

**PART A
INVITATION TO BID**

YOU ARE HEREBY INVITED TO BID FOR REQUIREMENTS OF THE (SOUTH AFRICAN NATIONAL BIODIVERSITY INSTITUTE)					
BID NUMBER:	Q9243-2023	CLOSING DATE:	16 May 2023	CLOSING TIME:	11:00
DESCRIPTION	THE SOUTH AFRICAN NATIONAL BIODIVERSITY INSTITUTE (SANBI) REQUIRES A SERVICE PROVIDER TO INSTALLATION OF A NEW WATER PURIFICATION SYSTEM AT THE HANTAM NATIONAL BOTANICAL GARDEN IN NIEUWOUDTVILLE, NORTHERN CAPE. <i>It is estimated that tenderers should have a CIDB contractor grading designation of CE Level 2 or higher</i>				
NON- COMPULSORY SITE BRIEFING:					
This is a non-compulsory Submission of proposals: proposals must be emailed to S.SCM-Quotations@sanbi.org.za with a copy to Ms. Zozi at S.Zozi@sanbi.org.za Please state the Bid number as the reference number on the subject line when responding to the RFQ.					
BIDDING PROCEDURE ENQUIRIES MAY BE DIRECTED TO			TECHNICAL ENQUIRIES MAY BE DIRECTED TO:		
CONTACT PERSON	Siphokazi Zozi		CONTACT PERSON	Amjad Hendricks	
TELEPHONE NUMBER	012 843 5292		TELEPHONE NUMBER	079 523 4440	
FACSIMILE NUMBER	N/A		FACSIMILE NUMBER	N/A	
E-MAIL ADDRESS	S.Zozi@sanbi.org.za		E-MAIL ADDRESS	A.Hendericks@sanbi.org.za	
SUPPLIER INFORMATION					
NAME OF BIDDER					
POSTAL ADDRESS					
STREET ADDRESS					
TELEPHONE NUMBER	CODE		NUMBER		
CELLPHONE NUMBER					
FACSIMILE NUMBER	CODE		NUMBER		
E-MAIL ADDRESS					
VAT REGISTRATION NUMBER					
SUPPLIER COMPLIANCE STATUS	TAX COMPLIANCE SYSTEM PIN:		OR	CENTRAL SUPPLIER DATABASE No:	MAAA
B-BBEE STATUS LEVEL VERIFICATION CERTIFICATE	TICK APPLICABLE BOX] ☐ Yes ☐ No		B-BBEE STATUS LEVEL SWORN AFFIDAVIT		TICK APPLICABLE BOX] ☐ Yes ☐ No
[A B-BBEE STATUS LEVEL VERIFICATION CERTIFICATE/ SWORN AFFIDAVIT (FOR EMES & QSEs) MUST BE SUBMITTED IN ORDER TO QUALIFY FOR PREFERENCE POINTS FOR B-BBEE]					

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Call our Fraud Hotline 0800 160 999 (toll-free) anytime**

SANBI

Biodiversity for Life



South African National Biodiversity Institute

ARE YOU THE ACCREDITED REPRESENTATIVE IN SOUTH AFRICA FOR THE GOODS /SERVICES /WORKS OFFERED?	☐ Yes ☐ No [IF YES ENCLOSE PROOF]	ARE YOU A FOREIGN BASED SUPPLIER FOR THE GOODS /SERVICES /WORKS OFFERED?	☐ Yes ☐ No [IF YES, ANSWER THE QUESTIONNAIRE BELOW]
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QUESTIONNAIRE TO BIDDING FOREIGN SUPPLIERS

IS THE ENTITY A RESIDENT OF THE REPUBLIC OF SOUTH AFRICA (RSA)?	☐ YES ☐ NO
DOES THE ENTITY HAVE A BRANCH IN THE RSA?	☐ YES ☐ NO
DOES THE ENTITY HAVE A PERMANENT ESTABLISHMENT IN THE RSA?	☐ YES ☐ NO
DOES THE ENTITY HAVE ANY SOURCE OF INCOME IN THE RSA?	☐ YES ☐ NO
IS THE ENTITY LIABLE IN THE RSA FOR ANY FORM OF TAXATION?	☐ YES ☐ NO
IF THE ANSWER IS "NO" TO ALL OF THE ABOVE, THEN IT IS NOT A REQUIREMENT TO REGISTER FOR A TAX COMPLIANCE STATUS SYSTEM PIN CODE FROM THE SOUTH AFRICAN REVENUE SERVICE (SARS) AND IF NOT REGISTER AS PER 2.3 BELOW.	

