans be

installed on the top section, the cabinets must be fitted with drip trays.

The cabinets must ensure that cable entry and connection will be from the bottom and additional support is provided for cable glands. A dedicated wire way shall be provided within the UPS module for routing user input and output wiring.

Uninterrupted Power Supply Unit plus Battery Cabinet must line up and match up in style and colour.

Service Area Requirements: The UPS module, shall require no more than 1 meter of front and side service access room.

Refer to Environment Conditions – Cabinets/Enclosures must be build to suit all temperatures and humidity conditions.

Cabinets/Enclosures must be labelled with 50mm high black engraved letters on white back ground fixed to cabinet with screw in centre of units.

E16.4.9 Batteries

The batteries used for the Uninterrupted Power Supply Unit will be 10 year designed cycle valve regulated, high-rate discharge, lead-acid calcium batteries, which provides energy to critical loads connected to the rectifier. The batteries shall be flame retardant in accordance with UL94V2 requirements. The batteries will be connected in strings via proper flexible multi stranded copper welding cable with a maximum 4 parallel string of batteries. Each string of batteries to be fused protected. All cable end to be connected with the correct lugs before installed.

All batteries must be labelled with 25mm high black engraved letters on white back ground fixed to cabinet with screws in centre of each battery.

E16.4.10 Manufacturer's Field Service

Field Engineering Support: The UPS manufacturer shall have a countrywide field service department staffed by factory-trained field service engineers dedicated to startup, maintenance, and repair of UPS equipment. The organization shall consist of local offices managed from a central location.

Field engineers shall be deployed in key population areas to provide on-site emergency response within 24 hours 80% of the time.

Location of all field service offices must be submitted with the proposal.

Third-party maintenance will not be accepted.

Spare Parts Support: Parts be available within 24 hours.

Operational Training: Before leaving the site, the field service engineer shall familiarize responsible personnel with the operation of the UPS. The UPS equipment shall be available for demonstration of the modes of operation.

Product Enhancement Program: The UPS manufacturer shall make available feature upgrade service offerings to all users as they are developed. These products shall be proposed as a field-installable, optional kit.

E16.4.11 Submittals

The UPS shall be supplied with sufficient documentation, including the following manuals:

(a) Operation Manual: Three copies of the operation manuals shall be furnished. It shall possess sufficient detail and clarity to enable the owner's technicians to understand and operate the UPS equipment. The manual shall describe the UPS in full by including the following major items:

- Operating Procedures
- Performance Data and Technical Data
- General Description
- UPS Module Description
- Communications Capability
- Battery Description

- Accessory Description
- (b) Installation Manual: Three copies of the installation manuals shall be furnished. In form of a method statement giving sufficient detail and clarity how the equipment will be installed. Three sets of the following drawings and data sheets shall be supplied:
 - Receiving and Installation Instructions
 - UPS One-Line Drawings
 - Equipment Outline Drawings
 - Interconnection Drawings
 - Battery Wiring Diagram

E16.5 DETAIL REQUIREMENTS

Below find details that the Uninterrupted Power Supply Unit will perform and comply to.

E16.5.1 Uninterruptible Power Supply Ratings and Operating Characteristics

E16.5.1.1 Uninterrupted Power Supply Continuous Ratings

The UPS shall be rated at 10 kVA maximum for a load power factor range of 0.8 lagging to 0.9 leading

The UPS shall be rated at 9 kW

E16.5.1.2 Rectifier/Charger Input and DC Link

- (a) Nominal Input Voltage: 400 VAC, 3-phase
- (b) Operating Input Voltage Range: +20%, -20% of average nominal input voltage without battery discharge.
- (c) Operating Input Frequency Tolerance Range window is -45Hz to 65Hz. The unit should not fluctuate 3Hz (up/down) of the nominal input frequency when in operation.
- (d) Input Power Factor Range: 0.95 lag minimum at full load and nominal input voltage with battery charged.
- (e) Magnetizing Inrush Current: Typically 8% of the model's full load rectifier input current.
- (f) Soft start walk in ramp over 10 seconds from 0 to 100% load will be provided.
- (g) Adjustable DC Link Voltage
- (h) Adjustable rectifier current limit
- (i) Rectifier to be rated to recharge the battery sufficiently, plus supply the losses within the Uninterrupted Power Supply unit and rated inverter load.
- (j) Rectifier input isolator inside Uninterrupted Power Supply unit to isolate the rectifier only
- (k) Rectifier power section temperature measurement and over temperature alarm
- (l) Fan failure monitoring

E16.5.1.3 Bypass Input

- (a) Bypass Voltage Range: +/-10% of average nominal input voltage.
- (b) Synchronizing Bypass Frequency Range is centered on the nominal frequency of 50hz
- (c) Magnetizing Inrush Current: Typically 8% full load rectifier input current.

E16.5.1.4 Rectifier/Charger Output

- (a) Nominal DC Voltage: Nominal DC voltage shall not be greater than 400 V
- (b) Steady State Voltage Regulation: +/- 0.5%
- (c) Voltage Ripple: less than 1% (peak to peak)
- (d) Capacity: The Rectifier/Charger shall support a fully-loaded Inverter and recharge the battery to 95% of its full capacity within c/10 rate of the battery design
- (e) Low Line Operation: The Rectifier/Charger shall be capable of sharing the DC load with the

Battery when the input voltage falls below the specified operating input voltage range, the On Battery indicator shall enunciate operation in this mode.

E16.5.1.5 UPS Output in Normal Mode

- (a) Nominal Output Voltage: 400/230 VAC, 4-wire plus ground
- (b) Steady-State Voltage Regulation (on Inverter): Within +/-1% average from nominal output voltage.
- (c) Transient Voltage Response: Within +/-5% from nominal voltage for a 100% load step, full load re-transfers and full load drop on battery.
- (d) Transient Voltage Recovery: 25 ms to within +/-1% of steady state.
- (e) Linear Load Harmonic Distortion Capability: Output voltage THD of less than 3% into 100% linear load; 2% for a single harmonic.
- (f) Non-Linear Load Harmonic Distortion Capability: Output voltage THD of less than 5% for 100% non-linear load with a 3:1 crest factor.
- (g) Manual Output Voltage Adjustment: +/-5% from nominal.
- (h) Line synchronization Range: +/-0.5 Hz, adjustable to +/- 1Hz.
- (i) Frequency Regulation: +/-0.005 Hz free running.
- (j) Frequency Slew Rate: 1 Hz/second maximum (adjustable).
- (k) Phase Angle Control:
 - Balanced Linear Loads: +/-1 degree from nominal 120 degrees.
 - Unbalanced Linear Loads: +/-3 degrees from average phase voltage for 100% load unbalance.
- (l) Phase Voltage Control:
 - Balanced Linear Loads: +/-1% from average phase voltage.
 - Unbalanced Linear Loads: +/-3% for 100% load unbalance.
- (m) Overload Current Capability (with nominal line and fully charged battery): The unit shall maintain voltage regulation for 125% for 10 minutes and 150% for 10 seconds.
- (n) Static Transfer Time: Make-before-break no break
- (o) Common Mode Noise Attenuation: -65 dB up to 20 kHz, -40 dB up to 100 kHz.

E16.5.1.6 Internal Static Switch

- (a) Shall have redundant power supplies
- (b) Lock out facility after 3 attempts
- (c) Individual phase sensing
- (d) Fully rated to the kva of the machine
- (e) Offer overload current capability of 150% for 2 hrs and 1000% for 5 cycles

E16.5.1.7 UPS Output in Bypass Mode

- (a) Nominal Output Voltage: 400/230VAC, 4-wire plus ground.
- (b) Static Transfer Time: Make-before-break transfer No Break
- (c) Common Mode Noise Attenuation: -65 dB up to 20 kHz, -40 dB up to 100 kHz.

E16.5.1.8 Batteries

Batteries shall feature vented Nickel-Cadmium battery bank designed for high-rate discharge performance, suitable for short-duration backup (15 to 60 minutes) typical of industrial UPS applications. The batteries must offer high reliability, low maintenance, and a long service life under floating charge conditions.:

- (a) Battery Capacity Time per Uninterrupted Power Supply at 25 degrees C, full load @ 0.8pf for minutes.

- (b) External Battery Disconnect: An enclosed DC fused isolator with an auxiliary shunt shall provide a manual means of disconnecting a battery that is not located adjacent to the UPS module.
- (c) Expected battery life: 200 complete full load discharge cycles when operated and maintained within specifications.
- (d) Final Discharge Voltage: After achieving required battery backup time
 - Full Load: 1.70V per cell (adjustable)
 - Nominal Float Voltage: 2.25 V per cell
- (e) The tenderer shall stipulate the specific battery manufacturer make and model and quantity of batteries
 - 2-3 year design Yes/No
 - 5 -10year design Yes/No
 - 20 year design Yes/No
 - Make of battery_____
 - Model of battery_____
 - Qty of battery per bank_ _____
 - Battery stands wooden /steel
 - Dimension of stands_____

The batteries must have a full battery management system to monitor and warn Clients of battery failures etc. The battery management system must make alarm whenever there are a failure with all aspects of the batteries for example;- charging, failure etc.

E16.6 QUALIFICATIONS

The UPS manufacturer shall have a minimum of ten years experience in the design, manufacture and testing of solid-state UPS. A list of installed UPS of the same type as the manufacturer proposes to furnish for this application shall be supplied with the proposal.

The UPS manufacturer shall have ISO 9001 certification for engineering/R&D and manufacturing facilities.

E16.7 PROGRAM

The successful vendor should adhere to the main contractors program and will be responsible to co-ordinate and liaise with the main contractor or Engineer. The sequence in which the work must be carried out, must be established in consultation with the Main Contractor or/and Engineer.

E16.8 BUILDERS WORK

The main contractor will be responsible for all builder repairs and works to be done to ensure that the supply and installation as described in this document is completed successfully. The successful vendor/supplier shall co-ordinate all such requirements with the main contractor or Engineer before such works are done to ensure that all is completed before equipment is delivered and installed on site.

E16.9 GUARANTEE

The successful vendor/supplier will guarantee the installation works and equipment for a period of twelve months after first delivery was taken by the Engineer.

E16.10 TESTING AND INSPECTION:

The testing and inspection procedures shall be approved prior to the commencement of manufacture.

The Contractor shall assemble the complete UPS for inspection and factory testing, and present the system to the Engineer, to who it shall be demonstrated that the equipment meets the requirements of the specification.

The Contractor shall provide suitably qualified personnel and all necessary equipment to carry out the tests to demonstrate conformance with the specification and simulate the operation of the system in its final operating state.

The Contractor shall prepare a set of completed test and inspection certificates for approval.

The contractor is required to perform site acceptance tests (SAT) on the UPS witnessed by the employer and the engineer, prior to commissioning the VSD. A schedule of the checks, tests and results of the SAT must be available for signing by the engineer at the completion of the SAT.

A thermal imaging record of the UPS shall be taken after the UPS has been in operation for a minimum one week under typical normal conditions and while running. The thermal imaging record will form part of the deliverable documentation together with Operation and Maintenance Manuals and delivered to the employer on completion of the works.

E16.11 PACKING AND MARKING

E16.11.1 Packing

The Contractor shall protect the equipment against scratching and damage by suitable application of wrapping, packing and crating of the equipment items.

E16.11.2 Marking

Each separately packed and transported piece of equipment shall be clearly marked.

E16.12 MEASUREMENT AND PAYMENT

<u>Item</u>	<u>Unit</u>
a) Supply and deliver UPS.....	No
The tendered rate shall include full compensation for the manufacture, supply, factory testing and delivery of the UPS incorporating all options/extras as detailed in the detail specification.	

<u>Item</u>	<u>Unit</u>
b) Install and commissioning UPS.....	No
The tendered rate shall include full compensation for the installation, site testing and commissioning plus the 12 months maintenance of the UPS incorporating all options/extras as detailed in the detail specification.	

<u>Item</u>	<u>Unit</u>
c) Supply and deliver support platform/stand for UPS.....	No
The tendered rate shall include full compensation for the manufacture, supply, testing and delivery of the support platform/stand for UPS as detailed in the detail specification.	

<u>Item</u>	<u>Unit</u>
d) Install support platform/stand for UPS	No
The tendered rate shall include full compensation for the installation of the support platform/stand as detailed in the detail specification.	

PARTICULAR SPECIFICATION

E17: VARIABLE SPEED DRIVE (VSD) UNITS

PARTICULAR SPECIFICATION: VOLUME E17 : VARIABLE SPEED DRIVES

E17.1 SCOPE

This specification shall cover all variable speed drives to be designed, supplied installed and tested that shall drive any of the items of equipment to be supplied under the contract.

E17.2 INTERPRETATIONS

E17.2.1 Abbreviations

In this Specification the following abbreviations will apply:-

VSD	:	Variable Speed Drive
ANSI	:	American National Standards Institute
ASTM	:	American Society for Testing and Materials
BS	:	British Standards Institution
SANS	:	South African National Standards

E17.2.2

Standards

The latest edition, including all amendments to until the date of tender, of the following particular national and international specifications, publications and codes of practice shall be read in conjunction with this specification and shall be deemed to form part thereof:

- (a) SANS 1222 Enclosures for electrical equipment (classified according to the degree of protection that the enclosure provides)
- (b) IEC 60 664 –1 Degree of Pollution – no condensation permitted during operation
- (c) EN 55011 (1991) Electromagnetic Compatibility Emission - Class A
- (d) IEC 60 801-3 and EN61 000-4-3 Electromagnetic Compatibility Interference

E17.2.3

Particular Specifications to be read in conjunction with this specifications

The following particular specifications shall be read in conjunction with the Project Specification:

E04: PARTICULAR SPECIFICATION FOR MCC

E17.3

GENERAL REQUIREMENTS

- (a) The VSD units shall be of a “vector control” type.
- (b) The VSD units shall be specifically designed for those applications which require broader functionality and ability to ensure greater dynamic response than is normally available.
- (c) The VSD units shall be provided with six programmable-isolated digital inputs. There shall be two scalable analog inputs (0V to 10 V, 0mA to 20 mA) which shall also be used as a 7th/8th digital input.
- (d) The VSD units shall have two programmable analog outputs (0 mA to 20 mA).
- (e) VSD units shall have three programmable relay outputs (30 V DC/5 A resistive load; 250V AC/2A inductive load)
- (f) The VSD shall have low-noise motor operation due to high pulse frequencies.
- (g) The VSD unit shall have complete protection for motor and inverter.
- (h) The VSD units shall comply with the requirements of the EU low-voltage guideline.
- (i) The VSD unit shall have the CE marking.
- (j) All VSD units shall have the same interface, including a control panel, I/O connections and software, regardless of power rating, voltage or enclosure (IP rating).
- (k) All VSD units shall be supplied with an internal Class A filter. The requirements are fulfilled using shielded cables with maximum length of 25m.
- (l) The VSD units shall be supplied with line commutating choke in line with EN61 000-3-2 regulations “Limits for harmonic currents with device input current < =16A per phase”.
- (m) The maximum permissible motor cable lengths (shielded/unshielded) for a mains voltage of 380V to 400V are 150 m/ 225 m.
- (n) The VSD units shall be supplied with output chokes.
- (o) The VSD units shall be supplied with Basic Operator Panel (BOP) for parameterising the inverter.
- (p) The unit shall have complete protection for motor and inverter.
- (q) VSD units shall be supplied with mounting kits for installing the operator panels in the control cabinet doors
- (r) The VSD units shall have the following communication modules PROFIBUS, DeviceNet, CANopen, MODBUS, MODBUSPLUS and ETHERNET.

E17.4 WORKING VOLTAGE AND SUPPLY SYSTEMS

(a) The following alternatives shall be available:

- i. AC 200 V to 240 V +/- 10% constant torque 0.12kW to 3kW
- ii. AC 200 V to 240 V +/- 10% constant torque 0.12 to 45kW variable torque 5.5 to 45kW
- iii. AC 380 V to 480 V +/- 10% constant torque 0.37 to 200kW variable torque 75 to 250kW
- iv. AC 500 V to 600 V +/- 10% constant torque 0.75 to 75kW variable torque 1.5 to 90kW

E17.5 ENVIRONMENTAL LIMITS

E17.5.1 Operating Temperature

	CT	VT
0.12kW to 75kW	-10°C to +122 °F (+14°F to 122 °F)	-10°C to +40 °F (+14°F to 104 °F)
90kW to 200kW (without derating)	0°C to +40 °C (+32°F to 104 °F)	

E17.5.2 Installation Altitude

0.12kW to 75kW	Up to 1000 m above sea level without derating
90kW to 200kW	Up to 2000 m above sea level without derating

E17.6 PROTECTION FUNCTIONS

The following protection functions shall be available:

- (a) Undervoltage
- (b) Overvoltage
- (c) Overload
- (d) Earth faults
- (e) Short-circuits
- (f) Stall prevention
- (g) Locked motor protection
- (h) Motor over temperature
- (i) Inverter over temperature parameter change protection.

E17.7 ASSEMBLY METHOD AND PROTECTION CLASS

VSD units in the power range from 0.75 to 110kW shall be wall mountable. Units with greater power may be available as freestanding units.

Wall mountable VSD units shall be available both IP54 and IP21 protection classes.

Wall mounted VSD units shall have IP21 protection class as a minimum in order to be installed against a wall or into a cabinet without any additional drip-water input terminal protection covers. IP20 is not acceptable.

Both IP21 and IP54 protection class VSDs shall have identical output current ratings.

E17.8 DOCUMENTATION

Technical details shall be delivered with the offered VSD unit:

User manual, describing step by step how to install, start up, trouble shoot and maintain the VSD
It shall be optionally possible to acquire multiple manuals together with a delivery unit.

Documents to be delivered per order:

- a) Dimensional drawings (both AutoCAD and .pdf formats)
- b) Customer connections and power wiring diagrams (both AutoCAD and .pdf formats).

- c) Power losses and cooling air temperature (both in .xls and .pdf formats).
- d) Manufactures statements on output currents available continuously in different ambient temperature up to 50°C. Type of product needed at 50°C continuous operations must be clearly listed.
- e) Environmental product declaration according to life cycle assessment (LCA).

E17.9 INSTALLATION, TESTING AND COMMISSIONING

The VSD shall be installed and commissioned by a competent person approved and accredited by the manufacturer. The installer must provide a method statement for transporting, storage, installation, testing and commissioning processes for approval by the engineer.

The installer is required to perform site acceptance tests (SAT) on the VSD witnessed by the employer and the engineer, prior to commissioning the VSD. A schedule of the checks, tests and results of the SAT must be available for signing by the engineer at the completion of the SAT.

A thermal imaging record of the VSD shall be taken after the VSD has been in operation for a minimum one week under typical normal conditions and while running. The thermal imaging record will form part of the deliverable documentation together with Operation and Maintenance Manuals and delivered to the employer on completion of the works.

E17.10 MEASUREMENT AND PAYMENT

VSD units shall not be paid as a separate item in the Bill of Quantities. VSD unit form part of motor starter circuits and payment thereof shall be included in the price/s of motor control centres.

E18: ELECTRICAL DISTRIBUTION BOARDS

PARTICULAR SPECIFICATION : VOLUME E18 : ELECTRICAL DISTRIBUTION BOARDS

E18.1 INTRODUCTION

This specification is for the supply of low voltage (380V) distribution boards.

All equipment and services shall comply with the mandatory requirements of the Occupational Health and Safety Act 85 of 1993 and regulations (as amended).

E18.2 SCOPE

E18.2.1 General

The scope of work includes the furnishing of all labour, material and services for the design, supply, manufacture, testing and inspection at works, delivery to site, off loading and rectification of defects developing during the warranty period for equipment as specified below.

E18.2.2 Work to be Included

The work includes, but shall not be limited to the items listed below.-

- (f) All work in E18.2.1 above.
- (g) Documentation, as called for in the vendor QA and document requirement list and drawings and data.
- (h) The supply of one complete set of any special tools required that will be required for operation or maintenance purposes, including three spare sets of each type of fuse.
- (i) Recommended spares for one year's operating period and prices of same.
- (j) Technical assistance if requested during checking for operational readiness.

E18.3 STANDARDS

In general work and materials shall be in accordance with the latest practice and in particular in accordance with the latest revision of the following specifications, and any amendments thereto, the SANS specification taking precedence:

SANS 10142-1	The Wiring of Premises Part 1 – Low-voltage Installations
SANS 60439	Low-voltage Switchgear and Control gear Assemblies
SANS 1973-1	Low-voltage Switchgear and Control gear Assemblies
IEC 60529	Degrees of Protection of Enclosures for Low Voltage Switchgear and Control gear
BSCP 1014	Protection of Electrical Power Equipment against Climatic Conditions
SANS 60947	Low-voltage Switchgear and Control gear: Pt 1 General rules Pt 2 Circuit breakers Pt 3 Switches/Isolators/Switch Isolators and Combination Fuse Switch Units Pt 4 Contactors Pt 5 Relays
IEC 60337	Low Voltage Control Switches
IEC 60228/BSS 159	Busbars, Main Connections and Small Wiring for Switchgear
BSS 3858	Binding/Identification Sleeves for Cables and Wires
SANS 1507	Electric Cables with Extruded Solid Dielectric Insulation For Fixed Installations (300/500V to 1900/3300V)
SANS 1574	Electric Cables – Flexible Cords and Flexible Cables
SANS 1619	Small Power Distribution Units (Ready Boards) for Single-phase

	230V Service Connections
SANS 61643	Surge Protective Devices Connected to Low-voltage Power Distribution Systems
SANS 61238-1	Compression and Mechanical Connectors for Power Cables with Copper or Aluminium Conductors, Part 1: Test Methods and Requirements
IEC 60730-2-7	Timer Switches
SANS 61036	Alternating Current Static Watt-hour Meters for Active Energy (Classes 1 and 2)
BSS 1322	Aminoplastic Moulding Materials
BSS 152	Electric Power Switchgear and Associated Apparatus
BSS 158	Marking and Arrangement for Switchgear Busbars Main Connections of Auxiliary Wiring
SANS 60076/BSS 3535	Transformers
SANS 1091	National Colour Standards for Paint
IEC 60185/BSS 3938	Current Transformers
IEC 60186/BSS 3941	Voltage Transformers
IEC 6043/BSS 37	Meters
IEC 6051/BSS 89	Indicating Instruments
BSS 142	Protective Relays
SANS 156	MCB's and MCCB's
SANS 1195	Busbars
BSS 1767	Grommets

E18.3.1 Particular specifications to read conjunction with this specification

This specification shall be read in conjunction with the following specifications:-

G01: PARTICULAR SPECIFICATION FOR COLOUR CODES

G02: PARTICULAR SPECIFICATION FOR CORROSION PROTECTION

E06: ELECTRICAL MEDIUM AND LOW VOLTAGE CABLE INSTALLATION

E08: WIRING

E18.4 CODES

All equipment and services shall comply with the mandatory requirements of:

- (f) Mine Health and Safety Act 29 of 1996 and Regulations (as amended).
- (g) Occupational Health and Safety Act 85 of 1993 (as amended).
- (h) Road Traffic Act, Act No 29 of 1989 (as amended).
- (i) The SANS Standard and Regulations for the wiring of premises (SANS 10142-1) (as amended).
- (j) The South African Minerals Act 50 of 1991 (as amended).

E18.5 DESIGN CRITERIA AND MATERIAL OF CONSTRUCTION

E18.5.1 System Details

Busbar voltage	380V $\pm$ 10% (or 400V $\pm$ 10%) as per system voltage.
Phases	3 + N
Frequency	50 Hz
Phase rotation	R-Y-B-R

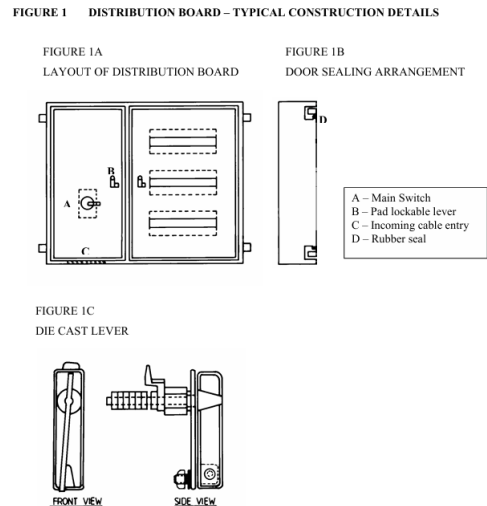
Note:

The fault levels as indicated on drawings shall be deemed to be the maximum current occurring at the distribution board under symmetrical short circuit conditions on the line side of the final limiting device in a circuit. The duration of the maximum short circuit currents shall be deemed to be a minimum of one second. Evidence (in the form of Certificates from testing authorities recognized by City of Tshwane) of the ability of the 380V distribution switchgear boards offered

to withstand satisfactorily the prospective fault conditions shall be furnished with the tender.

E18.5. 2 Enclosure

The boards shall be either free-standing or wall-mounted as required, and shall be manufactured from sheet steel. The boards shall have two separate compartments segregated by sheet steel, with two hinged front doors (except for single phase distribution boards, which will have only one door / panel) and shall be suitable for the environmental conditions in which it operates



E18.5. 2 Circuitis

All circuit breakers shall be manually operated, front mounted, miniature moulded case type, equipped with hydraulic-magnetic overload trip devices.

The main incoming circuit breaker shall be a manually operated device equipped with a thermal-magnetic trip, and shall be of the current limiting type if fault current exceeds 10 kA

A main bus shall be provided for every phase, neutral and earth, except in case of a very small board (less than 30 ways of predominantly single phase switchgear). The buses shall be of a hard-drawn high conductivity copper, sized to match the current ratings of the feeder cable.

E18.5. 2 Finish and Labeling

All steelwork shall be smooth, free from blemishes, cleaned and powder coated.

Board and tag numbers shall be 10 mm lettering engraved Black on White laminated plastic.

A circuit identification chart shall be prepared for each board, consisting of a typed sheet of A4 format, listing the equipment numbers, their function and the room or area designations served by each branch circuit. The chart shall be inserted in a holder behind a 1,5 mm thick transparent acrylic cover plate, fixed to the inside of the door or some other approved location.