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PART B TERMS AND CONDITIONS FOR BIDDING

1. BID SUBMISSION:
1.1. BIDS MUST BE DELIVERED BY THE STIPULATED TIME TO THE CORRECT ADDRESS. LATE BIDS WILL NOT BE ACCEPTED FOR CONSIDERATION.
1.2. ALL BIDS MUST BE SUBMITTED ON THE OFFICIAL FORMS PROVIDED–(NOT TO BE RE-TYPED) OR IN THE MANNER PRESCRIBED IN THE BID DOCUMENT.
1.3. THIS BID IS SUBJECT TO THE PREFERENTIAL PROCUREMENT POLICY FRAMEWORK ACT, 2000 AND THE PREFERENTIAL PROCUREMENT REGULATIONS, 2017, THE GENERAL CONDITIONS OF CONTRACT (GCC) AND, IF APPLICABLE, ANY OTHER SPECIAL CONDITIONS OF CONTRACT.
1.4. THE SUCCESSFUL BIDDER WILL BE REQUIRED TO FILL IN AND SIGN A WRITTEN CONTRACT FORM (SBD7).
2. TAX COMPLIANCE REQUIREMENTS
2.1 BIDDERS MUST ENSURE COMPLIANCE WITH THEIR TAX OBLIGATIONS.
2.2 BIDDERS ARE REQUIRED TO SUBMIT THEIR UNIQUE PERSONAL IDENTIFICATION NUMBER (PIN) ISSUED BY SARS TO ENABLE THE ORGAN OF STATE TO VERIFY THE TAXPAYER'S PROFILE AND TAX STATUS.
2.3 APPLICATION FOR TAX COMPLIANCE STATUS (TCS) PIN MAY BE MADE VIA E-FILING THROUGH THE SARS WEBSITE WWW.SARS.GOV.ZA .
2.4 BIDDERS MAY ALSO SUBMIT A PRINTED TCS CERTIFICATE TOGETHER WITH THE BID.
2.5 IN BIDS WHERE CONSORTIA / JOINT VENTURES / SUB-CONTRACTORS ARE INVOLVED, EACH PARTY MUST SUBMIT A SEPARATE TCS CERTIFICATE / PIN / CSD NUMBER.
2.6 WHERE NO TCS PIN IS AVAILABLE BUT THE BIDDER IS REGISTERED ON THE CENTRAL SUPPLIER DATABASE (CSD), A CSD NUMBER MUST BE PROVIDED.
2.7 NO BIDS WILL BE CONSIDERED FROM PERSONS IN THE SERVICE OF THE STATE, COMPANIES WITH DIRECTORS WHO ARE PERSONS IN THE SERVICE OF THE STATE, OR CLOSE CORPORATIONS WITH MEMBERS PERSONS IN THE SERVICE OF THE STATE."

NB: FAILURE TO PROVIDE / OR COMPLY WITH ANY OF THE ABOVE PARTICULARS MAY RENDER THE BID INVALID.

SIGNATURE OF BIDDER:

CAPACITY UNDER WHICH THIS BID IS SIGNED:
 (Proof of authority must be submitted e.g. company resolution)

DATE:

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

BIDDER'S DISCLOSURE

1. PURPOSE OF THE FORM

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

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

2. Bidder's declaration

2.1 Is the bidder, or any of its directors / trustees / shareholders / members / partners or any person having a controlling interest¹ in the enterprise, employed by the state? **YES/NO**

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

Full Name	Identity Number	Name of State institution

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

2.2 Do you, or any person connected with the bidder, have a relationship with any person who is employed by the procuring institution? **YES/NO**

2.2.1 If so, furnish particulars:

.....

2.3 Does the bidder or any of its directors / trustees / shareholders / members / partners or any person having a controlling interest in the enterprise have any interest in any other related enterprise whether or not they are bidding for this contract?

YES/NO

2.3.1 If so, furnish particulars:

.....

3 DECLARATION

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

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

² Joint venture or Consortium means an association of persons for the purpose of combining their expertise, property, capital, efforts, skill and knowledge in an activity for the execution of a contract.

clarification on the bid submitted where so required by the institution; and the bidder was not involved in the drafting of the specifications or terms of reference for this bid.

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

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

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

.....	
Signature	Date
.....	
Position	Name of bidder

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

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

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

1. GENERAL CONDITIONS

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

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

1.2 To be completed by the organ of state

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

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

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

1.4 To be completed by the organ of state:

The maximum points for this tender are allocated as follows:

	POINTS
PRICE	80

SPECIFIC GOALS	20
Total points for Price and SPECIFIC GOALS	100

- 1.5 Failure on the part of a tenderer to submit proof or documentation required in terms 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.
- 1.6 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 80/20 OR 90/10 PREFERENCE POINT SYSTEMS

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

80/20

or

90/10

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

Where

Ps = Points scored for price of tender under consideration

Pt = Price of tender under consideration

Pmin = Price of lowest acceptable tender

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

3.2.1. POINTS AWARDED FOR PRICE

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

$$\begin{array}{ccc} \mathbf{80/20} & \mathbf{or} & \mathbf{90/10} \\ Ps = 80 \left(1 + \frac{Pt - P_{max}}{P_{max}} \right) & \text{or} & Ps = 90 \left(1 + \frac{Pt - P_{max}}{P_{max}} \right) \end{array}$$

Where

Ps = Points scored for price of tender under consideration

Pt = Price of tender under consideration

Pmax = Price of highest acceptable tender

4. POINTS AWARDED FOR SPECIFIC GOALS

4.1. In terms of Regulation 4(2); 5(2); 6(2) and 7(2) of the Preferential Procurement Regulations, preference points must be awarded for specific goals stated in the tender. For the purposes of this tender the tenderer will be allocated points based on the 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 (80/20 system) (To be completed by the organ of state)	Number of points claimed (80/20 system) (To be completed by the tenderer)
1. Categories of persons historically disadvantaged by unfair discrimination on the basis of race. 100% black ownership (Points will be allocated based on the percentage of ownership per goal. Information will be verified on CSD. CSD must be attached as proof)	10	
2. Categories of persons historically disadvantaged by unfair discrimination on the basis of gender. 100 % female ownership (Points will be allocated based on the percentage of ownership per goal. Information will be verified on CSD. CSD must be attached as proof)	10	

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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.

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

SOUTH AFRICAN NATIONAL BIODIVERSITY INSTITUTE

INSTALLATION OF A NEW WATER PURIFICATION SYSTEM AT THE HANTAM NATIONAL BOTANICAL GARDEN IN NIEUWOUDTVILLE, NORTHERN CAPE

QUOTATION No. Q9243-2023

16 May 2023

NAME OF TENDERER:

TENDER AMOUNT:

CLOSING DATE: 16 May 2023

CLOSING TIME: 11H00

Tender Notice and Invitation to Tender

THE SOUTH AFRICAN NATIONAL BIODIVERSITY INSTITUTE INVITES TENDERERS FOR THE PROVISION OF:

The appointment of a contractor for the Installation of a New Water Purification System at the Hantam National Botanical Garden in Nieuwoudtville, Northern Cape.

Tender documents will be available as from **28 April 2023** and will be available **ONLINE ONLY** on the SANBI website www.sanbi.org (click on "Opportunities").

No briefing session or site inspection will be held.

(a) CIDB registration

Only those tenderers who are registered with the CIDB or are capable of being so prior to the evaluation of submissions, in a contractor grading designation equal to or higher than a contractor grading designation determined in accordance with the sum tendered, or a value determined in accordance with Regulation 25 (1B) or 25(7A) of the Construction Industry Development Regulations, for a **2 CE** class of construction work, are eligible to have their tenders evaluated.