E18.12 MEASUREMENT AND PAYMENT

Item	Unit
a) Supply and deliver Distribution Board	No
The tendered rate shall include full compensation for the manufacture, supply, factory testing and delivery of the Distribution Board incorporating all options/extras as detailed in the detail specification.	

<u>Item</u>	<u>Unit</u>
b) Install and commissioning Distribution Board.....	No
The tendered rate shall include full compensation for the installation, site testing and commissioning plus the 12 months maintenance of the Distribution Board incorporating all options/extras as detailed in the detail specification.	

Contract No: WSBU 15-2025/26

Tender for the refurbishment of Bronkhorstspuit water treatment plant for a period of twenty-four (24) months from commencement date

Volume1: General Clauses, Tender Procedures, Contract Data, Schedule of Quantities and Scope of Work

Portion 2: Contract

Part C3: Scope of Work

Section C3.4.7: Instrumentation Specifications

CITY OF TSHWANE WATER AND SANITATION BUSINESS UNIT

CONTRACT NO: WSBU 15-2025/26

TENDER FOR THE REFURBISHMENT OF BRONKHORSTSPRUIT WATER TREATMENT PLANT FOR A PERIOD OF TWENTY-FOUR (24) MONTHS FROM COMMENCEMENT DATE

C3.4.7 INSTRUMENTATION SPECIFICATIONS

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1. BACKGROUND

Ralema Consulting Engineers were appointed as for the design and supervision for the REFURSHMENT OF BRONKHORSPRUIT WATER TREATMENT PLANT

The project focuses on upgrading the Bronkhorstspuit Water Treatment Plant to address current challenges and ensure compliance with standards. Some key units have been non-operational:

- Lime plant is non-operational taking away softening function and reducing precipitation rate for the pre-treatment units;
- Some clari-flocculators heavily clogged taking away adequate floc formation for the DAF feed;
- The air flow into the DAF unit inadequate leading to multi phasing or inadequate froth formation in the DAF unit reducing ability to reduce fines into the filtration units;
- Less than adequate filtration unit maintenance with one unit found non-operational taking away plant ability to further reduce turbidity in the final effluent;
- Scada system non-operational leading to large water losses and inadequate process control.

The refurbishment aims to enhance operational efficiency, address maintenance issues, and ensure the sustainability of the water supply system.

This report provided a general instrumentation and control system design of the Bronkhorstspuit water treatment plant.

2. INTRODUCTION

This specification is for the supply, delivery to site, off loading, storing on site, erection, testing and commissioning of electrical and instrumentation equipment associated with upgrading the Bronkhorstspuit Water Treatment Plant project.

The specification prescribes the basic minimum requirements and principles for the electrical design, selection, and protection of electrical equipment, materials and installation of electrical facilities relevant to the Refurbishment of the Bronkhorstspuit Water Treatment Plant Project. The Works shall ensure safety to personnel and equipment during operation and maintenance and, in particular, safe starting, safe operation and safe shutdown of units under all conditions.

The electrical facilities shall include power distribution, motor starts, lighting, earthing & lightning protection as well as various electrical field equipment.

Vendors are invited to make recommendations with justification, any options, additional accessories, fabrication methods or operational methods available that can be beneficial in considering cost performance, maintainability and quality. Where applicable, such options shall be jointly considered by Ralema Consulting Engineers and the City of Tshwane in the evaluation of suitability and benefits offered.

All work shall be carried out in accordance with this document and all relevant standard specifications and codes of practice.

3. OVERVIEW OF WORK

3.1. General

The scope of work shall include for the furnishing of all plant, materials, tools, consumables, supervision, labour, transportation, technical and professional services necessary for the construction, installation, testing and commissioning of all electrical equipment as detailed within the body of this specification, attached drawings and relevant contract documentation.

The tenderer shall acquaint himself with requirements of this documentation and any conditions that may exist on site.

All items supplied and installed shall be complete, assembled, installed, tested and commissioned. The Contractor shall be responsible for the functional testing of the installation.

Built in items shall not be covered before inspection by the Engineer or his authorised representative.

In all cases where reference is made to the Engineer it shall be read to include the Engineer's authorised representative.

4. CONTROL SYSTEMS

4.1. General

- a) The Process Control System (PCS) will be a microprocessor-based system composed of functionally distributed processors, input/output modules, and operator interface devices, all connected via a dedicated communications network. System shall be modular and scalable to cater for future expansions.
- b) Automation levels will be low to moderate. Sequencing of equipment and the automatic operation of on/off valves shall only be provided when necessary for the safe and effective operation of the plant.
- c) Integrated control of the process plant via the PCS for all areas where equipment requires sequencing or process interlocking.
- d) Monitoring of all relevant operating conditions on the PCS and recording selected information for data logging or trending.
- e) All control loops are via the PCS except where integrated into package equipment functionality.
- f) Individual PLCs for control of packaged equipment shall be restricted to where specialised control functions are required. These PLCs will communicate via data links using industry standard protocols to the plant PCS for the purpose of recording, monitoring and remote operation of the package.
- g) Use of field bus technology for field instrumentation to minimise site control cabling and provide comprehensive information for maintenance personnel. Refer to Appendix A for the listing of communication links to the PCS.
- h) Telemetry systems shall be used where distance precludes economic physical communication links between components of the control system.
- i) As required by statutory regulations, emergency stops and conveyor pull wire switches and similar shall be hardwired. In general, all interlocks necessary for personnel safety and equipment protection shall be hardwired.
- j) Trip and alarm conditions shall be failsafe in operation.

4.2. Control Areas

The process plant is split into the following control areas:

- a) Chemical dosing
 - Chlorination – pre and post filtration chlorination is required.
 - Lime Stabilization;
 - Addition of a coagulant/flocculant;
 - Addition of a ballasting agent;
- b) Flash mixing and coagulation
- c) Flocculation;
- d) New High-rate clarification;
- e) DAF units
- f) Gravity Filtration unit
- g) Disinfection;
- h) Bronkhorstspuit raw water

Each of the control areas will have at least one dedicated PCS processor, which will be housed in cubicles located in the local area substations.

Associated with some of the control areas will be local operator stations to allow the area processes to be started, controlled, and monitored. Control areas the operator stations will be housed in suitable enclosures located in the plant operational areas.

All the operator stations in the main control room will be able to control and monitor all the control areas of the entire plant.

4.3. Major Components

The PCS shall include the following equipment:

4.3.1. PCS Cabinets

Within each control area, PCS cabinets will be provided to house control hardware and for the termination for communication bus and field cabling. Control hardware will include the controller units, communication equipment, power supplies, system input/output and interface modules.

Typically, the cabinets shall be divided into separate panels segregating control system hardware from the termination of field cables. PCS network and local field network cables terminate in the hardware panel of the cubicle.

Within the termination panel separate terminal rails shall be used for discrete digital and analogue signal cables.

Each termination cubicle shall have an isolated earth connection for cable screens.

Remote IO cabinets will be used in remote areas of the plant containing a high concentration of field equipment that interfaces with the PCS.

4.3.2. Control Network

A redundant control network will provide communication between the various components of the PCS. This control network shall be part of a site wide communication backbone utilizing fibre optic cables between facilities and to use copper cables internally within buildings, and comprise either complete redundant cabling via differing routes for each, or 'spanning tree' type communications ring technology.

The control network design shall be such that no single point of failure shall degrade other components within the system.

4.3.3. Operator Interfaces

Operator control stations, each composed of colour VDUs, a keyboard, and a cursor control (trackball or mouse), will provide the normal interface between the operator and the plant processes and equipment being controlled or monitored. Alarm functions will also be displayed on these VDU units. The operator stations in the control rooms shall be based on personal computers (PCs) with Windows operating systems.

Local control stations provided in the main process plant operating areas shall use industrialised equipment and graphic screen displays providing identical views to the operator stations in the control rooms. The stations will be housed in or achieve IP65 rated enclosures.

Separate levels of access control shall be provided for:

- Monitoring only (Viewer)
- Starting and stopping of drives and changes to operating settings (Operation)
- Program configuration and loop tuning changes (Engineering)

4.3.4. Engineering Workstations

Engineer/Programmer's workstation will provide the interface between the plant engineer and the plant processes and equipment for control system tuning, system program modification, and VDU graphic display development.

The programming tools provided for configuration of control functions shall be compatible with International Standard IEC 1131-3. It shall include the following options:

- Functional Block Diagrams (FBD)
- Ladder Diagrams (LD)
- Structured Text Language (STL)

4.3.5. Printers

Printers will provide the operator with a hard copy record of logs, reports, system events, and VDU displays. One black and white laser and one colour video copier will be furnished.

A printer will also be located next to engineering console to provide the engineer logs and special reports, and documentation of system programming changes.

4.3.6. Historian Server

A plant data historian will be provided to capture critical data, improved management reporting and interface to corporate systems. Acquisition of data shall focus on assisting with commissioning and early operations, and for later plant optimisation.

4.3.7. Information for Maintenance

Personal computers may be provide in substations and engineering and maintenance areas with connection to the PCS LAN to provide detail information on drive faults and status.

4.3.8. Signal Transmissions

In general, field I/O will be interfaced to the PCS in two different ways, field bus technology or hard wired.

Field Bus

Profinet shall be the preferred protocol for analog signals and Asi bus for digital signals.

Where Profinet instrumentation is not available, remote I/O stations incorporating a Profinet link shall be used for digital and 4 – 20 mA instrumentation (ET 200 S, M or G [for hazardous area's])

Fieldbus devices shall be powered either from the segment (bus) or locally powered depending on the device design.

In most situations, field bus segment trunks will run from the PCS system cabinets to field junction boxes where the field devices will be connected (dropped).

Fifteen percent (15%) spare pairs shall be provided for all fieldbus segment trunk cables, with a minimum of one spare pair. This requirement includes spares on trunk cable runs between PCS control cabinets and junction boxes, and between junction boxes.

The fieldbus networks shall not be loaded past 80% of their nominal segment capacity.

Hardwired I/O

For non-fieldbus compatible devices, traditional wiring methods will be used. and field signals from devices such as flow switches and solenoid valves, shall be wired to 220 V ac remote I/O boxes located in the process areas with Profinet communication links to the PCS. For non-fieldbus instrumentation, signal levels to and from the control system shall be as follows:

- Digital Inputs: 24 V dc powered from the interface I/O module
- Digital Output: 24 V dc powered from the interface I/O module or isolated voltage free relay contact, as applicable.
- Analogue Inputs: 24VDC, 4-20 mA, preferably loop powered or else field powered transmitters shall be used as appropriate.
- Analogue Outputs: 24VDC, 4-20 mA, loop powered and individually isolated.

Individual fuses shall be provided for all inputs and outputs.

Field contacts in process sensing switches will have minimum ratings of 1 A at 220 V ac and 0.5 A at 125 V dc.

Spare Capacity

The system arrangement shall permit significant future expansion if required. Nominally 15% spare installed I/O shall be provided at all control centres.

4.3.9. Interfaces to Electrical Switchrooms

MCC's and Smart Devices

Smart devices such as protection relays and variable speed drives shall use multidropped Profinet as the preferred communications protocol. The Profinet networks shall be arranged such that standby drives are on separate segments to the duty drives.

Hardwired Signals

Other hardwired signals originated from electrical switchrooms, if applicable, shall be connected to remote I/O units located in dedicated cubicles and connected to the PCS via Profinet communication link. These may include UPS circuits, ACB's, etc.

4.3.10. Safety Interlocks

All personnel safety devices (e.g. emergency stops) shall be directly wired into the drive control circuit, maintained in the control circuit under all conditions, and designed such that de-energising of the control circuit stops the drive. All other interlocks shall be soft wired via the PCS.

All software interlocks and control signals sent over the network or via any serial communication system, shall be engineered such that failure of the communication link results in control action that does not affect plant safety.

4.3.11. Telemetry

Depending on geographical requirements, radio-links may be necessary to control and monitor remote areas of the plant if fibre optic cores are not cost effective. These areas may include:

- Sokhulumi boreholes
- Raw water abstraction

4.3.12. Power supplies

Power supply for the PCS shall be 220 V ac from an instrument Uninterruptable Power Supply (UPS). This supply shall be sufficient to supply the PCS, including all operator interface stations, for 30 minutes in the event of loss of power supply. The UPS shall be equipped with a bypass switch to allow system maintenance.

- 24 V dc UPS power supplies for digital and analog I/O.
- Motor starters will have 220 V ac sourced from the switchboard modules control voltage.

Power supplies to remote PLC I/O modules shall be provided from dedicated distribution boards fed from 220 V ac UPS power supplies. Each supply shall be fed from a separate circuit breaker.

4.4. Control Valves

- a) The Contractor shall allow installation and termination of motorised valves and communication set-up to interface with fieldbus module. This includes valve feedback signal and valves positioner. Included in the service scope is Junction box, terminals strip, wiring, labelling and wire numbers. The scope included but not limited to:
 - Installation of Motorised Valves
 - Termination of valve feedback signals including valve positioner
 - Installation of Pneumatic line and
 - Auxiliary fitting required for instrument operability
 - ProfiNet communication wiring and set-up
- b) How the works will be measured:
 - What the Contractors rate should cover, e.g. cover the cost of design, drawings, manufacture, supply, testing at the manufacturers works, delivery to site, off-loading, installation, site testing, setting into operation, the supply of O & M manuals, commissioning and maintenance during the warranty period of all equipment specified and also for anything not specifically mentioned but obviously required, (e.g. all ancillaries, including all bolts, fastenings and brackets, safety guards and any work or material required for the proper installation of such equipment) to enable the equipment 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 equipment or a part thereof is not specifically mentioned

4.5. Turbidity Transmitter

- a) The Contractor shall allow installation and termination of turbidity transmitter and communication set-up to interface with PLC. This includes instrument interface with mechanical equipment for

installation of level transmitters. Incorporated in the service scope is Junction box, terminals strip, wiring, labelling and wire numbers to be provided as priced. Included in the service scope for this includes but not be limited to:

- Installation of turbidity Transmitter
- Termination of field signals including PLC interface
- Installation of meter panel
- Auxiliary fitting required for instrument operability i.e. flanges, brackets etc.

Section C3.4.7-5 provides detailed specifications of the turbidity transmitter

- b) How the works will be measured:
- What the Contractors rate should cover, e.g. cover the cost of design, drawings, manufacture, supply, testing at the manufacturers works, delivery to site, off-loading, installation, site testing, setting into operation, the supply of O & M manuals, commissioning and maintenance during the warranty period of all equipment specified and also for anything not specifically mentioned but obviously required, (e.g. all ancillaries, including all bolts, fastenings and brackets, safety guards and any work or material required for the proper installation of such equipment) to enable the equipment 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 equipment or a part thereof is not specifically mentioned

4.6. Level Transmitters

- a) The Contractor shall include but not limited to installation and termination of level transmitters and communication set-up to interface with various process control systems such as Hart, Profnet, Profinet, etc. This includes instrument interface with mechanical equipment for installation of level transmitters. Incorporated in the service scope is Junction box, terminals strip, wiring, labelling and wire numbers to be provided as priced. Included in the service scope for this includes but not be limited to:
- Installation of Level Transmitter
 - Termination of field signals including PLC interface
 - Installation of Level - Pressure Transducers
 - Auxiliary fitting required for instrument operability i.e. flanges, brackets etc.

Section C3.4.7-3 provides detailed specifications of the level transmitter

- b) How the works will be measured:
- What the Contractors rate should cover, e.g. cover the cost of design, drawings, manufacture, supply, testing at the manufacturers works, delivery to site, off-loading, installation, site testing, setting into operation, the supply of O & M manuals, commissioning and maintenance during the warranty period of all equipment specified and also for anything not specifically mentioned but obviously required, (e.g. all ancillaries, including all bolts, fastenings and brackets, safety guards and any work or material required for the proper installation of such equipment) to enable the equipment 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 equipment or a part thereof is not specifically mentioned

4.7. Flow Transmitters

- a) The Contractor will install Magnetic Flow Meters. This includes pulling wiring cables, termination, providing labeling and wire numbers. Instrument interface with piping shall be 1/2" BSP for flow switches and SANS 1123 Flange for respective line sizes (female on piping) as outlined in data sheets. The Contractor shall provide all necessary auxiliary fittings required for instrument operability.
- b) The Contractor shall include but not limited to installation and termination of magnetic flow meters and communication set-up to interface with various control system modules and communication module such as Profinet, etc. This includes instrument interface with piping for installation of flow meters. Incorporated in the service scope is Junction box, terminals strip, wiring, labelling and wire numbers to be provided as priced. Included in the service scope for this includes but not be limited to:
- Installation of Magnetic Flow Meters
 - Termination of field signals including PLC interface
 - Installation of Magnetic Flow Meters

- Auxiliary fitting required for instrument operability

Section C3.4.7-2 provides detailed specifications of the flow transmitter

- c) How the works will be measured:
 - What the Contractors rate should cover, e.g. cover the cost of design, drawings, manufacture, supply, testing at the manufacturers works, delivery to site, off loading, installation, site testing, setting into operation, the supply of O & M manuals, commissioning and maintenance during the warranty period of all equipment specified and also for anything not specifically mentioned but obviously required, (e.g. all ancillaries, including all bolts, fastenings and brackets, safety guards and any work or material required for the proper installation of such equipment) to enable the equipment 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 equipment or a part thereof is not specifically mentioned

4.8. Interposing Relay (IR) with PLC Panel

- a) The existing IR Panel is still in fair conditions though the used interposing relays are outdated and not available in the market. The scope allows for a new IR panel complete with new PLC to enable automation of the plant.

Section C3.4.7-1 provides detailed specifications of the PLC panel

- b) How the works will be measured:
 - What the Contractors rate should cover, e.g. cover the cost of design, drawings, manufacture, supply, testing at the manufacturers works, delivery to site, off loading, installation, site testing, setting into operation, the supply of O & M manuals, commissioning and maintenance during the warranty period of all equipment specified and also for anything not specifically mentioned but obviously required, (e.g. all ancillaries, including all bolts, fastenings and brackets, safety guards and any work or material required for the proper installation of such equipment) to enable the equipment 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 equipment or a part thereof is not specifically mentioned

4.9. Communication

- a) The backbone communication medium shall be a fibre optic cable system. All hardware required to effect communication to the switchboards in the substation, such as the PC-based HMI, fibre cable connections, device couplers, fibre-to-RS232 converters and communication hubs is included in the scope.
- b) The substation shall be supplied with an RTU (Remote Terminal Unit), installed in a floor standing, front access panel. The RTU panel shall serve as communications hub for the following:
 - LV Profinet/Ethernet Network.
 - MV IEC 61850 Network
- c) Software requirement:
- d) The following shall form part of the automation scope of supply:
 - SCADA license to support the total number of equipment that will be monitored and controlled by the system.
 - RTU interfacing as well as programming and configuration software.
 - Full set of engineering software (latest version) for configuration and programming of all multifunction relays, and analysis of relay oscillographic disturbance records shall be included as part of the automation scope of supply.
- e) Substation alarming:
 - Substation alarming is to be employed by means of two systems: 1) via soft-link (i.e.

automation network) and 2) hardwire. All IED's connected to the substation automation network shall be enabled to alarm predefined occurrences at the engineering workstation. Alarms and events are to be time-stamped and sequenced at the engineering workstation and shall be defined during the detail engineering phase of the project.

Section C3.4.7-4 provides detailed specifications of networking and communication

- f) How the works will be measured:
- o What the Contractors rate should cover, e.g. cover the cost of design, drawings, manufacture, supply, testing at the manufacturers works, delivery to site, offloading, installation, site testing, setting into operation, the supply of O & M manuals, commissioning and maintenance during the warranty period of all equipment specified and also for anything not specifically mentioned but obviously required, (e.g. all ancillaries, including all bolts, fastenings and brackets, safety guards and any work or material required for the proper installation of such equipment) to enable the equipment 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 equipment or a part thereof is not specifically mentioned

5 GENERAL TECHNICAL SPECIFICATION FOR INSTRUMENTATION INSTALLATION

5.1. Scope

The Installation Contractor shall be responsible to supply and install field instrumentation and provide amongst others: Site supervision, material storage, supply consumable lot required for installation of instrumentation, consumable materials, all necessary tools and equipment, any unforeseen items necessary for the installation design, fabrication, assembly, packaging, transport to Site, quality inspections, workshop and perform equipment functional test as well as field commissioning support.

The Contractor will be responsible for, but not limited to consulting the Drawings, Specifications and Bills of Quantities, to ensure full comprehension of the Scope of Work and required services. The Scope of Services will include, but not be limited to the following:

- Manufacturing detailed engineering design based on detail engineering installation Drawings, Specification, supporting documents, datasheets, Specifications provided etc.
- The Contractor will be required to complete, at tender stage, the priced Bill of Quantities (BOQ) including unforeseen items which were not catered for in the scope award but only identified later on.
- The Contractor will provide service to install and termination of instruments, continuity test and commission of Control System Panels "Free-issued" according to associated equipment listed in the BOQ i.e. Remote I/O Panels, termination & testing of vendor instrumentation etc.
- Where necessary, the Contractor will disconnect, remove existing field instrumentation and be required to install new or like for like instrumentation for refurbishment purpose necessary for plant upgrade.
- The Contractor will provide temporary support to protect associated instruments cables, remove corroded racking, supply and install new racking and covers / supports, refurbishment as deemed necessary and safe to carry out equipment refurbishment.
- Where necessary, the Contractor will remove existing field control system panels, supply and install new equivalent as listed in the BOQ. This will include but not limited to paint refurbishment of commended by control equipment.

5.2. Specification

Where reference is made to a specification, standard or code, the reference shall be taken to indicate the latest edition of such specification, standard or code, including addenda, supplements and revisions thereto, current at the date of award of contract. The following lists of specifications standards, as well as all associated references, shall be applied on this project as the basis of design, manufacture and construction, as appropriate.

Should any conflict arise between the various specifications listed below and those cited elsewhere in this document, the precedence from a design perspective, shall be as follows:

1. South African Legislation and Legal requirements;
2. SANS and IEC standards;

3. This specification;
4. Client Specifications or preference;

5.3. Standards and Code of Practice

Number	Title
ISO 9001	Quality Management Systems - Requirements
IEC / SANS 60099	Surge Arrestors
IEC / SANS 60269	Low-voltage fuses
IEC / SANS 60289	Convertor Transformers and Reactors.
IEC / SANS 60305	Insulators for overhead lines with a nominal voltage above 1 000 V
IEC / SANS 60439	Low-Voltage Switchgear and Control gear assemblies Parts 1 & 2
IEC / SANS 60529	Degrees of protection provided by enclosures (IP Code)
IEC / SANS 60720	Characteristics of line post insulators
IEC / SANS 60934	Circuit-breakers for equipment (CBE)
IEC / SANS 60947	Low Voltage Switchgear and Control gear
IEC / SANS 61000	Electromagnetic compatibility (EMC) – All parts
SANS 1239	Plugs, socket-outlets and couplers for industrial purposes
SANS 1411	Materials of insulated electric cables and flexible cords – Part 1, 6, 7
SANS 1474	Uninterruptable Power System
SANS 1973	Low-Voltage Switchgear and Control Gear Assemblies - Part 1
SANS 10142-1	The wiring of premises Part 1: Low-voltage installations
SANS 10142-2	The wiring of premises Part 1:
SANS 10280	Overhead power lines for conditions prevailing in South Africa – Part 1
SANS 10292	Earthing of Low Voltage (LV) Distribution Systems

5.4. Quality Assurance

- The installation work, materials, and equipment supplied for this contract, shall comply fully with the latest revision of the relevant SANS Specification. Where no SANS specification exists, the relevant IEC or BS Specification shall be used. Should the Electrical Contractor wish to use equipment not displaying any "Mark of Approval" he shall first obtain the approval of the Engineer in writing.
- Where a certain manufacturer's material or equipment is called for in this specification or on the drawings these shall be supplied as specified.
- Where the Tenderer is unable to offer the equipment specified, he may offer an alternative, provided attention is drawn to the fact in the relevant section of the tender documents.
- All materials and equipment shall be new, of the best of their kind and adequate for the purpose specified. Any materials or equipment found to be substandard or unsuitable for the purpose for which they are intended shall be removed and replaced at the Electrical Contractor's expense.
- Workmanship shall be of the highest standard throughout, and follow the best modern engineering practice. All work shall be performed by personnel, or under the direct supervision of personnel fully qualified in work of this nature. Any substandard work shall be dismantled and replaced at the Electrical Contractor's expense.
- Equipment and components of a similar class or purpose, such as wiring accessories, switch-disconnectors, etc, shall be of the same make and pattern throughout the Contract. Luminaires shall be sourced via a single manufacturer, unless agreed in writing with the Engineer.
- If in the opinion of the Electrical Contractor any method described in the specification may be improved upon, the Electrical Contractor shall first obtain the approval of the Engineer.
- The Engineer will inspect the installation work periodically during the progress of the contract, but the Electrical Contractor shall notify the Engineer timeously whenever important stages are reached, so that the Engineer may schedule his inspections in the interests of all parties. Any discrepancy between the installation and the requirements of this specification shall be remedied at the Electrical Contractor's expense. Under no circumstances shall these inspections relieve the Electrical Contractor of his obligations in terms of the contract.
- The Electrical Contractor may be required to submit for approval, drawings or samples of materials or equipment which he proposes to use on the contract. Such samples may also be called for during the Tender period or during the Tender adjudication period.
- Note: A request for submission of samples or drawings does not necessary imply that the Tenderer's quotation will be accepted
- Drawings shall be clearly marked "WORKING DRAWINGS FOR APPROVAL". Samples shall be forwarded to and, if necessary, remain in the possession of the Engineer until the completion and handover of the Contract. With the approval of the Engineer the samples may used in the completion of the installation. Any expenses incurred in the supply and return of drawings and samples shall be borne by the Tenderer or Electrical Contractor, as the case maybe.
- The Electrical Contractor shall supply all materials, consumables, equipment and labour necessary for the completion of this contract whether specifically mentioned or not.

6 Field Instruments

6.1. General

All field instrument requirements are as detailed on the instrument data sheets

The Contractor will be required to provide supply and installation services. This entails but will be not limited to manufacturing, installation, inspection and commissioning support for field control system while equally adhering to design Specification documents, design Drawings, installation hook-ups, Manufacture drawings etc.

This entails supply of instrumentation cables for various equipment i.e. flow meters, level transmitters, solenoid valves, fieldbus, associate cable racks and consumable material lot, field instrumentation power supply cable, control panels cable installation and termination of field equipment.

6.2. Conduits

- All conduits shall be heavy duty solid drawn or welded, black enamel or galvanised, complying

fully with the requirements of SANS requirements. All conduits shall be sized to comply with the requirements of SANS 10142-1, but no conduit having a diameter smaller than 20 mm shall be used.

- All conduit fittings shall comply fully with the requirements of SANS requirements. Conduit bushes shall be of brass or nylon, with the outlet smoothly rounded, the threads shall be undercut to ensure that the bushes may be screwed fully home. Other conduit fittings shall be of malleable cast iron with screwed entries, and finished hot dip galvanised, sheradized or black enamelled according to the nature of the conduit run.
- No manufactured elbows, tee-pieces, inspection or solid bends shall be used, except where approved in writing by the Engineer.
- Where conduit is to be used for final connections to motors or other vibrating equipment, or for connections to thermostats, sensors, stoves, etc., only flexible metal conduits shall be used complying with BS 731, which shall be sheradized or hot dip galvanised and PVC sheathed overall.
- The conduit shall terminate in adaptors or glands, of brass, zinc or cadmium plated mild steel. A copper earth conductor of not less than 2,5 mm², connecting the adaptors or glands, shall be spiralled around and fixed to the flexible conduit with cable ties.
- As an alternative to screwed conduit the Electrical Contractor may also use, if preferred and with the approval in writing of the Engineer, the plain-ended (threadless) steel conduit system. Where this system is used the minimum wall thickness of the material shall be 1,2 mm. Plain-ended conduit shall not be used in the following circumstances:
 - In flameproof installations
 - As load bearing conduit, or
 - For the suspension of luminaires
- The Electrical Contractor shall agree all conduit runs with the Engineer, where these are not clearly defined on the drawings.
- How the works will be measured:
 - The unit of measurement shall be the length of conduits installed.
 - The tendered rate shall include full compensation for the handling, inspection, laying, and cutting.

6.3. Cabling

- 6.3.1 The scope includes cable installed both aboveground and in cable racks, measured net from the drawings, inclusive of change of direction, mode of installation and any variation in degree of difficulty caused by restriction in working areas or elevation from grade.
- 6.3.2 The installation scope includes but not limited to the following items:
 - Installation of cable conduit, joints, access manhole, etc.
 - Cable termination consumable lot i.e. tags and lugs etc.
- 6.3.3 The Contractor is responsible for installing the fibre optic ADSS cable complete with necessary supporting hardware from Bronkhorstspuit Water Treatment Plant to the Water Extraction area. The fibre optic ADSS cable shall be routed on existing poles. The Contractor shall inspect existing pole for replacement where required. Where the overhead line crosses, the road, the fibre optic ADSS cable shall be routed under the road on cable sleeves.

- **Section C3.4.7-6 provides detailed specifications of cabling**

6.4. Instrument Cable Termination

- 6.4.1 The Contractor shall be responsible for accurate supply and installation of field instrumentation including cables and must sustain SANS practices together with cable manufacturer's installation and handling requirements. All cables supplied by the Contractor will have a valid test certificate from the cable manufacture.
- 6.4.2 The scope includes cable installed both aboveground and in cable racks, measured net from the drawings, inclusive of change of direction, mode of installation and any variation in degree of difficulty caused by restriction in working areas or elevation from grade.
- 6.4.3 The installation scope includes but not limited to the following items:
 - Installation of cable conduit, joints, access manhole, etc.
 - Cable termination consumable lot i.e. tags and lugs etc.

6.5. Network Cable Termination

- 6.5.1 The Contractor shall be responsible for accurate supply and installation of network cable termination including splicing and connector requirements. All cables supplied by the Installation Contractor will have a valid test certificate from the cable manufacture.
- 6.5.2 The scope includes cable installed both aboveground and in cable racks, measured net from the drawings, inclusive of change of direction, mode of installation and any variation in degree of difficulty caused by restriction in working areas or elevation from grade. In addition, the scope includes but not limited to the following items:
 - Installation of cable conduit, joints, access manhole, etc.
 - Cable termination consumable lot i.e. tags and lugs etc

6.6. Junction Boxes (JB's)

- 6.6.1 JB'S shall be constructed of 3CR12 Steel, powder coated with a Powder Coat finish.
- 6.6.2 The JB will be equipped with a removable chassis plate upon which the field instrumentation equipment including surge arrestors etc. shall be mounted;
- 6.6.3 The front door of the JB shall be a hinged door with an armour plate glass window mounted in a rubber seal in the door. The equipment mounted in the JB shall be located such that the display can be read without opening the door. The door is to be fitted with a lockable latch.
- 6.6.4 The JB shall be equipped with removable, bottom entry, gland plates. All cabling to and from the equipment mounted in the JB shall be glanded off on gland plates.
- 6.6.5 Power and signal cable cores are to be terminated on rail mounted surge arrestors mounted in the JB
- 6.6.6 The JB's shall be numbered using White/Black/White traffolyte labels with 10 mm high letting
- 6.6.7 A prototype of each type of JB proposed shall be submitted to the Engineer for approval before purchasing in quantity
- 6.6.8 The JB shall be installed with the front facing south.

6.7. Earthing

- The Contractor shall supply and terminate earthing cable requirements for control system panels, field instruments and cable racks. This entails pulling earth cables, terminating instruments,

providing labeling and wire numbers.

- Field instrument earth will be outline but not limited to design drawings but earth recommendation from manufacture's catalogue will be implemented. Outlined in instrument engineering drawings will be earth according to system control panels i.e. PLC, RIO, JB/MB Panels and field instrumentation. The Contractor shall provide all necessary auxiliary fittings required for control system earth.

7 Labelling

- The Contractor shall supply and install labels for all equipment, distribution boards, control panels, etc. corresponding with the designations shown on the drawings and or schedules.
- All labels shall be of plastic "sandwich board" material, the legends being engraved through the front plastic layer to the contrasting inner layer.
- The lettering shall be not less than 6 mm high, in sans-serif capitals. Black lettering on a white background shall be selected to ensure maximum legibility.
- All labels shall be secured with at least two screws or rivets, and shall be accurately level and central over their subjects. The Electrical Contractor may propose alternative methods of labelling which he considers superior to that specified, but shall use the specified method without extra charge, if required to do so by the Engineer.

8 Testing and Commissioning

- The Contractor shall carry out all the necessary testing and commissioning of all equipment and systems, including the earthing system, function testing, etc.
- The Contractor is responsible to conduct a complete internal Factory Acceptance Test (FAT) and approve all equipment before releasing to the Principal Representative and the Client, for inspection.
- The contractor being responsible for the performance of all inspection and testing activities associated with equipment installed by Contractor as well as full system checks.
- As a minimum, the following quality control checks are required:
- Megger tests and record sheets for all cables within the contractor's scope,
- Issuing of Certificate of Compliance (COC) for all relevant systems within the Contractor's scope,
- Visual inspections and final checkout of all installations.
- The creation of a 'Hand Over File' for each electrical item of equipment, which shall include copies of all relevant 'As-Built', marked up drawings and approved Quality Control Certificates.
- Field Instrumentation Calibration and Testing: The contractor being responsible for the performance of all calibration, inspection and testing activities associated with equipment installed by Contractor as well as full system checks.
- The creation of a 'Hand Over File' for each electrical item of equipment, which shall include copies of all relevant 'As-Built', marked up drawings and approved Quality Control Certificates.
- Certificate of Compliance: The Sum Price for this item shall include, but not be limited to:
- Issuing of Certificate of Compliance (COC) for all relevant systems within the Contractor's scope.

9 Detailed specifications

- Detailed specifications attached

REFERENCE	DETAILED SPECIFICATION DESCRIPTION
C3.4.7-1	PROGRAMMABLE LOGIC CONTROLLER (PLC) PANELS
C3.4.7-2	FLOW MEASUREMENT
C3.4.7-3	LEVEL MEASUREMENT
C3.4.7-4	NETWORKING
C3.4.7-5	TURBIDITY TRANSMITTER
C3.4.7-6	CABLING

**10 SECTION C3.4.7-1 DETAILED SPECIFICATIONS PROGRAMMABLE LOGIC CONTROLLER (PLC)
PANELS**

PROGRAMMABLE LOGIC CONTROLLER (PLC) PANELS

10.1 Scope

10.1.1 This specification covers the manufacturing, supply and installation of Programmable Logic Controller panels used for process monitoring and control application.

10.2 Abbreviations

10.2.1 In this specification the following abbreviations will apply :-

BS	:	British Standards
PLC	:	Programmable Logic Controller
I/O	:	Input/Output
CPU	:	Central Processing Unit
UPS	:	Uninterruptible Power Supply
MCC	:	Motor Control Centre
MCB	:	Miniature Circuit Breaker

10.3 Standards

10.10.1 All design standards for cabling shall be subject to the latest amendments and editions of the following standard specifications:-

SANS 10142-1	:	National Standards for the wiring of premises.
SANS 1091:2004	:	National Colour Standard.
SANS 1274-2005	:	Coatings applied by the powder-coating process.
BS 381C:1980	:	Paint colour chart.

10.4 General Requirements

10.4.1 The PLC control panel shall house the following items:-

- 10.4.1.1 The PLC and all I/O modules and racks.
- 10.4.1.2 Fibre-optic network interface modules.
- 10.4.1.3 All network switches and hubs.
- 10.4.1.4 All field instrumentation and MCC interface cables shall be marshalled in this panel.
- 10.4.1.5 All power supply and distribution circuitry and equipment.
- 10.4.1.6 All lightning and surge protection devices as required.
- 10.4.1.7 Marshalling terminals as required
- 10.4.1.8 Interposing relays as required.

- 10.4.2 The supply and installation shall in general comply with the relevant clauses in all specifications attached to the tender documentation.
- 10.4.3 The panels shall be free standing units with bottom cable entry (via a glanding plate) and have front door access (hinged and lockable).
- 10.4.4 The panel should be manufactured from sheet steel typically not less than 2,0 mm thick. The panel will have a door on the front which opens to practically the full width and height of the panel. The panel shall be free standing and shall not be more than 2 200 mm high, 2 400mm wide and 600mm deep and it should be sized to accommodate all the PLC and associated equipment required for the actual PLC I/O and future spare capacity.
- 10.4.5 Once the door is open there should be no obstruction to prevent full access to every point inside the panel.
- 10.4.6 The panel shall be epoxy powder coated electric orange (Shade B26) finish. Interior chassis mounting plates will be finished in appliance white. All removable parts and hardware will be cadmium yellow passivated.
- 10.4.7 Each panel and control function should be clearly labelled with labels engraved on laminated engraving board with black letters on a white background. All labels must be attached with chrome plated, screws and nuts or screws and tapped holes. On the backing plate only tapped holes may be used. Screws with nuts on the backing plate will not be acceptable.
- 10.4.8 The panel must be vermin-proof and must have a protection rating of no less than IP 55.
- 10.4.9 This specification must be read in conjunction with the PLC Hardware Specification (Volume 2 of the Automation And Control Standards).

10.5 Standard Features

- 10.5.1 Each panel shall have the following features as standard:-
 - 10.5.1.1 Ventilation fans with air filters shall be mounted on the PLC panel at low level with un-filtered air outlets at high level. The fans must pressurise the panel to prevent the ingress of dust.
 - 10.5.1.2 A 230V AC switch socket outlet shall be mounted inside the panel (supplied from the UPS section). This socket must have a shaved earth which shall be used for the PLC programmer only.
 - 10.5.1.3 Interior fluorescent lighting at the top of the panel, arranged to switch on, via a micro switch, when the panel door is opened.
 - 10.5.1.4 A substantial area of removable gland plates on the floor of the panel, split into two or more sections.
 - 10.5.1.5 A sheet steel pocket welded onto inside of the door to hold A4 sized drawings, books etc.
 - 10.5.1.6 A copper earth bar running the width of the panel at the bottom with solid electrical connection to the panel doors and to the steel of the panel at two or more places and provided with terminals for connection of equipment and

screen earth wires.

10.5.1.7 Separate AC and DC distribution sections if both AC and DC are used.

10.5.1.8 A free-standing (i.e. not the PLC rack mounted) 24V DC Power supply for all analogue I/O cards (where required), 24V DC I/O distribution (if required), field instrumentation supplies (if required), etc.

10.6 Wiring and Terminals

10.6.1 All screwed terminals shall be mounted on raised DIN terminal rail, secured to the chassis plate at the back of the panel.

10.6.2 Not more than one wire shall be connected to one side of any terminal.

10.6.3 Every wire shall be marked at both ends with a numbering system approved by the Engineer, and all terminating wires shall also be suitably crimped to a terminal lug. Not more than one wire shall be crimped into a single lug.

10.6.4 All wiring shall be flexible, tinned, annealed, multi-strand copper wire not less than:-

10.6.4.1 1,5mm² for 230V AC power

10.6.4.2 1,0mm² for 24V DC or AC power

10.6.4.3 0,5mm² for all PLC I/O wiring between modules and marshalling terminals

10.6.4.4 4,0mm² for earth drain

10.6.5 Irrespective of the minimum wire sizes allowed in this specification, contractors must ensure that all cables and wiring are capable of carrying the full system currents, inclusive of de-rating factors as specified in the latest version of SANS 10142.

10.6.6 All wire terminations must be done by using suitable lugs. No more than one wire may be crimped into a single lug. Where pin lugs are crimped onto the ends of wires, correctly sized pin lugs must be used, which fit into the terminals properly and such that the tightening of the terminal does not result in the loosening of the pin lug.

10.6.7 All panel wiring shall run in suitable sized slotted trunking for as much of their course as possible, thereafter in spiral band or similar conduit to its destination if the exposed run would exceed 100mm.

10.6.8 The distance between the terminals and the trunking or between equipment (such as relays, surge protection, circuit breakers, etc.) and trunking shall not be less than 50mm.

10.6.9 Control wiring should not run with power wiring and all cross-overs shall be at ninety degrees.

10.6.10 A block of terminals shall be allocated to each I/O module. The terminal block shall be labelled with the PLC rack number and module slot allocation.

10.6.11 The terminals allocated for the various I/O modules must be as per the design drawings submitted by the consultant. If it forms part of the contractor's scope of work to submit design drawings, the terminals allocated for the various I/O modules must be approved by the consultant. All terminals shall be sequentially numbered

from top to bottom for each I/O channel for every type of I/O card.

- 10.6.12 Each analogue and digital input and output channel shall have surge protection units as specified in the Clean Power And Surge Protection Specification (Volume 5 of the Automation And Control Standards).

- 10.6.13 Internal wiring shall be colour coded as follows:-

10.6.110.1	<u>230V AC Power</u>	
	Live	Brown
	Neutral	Blue
	Earth	Green and Yellow
10.6.110.2	<u>24V DC Power</u>	
	Positive	Red
	Negative	Black
10.6.110.3	<u>Digital Inputs</u>	
	230V AC	Yellow
	24V DC	Red
10.6.110.4	<u>Digital Outputs</u>	
	230V AC	Grey
	24V DC	Red
10.6.110.5	<u>Relay Outputs</u>	
	230V AC	Grey
	24V DC	Red
10.6.110.6	<u>Analogue Signals</u>	
	Positive	Orange
	Negative	Purple

- 10.6.14 A terminal section for AC and DC power distribution shall be included in the PLC panel where both voltages are used for PLC I/O. The terminal groups shall be clearly identified to indicate the various voltages.

- 10.6.15 A separate power distribution section shall be used for the AC and DC supplies where both voltages are used. Miniature circuit breakers (MCB's) shall be used to feed the various items of equipment such as PLC I/O cards, fans, lights, field instruments, etc.

- 10.6.16 Two types of mains supplies shall be made available to the PLC panels: Raw Mains and UPS Mains. The raw mains incomer shall feed the non-critical items such as fans, 24V DC power supplies, 230V AC terminal section, 230V AC I/O modules, relay output modules, etc. The UPS supply shall feed the critical items required for PLC communications in the event of a raw mains power supply interruption. Such items are plugs (for PC), lights (inside the PLC panel), fibre-optic interface modules, PLC Processor, etc. Unless otherwise specified, PLC I/O and field instruments need not be supplied by UPS power.

- 10.6.17 All wiring must be continuous from one termination (in a terminal strip or device such as a relay, contactor, surge arrester, etc.) to the next. No spliced wiring will be accepted.

10.7 Existing PLC Panels

- 10.7.1 All modifications and wiring changes to existing panels must comply with the specifications as laid down for new panels.

10.8 Factory Acceptance

- 10.8.1 Before delivery of the PLC systems and/or the PLC panels, a comprehensive system factory acceptance test must take place. The Engineer must be notified one week in advance of the proposed test.

- 10.8.2 The test shall comprise of at least, but not be limited to:

- 10.8.2.1 Checking the panel manufacturing and assembly for compliance with this specification.
- 10.8.2.2 Layout, numbering and labelling of equipment.
- 10.8.2.3 Wiring – sizes, numbering, colours, termination, etc.
- 10.8.2.4 Wiring as per drawings, I/O schedules, etc. (i.e. loop checks).

10.9 Loop Isolators

- 10.9.1 Loop isolators are required where the instruments and the relevant PLC are fed from different power sources. Loop isolators must provide isolation between the instrument signals and the power supply. Separately powered isolators are preferred.

10.10 Uninterruptible Power Supply (UPS)

- 10.10.1 An Uninterruptible power supply must be installed to isolate the PLC from the "raw" mains supply.
- 10.10.2 The UPS must comply with the UPS requirements as specified in the Clean Power And Surge Protection specification (Volume 5 of the Automation And Control Design Standards).
- 10.10.3 The raw mains incomer to the PLC panel shall feed the non-critical items such as fans, 24V DC power supplies, 230V AC terminal section, 230V AC I/O modules, relay output modules (if required), etc. The UPS supply shall feed the critical items that keep PLC communications established should the raw mains power supply be interrupted, such as plugs, lights, fibre-optic interface modules, PLC (CPU), etc.
- 10.10.4 Tenderers must satisfy themselves that the UPS rating is adequate to supply all the equipment which they are offering.

10.11 Over-Voltage/Lightning Protection

- 10.11.1 The function of the over-voltage/lightning protection units is to prevent damage from occurring to the electrical and electronic devices due to destructive voltages, by resistive coupling, capacitive coupling or inductive coupling, arising from extraneous events such as lightning discharges, switching surges etc. All lightning and surge

protection must be in accordance with the requirements in the Clean Power And Surge Protection specification (Volume 5 of the Automation And Control Design Standards).

10.11.2 The protection units on the 230V AC mains incomers of the PLC panel (if not provided on the mains elsewhere) shall consist of at least IEC Class II protection. Preferably Class I and Class II, or a combined Class I + Class II protection must be used.

10.11.3 All analogue and digital input and output circuits must have Class III surge arresters for protection of these circuits.

10.11.4 Each individual supply from the 24V DC distribution and from the 230V AC distribution to field instruments or other field supplies must be equipped with at least Class II medium surge protection.

10.12 Spares

10.12.1 The tenderer will be required to provide at least 10% spare fuses and other consumable items which may be required during commissioning. In addition to commissioning spares, a recommended spare list for three years maintenance, should be submitted. This item must be completed so that spares may be ordered as part of the capital contract. Tenderers ignoring this condition may be disqualified.

10.13 Painting (Powder Coating Method)

10.110.1 General

Switchboards and panels shall be epoxy powder coated in accordance with Type 1 coatings to SANS 1274-2005.

Unless specified otherwise, a high gloss finish in the following colour shall be provided: Colour - Light Orange, Colour No. B26, Munsell Ref. 2,5 YR C/14 to SANS 1091 : 2004 and Colour No. 381C-557 to BS 381C : 1980.

Paintwork must be guaranteed against blistering, peeling, cracking and general deterioration which can lead to rusting, corrosion, etc. for a period of no less than three years. If the tenderer cannot comply with this requirement, it must be clearly stated as such in the tender.

10.110.2 Specifications

The following specifications in accordance with SANS 1274-2005 shall be provided:-

<u>Property</u>	<u>Requirement</u>	<u>Test Method</u>
Thickness, minimum	50 micron	6.7
Marking Resistance (400g)	No marking	6.20
Impact Resistance, J, minimum	6,78	6.10
Water Resistance, h, minimum	720	6.13
Humidity resistance, h, minimum	1000	6.14
Resistance to salt fog, h, minimum	1000	6.16

10.110.3 Surface Preparation

Surface preparation of sheet steel components shall be carried out by means of the multi-bath zinc phosphate/chromate passivation treatment.

All fabricated sheet steel components are to be degreased and de-rusted ready for treatment.

A steel surface is considered ready for treatment when all dirt, grease, rust, mill scale, moisture or other contaminants have been removed in an alkaline degreaser to give a dry, clean, bright, metallic surface.

Steel plate less than 4mm thick - black steel sheet shall be pickled to white metal condition while pre-pickled, bright, cold rolled sheet steel shall be solvent cleaned. These surfaces shall be treated within eight hours in all cases while still uncontaminated and rust-free.

The prepared steel surface shall be treated by means of immersion in a heated zinc phosphate solution bath, rinsing and thereafter chromate passivated by means of immersion in the final treatment bath.

10.110.4 **Powder Coating**

A thermosetting powder consisting of epoxy/polyester resin shall be applied by means of an electrostatic spray gun to give a uniform coating thickness of 50 to 60 micron. Less than 50 micron will not be acceptable.

The powder coating shall be baked at a metal temperature of 185°C so as to melt the powders to form a continuous film over the metal substrate.

10.14 **Drawings And Diagrams**

10.14.1 The tenderer must submit layout drawings, showing the PLC panel size, cable entry, location of equipment, details of equipment (such as fans, lights, plugs, trunking size, circuit breakers, fuses, terminals, etc.), panel colour, material of construction (e.g. 2mm mild steel), etc. for approval by the Engineer before any manufacturing commences.

10.14.2 The drawings must be accompanied with data lists of the proposed equipment. These data sheets must show the type, supplier, make, model, size, etc. of equipment where applicable. For example:

Terminals	- Phoenix SK12, 4mm, white.
MCB's	- Merlin Gerin, 5A, 10kA, single-pole.
Etc.	

11 SECTION C3.4.7-2 DETAILED SPECIFICATION FLOW MEASUREMENT

FLOW MEASUREMENT

11.1 Scope

11.1.1 This specification covers the supply and installation of Flow meters, complete with sensors, transmitters, indicators, panels, etc. used for process monitoring and control application.

11.2 Abbreviations

11.2.1 In this specification the following abbreviations will apply :-

BS	:	British Standards	
PLC	:	Programmable Logic Controller	
I/O	:	Input/Output	
CPU	:	Central Processing Unit	
UPS	:	Uninterruptible Power Supply	
MCC	:	Motor Control Centre	
MCB	:	Miniature Circuit Breaker	
SPD	:	Surge Protection Device	
FJB	:	Field Junction Box	
SSO	:	Switched Socket Outlet	
SPDT	:	Single Pole Double Throw (refers to relay or switch arrangements).	contact
LCD	:	Liquid Crystal Display	
LED	:	Light Emitting Diode	
PTFE	:	Polytetrafluoroethylene	
O&M	:	Operating And Maintenance	
NPT	:	National Pipe Thread	
DP	:	Differential Pressure	
LP	:	Low Pressure	
HP	:	High Pressure	
RH	:	Relative Humidity	
IS	:	Intrinsically Safe	

11.3 Standards

11.3.1 The supply and installation of all Flow meters and associated cabling, panels and any other equipment shall be subject to the latest amendments and editions of the following standard specifications:-

SANS 10142-1 : National Standards for the wiring of premises.

- SANS 1091:2004 : National Colour Standard.
- SANS 1274-2005 : Coatings applied by the powder-coating process.
- BS 381C:1980 : Paint colour chart.
- BS 3680 : Measurement of liquid flow in open channels.
- SANS10108:2005 : The classification of hazardous locations and the selection of apparatus for use in such locations.
- SANS60079-10:2005 : Electrical apparatus for explosive gas atmospheres.
Part 10: Classification of hazardous areas.
- SANS60079-11:2005 : Electrical apparatus for explosive gas atmospheres.
Part 10: Intrinsic safety "i".
- SANS10086-1 : The installation, inspection and maintenance of equipment used in explosive atmospheres Part 1:
Installations including surface installations on mines

11.4 General Requirements

- 11.4.1 This specification must be read in conjunction with the following specifications: -
- 11.4.1.1 PLC Panels Specification
 - 11.4.1.2 Clean Power And Surge Protection Specification
 - 11.4.1.3 Cabling Specification
 - 11.4.1.4 Field Junction Boxes And Panels
- 11.4.2 Where cables are exposed to physical damage (including damage from rodents) armoured cables must be used or un-armoured cables must be run in steel conduit.
- 11.4.3 All power supply cables to instruments must have a black outer sheath, while all control cables (such as digital and analogue signals to PLC's) must have an orange outer sheath as specified in the Cabling Specification (Volume 6 of the Automation And Control Standards).
- 11.4.4 FJB's and as far as practically possible all instrument sensors and transmitters, must be mounted such that all equipment, wiring, numbers, terminations, etc. are readily accessible and can be viewed clearly. No equipment may be mounted such that it becomes a hazard or dangerous to view or gain access to such equipment.
- 11.4.5 Where sensors and/or transmitters cannot be mounted where they are readily accessible, the installation must be done in such a way that the sensor or transmitter can easily be moved to a safe and convenient position for testing, maintenance, replacement, etc. (e.g. by using hinged brackets, telescopic brackets, etc.).
- 11.4.6 Where transmitters can be exposed to the elements (wind, rain, ultra violet, etc.) such transmitters must be installed inside the FJB. LCD displays must always be

protected from direct sunlight, either by facing them away from the sun or by installing it inside the FJB, in the shade of the FJB canopy. Where transmitters are protected from the elements (i.e. inside buildings) but they are exposed to potentially harmful conditions like moisture from splashing or equipment being hosed down, or the sensor is in such a position that the transmitter display is not clearly visible from floor level, without the need to climb onto ladders or structures to access it, the transmitter must also be installed inside the FJB. Only where transmitters are not exposed to the elements or any other harsh or potentially harmful conditions and where the displays on such transmitters are clearly legible by an average person standing on the ground or the normal walking surface (e.g. grating above ground level), can the transmitter be mounted outside the FJB.