Joint ventures are eligible to submit tenders provided that:

1. every member of the joint venture is registered with the CIDB;
1. the lead partner has a contractor grading designation in the **2 CE** class of construction work; and
2. the combined contractor grading designation calculated in accordance with the Construction Industry Development Regulations is equal to or higher than a contractor grading designation determined in accordance with the sum tendered for a **2 CE** class of construction work or a value determined in accordance with Regulation 25 (1B) or 25(7A) of the Construction Industry Development Regulations.

(b) National Treasury Central Supplier Database

Tenderers who are not registered on the National Treasury Central Supplier Database at close of tender, shall submit a copy of their application of registration, with their tender submission. Tenders received from such tenderers who have not submitted proof of their registration within 21 days after the closing date for tender submissions, will not be considered.

C) The second stage – Specific Goals

The second stage will evaluate the price and Specific goals of those bids that meet the minimum threshold for functionality. In accordance with the Preferential Procurement Regulations, 2022 pertaining to the Preferential Procurement Policy Framework Act (No. 5 of 2000), the 80/20-point system will be applied in evaluating proposals that qualify for further consideration, where price constitutes 80 points and a maximum of 20 points will be awarded based on the bidder's specific goals.

Specific Goal	Total Points
Categories of persons historically disadvantaged by unfair discrimination on the basis of race. CSD report must be attached for proof.	(10)
Categories of persons historically disadvantaged by unfair discrimination on the basis of gender. CSD report must be attached for proof.	(10)
Total	20

FORM OF OFFER AND ACCEPTANCE

PROJECT TITLE:	INSTALLATION OF A NEW WATER PURIFICATION SYSTEM AT THE HANTAM NATIONAL BOTANICAL GARDEN IN NIEUWOUDTVILLE, NORTHERN CAPE
CONTRACT NO:	Q9243-2023

The Employer, identified in the Acceptance signature block, has solicited offers to enter into a contract for the appointment of a contractor for the Installation of a New Water Purification System at the Hantam National Botanical Garden in Nieuwoudtville, Northern Cape.

The tenderer, identified in the Offer signature block, 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.

The tenderer, identified in the Offer signature block, has examined the draft contract as listed in the Acceptance section and agreed to provide this Offer.

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 VAT IS:

(in words)Rand;

R..... (in figures)

THE OFFERED PRICES ARE AS STATED IN THE PRICING SCHEDULE

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 including the Schedule of Deviations (if any) to the tenderer before the end of the period of validity stated in the Tender Data, or other period as agreed, whereupon the tenderer becomes the party named as the **Contractor** in the conditions of contract identified in the Contract Data.

Signature(s)

Name(s)

Capacity

**For the
tenderer:**

.....

.....
(Insert name and address of organisation)

Name &
signature of
witness

Date

.....

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 C1 Agreements and Contract Data *[which includes this Agreement]*
- Part C2 Pricing Data
- Part C3 Scope of Work
- Part C4 Site Information

and drawings and documents or parts thereof, which may be incorporated by reference into Parts C1 to C4 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 the said documents are valid unless contained in this Schedule, which must be duly signed by the authorised representative(s) of both parties.

The Tenderer shall within the time required to submit documentation in accordance with clause 5.3.2 of the Contract Data (C1.2) after receiving a completed copy of this Agreement, including the Schedule of Deviations (if any), contact the Employer's agent (whose details are given in the Contract Data) to arrange the delivery of any bonds, guarantees, proof of insurance and any other documentation to be provided in terms of the Conditions of Contract identified in the Contract Data at, or just after, the date this Agreement comes into effect. Failure to fulfil any of these obligations in accordance with those terms shall constitute a repudiation of this Agreement.

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

Signature(s)

Name(s)

Capacity

For the Employer:

.....
(Insert name and address of organisation)

Name &
signature of
witness

Date

Schedule of Deviations

1 Subject .....	.....
Details .....	.....
.....	
.....	
.....	
2 Subject .....	.....
Details .....	.....
.....	
.....	
.....	
3 Subject .....	.....
Details .....	.....
.....	
.....	
.....	
4 Subject .....	.....
Details .....	.....
.....	
.....	
.....	
5 Subject .....	.....
Details .....	.....
.....	
.....	
.....	

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

It is expressly agreed that no other matter whether in writing, oral communication or implied during the period between the issue of the 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 THE TENDERER:

Signature(s) _____

Name(s) _____

Capacity _____

[Name and address of organisation]

Name and
signature of
witness

Date _____

FOR THE EMPLOYER:

Signature(s) _____

Name(s) _____

Capacity _____

[Name and address of organisation]

Name and
signature of
witness

Date _____

CONFIRMATION OF RECEIPT

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

The..... [day]

of [month]

20.....[year]

at [place]

For the Contractor:

.....
 Signature

.....
 Name

.....
 Capacity

Signature and name of witness:

.....
 Signature

.....
 Name

C.1.2 Contract Data

PROJECT TITLE:	INSTALLATION OF A NEW WATER PURIFICATION SYSTEM AT THE HANTAM NATIONAL BOTANICAL GARDEN IN NIEUWOUDTVILLE, NORTHERN CAPE
CONTRACT NO:	Q9243-2023

C.1.2 Contract Data

The General Conditions Of Contract For Construction Works, Third Edition (2015), published by the South African Institution of Civil Engineering, Private Bag X200, Halfway House, 1685, is applicable to this contract and is obtainable from www.saice.org.za

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

Part 1: Data provided by the Employer

Clause	Data
1.1.1.13	Clause 1.1.1.13: Defects Liability Period The Defects Liability Period is 12 months , measured from the date of the Certificate of Completion
1.1.1.14	Clause 1.1.1.14: Due Completion Date The time for achieving Practical Completion is 6 months after the Commencement Date
1.1.1.15	The name of the Employer is The South African National Biodiversity Institute , represented by Mr C Willis and/or such persons or person duly authorised thereto be the Employer in writing.
1.2.1.2	The Employer's address for receipt of communications is: Delivery Address: Attention: Deputy Director: Supply Chain Management Pretoria National Botanical Garden 2 Cussonia Avenue, Biodiversity Centre Brummeria, Pretoria Postal Address: Attention: Supply Chain Management South African National Biodiversity Institute Private Bag X101 Silverton, 0184
1.1.1.16	The name of the Engineer is the Virtual Consulting Engineers (Pty) Ltd
1.2.1.2	The address of the Engineer is: Virtual Consulting Engineers PO Box 323 Groenkloof

	0027 CONTACT PERSON: Dr JA Wilsenach Tel: 012 452 0444
1.1.1.26	Clause 1.3.: Pricing Strategy The Pricing Strategy is a re-measurement contract.
3.1.3	Clause 3.1.3: Specific Approval of the Employer Required The Engineer is required to obtain the specific approval of the Employer before executing any of the following functions or duties: 1 Clause 6.3: Variations 2 Clause 5.11.1: Suspension of the Works 3 Clause 5.12: Extension of Time for Practical Completion
5.3.1	Clause 5.3.1: Commencement of the Works 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) Insurance (Refer to Clause 8.6)
5.3.2	Clause 5.3.2: Timeframe to deliver documentation The time to submit the documentation required before commencement with Works execution is Fourteen (14) days .
5.4.2	The access and possession of Site shall not be exclusive to the Contractor but as set out in the Site Information.
5.8.1	Clause 5.8.1: Non-Working Times The non-working days are Saturdays and Sundays. The special non-working days are: 1. All gazetted public holidays falling outside the year end break. 1. The year-end break commencing on 16 December 2022 and ending on 15 January 2023.
5.12.2.	Clause 5.12.2.: Some reasons for extension of time Clause 5.12.2.2: Abnormal climatic conditions. <i>Add the following:</i> Regardless of the cause of any delay an extension of time will only be considered if it can be shown that the activity delayed is on the critical path indicated on the Programme of Works (Clause 5.6.1). No extension of time will be granted in respect of any delays attributed to normal climatic conditions. Normal Climatic Conditions shall be deemed to include normal rainfall and associated wet conditions and materials, strong winds and extremes of temperature. However, in the event that delays to critical activities exceed the number of working days listed below for each month, then abnormal climatic conditions shall be deemed to exist, and an extension of time shall be granted in accordance with the provisions of that Clause.