- 11.4.7 FJB's must be mounted against a wall or structure or on a sturdy pedestal such that the top of the FJB enclosure is no higher than 1.8 m from the floor and easily accessible from the front.
- 11.4.8 All instrument installations must be done in accordance with the manufacturer's requirements and recommendations for proper operation. It is the tenderer's responsibility to ensure that he/she is familiar with both the requirements of the manufacturer as well as the installation requirements, in terms of location, site conditions, materials, equipment or substances to be measured (e.g. hot liquids, acids, abrasive material, etc.) and to ensure that if there are potential problems, they can be pointed out and rectified before orders for equipment are placed.
- 11.4.9 Costs incurred for alterations required to ensure proper operation of instruments, after orders have been placed, will be for the tenderer's account. For example, if instruments have been ordered and it is found there is insufficient space to install the instrument, or the instrument is not flooded with liquid all the time as it is required for proper operation, or the instrument transmitter is sometimes flooded in its installed position, or the sensing head is sometimes outside the medium it is supposed to measure, or the instrument linings are damaged by abrasive liquids, or the sensor is does not have a suitable range of measurement, etc. alterations or replacements required to rectify such problems will be for the tenderer's account if the Engineer finds that the tenderer was negligent in his/her assessment of the installation.
- 11.4.10 Each instrument must be equipped with a circuit breaker connected to the power supply of the instrument, to enable local isolation in case of repairs or replacement.
- 11.4.11 The supplier of the instrument must be present for the installation, testing and commissioning of the instrument on site. Due allowance must be made for this in the tender sum.
- 11.4.12 The tenderer must supply a complete and detailed set of documentation for the installation, connections, terminations, power supply, technical details, setting up, calibration (if applicable), testing, etc. of the instrument for inclusion in a final O&M manual.
- 11.4.13 Completed data sheets are required as part of the returnable documents of each tender. Failure to complete these data sheets, supplied at the end of this specification, will lead to disqualification of the tender.

11.5 Surge Protection

- 11.5.1 Each instrument and its associated equipment must be suitably protected against

surges from induced voltages, switching of equipment, lightning strikes, etc. as detailed in the Clean Power And Surge Protection Specification (Volume 5 of the Automation And Control Standards).

- 11.5.2 The power supply to the instrument must be equipped with suitable surge protection, both at the instrument and at the source of the power supply (i.e. at the distribution board, MCC, PLC panel, etc.), as detailed in the Clean Power And Surge Protection Specification (Volume 5 of the Automation And Control Standards).
- 11.5.3 Both the digital and analogue signals between the instrument and other remote devices (such as the PLC), must be equipped with suitable surge protection, both at the instrument and at the remote device as detailed in the Clean Power And Surge Protection Specification (Volume 5 of the Automation And Control Standards).

11.6 Open Channel Flow Measurement – Controller/Transmitter

- 11.6.1 Flow calculations for all open channel flow measurement must be done in accordance with BS 3680.
- 11.6.2 All flow measurements in open channels must be done by using ultra-sonic distance measurement, which is converted into a flow value.
- 11.6.3 All instrument transmitter enclosures must have at least an IP 65 or higher rating.
- 11.6.4 The instrument must be equipped with an isolated, active, 4 – 20mA output which will be connected to a maximum 500 ohm load. This output must be user-programmable.
- 11.6.5 The instrument must be equipped with at least one SPDT relay, rated for at least 230V AC, 500mA, for totalised flow pulses. This output must be user- programmable for the units-per-pulse.
- 11.6.6 The transmitter must be suitable for use with a 230V AC, 50/60 Hz power supply.
- 11.6.7 The transmitter must have an accuracy of at least 0.25% or 6mm, whichever is greater.
- 11.6.8 The transmitter must have a resolution of at least 0.1% or 2mm, whichever is greater.
- 11.6.9 The transmitter must have an LCD or LED display showing instantaneous flow and totalised flow.

11.7 Open Channel Flow Measurement – Sensor/Transducer

- 11.7.1 The range of the sensor must be suitable for the application (see items 11.4.8 and 11.4.9 of this specification).
- 11.7.2 The sensor must be suitable for an operating temperature range of -10°C to +50°C.
- 11.7.3 The sensor must be equipped with automatic temperature compensation.
- 11.7.4 The sensor must have a protection rating of at least IP 67 or higher.

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- 11.7.5 Brackets used for the mounting of ultra-sonic sensor heads must be made of at least 3CR12 grade stainless steel.

11.8 Full Pipeline Flow Measurement – Controller/Transmitter

- 11.11.1 All flow measurements in full pipelines must be done by using electro-magnetic flow (mag-flow) measurement, which is converted into a flow value where accuracy of measurement is required for dosing and/or custody transfer of flow. Where measurement for flow distribution or flow diversion is required (i.e. where high accuracy is not essential), non-intrusive flow measurement using external sensors can be applied. These systems must incorporate either ultrasonic time of flight or Doppler principles. Ultrasonic time of flight systems can be used on clean water with low contents of air bubbles or other entrained gasses and suspended solids of less than 10,000 milligrams/litre. Doppler systems can be used on liquids with entrained particles or gasses of 100 microns or larger and suspended solids in excess of 75 milligrams/litre.
- 11.11.2 All instrument transmitter enclosures must have at least an IP 65 or higher rating.
- 11.11.3 The instrument must be equipped with an isolated, active, 4 – 20mA output which will be connected to a maximum 500 ohm load. This output must be user-programmable.
- 11.11.4 The instrument must be equipped with at least one SPDT relay, or an output that can be used to drive a relay, for totalised flow pulses. This output must be user-programmable for the units-per-pulse.
- 11.11.5 The transmitter must be suitable for use with a 230V AC, 50/60 Hz power supply.
- 11.11.6 The transmitter for electro-magnetic flow meters must have an accuracy of at least 0.5%, or better, of the measured value for flow velocities which are greater than 0.5 meters/second. Transmitters of flow meters for flow distribution/diversion can have an accuracy of less than 0.5% but they must not be less accurate than $\pm 2\%$ of the full scale for Doppler meters and not less than $\pm 2\%$ of the measured value for time of flight meters. For both Doppler and time of flight meters these accuracy requirements apply to flow velocities of 0.5 meters/second or greater. Repeatability must not be less than 1% of the measured value.
- 11.11.7 The transmitter must have an LCD or LED display showing instantaneous flow and totalised flow.

11.9 Full Pipeline Flow Measurement – Sensor/Transducer

- 11.9.1 The range of the sensor must be suitable for the application (see items 11.4.7 and 11.4.8 of this specification).
- 11.9.2 The sensor lining for electro-magnetic flow meters used in sludge or non-corrosive liquids must be Neoprene or Rubber, suitable for operating in temperatures ranging from -10°C to +80°C.
- 11.9.3 The sensor lining for electro-magnetic flow meters used in corrosive or heated liquids must be PTFE, suitable for operating in temperatures ranging from -20°C to +150°C.
- 11.9.4 The sensor must have a protection rating of at least IP 68 or higher.

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- 11.9.5 The sensor tube material for electro-magnetic flow meters must be at least 304, 316 or 3CR12 grade stainless steel.
- 11.9.6 The sensor electrode material for electromagnetic flow meters must be at least 304, 316 or Hastelloy C grade stainless steel.
- 11.9.7 The sensor for electromagnetic flow meters must have either a grounding electrode or earth rings fitted.
- 11.9.8 Where process flow in the pipeline cannot be stopped or isolated by any other means, isolation hand valves must be fitted on either side of electro-magnetic flow meters for removal/replacement of the flow meter.
- 11.9.9 The sensor material for flow meters used for flow distribution/diversion must be stainless steel.
- 11.9.10 Magnetic flow meters must be equipped with an "Empty Pipe" detection which is configurable to stop the 4-20mA flow indication and/or operate a potential free contact, or an output that can be used to drive a relay, for PLC interfacing.
- 11.9.11 Electro-magnetic flow meters must not be a wafer-type. I.e. the sensor tube or wafer must be housed in a flanged stainless-steel unit which can readily be bolted onto flanges in the pipe where it must be installed.
- 11.10 Partially Filled Pipeline Flow Measurement – Controller/Transmitter**
- 11.10.1 Where electro-magnetic flow meters (e.g. for full pipes) or conventional ultrasonic flow meters (e.g. at weirs or venturi flumes) cannot be used, such as in partially filled pipes or open channels without a weir or venturi, area-velocity flow meters must be used. A liquid velocity measurement as well as a liquid depth measurement, together with the dimension of the pipe or channel which is programmed into the controller/transmitter, must then be used to produce a proportional flow measurement.
- 11.10.2 The flow measurement must be done by using ultrasonic signals to measure both velocity and depth of liquid.
- 11.10.3 The controller/transmitter must have at least an IP66 rating or higher.
- 11.10.4 The controller/transmitter must have a backlit LCD display to display flow rate and total flow.
- 11.10.5 The error of the level measurement must not be more than 0.25% of the range and the error of the velocity must not exceed 2% of the velocity reading.
- 11.10.6 The repeatability and linearity must be 0.1% or better.
- 11.10.7 The unit must be suitable for use with a 230V AC supply.
- 11.10.8 The unit must have 3 x 4-20mA outputs, one for flow, one for level and one for velocity.
- 11.10.9 The unit must have at least 2 x SPDT relays, rated at no less than 2A at 230V AC. One of the relays must be programmable for flow pulses and the other must be

programmable for flow and/or level alarm.

11.10.10 The unit must have at least 3 x 4-20mA outputs, one for velocity, one for level/depth and one for flow. These outputs will be connected to a maximum 500 ohm load.

11.10.11 The unit must be suitable for operating in temperatures ranging from minus 15°C to +60°C.

11.11 Partially Filled Pipeline Flow Measurement – Sensors/Transducers For Velocity Measurement

11.11.1 The velocity sensor must be shaped and installed in such a manner that the cabling to it is protected from any debris that might flow in that pipe or channel.

11.11.2 The velocity sensor must be able to measure in a range of 0.03 to 6.2 m/sec and reverse flow of -1.5m/sec.

11.11.3 The velocity sensor must be suitable for operating in temperatures ranging from minus 15°C to +65°C.

11.11.4 The velocity sensor must be equipped with continuous, automatic temperature compensation.

11.12 Partially Filled Pipeline Flow Measurement – Sensors/Transducers For Level Measurement

11.12.1 The level sensor must have a low profile, in order to provide the maximum measuring distance in enclosed pipes.

11.12.2 The level sensor must have a measuring range of at least 3.66m and a minimum range (deadband) of not more than 203.2mm.

11.12.3 The level sensor must be suitable for operating in temperatures ranging from minus 15°C to +65°C.

11.12.4 The level sensor must be equipped with continuous, automatic temperature compensation.

11.13 Partially Filled Pipeline Flow Measurement – General

11.13.1 The submerged velocity sensor must not be installed in locations where sediment builds up.

11.13.2 The sensors must not be installed in locations where there is high water turbulence (the lower the turbulence, the higher the accuracy).

11.13.3 The sensors must be installed in locations where the velocity and level are equally distributed across the channel or pipe.

11.13.4 The channel or pipe where the sensors are installed must not have drops or direction changes immediately upstream of the sensors.

11.13.5 The slope of the pipe or channel where the sensors are installed must not exceed 3%.

11.14 Gas Flow

- 11.14.1 The flow measurement must be done by using differential pressure measurement on either side of an orifice plate or from an averaging pitot tube or annubar and employing a capacitance silicon sensor.
- 11.14.2 All instrument transmitter enclosures must have at least an IP 67 or higher rating.
- 11.14.3 The instrument must be equipped with a 4 – 20mA output which will be connected to a maximum 500 ohm load.
- 11.14.4 The instrument must be suitable for use with a 24V DC power supply and it must have an Ex ia rating, suitable for use in a Zone 0 area with Methane gas.
- 11.14.5 The transmitter must have an accuracy of at least 0.07% for all calibrated spans and a stability of at least 0.1% of the upper range limit, for no less than 3 years.
- 11.14.6 The transmitter must have a span adjustment from 0-0,32 up to 32 kPa and a zero adjustment of -100% to +100% of maximum span.
- 11.14.7 The process wetted parts must all be manufactured from at least 316 stainless steel with Viton “O” rings. All mounting brackets must also be manufactured from at least 316 grade stainless steel.
- 11.14.8 The process connection must be ¼” NPT Female and the electrical connection must be M20 x 1,5 female.
- 11.14.9 The maximum static pressure and the maximum DP over-pressure (LP or HP side) must be 160 Bar.
- 11.14.10 The transmitter must have an LCD display showing instantaneous volumetric flow in m³/hr.
- 11.14.11 The range of the instrument must be suitable for the application (see items 11.4.7 and 11.4.8 of this specification)
- 11.14.12 The instrument must be suitable for an ambient operating temperature range of -20°C to +70°C and a process temperature operating range of -20°C to +120°C.
- 11.14.13 The instrument must be suitable for operating in a humidity range of 0 to 100% RH.

11.15 Spares

- 11.15.1 The tenderer will be required to provide a recommended spares list for three years maintenance. This item must be completed so that spares may be ordered as part of the capital contract. Tenderers ignoring this condition may be disqualified.

11.16 Hazardous Areas

- 11.16.1 If the flow meter is going to be used for any combustible gas flow measurement, the tenderer must ensure that there is a hazardous area classification for the area in which the instrument will be installed.

- 11.16.2 If no hazardous area classification exists, the tenderer must allow a suitable cost for the classification of all relevant areas and must clearly indicate this cost in either the Bill Of Quantities or in a covering letter.
- 11.16.3 The flow meter and associated equipment supplied must all be suitable for use in the hazardous area concerned.

11.17 Intrinsically Safe Installations

- 11.17.1 Where intrinsically safe (IS) installations are required the tenderer must allow a cost to have the IS design from the Engineer certified as safe and compliant with the relevant legal requirements. This certification can only be done by a suitably accredited organization or company.
- 11.17.2 Once the certified IS design has been installed, the installation must be certified as correct and in accordance with the certified design. The tenderer must allow a cost for the certification. This certification can only be done by a suitably accredited organization or company.
- 11.17.3 All instruments supplied for use in a hazardous area must have the hazardous area rating and classification (E.g. Ex ia IIC T5) and suitable marking as specified in SANS 10108, ARP 0108:2007, Annex B, indicated on the instrument and the instrument must be certified by an approved testing/certification body as listed in SANS 0108, ARP 0108:2007.

11.18 Data Sheets

- 11.111.1 All data sheets in the attached Appendix 1 must be completed.

12 SECTION C3.4.7-3 DETAILED SPECIFICATION LEVEL MEASUREMENT

12 LEVEL MEASUREMENT

12.1 Scope

12.1.1 This specification covers the supply and installation of Level meters, complete with sensors, transmitters, indicators, panels, etc. used for process monitoring and control application.

12.2 Abbreviations

12.2.1 In this specification the following abbreviations will apply :-

BS	:	British Standards	
PLC	:	Programmable Logic Controller	
I/O	:	Input/Output	
CPU	:	Central Processing Unit	
UPS	:	Uninterruptible Power Supply	
MCC	:	Motor Control Centre	
MCB	:	Miniature Circuit Breaker	
SPD	:	Surge Protection Device	
FJB	:	Field Junction Box	
SSO	:	Switched Socket Outlet	
SPDT	:	Single Pole Double Throw (refers to relay or switch arrangements).	contact
LCD	:	Liquid Crystal Display	
LED	:	Light Emitting Diode	
O&M	:	Operating And Maintenance	

12.3 Standards

12.3.1 The supply and installation of all Level meters and associated cabling, panels and any other equipment shall be subject to the latest amendments and editions of the following standard specifications:-

SANS 10142-1	:	National Standards for the wiring of premises.
SANS 1091:2004	:	National Colour Standard.
SANS 1274-2005	:	Coatings applied by the powder-coating process.
BS 381C:1980	:	Paint colour chart.

12.4 General Requirements

12.4.1 This specification must be read in conjunction with the following specifications:-

- 12.4.1.1 PLC Panels Specification
- 12.4.1.2 Clean Power And Surge Protection Specification
- 12.4.1.3 Cabling Specification
- 12.4.1.4 Load Cells And Their Installation
- 12.4.2 Where cables are exposed to physical damage (including damage from rodents) armoured cables must be used or un-armoured cables must be run in steel conduit.
- 12.4.3 All power supply cables to instruments must have a black outer sheath, while all control cables (such as digital and analogue signals to PLC's) must have an orange outer sheath as specified in the Cabling Specification
- 12.4.4 FJB's and as far as practically possible all instrument sensors and transmitters, must be mounted such that all equipment, wiring, numbers, terminations, etc. are readily accessible and can be viewed clearly. No equipment may be mounted such that it becomes a hazard or dangerous to view or gain access to such equipment.
- 12.4.5 Where sensors and/or transmitters cannot be mounted where they are readily accessible, the installation must be done in such a way that the sensor or transmitter can easily be moved to a safe and convenient position for testing, maintenance, replacement, etc. (e.g. by using hinged brackets, telescopic brackets, etc.).
- 12.4.6 Where transmitters can be exposed to the elements (wind, rain, ultra violet, etc.) such transmitters must be installed inside the FJB. Where transmitters are protected from the elements (i.e. inside buildings) but they are exposed to potentially harmful conditions like moisture from splashing or equipment being hosed down, or the sensor is in such a position that the transmitter display is not clearly visible from floor level, without the need to climb onto ladders or structures to access it, the transmitter must also be installed inside the FJB. Only where transmitters are not exposed to the elements or any other harsh or potentially harmful conditions and where the displays on such transmitters are clearly legible by an average person standing on the ground or the normal walking surface (e.g. grating above ground level), can the transmitter be mounted outside the FJB.
- 12.4.7 FJB's must be mounted against a wall or structure or on a sturdy pedestal such that the top of the FJB enclosure is no higher than 1.8 m from the floor and easily accessible from the front.
- 12.4.8 All instrument installations must be done in accordance with the manufacturer's requirements and recommendations for proper operation. It is the tenderer's responsibility to ensure that he/she is familiar with both the requirements of the manufacturer as well as the installation requirements, in terms of location, site conditions, materials, equipment or substances to be measured (e.g. hot liquids, acids, abrasive material, etc.) and to ensure that if there are potential problems, they can be pointed out and rectified before orders for equipment are placed.
- 12.4.9 Costs incurred for alterations required to ensure proper operation of instruments, after orders have been placed, will be for the tenderer's account. For example, if instruments have been ordered and it is found there is insufficient space to install the instrument, or the instrument is not flooded with liquid all the time as it is required for proper operation, or the instrument transmitter is sometimes flooded in its installed position, or the sensing head is sometimes outside the medium it is supposed to measure, or the instrument linings are damaged by abrasive liquids,

or the sensor is does not have a suitable range of measurement, etc. alterations or replacements required to rectify such problems will be for the tenderer's account if the Engineer finds that the tenderer was negligent in his/her assessment of the installation.

- 12.4.10 Each instrument must be equipped with a circuit breaker connected to the power supply of the instrument, to enable local isolation in case of repairs or replacement.
- 12.4.11 The supplier of the instrument must be present for the installation, testing and commissioning of the instrument on site. Due allowance must be made for this in the tender sum.
- 12.4.12 The tenderer must supply a complete and detailed set of documentation for the installation, connections, terminations, power supply, technical details, setting up, calibration (if applicable), testing, etc. of the instrument for inclusion in a final O&M manual.
- 12.4.13 Completed data sheets are required as part of the returnable documents of each tender. Failure to complete these data sheets, supplied at the end of this specification, will lead to disqualification of the tender.

12.5 Surge Protection

- 12.5.1 Each instrument and its associated equipment must be suitably protected against surges from induced voltages, switching of equipment, lightning strikes, etc. as detailed in the Clean Power And Surge Protection Specification
- 12.5.2 The power supply to the instrument must be equipped with suitable surge protection, both at the instrument and at the source of the power supply (i.e. at the distribution board, MCC, PLC panel, etc.), as detailed in the Clean Power And Surge Protection Specification
- 12.5.3 Both the digital and analogue signals between the instrument and other remote devices (such as the PLC), must be equipped with suitable surge protection, both at the instrument and at the remote device as detailed in the Clean Power And Surge Protection Specification

12.6 Level Measurement – Controller/Transmitter

- 12.6.1 All level measurements must be done by using ultra-sonic distance measurement, which is converted into a level value.
- 12.6.2 All instrument transmitter enclosures must have at least an IP 65 or higher rating.
- 12.6.3 The instrument must be equipped with an isolated, active, 4 – 20mA output which will be connected to a maximum 500 ohm load. This output must be user-programmable.
- 12.6.4 The instrument must be equipped with at least three to five SPDT relays, rated for at least 230V AC, 2A, for preset level outputs. These outputs must be user-programmable for various levels.
- 12.6.5 The transmitter must be suitable for use with a 230V AC, 50/60 Hz power supply.
- 12.6.6 The transmitter must have an accuracy of at least 0.25% or 6mm, whichever is greater.

- 12.6.7 The transmitter must have a resolution of at least 0.1% or 2mm, whichever is greater.
- 12.6.8 The transmitter must have an LCD or LED display showing instantaneous level and relay status.

12.7 Level Measurement – Sensor/Transducer

- 12.7.1 The range of the sensor must be suitable for the application (see items 12.4.8 and 12.4.9 of this specification).
- 12.7.2 The sensor must be suitable for an operating temperature range of -10°C to +50°C.
- 12.7.3 The sensor must be equipped with automatic temperature compensation.
- 12.7.4 The sensor must have a protection rating of at least IP 67 or higher.
- 12.7.5 Brackets used for the mounting of ultra-sonic sensor heads must be made of at least 3CR12 grade stainless steel.

12.8 Spares

- 12.8.1 The tenderer will be required to provide a recommended spares list for three years maintenance. This item must be completed so that spares may be ordered as part of the capital contract. Tenderers ignoring this condition may be disqualified.

12.9 Data Sheets

- 12.12.1 All data sheets in the attached Appendix 1 must be completed.

13 SECTION 3.4.7-4 DETAILED SPECIFICATION NETWORKING

13 NETWORKING

13.1 Scope

- 13.1.1 This specification covers the supply and installation of equipment, the network topologies, the communication methods and the security for data communication systems, typically between Programmable Logic Controllers and Supervisory systems, used in process monitoring and control applications.

13.2 Abbreviations

- 13.2.1 In this specification the following abbreviations will apply :-

CD	:	Compact Disk
CLI	:	Command Line Interface
DiffServ	:	Differentiated Services
EMC	:	Electro-Magnetic Compatibility
GARP	:	Generic Attribute Registration Protocol
GMRP	:	GARP Multicast Registration Protocol
GUI	:	Graphical User Interface
GVRP	:	GARP VLAN Registration Protocol
HTTPS	:	Hyper Text Transfer Protocol Secure switches
IEC	:	International Electrotechnical Commission
IEEE	:	Institute of Electrical and Electronic Engineers
IGMP	:	Internet Group Management Protocol
LACP	:	Link Aggregation Control Protocol
LAN	:	Local Area Network
LED	:	Light Emitting Diode
MAC	:	Media Access Control
Mbit	:	Mega bits
Mbps	:	Mega bits per second
MDI/MDI-X	:	Medium Dependent Interface/ Medium Dependent Interface (crossed)
OS	:	Operating system
PC	:	Personal Computer
PLC	:	Programmable Logic Controller
QoS	:	Quality Of Service
RD	:	Read
RSTP	:	Rapid Spanning Tree Protocol
SANS	:	South African National Standards
SCADA	:	Supervisory Control And Data Acquisition
SNMP	:	Simple Network Management Protocol
SSH	:	Secure Shell
SSL	:	Secure Sockets Layer
TCP/IP	:	Transmission Collision Protocol/Internet Protocol
TOS	:	Type Of Service

TX : Transmit
USB : Universal Serial Bus
VLAN : Virtual Local Area Network

13.3 Standards

13.3.1 All design standards shall be subject to the latest amendments and editions of the following standard specifications:-

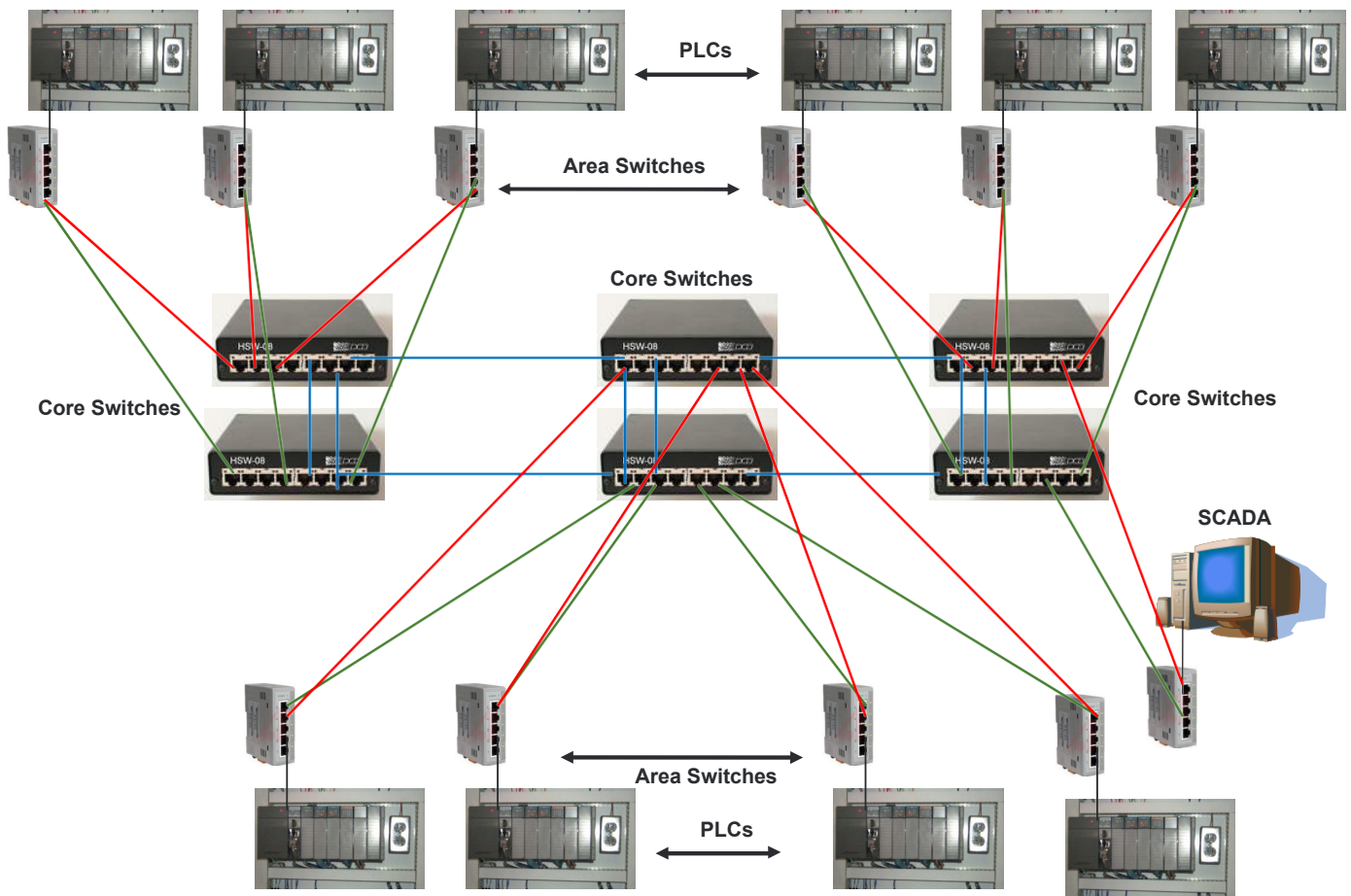
SANS 10142-1 : National Standards for the wiring of premises
IEEE 802.3-2005 : Carrier Sense Multiple Access with Collision Detection (CSMA/CD) access method and physical layer specifications
IEEE 802.3ad (Now IEEE 802.1AX): Link Aggregation
IEEE 802.1d : MAC Bridges
IEEE 802.1p : Quality of service
IEEE 802.1Q : VLAN Tagging
IEEE 802.1w : Rapid Spanning Tree Protocol
IEEE 802.1X : Port Based Network Access Control
IEC 60068-2-6 : Environmental Testing - Vibration
IEC 60068-2-27 : Environmental Testing – Test Ea and guidance: Shock
SANS 61000-4/IEC 61000-4 : Electromagnetic compatibility – testing and measurement techniques

13.4 Communication Protocol

13.4.1 The preferred method of communication between PLC's or between PLC's and SCADA systems is Ethernet TCP/IP.

13.4.2 Systems must be designed and equipment selected with the view of communicating via TCP/IP over Ethernet.

13.5 Network Topology



- 13.5.1 The preferred topology is an Ethernet star/mesh topology as indicated in the diagram above.
- 13.5.2 Where existing installations make the use of a star/mesh topology impractical, contractors must link into the existing system in such a way that future conversion to a star/mesh topology will not be hampered by the current installation.
- 13.5.3 All systems must be designed and equipment selected with the view of converting to a star/mesh topology when possible.
- 13.5.4 Network redundancy must be such that if one core switch fails, there must be a second one that can maintain communication (as shown in the diagram above).
- 13.5.5 Data communication between core switches and from core switches to the area switch patch panels must be done via 9/125µm, single mode, PVC, CST (Corrugated Steel Tape) cable or single mode blown fibre microduct assemblies (see the Cabling Specification (Volume 6 of the Automation And Control Standards)). The number of cores must be as specified in the project scope of work and the tender bill of quantities.

- 13.5.6 Each core switch pair (i.e. the two core switches which form a dual redundant system at a particular location) must be equipped with two UPSs (Uninterruptable Power Supplies) as specified in the "Automation And Control Design Standards, Volume 5, Clean Power And Surge Protection". The two power supplies must be connected to both switches (i.e. each UPS supplies both core switches) to provide redundancy. These supplies must also be equipped with proper surge protection as detailed in the same specification - "Automation And Control Design Standards, Volume 5, Clean Power And Surge Protection".

13.6 Switches

13.6.1 Minimum Requirements For Area Switches

- 13.6.1.1 Only industrial type switches will be accepted. No standard "commercial" or "Office" switches will be accepted. These switches must have at least an IP 20 rating, must have a rugged high-strength metal case and must have DIN-rail or panel mounting ability. They must have an operating temperature of at least 0 to 55°C, without the use of cooling fans and must be able to work in relative humidity up to 95% without condensation.
- 13.6.1.2 Redundancy and fault recovery:
- Must comply with IEEE 802.1w for Rapid Spanning Tree Protocol
- 13.6.1.3 Remote management and monitoring:
- Must support SNMP V1/V2/V3 for different levels of network management security
- 13.6.1.4 Area switches must have at least two SFP uplink ports which are 1000Base-LX Gigabit Ethernet standard compatible. These ports must be compatible with Duplex LC-type connectors for single- mode fibre.
- 13.6.1.5 Area switches must have the number of copper ports as specified in the project scope of work and the tender bill of quantities. The copper ports must be 10BASE-T/100BASE-TX compatible in order to communicate with the PLCs. These ports must be capable of accepting RJ45 connectors on CAT-6 cable.
- 13.6.1.6 In terms of configuration, maintenance, management and monitoring features required, all area switches must:
- Have support for loading or saving configurations to a remote host
 - Have port monitoring for debugging
 - Have line-swap fast recovery to normal operation (within milliseconds) after devices are unplugged and then re-plugged into different ports
 - Be configurable by Operating System (OS) independent web browser, using secure HTTPS

13.6.2 Minimum Requirements For Core Switches

- 13.6.2.1 Only industrial type switches will be accepted. No standard "commercial" or "Office" switches will be accepted. These switches

must have redundant, dual DC power units, must have at least an IP 30 rating, must have a rugged high-strength metal case and must be 19" rack-mounted switches. They must have an operating temperature of at least 0 to 55°C, without the use of cooling fans and must be able to work in relative humidity up to 95% without condensation.

- 7.6.2.2 Redundancy and fault recovery:
 - Must comply with IEEE 802.1w for Rapid Spanning Tree Protocol
 - Must comply with IEEE 802.3ad (now 802.1AX) for link aggregation or port trunking and must have at least 4 trunks.
- 7.6.2.3 Broadcast isolation and network segmentation:
 - Must comply with IEEE 802.1Q in terms of support for VLAN Registration Protocol (GVRP) to ease network planning
- 7.6.2.4 Quality of service:
 - Must comply with IEEE 802.1p/1Q in terms of support for TOS/DiffServ in order to increase determinism
- 7.6.2.5 Multicasting:
 - Must have IGMP Snooping and GMRP for filtering multicast traffic from industrial Ethernet protocols
- 7.6.2.6 Security and authentication:
 - Must comply with IEEE 802.1X in terms of support for SSL to enhance network security
- 7.6.2.7 Remote management and monitoring:
 - Must support SNMP V1/V2/V3 for different levels of network management security
- 13.6.2.8 Core switches must be managed, Layer 3 switches with the number of ports as specified in the project scope of work and the tender bill of quantities.
- 13.6.2.9 Core switches must provide support for a minimum of four trunked Gigabit SFP ports with 1000Base-LC, LC connectors.
- 13.6.2.10 Core switches must provide support for a minimum of eight SFP ports that will support a combination of Fast Ethernet ports (10/100Base-TX,) and Gigabit Ethernet ports (1000Base-T, 1000Base-LX).
- 7.6.2.11 In terms of configuration, maintenance, management and monitoring features required, all core switches must:
 - Have support for loading or saving configurations to a remote host
 - Have port monitoring for debugging
 - Have line-swap fast recovery to normal operation (within milliseconds) after devices are unplugged and then re-plugged into different ports
 - Be configurable by Operating System (OS) independent web browser, using secure HTTPS
 - Be configurable by CLI by Local Serial console and remote SSH network connection
 - Support ping commands to identify network segment integrity

13.7 Compliance With Standards

- 13.13.1 It is important that all equipment is selected and installations are done to industrial standards. These are usually harsh environments in terms of dirt, industrial activities such as welding, grinding, etc. and electrical interference such as lightning, capacitor switching, large drives starting and stopping, etc.
- 13.13.2 The complete installation and networking system must comply with IEEE 802.3-2005.
- 13.13.3 The equipment installed must comply with SANS 61000-4/IEC 61000-4 for EMC.
- 13.13.4 The equipment installed must comply with IEC 60068-2-6 for vibration (10 to 57 Hz – amplitude 0.15mm, 57 to 150 Hz – acceleration 2g).
- 13.13.5 The equipment installed must comply with IEC 60068-2-27 for shock (12 shocks semi-sinusoidal, 15g, 11ms).
- 13.13.6 All installations must comply with the requirements of SANS 10142-1.

13.8 Network Switch Data Sheets

- 13.8.1 For network switches supplied, the tenderer must supply the data sheets shown in Appendix A with his tender.
- 13.8.2 All installations must comply with the requirements of SANS 10142-1.

13.9 Redundancy Testing

- 13.9.1 All the core network switches and area switches that have been installed in a redundant configuration must to be tested by a network specialist and the results documented. The contractor must make the following equipment available to complete these tests:
- Two portable area switches as specified in 13.6.1
 - Two portable computers, running from a CD ROM-booted operating system (e.g. Linux LiveCD)
- 13.9.2 The following ping test procedures must be followed using ICMP (Internet Control Message Protocol).
- Continuous ping messages will be sent from a portable test computer located at the core switch to a remote portable test computer that will be moved around all the network points (i.e. the area switches) to confirm the data throughput, latency (ping time) and network failover time.
 - Confirm that the round-trip ping times with a packet size of 10kb does not exceed 2 milliseconds.
 - Confirm that the continuous ping messages recovers within 3 seconds after either one of the redundant core switches has been powered down or powered up and after either one of the fly leads to the area switch has been disconnected from a core switch.
 - Capture the result as indicated in the following example:

Port No	PING Time	SW0-A Switch Down	SW0-B Switch Down	SW0-A Link Down	SW0-B Link Down	Comments
1	<1ms	✓	✓	✓	✓	Location L2

14 SECTION 3.4.7-5 DETAILED SPECIFICATION TURBIDITY TRANSMITTER

14 TURBIDITY MEASUREMENT

14.1 Scope

14.1.1 This specification covers the supply and installation of Turbidity meters, complete with sensors, transmitters, indicators, panels, etc. used for process monitoring and control applications.

14.2 Abbreviations

14.2.1 In this specification the following abbreviations will apply :-

BS	: British Standards
PLC	: Programmable Logic Controller
I/O	: Input/Output
CPU	: Central Processing Unit
UPS	: Uninterruptible Power Supply
MCC	: Motor Control Centre
MCB	: Miniature Circuit Breaker
SPD	: Surge Protection Device
FJB	: Field Junction Box
SSO	: Switched Socket Outlet
SPDT	: Single Pole Double Throw (refers to relay or switch contact arrangements).
LCD	: Liquid Crystal Display
LED	: Light Emitting Diode
NTU	: Nephelometric Turbidity Unit (A measure of the cloudiness of water)
mg/l	: Milligram per litre
O&M	: Operating And Maintenance

14.3 Standards

14.3.1 The supply and installation of all Turbidity meters and associated cabling, panels and any other equipment shall be subject to the latest amendments and editions of the following standard specifications:-

SANS 10142-1	: National Standards for the wiring of premises.
SANS 1091:2004	: National Colour Standard.
SANS 1274-2005	: Coatings applied by the powder-coating process.
BS 381C:1980	: Paint colour chart.

14.4 General Requirements

- 14.4.1 This specification must be read in conjunction with the following specifications:-
- 14.4.1.1 PLC Panels Specification
 - 14.4.1.2 Clean Power And Surge Protection Specification (
 - 14.4.1.3 Cabling Specification
 - 14.4.1.4 Field Junction Boxes And Panels
- 14.4.2 Where cables are exposed to physical damage (including damage from rodents) armoured cables must be used or un-armoured cables must be run in steel conduit.
- 14.4.3 All power supply cables to instruments must have a black outer sheath, while all control cables (such as digital and analogue signals to PLC's) must have an orange outer sheath as specified in the Cabling Specification
- 14.4.4 FJB's and as far as practically possible all instrument sensors and transmitters, must be mounted such that all equipment, wiring, numbers, terminations, etc. are readily accessible and can be viewed clearly. No equipment may be mounted such that it becomes a hazard or dangerous to view or gain access to such equipment.
- 14.4.5 Where sensors and/or transmitters cannot be mounted where they are readily accessible, the installation must be done in such a way that the sensor or transmitter can easily be moved to a safe and convenient position for testing, maintenance, replacement, etc. (e.g. by using hinged brackets, telescopic brackets, etc.).
- 14.4.6 Where transmitters can be exposed to the elements (wind, rain, ultra violet, etc.) such transmitters must be installed inside the FJB. Where transmitters are protected from the elements (i.e. inside buildings) but they are exposed to potentially harmful conditions like moisture from splashing or equipment being hosed down, or the sensor is in such a position that the transmitter display is not clearly visible from floor level, without the need to climb onto ladders or structures to access it, the transmitter must also be installed inside the FJB. Only where transmitters are not exposed to the elements or any other harsh or potentially harmful conditions and where the displays on such transmitters are clearly legible by an average person standing on the ground or the normal walking surface (e.g. grating above ground level), can the transmitter be mounted outside the FJB.
- 14.4.7 FJB's must be mounted against a wall or structure or on a sturdy pedestal such that the top of the FJB enclosure is no higher than 1.8 m from the floor and easily accessible from the front.
- 14.4.8 All instrument installations must be done in accordance with the manufacturer's requirements and recommendations for proper operation. It is the tenderer's responsibility to ensure that he/she is familiar with both the requirements of the manufacturer as well as the installation requirements, in terms of location, site conditions, materials, equipment or substances to be measured (e.g. hot liquids, acids, abrasive material, etc.) and to ensure that if there are potential problems, they can be pointed out and rectified before orders for equipment are placed.
- 14.4.9 Costs incurred for alterations required to ensure proper operation of instruments,

after orders have been placed, will be for the tenderer's account. For example, if instruments have been ordered and it is found there is insufficient space to install the instrument, or the instrument is not flooded with liquid all the time as it is required for proper operation, or the instrument transmitter is sometimes flooded in its installed position, or the sensing head is sometimes outside the medium it is supposed to measure, or the instrument linings are damaged by abrasive liquids, or the sensor is does not have a suitable range of measurement, etc. alterations or replacements required to rectify such problems will be for the tenderer's account if the Engineer finds that the tenderer was negligent in his/her assessment of the installation.

- 14.4.10 Each instrument must be equipped with a circuit breaker connected to the power supply of the instrument, to enable local isolation in case of repairs or replacement.
- 14.4.11 The supplier of the instrument must be present for the installation, testing and commissioning of the instrument on site. Due allowance must be made for this in the tender sum.
- 14.4.12 The tenderer must supply a complete and detailed set of documentation for the installation, connections, terminations, power supply, technical details, setting up, calibration (if applicable), testing, etc. of the instrument for inclusion in a final O&M manual.
- 14.4.13 Completed data sheets are required as part of the returnable documents of each tender. Failure to complete these data sheets, supplied at the end of this specification, will lead to disqualification of the tender.

14.5 Surge Protection

- 14.5.1 Each instrument and its associated equipment must be suitably protected against surges from induced voltages, switching of equipment, lightning strikes, etc. as detailed in the Clean Power And Surge Protection Specification
- 14.5.2 The power supply to the instrument must be equipped with suitable surge protection, both at the instrument and at the source of the power supply (i.e. at the distribution board, MCC, PLC panel, etc.), as detailed in the Clean Power And Surge Protection Specification
- 14.5.3 Both the digital and analogue signals between the instrument and other remote devices (such as the PLC), must be equipped with suitable surge protection, both at the instrument and at the remote device as detailed in the Clean Power And Surge Protection Specification

14.6 Turbidity Measurement – Controller/Transmitter

- 14.6.1 All turbidity measurements must be done by using a light scatter operating principle.
- 14.6.2 All instrument transmitter enclosures must have at least an IP 65 or higher rating.
- 14.6.3 The instrument must be equipped with an isolated, active, 4 – 20mA output which will be connected to a maximum 500 ohm load. This output must be user-programmable for turbidity.
- 14.6.4 The instrument must be equipped with at least one to three SPDT relays, rated for at least 230V AC, 2A. Two relays for preset turbidity outputs and one relay for alarm status (i.e. transmitter failure, out of range measurement, etc.). The preset outputs

must be user-programmable for various turbidity values.

14.6.5 The transmitter must be suitable for use with a 230V AC, 50/60 Hz power supply.

14.6.6 The transmitter must have an accuracy of at least 5% or 0.02 NTU, whichever is greater.

14.6.7 The transmitter must have a resolution of at least 1% of full scale.

14.6.8 The transmitter must have an LCD or LED display, which will show instantaneous turbidity and relay status.

14.7 Turbidity Measurement – Transducer/Sensor

14.7.1 The range of the sensor must be from 0.00 to 99.9 mg/l and must be suitable for the application (see items 14.4.8 and 14.4.9 of this specification).

14.7.2 The sensor must be suitable for an operating temperature range of 0°C to +50°C.

14.7.3 The sensor must have a protection rating of at least IP 67 or higher.

14.7.4 Brackets used for the mounting of the sensor must be made of at least 3CR12 grade stainless steel if the sensor is not used within a flow cell.

14.7.5 The sensor must be supplied, complete with a cleaning unit (air or water), equipped with a user-programmable cleaning cycle if the sensor is not used within a flow cell.

14.8 Spares

14.8.1 The tenderer will be required to provide a recommended spares list for three years maintenance. This item must be completed so that spares may be ordered as part of the capital contract. Tenderers ignoring this condition may be disqualified.

14.9 Data Sheets

14.9.1 All data sheets in the attached Appendix 1 must be completed.

15 SECTION C3.4.7-6 DETAILED SPECIFICATION CABLING

15 **CABLING**

15.1 **Scope**

15.1.1 This specification covers the selection, installation, testing, marking and termination of electrical cables used for low voltage power and control installations as well as fibre-optic and copper cables for data transmission, used in process monitoring and control application.

15.2 **Abbreviations**

15.2.1 In this specification the following abbreviations will apply :-

SANS : South African National Standards
IEC : International Electrotechnical Commission
EN : Standards from the European Committee for Standardization
PLC : Programmable Logic Controller
UV : Ultra Violet
PVC : Poly Vinyl Chloride
OTDR : Optical Time Domain Reflectometer
OLTS : Optical Loss Test Set
MRM Ref. No. : The nominal mass in kg/m² multiplied by 100, used for steel wire mesh reinforcing.

15.3 **Standards**

15.3.1 All design standards for cabling shall be subject to the latest amendments and editions of the following standard specifications:-

SANS 10142-1	:	National Standards for the wiring of premises
SANS 1507	:	Electric Cables (300/500V to 900/3300V)
SANS 1574	:	Electric Cables Flexible cords and flexible cables
SANS 1411-1 to 7	:	Material of insulated electric cables and flexible cords
SANS 1507-1 to 3	:	Electric cables with extruded solid dielectric insulation for fixed installations (300/500V to 1900/3300V)
SANS 1803-1	:	Lugs and ferrules for insulated cables
SANS 60793	:	Optical fibres
SANS 1024:2006	:	Steel wire mesh
IEC 60793	:	Optical fibres
SANS 60794	:	Optical fibre cables
IEC 60794	:	Optical fibre cables
EN 50288	:	Multi-element metallic cables used in analogue and digital communications and control

ISO/IEC SANS 11801:2002 : Information Technology – Generic cabling for customer premises
IEC 60332-1 : Flammability of a single vertical cable

15.4 General

- 15.4.1 All cables and wiring supplied must be supplied complete with fittings, accessories, etc.
- 15.4.2 The installation of all wires and cables must comply with SANS 10142-1:2003 and SANS 1507-1 to 3, all as amended.
- 15.4.3 The installation of flexible cords must comply with SANS 1574:2004 as amended.
- 15.4.4 All power, control and instrumentation cables (i.e. excluding fibre-optic cabling for data transmission) and wires must have untinned, annealed, multi-strand copper conductors and must comply with, SANS 1507-2 and SANS 1507-3: 2002 as amended.
- 15.4.5 All power, control and instrumentation cables (i.e. excluding fibre-optic cabling for data transmission) and wires must comply with the latest edition of SANS 1411-1 to 7 in terms of material of construction. The sheath of these cables must be an impermeable, halogen-free, reduced smoke emission, flame retardant, UV stabilised compound in accordance with the latest edition of SANS 1411.
- 15.4.6 All fibre-optic cables must comply with SANS 60793-1 for measurement and test methods, SANS 60793-2 for product specifications and SANS 60794 for generic, sectional and family specifications.
- 15.4.7 All blown fibre-optic installations must comply with the requirements of SANS 60794-5 which specifies the requirements of microduct optical fibre cables, microduct fibre units, microducts and protected microducts for installation by blowing for outdoor and/or indoor use.
- 15.4.8 All fibre-optic micro cables must comply with the requirements of SANS 60794-5-10 and all blown fibre bundles must comply with the requirements of SANS 60794-5-20.
- 15.4.9 All blown fibre installations must be done by people who can provide proof of certified training by a recognized supplier/installer.
- 15.4.10 Where fibre-optic data communication is employed, blown fibre installations will be the preferred method. Only where the use of fibre-optic cabling is unavoidable, will such cabling, instead of blown fibre assemblies be accepted.
- 15.4.11 All wires and cables must be from fresh stock, with the manufacturer's original wrappings, labels and seals intact when delivered to site.
- 15.4.12 All cables must be inspected for visible defects or signs of damage before installation.
- 15.4.13 All cable ends must be sealed or capped immediately after cutting to prevent ingress of moisture, dirt, impurities, etc. This applies to cables to be installed as well as cable remaining on the drum.
- 15.4.14 Where cables or wires of different voltages run in the same trunking, cable trays, cable racks or cable supports, all insulation must be rated for the highest voltage being conducted.
- 15.4.15 For PLC panel wiring, this specification must be read in conjunction with the PLC Panels Specification (Volume 3 of the Automation And Control Standards).
- 15.4.16 All electrical and instrumentation cables must be tested, and the results recorded, for insulation

resistance and conductivity in accordance with SANS 1507-3:2002 as amended, before installation and again before final termination. Rectification of faults in cables before final termination will be for the contractor's account.

- 15.4.17 For PLC I/O wiring, the minimum conductor size shall be 0.5mm² but contractors must ensure that all cables and wiring are capable of carrying the full system currents, inclusive of de-rating factors as specified in SANS 10142-1:2003 as amended.
- 15.4.18 All wiring for PLC panels, junction boxes, control panels, etc. shall be flexible, untinned, annealed, multi-strand copper wire of not less than:-
- 15.4.14.1 6mm² for 230V AC power between the main incoming circuit breaker of the PLC panel and the distribution AC circuit breakers.
 - 15.4.14.2 4mm² for 24V DC power between the main DC circuit breaker of the PLC panel and the distribution DC circuit breakers.
 - 15.4.14.3 1,5mm² for 230V AC from below the distribution circuit breakers.
 - 15.4.14.4 1,0mm² for 24V DC or AC power from below the distribution circuit breakers.
 - 15.4.14.5 0,5mm² for all PLC I/O wiring between modules and marshalling terminals.
 - 15.4.14.6 4,0mm² for earth drain.
- 15.4.19 Irrespective of the minimum wire sizes allowed in this specification, contractors must ensure that all cables and wiring are capable of carrying the full system currents, inclusive of de-rating factors as specified in SANS 10142-1:2003 as amended. If wiring of greater cross-sectional area than the sizes indicated in item 15.4.17 and 15.4.18 above are indicated on project design drawings, the larger wiring sizes will take precedence.
- 15.4.20 All wires and cable cores must be fitted with suitable lugs at the end of each wire or core. The fitting of lugs and ferrules must comply with SANS 1803-1:2002 as amended. No more than one wire may be crimped into a single lug. Where pin lugs are crimped onto the ends of wires, correctly sized pin lugs must be used, which fit into the terminals properly and such that the tightening of the terminal does not result in the loosening of the pin lug.
- 15.4.21 The use of lugs and ferrules must comply with SANS 1803-1:2002 as amended.
- 15.4.22 The outer sheath of all power cabling must be black and the outer sheath of all instrumentation and control cabling must be orange. The power supply to instruments and transmitters are regarded as part of the instrumentation cabling and must therefore have an orange outer sheath. The outer sheaths of all blown fibre microduct assemblies must also be orange. Where blown fibre microduct assemblies have an outer sheath of a specific material (such as UV protection) which is not available in orange, the contractor can apply to the Engineer for a concession to use the assembly as is and only attach an orange heat-shrink (for identification purposes) at the ends where terminations are made.
- 15.4.23 The jacket or buffer tubes of fibre cores in fibre-optic cables must be colour coded and terminated in the following sequence:

Fibre/Tube	Colour
1	Blue

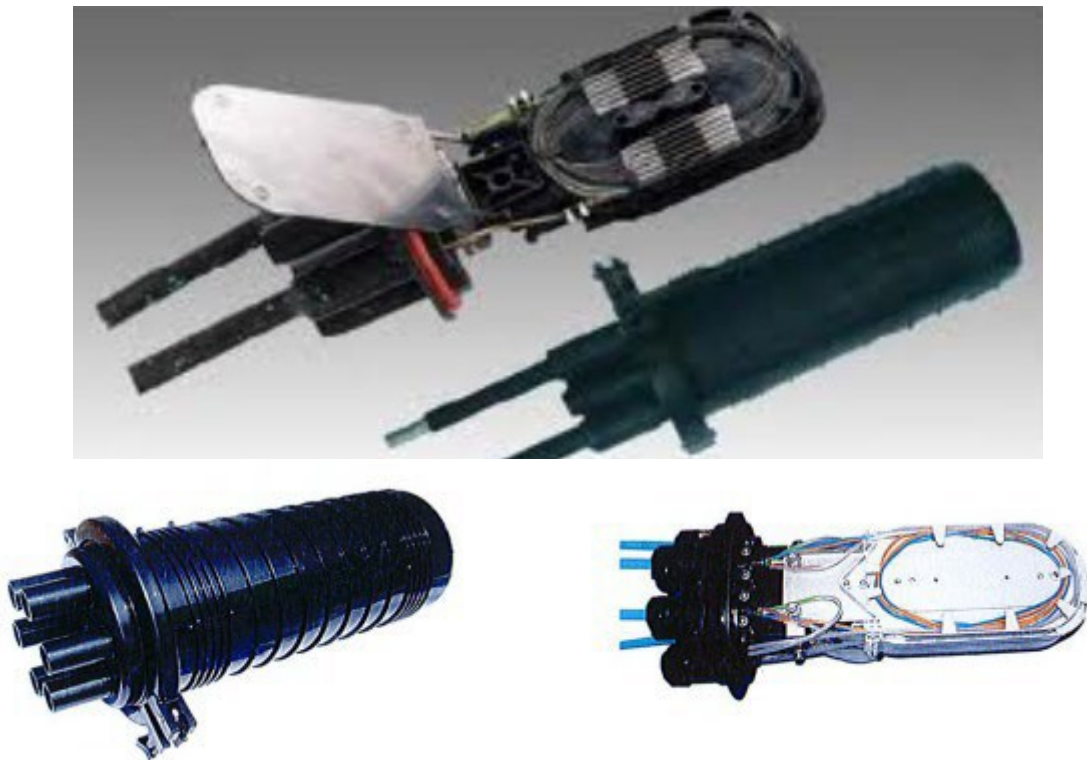
2	Orange
3	Green
4	Brown
5	Grey (Slate)
6	White
7	Red
8	Black
9	Yellow
10	Violet
11	Pink (Rose)
12	Aqua (Turquoise)

- 6.4.24 All fibre-optic cable will be CST (corrugated steel tape) armoured, rodent-proof, UV protected, loose-tube, water blocking, suitable for use in direct burial and manufactured with an orange PVC sheath. The conductive steel armour of installed fibre cables shall be properly grounded to the protective earth at all termination points.
- 6.4.25 All blown fibre microduct assemblies installed in trenches must be suitable for direct burial in terms of strength and mechanical protection.
- 6.4.26 All blown fibre microduct assemblies installed on cable racks or supports above ground must have suitable mechanical protection. Suitable mechanical protection includes, blown fibre microduct assemblies on racks that are covered with metal covers, blown fibre microduct assemblies installed in metal tubing and blown fibre microduct assemblies with steel wire armouring or steel tape armouring.
- 6.4.27 Where blown fibre microduct assemblies are installed in buildings or in cable tunnels, such microduct assemblies must have an inner and outer sheath of fire retardant material. The outer sheath must also be low-smoke and halogen-free.
- 6.4.28 Where blown fibre microduct assemblies are exposed to direct sunlight, such microduct assemblies must have an outer sheath that is UV protected.
- 6.4.29 The contractor must take very careful note of the requirements for blown fibre microduct assemblies as outlined in items 15.4.25 to 15.4.28 above. These requirements imply that where the installation conditions change, suitable blown fibre microduct assemblies must be installed to suit the requirements of each section of the installation. The table below gives an example of the blown fibre microduct assembly requirements for various sections of an installation:

Installation Condition	Blown Fibre Microduct Assembly Requirements
In ceiling of a building	Rodent-proof, low-smoke, fire retardant, halogen-free.
On a cable support against the side of the building	Steel wire or steel tape armoured, UV protected.
Buried in a trench	Suitable for direct burial.
On a rack in the open above ground	Mechanical protection, UV protection (if mechanical protection is not steel covers or metal tubing).
On a rack inside a building	Mechanical protection, low-smoke, halogen-free, fire retardant.

- 6.4.30 All cables on racks, in trenches, in tunnels, in wire ways, on cable supports, etc. must be vermin-proof. I.e. such cables must be equipped with suitable armouring to prevent rodents or other vermin from chewing through core conductors or their insulation.
- 6.4.31 Bending of all cables and microduct assemblies for blown fibres must be limited to the safe criteria specified by the manufacturers.

- 15.4.32 Holes for cables or blown fibre microduct assemblies passing through walls, floors, partitions, ceilings, etc. must be done neatly and must be sealed off with plaster or filler as appropriate.
- 15.4.33 Splices in cables are prohibited, unless the route lengths exceed the maximum length of a drum or if the Engineer agrees to a splice. In such cases splices are to be made by using approved proprietary types of junction boxes, installed in an appropriate manner. For fibre-optic cables, dome splicing kits with a protection rating of at least IP68, installed in a manhole must be used. The dome splicing kit must be mounted vertically inside the manhole. The manhole must be big enough to create a 3m service loop in the each cable without exceeding the minimum bending radius of the cable and big enough to mount the enclosure appropriately in the manhole. Only fusion splices will be acceptable and ease of access to the splice must be ensured. Examples of such dome splicing kits are shown below. Alternatively the splice can be made in a junction box that complies with all the requirements of the specification “Field Junction Boxes And Panels” (Volume 19 of the Automation And Control Standards), mounted on a proper support, above ground level. Once a splice is completed, all the testing requirements of items 15.8.8 and 15.8.9 below must be complied with.



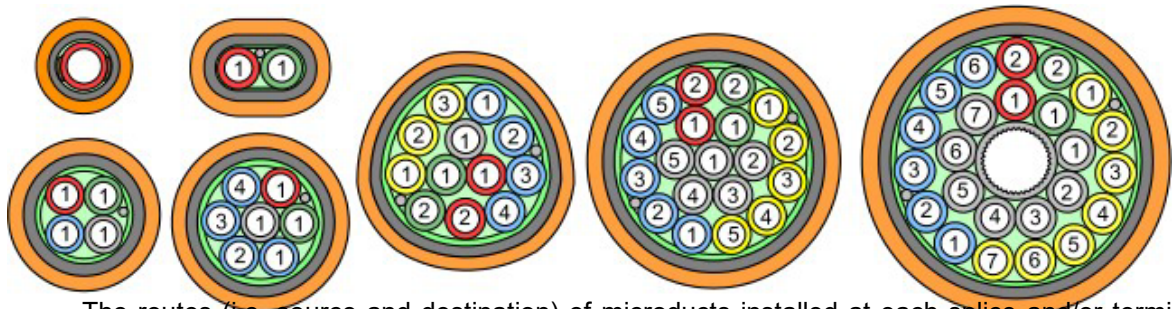
- 15.4.34 For blown fibre microduct assemblies, in-line splicing kits, installed in a manhole, can be used if a splice is approved by the Engineer. These kits must also have a protection rating of at least IP68. Only fusion splices will be acceptable and ease of access to the splice must be ensured. An example of such an in-line splicing kit is shown below. Alternatively the splice can be made in a junction box that complies with all the requirements of the specification “Field Junction Boxes And Panels” (Volume 19 of the Automation And Control Standards), mounted on a proper support, above ground level. Once a splice is completed, all the testing requirements of items 15.8.8 and 15.8.9 below must be complied with.



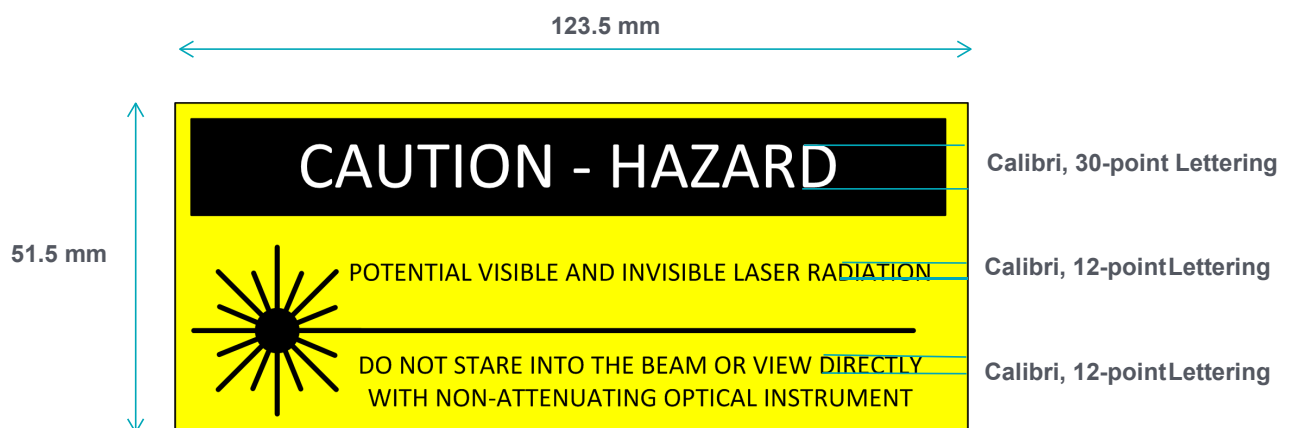
- 6.4.35 Splices in copper cables can be done with the aid of proprietary, resin-encapsulated splices that are completely water-proof (such as Scotch Cast or similar). Alternatively the splice can be made in a junction box that complies with all the requirements of the specification “Field Junction Boxes And Panels” (Volume 19 of the Automation And Control Standards), mounted on a proper support, above ground level.
- 6.4.36 Manholes used for splicing can be constructed using bricks or concrete. The manhole must allow for adequate drainage during occasional flooding. All sleeves entering the manhole must be sealed with an appropriate sealer that will prevent moisture, dirt, rodents, etc. from getting into the sleeves, but the sealant must be of such material that it can easily be removed if required in future. The area around the sleeve where it enters the manhole must also be sealed to prevent moisture, mud, rodents, etc. from getting into the manhole. The manhole must not have any sharp edges that can damage cables or microduct assemblies.
- 6.4.37 Cables or conductors passing through holes must be fully protected against damage by correctly fitted grommets, bushes, etc.
- 6.4.38 All cable routes, including trenches, cable racks, tunnels, cable supports, etc. must be clearly marked on drawings and submitted for approval by the Engineer. The project will not be regarded as complete until such cable route drawings have been submitted and approved.
- 6.4.39 The jacket or buffer tubes of fibre bundles used in blown fibre installations must be colour coded and terminated in the following sequence:

Fibre/Tube	Colour
1	Blue
2	Orange
3	Green
4	Brown
5	Grey (Slate)
6	White
7	Red
8	Black
9	Yellow
10	Violet
11	Pink (Rose)
12	Aqua (Turquoise)

- 15.4.40 The microducts (or inner tubes) of microduct assemblies used for blown fibre installations must be constructed from low-friction Poly Ethylene (PE). These microducts must be 5/3.5 in size (i.e. 5mm OD and 3.5mm ID). Surrounding the group of microducts, must be a layer of waterswell tape. Where steel wire armour or steel tape armour is not used, the microduct assembly must be metal-free.
- 15.4.41 Microducts in microduct assemblies must be available in 1, 2, 4, 7, 12, 19 and 24 microduct assemblies and must be numbered and colour-coded as indicated in the sketch below.



- 15.4.42 The routes (i.e. source and destination) of microducts installed at each splice and/or termination must be noted down in detail during installation. This record must indicate for each fibre bundle that is blown into a microduct: Source – microduct colour – microduct number and Destination – microduct colour – microduct number. This detailed record must be submitted to the Engineer for approval before the blowing in of fibre bundles commences. Once it is approved, installation must be done according to this record. If a change is made, such a change must be recorded and a final “as-built” record of the installation must be produced for record purposes. The project will not be regarded as complete until such microduct route records have been submitted and approved.
- 15.4.43 Wherever fibre-optic ends exist, such as at patch panels, splices, switches, transmitters, receivers, etc. and where it would be possible for a person to look into such fibre-optic ends, a danger warning as shown by the image below, must be affixed to the panel, enclosure, etc. It must be an engraved label. Prints that could fade over time will not be acceptable. It is preferred that the label is affixed with screws, but if there is a risk of compromising an IP protection rating, glued-on labels will be accepted.



15.5 Cabling On Racks And Supports

- 15.5.1 Cable ladders shall, unless otherwise specified, be heavy-duty cable ladder standard pattern.
- 15.5.2 Cable ladders used inside Elutriation Terrace pump stations or in areas within 50m or less of Ferric Chloride, Hypochlorite or Chlorine shall be manufactured from corrosion resistant GRP (Glass Reinforced Polyester) ladder racks in which vinylester resin is used. All GRP cable ladders shall consist of a 75 mm high side rail. The minimum thickness of the material that the cable rack is to be manufactured from, shall at least be 4mm. Cross rungs shall be spaced at maximum intervals of 300 mm (centre-to-centre). All screws, bolts and nuts shall be hexagonal to ISO Metric commercial standards. All bolts, nuts, spring washers, etc. shall be 316 grade stainless steel for all applications, except for Ferric Chloride areas, where 304 grade stainless steel must be used.
- Racks for instrumentation and control cabling shall contain pigmentation to produce an electric orange rack. A sample of the rack material must be approved by the engineer before manufacturing commences. Sections of rack, bends, t-pieces etc. shall be joined together with the correct dowels and resins as specified by the supplier. Wherever racking is drilled or cut, the exposed areas of GRP must be sealed with the same resin to ensure that the material does not fray. Channels or other sections used for securing of cable ladders should as far as possible be made from the same GRP material. Where this is not possible, 316 grade stainless steel support systems shall be used for all applications, except for Ferric Chloride areas, where 304 grade stainless steel must be used.
- 15.5.3 Cable ladders used inside de-watering buildings shall be metal cable ladders, manufactured from corrosion resistant, powder coated, 3CR12 grade stainless steel. All cable ladders shall consist of at least 75 mm high side rail. The minimum sheet thickness of the material that the cable rack is to be manufactured from shall at least be 2mm. Cross rungs shall be spaced at maximum intervals of 300 mm (centre-to-centre). All screws, bolts and nuts shall be hexagonal to ISO Metric commercial standards. All bolts, nuts, spring washers, etc. shall be 316 grade stainless steel. Metal racks for instrumentation and control cabling shall be powder coated electric orange. If GRP ladder racking (as described in item 15.5.2 above) is cheaper than 3CR12 grade ladder racking, the GRP racking should be used inside de-watering buildings as well.
- 15.5.4 Cable ladders used for all applications other than those mentioned in items 15.5.2 and 15.5.3 above shall be heavy-duty metal cable ladders, manufactured from corrosion resistant hot-dipped galvanised, powder coated, mild steel. All metal cable ladders shall consist of at least 75 mm high side rail. The minimum sheet thickness of the material that the cable rack is to be manufactured from shall at least be 3mm. Cross rungs shall be spaced at maximum intervals of 300 mm (centre-to-centre). All screws, bolts and nuts shall be hexagonal to ISO Metric commercial standards. All bolts, nuts, spring washers, etc shall be 316 grade stainless steel. Racks for instrumentation and control cabling shall be powder coated electric orange.
- 15.5.5 Power and control cabling must always be separated by no less than 500mm. Where it is unavoidable to cross power and control cabling, such cross-overs must be done at right angles.
- 15.5.6 Only single layers of cable will be allowed on a rack, to reduce de-rating and for ease of replacement and/or repairs.
- 15.5.7 Bends in cable racks and supports shall have radii which will ensure that cables are not bent more than the safe criteria specified by the cable manufacturers. For this reason all racking, whether horizontal or vertical must include 90 degree bends where there are 90 degree direction changes in cable runs. I.e. cabling cannot be run from one straight cable rack onto another straight cable rack at 90 degrees, without a 90 degree cable rack bend.
- 15.5.8 Angle iron cable supports may be used. All such angle iron supports must be hot-dipped galvanised, 3CR12 grade stainless steel, 304 grade stainless steel or 316 grade stainless steel
- and electric orange powder coated as for the cable racks. The material will depend on the application area as specified in items 15.5.2 to 15.5.4 above.
- 15.5.9 No more than two cables may be run on a single angle iron support.

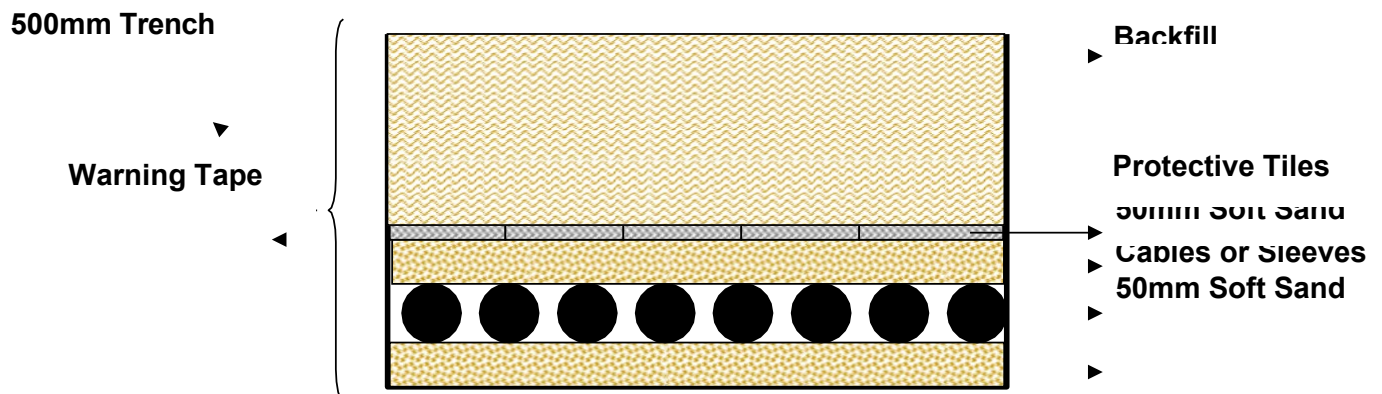
- 15.5.10 The size of angle iron supports must be such that no part of a cable projects beyond the support.
- 15.5.11 The minimum size of angle iron cable supports is 25mm x 25mm x 5mm.
- 15.5.12 Wherever possible cable racks must be mounted in the vertical plane to avoid accumulation of dirt and debris.
- 15.5.13 UV stabilised PVC straps may be used for cables up to 4core x 25mm². For cables of larger diameter than this, stainless steel strapping must be used.
- 15.5.14 Cables must be marked at both ends with stainless steel cable markers strapped to the cable with stainless steel or UV resistant straps in a position where this number is visible without the need to move cables or equipment to view the number.

15.6 Electric Cable Terminations

- 15.15.1 All cable terminations must be made in a professional manner and cables shall be made off by using appropriate cable glands and UV treated shrouds. Glands similar or equal to the “Enviro” glands supplied by some manufacturers must be used. All cable glands must be:
 - environmentally sealed to IP68 against the ingress of water from either end of the cable gland
 - constructed from brass and black nylon plastic encapsulation
 - supplied complete with brass locknut
 - have a loose cone bush and cone ring
 - suitable for use in an Ex e application and must therefore have an Ex identification band
- 15.15.2 Proprietary type wire strippers shall be used and no stranded conductor shall be terminated if one or more strand has been damaged.
- 15.15.3 Not more than one wire shall be connected to one side of any terminal.
- 15.15.4 Every wire shall be marked at both ends with a numbering system approved by the Engineer, and all terminating wires shall also be suitably crimped to a terminal lug. Not more than one wire shall be crimped into a single lug. Bare wire terminations will not be accepted.
- 15.15.5 Where lugs are bolted onto studs, suitably sized lugs must be used. Enlarged holes in lugs will not be accepted.
- 15.15.6 Where cable cores are terminated, sufficient slack must be allowed for wiring changes, re-terminations, etc.
- 15.15.7 Where cable junction boxes, terminal boxes or terminations in instruments or any other panels in the field take place it must be ensured that such a junction box, termination box, instrument, etc. is not exposed to fire hazards from burning grass or other vegetation. If such a termination point is out in the open field (e.g. where grass grows below and/or around it), a clear area of at least 2.5m radius around this termination point must be provided. This must be a permanent clearing, such as a cement or concrete surface. A mere clearing of vegetation which can grow back again will not be accepted.

15.7 Cables Or Microduct Assemblies In Trenches

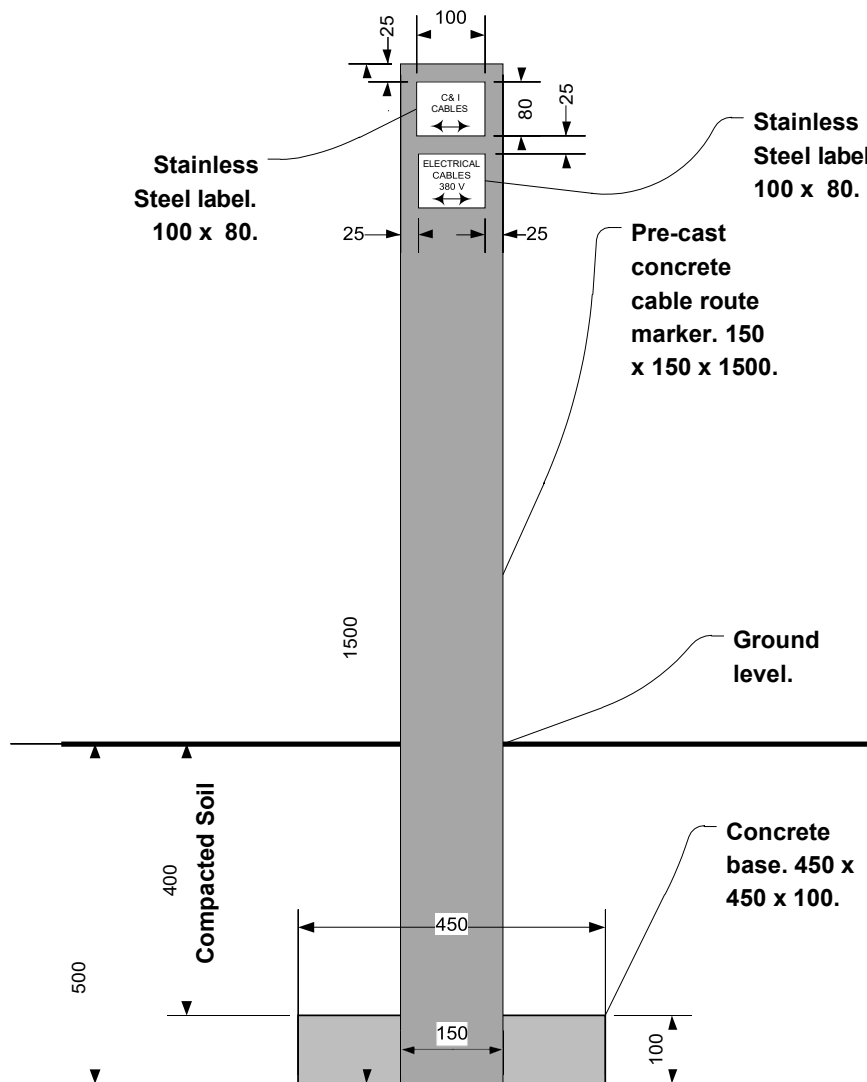
- 15.7.1 All cabling in trenches must be armoured cables to ensure sufficient mechanical protection.
- 15.7.2 Where cabling (electrical or fibre-optic) has to be done between points where cabling will not run along cable racks, in cable ducts or in cable tunnels, these cables or microduct assemblies for blown fibre must be run in trenches. Overhead cabling will not be acceptable. Blown fibre microduct assemblies buried in trenches must be suitable for direct burial.
- 15.7.3 Cable trenches must be at least 500 mm deep. There must be a 50mm layer of selective backfill (soft sand), free of sharp and hard objects, at the bottom of the trench and another 50mm layer of selective backfill (soft sand) directly above the cable, sleeves or microduct assemblies. On top of the soft sand plastic cable warning tape, consisting of a strip of polyethylene of thickness 0,04 mm and of nominal width 230 mm, completely impregnated with a pigment such that the colour of the tape is yellow, colour No B49 of SANS 1091, and having printed at intervals not exceeding 1 metre along its length, a black-triangle and an electric flash symbol and the words "Danger, Gevaar, Ingozi", must be installed. Thereafter a single layer of protective pre-cast concrete tiles must be placed, before the trench is filled with sand (see the sketch below).



- 15.7.4 Protective concrete tiles in trenches must be 300mm wide by 450mm long by not less than 50mm thick. Steel reinforcing mesh of MRM reference 156, in accordance with SANS 1024:2006 is required in the concrete and the concrete compressive strength of the tile must not be less than 15 MPa. For wider trenches, two or more tiles must be laid side-by-side to ensure that the total width of the trench is covered. (Note: Reinforcing mesh to MRM 156 consists of 3.55mm diameter wire used to create 100 x 100 mm squares).
- 15.7.5 Protective concrete tiles in trenches under roads must be 300mm wide by 600mm long by not less than 100mm thick. Steel reinforcing mesh of MRM reference 156, in accordance with SANS 1024:2006 is required in the concrete and the concrete compressive strength of the tile must not be less than 15 MPa. For wider trenches, two or more tiles must be laid side-by-side to ensure that the total width of the trench is covered. (Note: Reinforcing mesh to MRM 156 consists of 3.55mm diameter wire used to create 100 x 100 mm squares).
- 15.7.6 Cable route markers, in the form of concrete pre-cast posts, which stand 1.0m above ground level, secured in the ground, must be installed every 50m on straight runs and at every change in direction of the trench. Movable route markers will not be acceptable. The post must be equipped with a stainless steel plate engraved with "C&I CABLES" and the direction indicated in which the cables run. If there are electrical cables in the same trench, there must be a separate label engraved with "ELECTRICAL CABLES", the voltage and the direction indicated in which the cables run. If there are data communication cables in the same trench, there must be a separate label

engraved with "DATA CABLES" and the direction indicated in which the cables run. These labels must be cast into the concrete post so that they cannot be pried off.

- 6.7.7 At the bottom of the post a 450 x 450 x 100mm concrete base must be cast to ensure that the route marker can only be removed if it is deliberately dug out of the ground. Steel reinforcing mesh of MRM reference 156, in accordance with SANS 1024:2006 is required in the concrete and the concrete compressive strength of the base must not be less than 15 MPa. (Note: Reinforcing mesh to MRM 156 consists of 3.55mm diameter wire used to create 100 x 100 mm squares).
- 6.7.8 These route markers must be installed right next to the trench and not over the cables, so that the trench can be re-opened without affecting the route marker. The labels on the route marker must be on the trench side of the route marker.
- 6.7.9 The diagram below provides the required detail of these cable route markers.

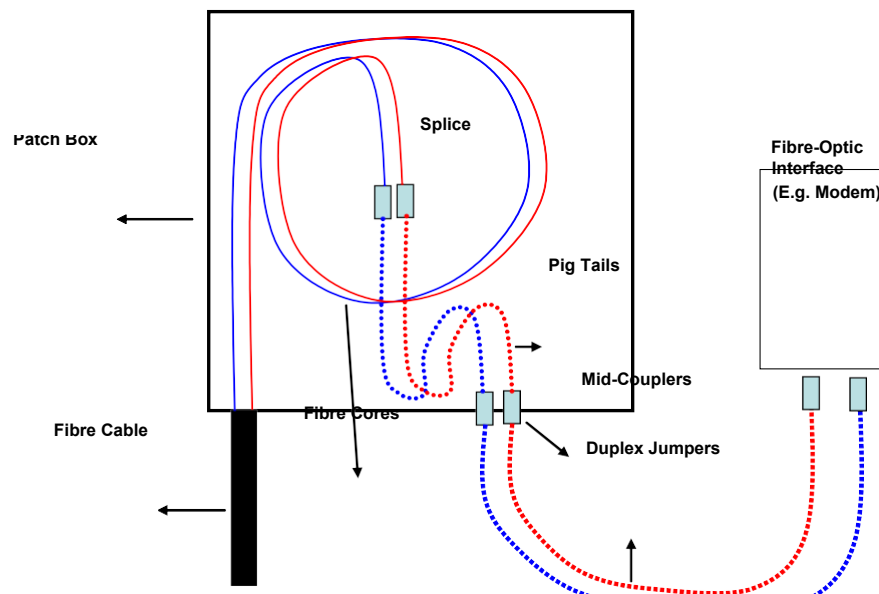


- 6.7.10 Where trenches pass under roads, railway lines, buildings, structures, etc., the cable trench must be at least 800 mm deep and at least a 110mm HDPE (High-density polyethylene) double wall, corrugated pipe will be used as sleeving.

- 15.7.1
1 Power and control cables must remain separated by at least 500mm as stated earlier. This means that power and control cables are not to be installed in the same cable sleeve.

15.8 Fibre-Optic Data Cable Terminations

- 15.8.1 All terminations must be done by fusion splicing cores of the fibre-optic cable onto pre-fabricated “pig tails”, inside a “patch box”. The optical fibres will be terminated in the sequence specified in item 15.4.23 and 15.4.39 above.
- 15.8.2 The “patch box” must be equipped with mid-couplers, to accept the “pig tails” from inside the “patch box”. The other end of these mid-couplers must accept the ends of the duplex jumpers fitted with LC connectors at both ends, which in turn are connected to the fibre-optic interface (modem, switch, hub, etc.). This arrangement is to ensure that disconnecting for testing or maintenance purposes does not involve working where the splices were made (see the sketch below).



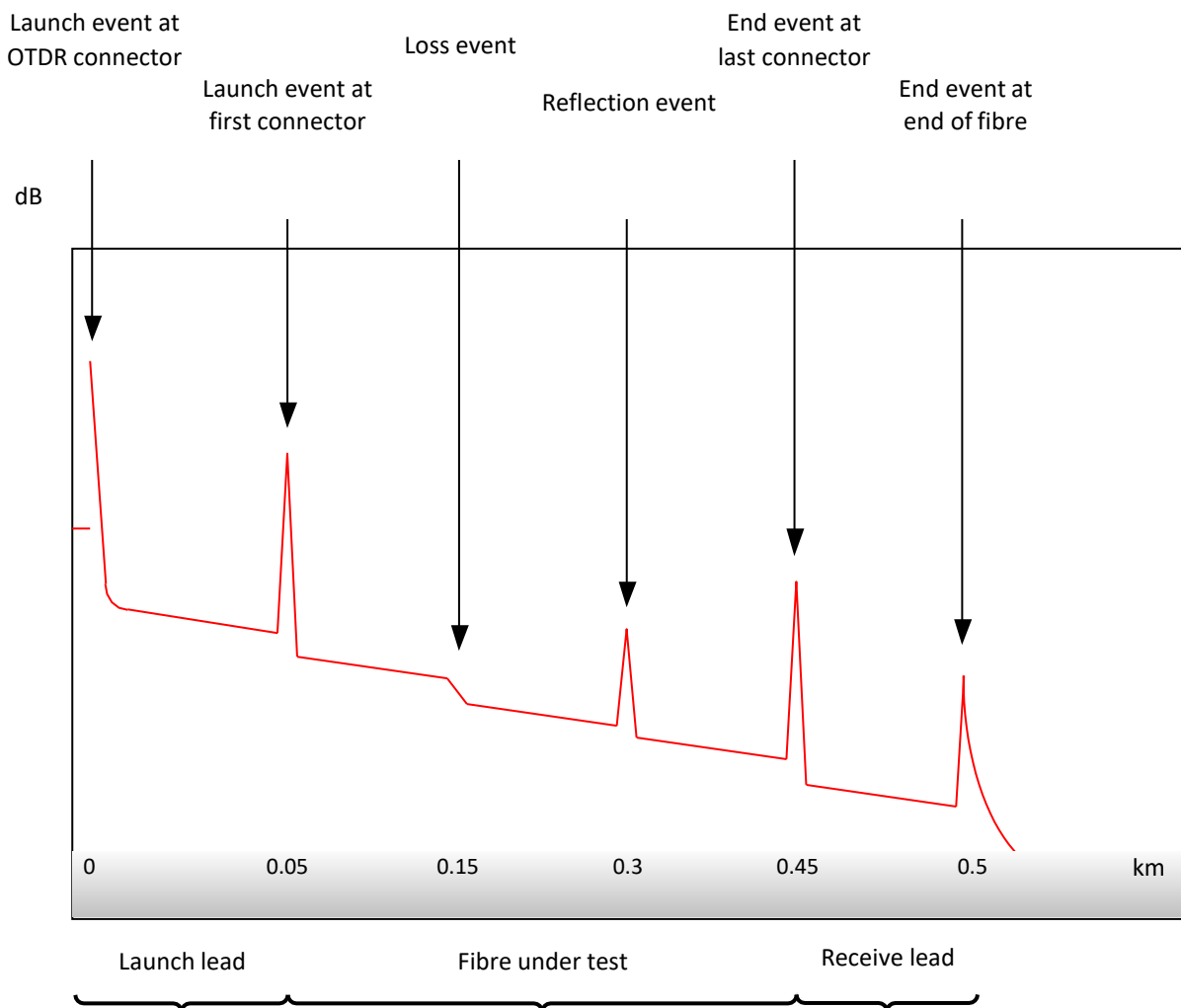
- 15.8.3 The “patch box” must be hardened and robust, with a minimum environmental rating of IP65 and suitable for use in industrial applications.
- 15.8.4 All splices must be fusion splices, and not mechanical splices.
- 15.8.5 All fibre-optic cables must be at least 12-core cables to ensure sufficient spare cores in the event of faults and for future modifications, additions, etc.
- 15.8.6 All fibre-optic data communication cables must be single mode.
- 15.8.7 All fibre-optic cables supplied must comply with the relevant parts of SANS 60793/ IEC 60793 and SANS 60794/ IEC 60794 in terms of construction, installation and testing.
- 15.8.8 All the fibres and splices must be tested by an experienced fibre-optic network specialist and the results saved for analysis. The following tests have to be completed and test certificates have to be produced:
- 15.8.8.1 OTDR (optical time domain reflectometer) tests for all fibres at both 1310nm and 1550nm

wavelengths, in both directions, must be completed when the cable is delivered to the site and again after the installation has been completed.

15.8.8.2

When performing OTDR tests, adequate launch and receiving leads must be used so that the splicing on both ends of the cable is clearly visible on the OTDR trace. The pulse width must be set to the minimum possible width for the distance under test and the time duration of the test must not be less than sixty (60) seconds. The scale of the trace should be set to 1.5x to 2x the length of the cable under test. The measured loss of each event must be captured in MS Excel and the original OTDR results must be saved in its native format. The results must be supplied to the engineer for approval. A typical OTDR trace is shown below.

Typical OTDR trace



- 15.8.8.3 OLTS (optical loss test set) analysis with a power source and power meter must be done for all fibres after the installation has been completed. These tests must be done in both directions and the results have to be captured in MS Excel. A typical test report for one fibre is shown below. (P/Loss = Power Loss; ORL = Optical Reflection Loss).

Fibre ID	Wavelength	P/Loss	P/Loss	Average	ORL A	ORL B	Length
		A->B	B->A				
	(nm)	(dB)	(dB)	(dB)	(dB)	(dB)	(km)

- 15.8.9 Losses in any fibre-optic core measured end-to-end at wavelengths of 1310nm and 1550nm, must not exceed 0.25dB per splice. The attenuation over the length of the fibre must not exceed 0.35dB/km at 1310nm and 0.25dB/km at 1550nm.

6.9 Copper Data Cables

- 6.9.1 All copper cable shall be a high performance, 4-pair, Category 6, 23 AWG, unshielded, twisted pair (U/UTP) with solid copper conductors, polyolefin insulated PVC or low-flammability sheath and colour-coded pairs.
- 6.9.2 All copper cable shall be tested after installation using an instrument with the capability of certifying the cable as Category 6 as specified in the TIA/EIA 568-B.2-10 industry standard.

6.10 Data Cabling General

- 6.10.1 All data cabling systems must be designed and installed in accordance with ISO/IEC SANS 11801:2002.
- 6.10.2 The cables must comply with EN 50288-5/15.
- 6.10.3 In terms of flammability, the cables or blown fibre microduct assemblies inside buildings (whether on racks, in ceilings, under floor panels, etc.) must comply with IEC 60332-1.

6.11 Cable Theft Prevention Measures

- 6.11.1 Cable theft prevention methods must be discussed with each site manager and implemented to suit the unique requirements in each area on each site.
- 6.11.2 Trenches in high risk areas (as defined by the relevant site manager) will have a 100mm thick layer of 20/20 concrete (i.e. 20MPA strength and 20mm aggregate size) supplied in the place of the concrete tiles.
- 6.11.3 No inverted culverts with cable racking inside the culverts and concrete covers over the culverts will be used in high risk areas. Instead, normal trenching with a layer of 20/20 concrete will be used.
- 6.11.4 Where cables are laid in trenches, the contractor must ensure that cable de-rating factors are strictly applied in accordance with SANS 10142-1:2003 to prevent cables from overheating. This clause is especially important to adhere to when existing inverted culverts with existing installed cables are to be filled with soil.
- 6.11.5 No bare copper conductors are to be used for earth conductors, earth strapping, earth bonding, etc. If possible a 5-core cable should be used to allow the 5th core to be used as an earth

conductor. If this is not a viable option, a 2-core PVC, SWA cable must be installed as an earth cable.

- 15.11.6 For short runs of earth cable (such as bonding of earth bars or earthing conductors of buildings), other cable (i.e. not copper), approved by the Engineer, must be used.
- 15.11.7 For high risk areas where cable racking is used, such cable racks must be covered with solid covers of the same material and complying with the same paint specification as the racking itself. Such covers must be bolted onto the rack in such a way that either special tools or a disk grinder would be required to remove these covers.
- 15.11.8 If any additional cable theft prevention methods are required, such requirements will be made clear to the contractor at the time of tender.

6.12 All Dielectric Self-Supporting (ADSS) fiber optic cable

15.12.1 General

All Dielectric Self-Supporting (ADSS) fiber optic cable is a specialized aerial cable designed to be strong enough to support itself between structures without metallic elements. Because it is non-conductive, it is the standard choice for installation on high-voltage power lines.

15.12.2 Mechanical criteria

- Ultimate Tensile Strength (UTS/RTS): The maximum theoretical breaking force. Actual breaking force must be $\geq 95\%$
- Maximum Allowable Tension (MAT): The maximum tension the cable can handle under design weather conditions (wind/ice). Under this load, fiber strain should be $\leq 0.05\%$
- Span Lengths: * Short Span: 50m to 100m (for distribution poles)
- Span Lengths: * Medium: 100m to 300m (for distribution poles)

15.12.2 Installation accessories

The Contractor shall supply and install a required installation accessories including but not limited to temporary grips, Tension/suspension clamps, dead-end fittings, guy grips, pole brackets, suspension grips, etc

15.12.3 MEASUREMENT AND PAYMENT

Measurement and payment will distinguish between supply/delivery and installation/ commissioning of the cabling lengths required.

<u>Item</u>	<u>Unit</u>
a) Supply and delivery of ADSS cable	metre

The unit of measurement shall be the length of ADSS cable supplied. It is the responsibility of the Contractor to verify the lengths of cables required on site. The Contractor shall only supply the required length of cables required. The final quantity of installed cable lengths shall determine the final quantity to be paid of the supplied cable lengths.

The tendered rate shall include for the design, manufacture, supply and delivery of the specified cable to the site.

Separate items shall be scheduled under this payment item for each size and type of cable.

<u>Item</u>	<u>Unit</u>
b) Install ADSS cable poles	No

The unit of measurement shall be the length of ADSS cable installed on pole.

The tendered rate shall include full compensation for the handling, inspection, affixing to poles, cutting and testing the cable. Cables shall be measured linearly over route length.

**CITY OF TSHWANE
WATER AND SANITATION BUSINESS UNIT**

CONTRACT NO: WSBU 15-2025/26

**TENDER FOR THE REFURBISHMENT OF BRONKHORSTSPRUIT WATER
TREATMENT PLANT FOR A PERIOD OF TWENTY-FOUR (24) MONTHS FROM
COMMENCEMENT DATE**

C3.5 MANAGEMENT

C3.5 MANAGEMENT

C3.5.1 Applicable SANS 1921 standards

The following part of SANS 1921 (Construction and management requirements for construction works) and associated specification is applicable:

SANS 1921-5: Earthworks activities, which are to be performed by hand

SANS 1921-5: Earthworks activities that are to be performed by hand	
Clause No	Specification Data
5.1	The depth of the trenches to be excavated by hand is 1,5m.
Variations:	None.
Additional clauses	None.

C3.5.2 Recording of weather and extension of time due to abnormal rainfall

The Contractor shall supply, install, calibrate and maintain on site a tipping-bucket type electronic rain gauge with an integrated data logger, suitable for outdoor use and compliant with standard meteorological practice for rainfall measurement.

The instrument shall as a minimum:

- Measure rainfall in metric units (mm) with a resolution not exceeding 0,2 mm per tip and an accuracy of $\pm 2\%$ or better over the normal operating range.
- Automatically record and store the date and time of each tip/event in non-volatile memory, enabling determination of rainfall depth, rate and duration for any day during the contract period.
- Provide automatic calculation and display/export of daily rainfall totals and cumulative rainfall over user-selectable periods (at least daily, weekly and monthly).
- Have sufficient onboard data storage for at least 24 months of rainfall data when sampled at event level, or be fitted with a communication module (e.g. GSM / LTE or Wi-Fi) that automatically uploads data to a secure web portal or server for archiving and retrieval.
- Be supplied complete with mounting mast/stand, levelling device and bird/debris guards, installed in an open location free from local obstructions and splash, in accordance with the manufacturer's instructions and good hydrometeorological practice.

The Contractor shall ensure that the electronic rain gauge is operational before commencement of weather-sensitive work and remains in continuous operation for the duration of the Contract, with routine inspection, cleaning and functional checks carried out at intervals not exceeding one month and after significant storm events.

Daily rainfall figures and associated electronic records shall be downloaded or retrieved at least monthly and whenever rainfall is considered by the Contractor to justify an extension of time, and shall be printed or exported in tabular form and recorded in the site diary / weather register for the Engineer's verification and signature within 10 days after such rainfall occurs, in accordance with the Contract.

The electronically recorded rainfall data (event log and daily totals), together with any agreed weather-lost working day records, shall constitute the primary basis for determining abnormal rainfall and assessing extensions of time in terms of Method 1 or Method 2 as defined in the Contract Data.

C3.5.3 Management meetings

They shall be responsibility of Contractor having necessary representatives with the necessary delegated authority in respect of aspects such as planning, change management, health and safety.

C3.5.4 Forms for contract administration

City of Tshwane standard forms for contract administration purposes shall be used in the project and stipulated in the Site Management Manual

C3.5.5 Electronic payments

City of Tshwane requirement shall be made known to the Contractor.

C3.5.6 Daily records

Daily requirements of resources (people and equipment employed), or site diaries in respect of work performed on site, and where such documents are kept shall follow the City of Tshwane Site Management Manual.

C3.5.7 Guarantees

Guarantees are to be lodged, collected and released in accordance with the Contract Data.

C3.5.8 Payment certificates

The requirements for substantiation of claims in payment certificates to expedite verification and certification by the employer are stipulated in the City of Tshwane Site Management Manual.

C3.5.9 Permits

Contractor shall be responsible for his staff's security and entrance permission.

C3.5.10 Proof of compliance with the law

None.

C3.5.11 Insurance provided by the employer

The copies of insurance effected by the employer can be obtained from the Project Manager.

C3.5.1.1 Construction Programme

The Contractor shall supply within the period stated in the Contract Data a suitable and realistic construction programme that is based on the construction drawings issued by the Engineer, for consideration by the Engineer. This programme shall show the proposed scheduling and methods of execution of the Works, as well as the resources that will be allocated to each item or phase of the Works. Quantities proposed for execution during each month must be shown. In addition, the anticipated cashflow for the Contract, based upon these quantities, shall be shown following the prescribed format.

The Contractor will be expected to progress with the Works in accordance with the approved programme, and shall not deviate from the order of execution shown in the programme without the prior approval of the Engineer or his Representative. Should such approval be given an adjusted programme shall be produced within five (5) working days and submitted to the Engineer for evaluation.

Progress in advance of the programme on certain portions or phases of the Works shall not be considered adequate reason for poor progress on another portion or phase.

C3.5.1.2 Site Administration

Acceptance control, record keeping and payment certificates shall be done in accordance with the Engineer's standard system except if the Engineer approves that the Contractor's standard system may be used.

C3.5.1.3 Daily Site Diary

The daily site diary shall be kept up to date by the Contractor's Representative and will be signed on a daily basis by the Engineer's Representative.

C3.5.1.4 Information in Respect of Plant

Information relating to plant on Site shall be recorded in the daily site diary. In addition, the Contractor shall deliver to the Engineer, on a monthly basis, a detailed summary of construction plant kept on the Site, full particulars given for each day of the month. A distinction shall be made between the plant in working order and plant out-of-order. Such inventory shall be submitted by the first day of the month following the month to be reported.

C3.5.1.5 Information in Respect of Labour

Information relating to labour and management on Site shall be recorded in the daily site diary in addition, the Contractor shall deliver to the Engineer, on a monthly basis, a detailed summary of supervisory staff, labour employed (own and local labour) by category, and sub-contractors (both local and imported) for each day of the month. Such return shall be submitted by the first day of the month following the month to be reported.

C3.5.1.6 Rainfall Records

Rainfall records for the period of construction shall be taken on Site and recorded in the daily site diary. The Contractor shall provide and install all the necessary equipment for accurately measuring the rainfall. The Contractor shall also provide, erect and maintain a security fence plus gate, padlock and keys at each measuring station, all at his own cost. The Engineer or his Representative shall take and record the daily rainfall readings. The Contractor shall be permitted to attend these readings, in the company of the Engineer's Representative. Access to the measuring gauge(s) shall at all times be under the Engineer's control.

C3.5.1.7 Site Instructions

Site instructions issued by the Engineer, addressed to the Contractor at his office on the Site, will be numbered consecutively and will be deemed to have been received by the Contractor's representative unless a break in the sequence of numbers is brought to the notice of the Engineer in writing immediately.

C3.5.1.8 Site Meetings

The Contractor and his authorised representative shall attend all meetings held on the Site with the Employer and the professional team at dates and times to be determined by the Engineer. Such meetings will be held to evaluate the progress of the Contract, and to discuss matters pertaining to the Contract which any of the parties represented may wish to raise. It is not the intention to discuss day-to-day technical matters at such meetings. The Contractor shall submit monthly progress reports as required in Clause 4.21 of the Conditions of Contract.

C3.5.1.9 Payment Certificates

Monthly progress payment certificates shall be submitted to the Engineer's Representative on Site not later than the 20th of each month (or on the last working day prior to this date) in order to allow for checking and reconciliation of all quantities, rates, extensions and additions in the certificate.

Where dayworks have been instructed by the Engineer, the Contractor shall submit the returns to the Engineer for signature and approval within twenty-four (24) hours of the end of the working day on which the work was executed. Daywork returns shall be submitted on forms following the standard format to be issued at project commencement. Failure to comply with the terms of this clause will result in non-payment for such dayworks.

The tax invoice submitted with the certificate shall be dated the date of submission to the Engineer of the payment certificate that was agreed between the Contractor and the Engineer. All costs for the preparation and submission of progress certificates shall be borne by the Contractor.

C3.5.1.10 Occupational Health and Safety Act

The Contractor shall complete the Returnable Schedule T2.2.6 in Section T2.2 bound in this document and designate in writing the name of the responsible person required under sub-clause 1 of the General Safety Regulations R11 (the Regulations) issued under the Occupational Health and Safety Act, 1993, No 95 of 1993, (the Act).

The responsible person shall carry out the duties required of him in terms of the Act and the Regulations, including conducting regular inspections of the Site and of the Contractor's Equipment in order to ensure they are safe and without risk to the health of the Employer's Personnel, the Contractor's Personnel and the public at all times. All inspection certificates shall be up-to-date before the Contractor's Equipment is used at any stage of the Contract. This especially applies to scaffolding, lifting equipment and vessels under pressure, which require legal certification. The Contractor shall also provide personal safety equipment and facilities as required by regulation 2 of the Regulations. In order to deal with accidents and ailments which are likely to occur during the Contract the Contractor shall provide a fully equipped and maintained first aid cabinet as required by regulation 3 with the minimum contents listed in the Annexure to the Regulations. The Employer

has the authority to inspect any of the Contractor's Equipment at any time during the Contract as may be desired.

C3.5.1.11 Community Liaison and Community Relations

In all dealings with communities through which the Works are to be executed, and in all dealings with workers employed from within such communities, the Contractor shall take due cognisance of the character, culture and circumstances of the specific community, and shall at all times use his best endeavours to avoid the development of disputes and rather to foster a spirit of co-operation and harmony towards the project.

The Contractor shall at all times, keep the Engineer fully informed regarding all matters affecting or negotiated between the Contractor and the community, and he shall attend all liaison meetings as may be arranged by the Engineer and/or the Employer. All matters concerning the community shall be discussed and where possible, resolved at such meetings.

Where any resolution during such negotiations or at such meetings shall be contrary to the terms and provisions of the Contract, the Contractor shall not give effect thereto without a prior written instruction from the Engineer. Where the Contractor is of the opinion that any instruction of the Engineer issued in terms of this clause will result in the incurring of additional costs which were not provided for in his tendered rates and prices and/or that a delay in the progress of the Works will result, he shall be entitled to submit a claim in terms of Clause 20 of the Conditions of Contract, provided always that the period of twenty-eight (28) days referred to in Clause 20 shall be reduced to three (3) normal working days in respect of all claims submitted in terms of this clause.

C3.5.1.12 Features Requiring Special Attention

(a) Built-up Areas

The Contractor's attention is drawn to the fact that the Works will be constructed on the existing waster treatment works. The Contractor shall exercise all necessary precautions and take all necessary steps to ensure the safety and convenience of the staff and public. In addition, the Contractor shall provide access for traffic over and through the works. Allowance must be made by the Contractor in his programming for delays resulting from the aforesaid.

(b) Reinstatement of Fences

Existing fences needs to be reinstated under this contract. If existing fences need to be removed all material shall be neatly stacked or dispose of as directed by the Engineer.

(c) Care of the Site

At all times during construction of the Works and upon completion thereof, the Site of the Works shall be kept and left in a clean and orderly condition. The Contractor shall store all materials and equipment for which he is responsible in an orderly manner, and shall keep the Site free from debris and obstructions.

(d) Control of Water

The Contractor shall at all times and in all respects be responsible for the handling of stormwater from higher-laying areas above the Works, and for the handling of any sub-surface water that may affect the Works. No separate payment shall be made in this regard, as all costs related thereto shall be deemed to be included in the rates tendered for the various items of work that are included in the Bill of Quantities.

(e) Survey and Setting Out

The Contractor shall be responsible for the protection of all survey beacons and reference points from handing over of the beacons to the Contractor to completion of the Works. Property beacons and trigonometrical survey beacons that are disturbed or destroyed during the course of the contract shall be replaced at the Contractor's cost by a registered land surveyor who shall verify such replacement.

The Contractor shall be responsible for the true and proper setting out of the Works and for the correctness of the position, levels, dimensions and alignment of all parts of the Works from the beacons established above and for the provision of all necessary instruments, appliances and labour in connection therewith. Such setting out shall be executed by a registered surveyor. No separate payment shall be made in respect of setting out, such work being deemed as included in the rates tendered for construction of the Works.

The checking of any setting-out or of any line or level by the Engineer shall not relieve the Contractor of his responsibility for the correctness thereof.

If at any time during the progress of the Works, any error shall appear or arise in the position, levels, dimensions or alignment of any part of the Works, the Contractor, on being required to do so by the Engineer, shall at his own expense rectify such error to the satisfaction of the Engineer.

C3.5.1.14 Notices, Signs, Barricades and Advertisements

Notices, signs and barricades as well as advertisements may only be erected where approved by the Engineer. The Contractor shall be responsible for their supply, erection, maintenance and ultimate removal and shall make provision for this in his tendered rates.

The Engineer shall have the right to have any sign, notice or advertisement moved to another location, or to have it removed from the Site of the Works, should it in any way prove to be unsatisfactory, inconvenient or dangerous to the general public.

C3.5.1.16 Precautions against nuisance

The Contractor shall exercise all necessary precautions and take all necessary steps to ensure the safety and convenience of the public, including the prevention of unnecessary noise, dust or other nuisance. Where applicable, the Contractor shall provide access for traffic over and through the Works, and for residents to their places of abode, all as described in the Specifications.

Any rock or debris falling from trucks on the roads in use by the public shall be removed immediately. Precautions shall be taken to prevent fouling of public roads and completed works by trucks transporting muddy material. The Engineer may order the Contractor to broom off and clean roads continuously where the mud tracking of vehicles or falling debris may constitute a danger to the travelling public.

Allowance should be made by the Contractor in his construction programme for delays that may result from foreseen and unforeseen actions that are required to ensure the safety and convenience of the public.

Contract No: WS 15 2025/26

Tender for the appointment of a Contractor for the Refurbishment of Bronkhorstspuit Water Treatment Plant and Sokholumi Boreholes

Volume1: General Clauses, Tender Procedures, Contract Data, Schedule of Quantities and Scope of Work

Portion 2: Contract

Part C3: Scope of Work

Section C3.6: Health and Safety Specifications

*CITY OF TSHWANE
WATER AND SANITATION DEPARTMENT*

CONTRACT NO: WS 15 2025/26

**APPOINTMENT OF A CONTRACTOR FOR THE REFURBISHMENT OF
BRONKHORSTSPRUIT WATER TREATMENT PLANT AND SOKHOLUMI
BOREHOLES**

C3.6 HEALTH AND SAFETY SPECIFICATIONS

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C3.6.1. INTRODUCTION

C3.6.1.1 Project Overview

The project involves the **refurbishment and upgrade of the Bronkhorstspuit Water Treatment Plant (WTP)**. Activities include civil, mechanical, electrical, chemical, and environmental works.

C3.6.1.2 Scope of Work

This SHE Specification sets out the health, safety, and environmental requirements for the construction, refurbishment, installation, testing, commissioning, and operational activities at the **Bronkhorstspuit Water Treatment Plant**. It is based on the Baseline Risk Assessment and the Scope of Works and aligns with the Occupational Health and Safety Act 85 of 1993 and Construction Regulations 2014. The SHE Specification applies to all construction, refurbishment, installation, testing, commissioning, and operational activities, including:

- Civil works (excavations, clarifiers, reservoirs, access roads)
- Mechanical works (pump installations, pipework, lifting operations)
- Electrical works (MV/LV switchgear, MCCs, SCADA, solar backup systems)
- Chemical handling (chlorine, lime, caustic substances)
- Environmental management (sludge, waste, erosion control)

Bronkspruit water treatment works

- **Civil Engineering Works:**
 - Structural upgrades to the Raw Water Pump Station
 - Construction of new High-Rate Lamella Clarifiers
 - Modification of clari-flocculators and filters

- Desludging of the 2ML clear water reservoir and lagoons
 - Sanitation upgrades (additional septic tank)
 - New off-take point for water tankers
 - Access road upgrade to the intake station
- **Mechanical Engineering Works:**
 - Replacement/refurbishment of raw water and high-lift pumps
 - Rehabilitation of the lime plant and associated dosing systems
 - Mechanical systems for the new clarifiers (rake arms, scrapers, etc.)
- **Electrical Engineering Works:**
 - Replacement of 3.3kV MV switchgear and 400V LV MCCs
 - Installation of VSDs, UPS, and battery tripping unit
 - Upgrades to lighting and power distribution systems
- **Control and Instrumentation:**
 - Installation of new PLC and SCADA systems
 - Instrumentation upgrades (flow, level, pH, turbidity, chlorine sensors)
 - Integration with historian and remote telemetry systems
- **Process Engineering:**
 - Reactivation of lime dosing and clari-flocculators
 - Filtration system rehabilitation

- Installation of new high-rate clarifier
- Optimization of DAF and SCADA for automation

The project also includes interventions at the Raw Water Intake Station, located near the dam wall, and new offtake connections for water tanker supply to Zithobeni and nearby villages

Project Duration: 24 Months

Location: Bronkhorstspuit Water Treatment Plant & Ward 105, Region 7 (City of Tshwane)

The Bronkhorstspuit WTP site is located in region 7, Ward 102, within the City of Tshwane Metropolitan Municipality. It lies adjacent to the Bronkhorstspuit Dam and services a significant portion of the City's eastern regional communities.

C3.6.2. LEGAL AND REGULATORY FRAMEWORK

All work must comply with the following legislation / standards:

- **Occupational Health and Safety Act (Act 85 of 1993)**
- **Construction Regulations (2014)**
- **Hazardous Chemical Agents Regulations**
- **Confined Space Regulations**
- **Electrical Installation Regulations**
- **General Safety Regulations**
- **SANS Standards** applicable to water treatment, electrical installations, scaffolding, PPE, and chemical handling.

C3.6.3. HEALTH & SAFETY POLICY

- Commitment to **zero harm** and safe delivery of water infrastructure.
- Promotion of a safety culture through leadership, training, and compliance.
- Continuous improvement through audits, incident reviews, and risk assessments.

C3.6.4. ROLES AND RESPONSIBILITIES OF PROJECT PARTICIPANTS

C3.6.4.1 Details of the client and professional team

This section provides full details of the client and the professional team.

Client:

Client details	
Company name	City of Tshwane
Contact person	Elelwani Radali
Contact number	+27 (012) 358 7722
Email	elelwanir@tshwane.gov.za

Civil Engineer:

Civil engineers' details:	
Company name	Ralema Consulting Engineers
Contact person	Levi Kamanga
Contact number	+27 (012) 753 0744 | +27 (082) 697 6492
Email	levi@ralemacons.co.za

Health and Safety Consultant:

Health and Safety Consultants details:	
Company name	BOSELE Consulting
Contact person	Ms. Nolwazi Mthethwa
Contact number	+27 (010) 221 1261 | +27 (064) 538 7245
Email	Nolwazi@boseleconsulting.co.za

C3.6.4.2 Roles and Responsibilities'

C3.6.4.2.1 Client

- Provide H&S Specifications and ensure compliance.
- Appoint competent Principal Contractor and Agents.
- Conduct audits and site inspections.

C3.6.4.2.2 Principal Contractor

- Implement the SHE Plan and Baseline Risk Assessment.
- Ensure subcontractor compliance.
- Maintain safety file, permits, and training records.

C3.6.4.2.3 Subcontractors

- Conduct task-specific risk assessments.
- Provide competent personnel and maintain PPE.
- Follow safe work procedures and report incidents.

C3.6.4.2.4 Health & Safety Officer

- Monitor confined spaces, chemicals, electrical works.
- Conduct inspections, audits, and incident investigations.
- Maintain risk register and update controls.

C3.6.4.3 Site Establishment & General Safety

C3.6.4.3.1 Site Establishment & Mobilization

This section provides guidelines for site establishment and mobilization, outlining essential protocols and procedures to ensure a safe, efficient, and organized work environment. All team members must familiarize themselves with these protocols to promote cooperation, compliance, and overall site safety:

1. **Site Induction & Orientation:** All workers and visitors must undergo a comprehensive site induction covering hazards, emergency procedures, PPE requirements, and site rules.
2. **Training, Toolbox Talks & Communication Channels:** Regular training sessions and toolbox talks will facilitate effective communication regarding safety protocols and site operations.
3. **PPE Requirements & Enforcement:** Personal Protective Equipment (PPE) must always be worn, with strict enforcement of requirements to ensure safety on site.
4. **Emergency Preparedness & Response Procedures:** Evacuation plans and first aid stations must be established, with trained first aiders available on site. Emergency drills will be conducted quarterly to enhance preparedness.
5. **Supervision & Reporting Structures:** Clear supervision and reporting structures will be established to ensure compliance with safety regulations and effective incident reporting.
6. **Workers' Facilities:** Adequate welfare facilities, including toilets, washing stations, sheltered eating areas, and potable water, will be provided and regularly maintained.

7. **Traffic Management at Site Access Points:** Secure fencing, controlled entry/exit points, and traffic marshals at site entrances will be implemented to prevent unauthorized access and vehicle collisions.
8. **Weather Monitoring & Extreme Weather Protocols:** Work stoppage procedures will be established during lightning, heavy rain, or extreme heat, along with the provision of shelters and appropriate PPE for weather protection.
9. **Placement of Mobile Facilities & Temporary Structures:** Mobile facilities and temporary structures will be strategically placed to ensure safety and accessibility.
10. **Temporary Electrical Installations – Safe Work Practices:** Strict safe work practices for temporary electrical installations will be enforced to mitigate risks associated with electrical hazards.

By integrating these elements, we can create a safer work environment that prioritizes the health and safety of all personnel on site.

C3.6.5. RISK MANAGEMENT

A **Baseline Risk Assessment (BRA)** must be developed and maintained. Key hazards include:

C3.6.5.1 Confined Spaces

- Reservoir desludging
- Valve chambers

Risks: asphyxiation, toxic gases (H₂S, methane), drowning.

C3.6.5.2 Biological Hazards

- Sludge, sewage, pathogens
- Lagoon cleaning

C3.6.5.3 Working at Heights

- Clarifiers, elevated tanks
- Scaffolding, ladders
- Solar installations

C3.6.5.4 Traffic Hazards

- Access road upgrades
- Tanker off-take points
- Heavy vehicle movement

C3.6.5.5 Mechanical Hazards

- Pump installation
- Lifting operations
- Rotating equipment

C3.6.5.6 Electrical Hazards

- MV/LV switchgear
- MCCs, SCADA, UPS, VSDs
- Portable electrical tools

C3.6.5.7 Chemical Hazards

- Chlorine gas/liquid
- Lime dust and caustic burns
- Chemical dosing systems

C3.6.5.8 Ergonomic Hazards

- Manual handling
- Fine wiring tasks
- Repetitive strain

C3.6.5.9 Environmental Hazards

- Flooding, erosion
- Heat/cold stress
- Dust, noise, vibration
- Inclement weather

C3.6.5.10 Waste Management

- Sludge
- Chemical containers
- Construction debris

C3.6.6. HEALTH & SAFETY PLANNING

C3.6.6.1 Permit-to-Work Systems

Required for:

- Confined space entry
- Electrical isolation
- Hot works
- Excavations deeper than 1.5m
- Working at heights

C6.3.6.2 Method Statements

Must be developed for:

- Excavation and trenching
- Borehole drilling
- Chemical dosing
- Pump installation
- Electrical switching and testing

C3.6.6.3 Emergency Preparedness

Plans must cover:

- Chlorine leaks
- Trench collapse
- Fire and electrical faults
- Flooding and severe weather

C3.6.7. TRAINING AND COMPETENCE

- Site induction covering all major hazards.
- Toolbox talks on manual handling, traffic hazards, ergonomics.
- Competency certificates for operators (TLB, crane, rock breaker).
- Electrical workers must be competent and authorized.
- Chemical handling training for chlorine and lime.

C3.6.8. COMMUNICATION AND CONSULTATION

- Monthly safety committee meetings.
- Incident reporting and investigation.
- Daily DSTI (Daily Safety Task Instruction) briefings.
- Noticeboards displaying emergency contacts, risk registers, and PPE requirements.

C3.6.9. SAFE WORK PROCEDURES

C3.6.9.1 Confined Space Entry

- Gas testing
- Ventilation
- Rescue plan
- Standby person
- SCBA where required

C3.6.9.2 Working at Heights

- Fall protection plan

- Scaffolding inspections
- Harnesses and anchor points

C3.6.9.3 Excavations & Trenching

- Soil classification
- Shoring and benching
- Barricading
- Daily inspections

C3.6.9.4 Electrical Works

- Lock-out/Tag-out
- Arc-rated PPE
- Insulated tools
- No live work unless authorized

C3.6.9.5 Chemical Handling

- Chlorine: SCBA, emergency showers, ventilation
- Lime: dust masks, goggles, gloves
- Spill kits and MSDS availability

C3.6.9.6 Manual Handling & Ergonomics

- Lifting techniques
- Task rotation
- Mechanical aids

C3.6.9.7 Traffic & Plant Movement

- Flagmen

- Speed limits (15 km/h)
- Reversing alarms
- Exclusion zones

C3.6.10. HEALTH MANAGEMENT

- Medical surveillance for noise, dust, vibration, chemicals.
- Fatigue management for EPWP workers.
- Heat/cold stress monitoring.
- Annexure 3 medicals for all workers.

C3.6.11. EMERGENCY PREPAREDNESS & RESPONSE

- Fire safety for electrical and solar systems.
- First aid for chemical burns, falls, electrocution.
- Evacuation procedures for flooding and chlorine leaks.
- Emergency drills every 3 months.

C3.6.12. INCIDENT MANAGEMENT

- Reporting of confined space incidents, electrical shocks, chemical exposures.
- Root cause analysis linked to the BRA.
- Corrective and preventive actions logged and tracked.

C3.6.13. MONITORING AND COMPLIANCE

- Inspections of scaffolding, trenches, electrical installations.
- Audits of waste management and chemical storage.
- Weekly H&S reports submitted to the Client.

C3.6.14. ENVIRONMENTAL & WASTE MANAGEMENT

- Sludge handling and pathogen control.
- Safe disposal of chemical containers.
- Dust suppression and erosion control.
- Spill response procedures.

C3.6.15. DOCUMENTATION & RECORD KEEPING

- Risk registers and residual risk ratings.
- Training records (confined space, chemical handling).
- Incident reports and investigation files.
- Audit reports and inspection checklists.
- Permits-to-work and method statements.

C3.6.16. REVIEW & CONTINUOUS IMPROVEMENT

- Lessons learned from incidents (falls, chemical leaks, electrical faults).
- Updates to SHE Specifications based on risk register findings.
- Annual review or when scope changes.

C3.6.17. ELECTRICAL HEALTH, SAFETY & ENVIRONMENTAL REQUIREMENTS

This section defines the mandatory health, safety, and environmental controls applicable to all electrical works undertaken as part of the Bronkhorstspuit Water Treatment Plant and Sokholumi Boreholes refurbishment project. These requirements apply to the Principal Contractor, all subcontractors, suppliers, and any personnel involved in electrical installation, testing, commissioning, or maintenance activities.

C3.6.17.1 Competency and Supervision

- All electrical work shall be performed by **competent persons** as defined in the Electrical Installation Regulations.
- A **Competent Electrical Supervisor** shall be appointed in writing and shall be present on site during all electrical activities.
- Only registered persons may issue Certificates of Compliance (CoC).
- Proof of qualifications, trade test certificates, and competency records shall be submitted to the Engineer prior to commencement of work.
- Personnel performing specialised tasks (e.g., cable jointing, MV switching, battery maintenance) must hold appropriate certification.

C3.6.17.2 Electrical Safe Work Planning

The Contractor shall prepare and submit detailed method statements and risk assessments for all electrical activities, including but not limited to:

- Cable installation (racks, trenches, tunnels)
- MV and LV switchgear installation
- MCC modifications and VSD installations
- Battery and charger systems
- Earthing and lightning protection

- SCADA/PLC/RTU integration
- Testing and commissioning
- Lifting and handling of electrical equipment
- Work in substations
- Work in confined spaces involving electrical hazards

All method statements must include:

- Task steps
- Identified hazards
- Control measures
- PPE requirements
- Emergency procedures
- Competency requirements

No electrical work may commence without written approval of the Engineer.

C3.6.17.3 Lock-Out/Tag-Out (LOTO)

A formal LOTO system shall be implemented for all electrical work. The system shall include:

- Isolation of all energy sources
- Locking and tagging of isolation points
- Use of personal locks and tags
- Verification of zero energy before work begins
- LOTO registers and key control

- Clear identification of authorised persons

Locks may only be removed by the person who applied them, unless a formal override procedure is followed.

C3.6.17.4 Arc Flash Protection

The Contractor shall implement arc flash controls including:

- Establishment of arc flash boundaries
- Arc-rated PPE appropriate to the calculated incident energy
- Use of insulated tools and equipment
- Prohibition of racking breakers under load
- Verification of interlocking systems (e.g., Castell key interlocks)
- Safe working distances for MV and LV equipment
- Arc flash labels on all switchgear and MCCs

Arc flash risk assessments must be included in the project risk register.

C3.6.17.5 Earthing and Bonding Requirements

All earthing and bonding shall comply with:

- SANS 10142-1
- SANS 10292
- SANS 10199
- Project specifications

Requirements include:

- Bonding of all metallic structures, conduits, cable armouring, and equipment
- Bridging of anti-vibration mounts
- Testing of earth resistance values prior to energisation
- Installation of earth electrodes and earth bars as specified
- Earthing of switchgear, MCCs, DBs, and battery systems

Earthing test results shall be included in the handover file.

C3.6.17.6 Cable Installation Safety

C3.6.17.6.1 Handling and Storage

- Cable drums shall be stored upright with end seals intact.
- Drums shall not be rolled on the ground.
- Damaged cables shall be removed from site immediately.

C3.6.17.6.2 Cable Laying on Racks

- Cables shall not be bunched.
- Minimum bending radii shall be maintained.
- Cables shall be supported at intervals not exceeding:
 - 1 000 mm (vertical)
 - 2 000 mm (horizontal)
- UV-stabilised cable ties shall be used.
- Communication and power cables shall not share the same rack.

C3.6.17.6.3 Underground Cable Installation

- Minimum trench depth: **600 mm**
- Bedding: **150 mm clean sand**
- Covering: **150 mm clean sand**
- Marker tape: "DANGER – ELECTRIC CABLE"
- Minimum spacing between multicore cables: **150 mm**
- Single-core cables shall be laid in trefoil formation.
- Cable markers shall be installed every **30 m**, at direction changes, and at sleeves.

C3.6.17.6.4 Cable Jointing

- Only manufacturer-approved joint kits shall be used.
- Jointing shall be performed by trained personnel.
- Joints shall be accessible for inspection.
- Moisture ingress shall be prevented at all times.

C3.6.17.7 Switchgear and MCC Safety

C3.6.17.7.1 Switchgear Installation

- MV and LV switchgear shall comply with all relevant SANS/IEC standards.
- Enclosures shall be weatherproof, vermin-proof, and fully gasketed where required.
- Earthing arrangements shall withstand short-circuit forces.
- Interlocking systems shall prevent unsafe switching.

C3.6.17.7.2 MCC Safety

- MCC modifications shall not compromise safety clearances.
- Remote and local control shall be clearly identified.
- VSD installations shall comply with EMC requirements.
- All outgoing feeders shall be clearly labelled.

C3.6.17.8 Battery System Safety

- Battery rooms shall be ventilated.
- Acid-resistant PPE shall be provided.
- Spill kits shall be available.
- Battery isolators shall disconnect both positive and negative conductors.
- Charging systems shall be protected against overvoltage and overheating.
- Eye wash stations shall be provided where batteries are installed.

C3.6.17.9 SCADA, PLC and RTU Safety

- Only authorised personnel may access automation equipment.
- Fibre optic cables shall be installed separately from power cables.
- RF equipment shall comply with radio licensing requirements.
- All control panels shall be labelled and locked.
- Software changes shall follow a formal change-control process.

C3.6.17.10 Testing and Commissioning Safety

Before energisation, the Contractor shall perform:

- Insulation resistance testing
- Continuity testing
- Earth resistance testing
- Functional testing
- Protection relay testing
- SCADA/PLC/RTU integration testing
- Factory Acceptance Tests (FAT) where applicable
- Issuing of Certificates of Compliance (CoC)

Testing shall only be performed by competent persons.

C3.6.17.11 Labelling and Identification

- All cables, panels, DBs, MCCs, and equipment shall be permanently labelled.
- Labels shall be engraved, durable, and legible.
- Underground cables shall have non-corrosive markers with embossed cable numbers.
- All labels shall correspond to as-built drawings.

C3.6.17.12 Electrical Emergency Response

The Contractor shall provide:

- Electrical fire extinguishers (CO₂ or dry chemical)
- First-aid kits suitable for electrical burns
- Trained first-aiders
- Emergency isolation procedures

- Arc flash incident response procedures
- Battery acid spill response procedures

All electrical incidents shall be reported immediately to the Engineer.

C3.6.17.13 Environmental Controls for Electrical Works

- Excavated material shall be managed to prevent contamination.
- Waste cables, insulation, and packaging shall be disposed of responsibly.
- Oil-filled equipment shall be handled to prevent spills.
- Batteries shall be disposed of in accordance with hazardous waste regulations.
- Noise and dust shall be controlled during installation activities.

C3.6.18. CONCLUSION

C3.6.18.1 Continuous Improvement in Health, Safety & Environment

The Bronkhorstspuit Project has reinforced the principle that continuous improvement in Health, Safety, and Environmental (HSE) performance is essential for delivering infrastructure that is safe, sustainable, and aligned with regulatory expectations. Throughout the project lifecycle, proactive leadership, structured training, dynamic risk management, and active worker participation formed the foundation of a strong safety culture. These initiatives not only protected the workforce but also enhanced productivity, operational resilience, and long-term project value.

The following elements were central to continuous improvement:

1. Leadership & Safety Culture

- Routine leadership walkabouts to reinforce expectations and identify improvement opportunities.
- Appointment of Safety Ambassadors to promote peer-to-peer accountability.
- Recognition of teams demonstrating exemplary safety performance and incident-free milestones.

2. Worker Engagement & Competency Development

- Daily toolbox talks aligned with planned activities.
- Short, focused training sessions for high-risk tasks.
- Integration of safety learning with broader skills development programmes.

3. Enhanced Risk Management

- Weekly updates to the dynamic risk register to reflect changing site conditions.
- Encouragement of near-miss reporting within a constructive, no-blame environment.
- Implementation of ergonomic and task-specific controls to reduce physical strain and repetitive-motion risks.

4. Health & Wellbeing Initiatives

- Fatigue-management strategies, including structured shift rotations.
- Heat-stress mitigation through hydration, shaded rest areas, and monitoring.
- Ongoing health awareness sessions for workers and subcontractors.

5. Learning, Review & Knowledge Sharing

- Post-task reviews following high-risk operations.
- Lessons-learned workshops to strengthen future planning and execution.

- Benchmarking against similar municipal infrastructure projects to drive continuous improvement.

6. Close-Out & Project Legacy

- Training of local stakeholders on the safe use and maintenance of new infrastructure.
- Alignment of safety improvements with environmental stewardship and long-term sustainability goals.

C3.6.18.2 Handover & Close-Out Requirements

The successful close-out of the Bronkhorstspuit Project relies on comprehensive documentation, regulatory compliance, and structured engagement with stakeholders. These measures ensure a seamless transition from construction to operational use and fulfil all contractual and statutory obligations.

1. Technical Documentation

- **As-Built Drawings:**
Updated throughout construction and submitted in hard copy and digital formats, covering roadworks, stormwater systems, kerbing, manholes, junction boxes, and erosion-control structures.
- **Operation & Maintenance Manuals:**
Guidance on the upkeep of stormwater infrastructure, erosion-protection measures, and road furniture, including warranties and supplier details.
- **Quality Assurance Records:**
Test results for surfacing, compaction, bedding, and concrete works, along with inspection reports, snag lists, and corrective actions.

2. Health, Safety & Environmental Close-Out

- **Final H&S File (Construction Regulations 2014 compliant):**
Risk assessments, method statements, incident records, medical surveillance, appointment letters, emergency procedures, and audit reports.
- **Environmental Compliance Report:**
Rehabilitation of disturbed areas, waste-management documentation, and verification of stormwater and erosion-control measures.

3. Community & Stakeholder Handover

- **CLO Report:**
Summary of community engagements, dispute resolution, attendance registers, and confirmation of CLO contract closure.
- **Stakeholder Engagement Records:**
Evidence of PSC involvement, monitoring activities, and final community briefing sessions.

4. Physical Handover

- **Joint Site Walk-Through:**
Verification of completed works against scope, clearance of outstanding snags, and confirmation of infrastructure readiness.
- **Transfer of Facilities & Utilities:**
Handover of keys, access points, depots, and reinstated temporary works areas.

5. Post-Completion Obligations

- **Defects Liability Period:**
Scheduled inspections and contractor responsibility for rectification of defects.

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Portion 2: Contract

Part C3: Scope of Work

Section C3.6: Health and Safety Specifications

- **Final Close-Out Report:**

Summary of project achievements, lessons learned, and recommendations for future municipal infrastructure projects.

ANNEXURE A: TEMPLATE OF SAFETY FILE

1. COPY OF CONSTRUCTION WORK PERMIT
2. APPOINTMENT LETTER OF PRINCIPAL CONTRACTOR
3. APPOINTMENT OF CHSM AND COMPETENCIES
4. APPOINTMENT OF CHSO AND COMPETENCY
5. HEALTH & SAFETY SPECIFICATIONS
6. BASELINE RISK ASSESSMENT
7. COIDA CERTIFICATE
8. HEALTH & SAFETY AND POLICY
9. SITE SPECIFIC HEALTH & SAFETY PLAN
10. RISK ASSESSMENT, RISK REVIEW & MONITORING PLANS
11. EMERGENCY PROCEDURES AND PREPAREDNESS PLANS
12. SITE-SPECIFIC HEALTH & SAFETY RULES
13. APPOINTMENT LETTERS AND COMPETENCIES (CONSTRUCTION MANAGERS & SUPERVISORS)
14. OCCUPATIONAL HEALTH & SAFETY ACT & REGULATIONS
15. COIDA ACT
16. ANNEXURE 3 – MEDICAL CERTIFICATE OF FITNESS
17. NCIDENT/ACCIDENT RECORD/REPORTS
18. INDUCTION TRAINING & REGISTERS
19. TOOLBOX TALKS & REGISTERS
20. INSPECTION CHECKLISTS & REGISTERS
21. HEALTH & SAFETY REP REPORTS
22. HEALTH & SAFETY AUDITS (CONTRACTORS REPORTS)
23. HEALTH & SAFETY AUDITS (CLIENT REPORTS)
24. MINUTES OF SITE MEETINGS
25. SAFE WORKING PROCEDURES
26. MATERIAL SAFETY DATA SHEET
27. LIST OF SUB-CONTRACTORS & APPOINTMENT LETTERS
28. HEALTH AND SAFETY MANDATORY AGREEMENTS
29. SITE SURVEYS AND INVESTIGATIONS
30. DRAWINGS
31. DESIGNS

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ANNEXURE B: BASELINE RISK ASSESSMENT

THE END