	The number of days quoted below shall be regarded as a fair estimate of the delays to be anticipated and allowed for under normal climatic conditions where inclement weather prevents or disrupts work on the critical path. <table><tr><td>January</td><td>9 days</td><td>May</td><td>5 days</td><td>September</td><td>6 days</td></tr><tr><td>February</td><td>9 days</td><td>June</td><td>4 days</td><td>October</td><td>9 days</td></tr><tr><td>March</td><td>10 days</td><td>July</td><td>4 days</td><td>November</td><td>9 days</td></tr><tr><td>April</td><td>8 days</td><td>August</td><td>5 days</td><td>December</td><td>10 days</td></tr></table> Claims for delays for abnormal climatic conditions shall be accompanied by substantiating facts and evidence, which shall be submitted timeously as each day or half-day delay is experienced. Should an extension of time be granted by the Engineer such extension of time will be added to the Time for Completion. It shall be further noted that where the critical path is not affected, no extension of time for <u>abnormal</u> climatic conditions or for any other reason will be entertained. Rainfall of 10mm or less per day shall be deemed to be normal climatic conditions.	January	9 days	May	5 days	September	6 days	February	9 days	June	4 days	October	9 days	March	10 days	July	4 days	November	9 days	April	8 days	August	5 days	December	10 days
January	9 days	May	5 days	September	6 days																				
February	9 days	June	4 days	October	9 days																				
March	10 days	July	4 days	November	9 days																				
April	8 days	August	5 days	December	10 days																				
5.13.1	Clause 5.13.1: Penalty for Delay The penalty for failing to complete the Works is R 900.00 per day																								
5.16.3	Clause 5.16.3: Latent defect liability The latent defect period is one (1) year for the project.																								
6.2	Clause 6.2: Security The Form of Guarantee is to contain the wording of the pro-forma document as per the contract document. The liability of the guarantee shall be for 10% of the Approved Contract Sum.																								
6.8.2	Clause 6.8.2: Contract Price Adjustment Contract Price Adjustment: Is not applicable																								
6.8.3	Clause 6.8.3: Variation in Cost of Special Materials Price adjustments for variations in the costs of special materials are not allowed																								
6.10.1.5	Clause 6.10.1.5: Interim Payments - Materials on Site No percentage advance on materials on site but not yet built into the Permanent Works is allowed for, or will be paid.																								
6.10.3	Clause 6.10.3: Retention Money The percentage retention on the amounts due to the Contractor is 10% (ten percent). The limit of retention is 5% of the Contract Sum, including allowances for contingencies. This reduces to 2,5% upon the issue of the Certificate of Completion. The remaining 2,5% retention will be released upon the issue of the Final - Approval Certificate upon lapse of the defects liability period. Security plus Retention amount will not exceed 15% of the Contract Sum																								
6.10.4	Clause 6.10.4: Delivery, dissatisfaction with and payment of payment certificate <i>Replace “28 days” in the second last sentence with “30 days”</i>																								
6.10.6	Clause 6.10.6: Set-Off and Delayed Payments A guarantee in lieu of retention is not permitted																								

6.10.6.2	Clause 6.10.6.2: Set-Off and Delayed Payments <i>Replace the words “prime overdraft rate certified by the Contractor’s banker” with the words “interest rate as determined by the Minister of Finance, from time to time, in terms of section 80(1)(b) of the Public Finance Management Act, 1999 (Act No. 1 of 1999), will apply”</i>
6.10.8	Clause 6.10.8: Contractor’s completion statement <i>Replace “28 days” in the last sentence with “30 days”</i>
6.10.9	Clause 6.10.9: Final payment certificate <i>Replace “28 days” in the last sentence with “30 days”</i>
6.12	Clause 6.12: Additional <i>Add Clause 6.12 as follows:</i> In respect of any amount owed by the Contractor to the Employer, the Contractor shall pay the Employer interest at the rate as determined by the Minister of Finance, from time to time, in terms of section 80(1)(b) of the Public Finance Management Act, 1999 (Act No. 1 of 1999), will apply
8.6.1	Clause 8.6.1: Insurance <i>Add the following:</i> Damage to the Works (a) Without in any way limiting the Contractor’s obligations in terms of the Contract, the Contractor shall bear the full risk of damage to and/or destruction of the Works by whatever cause during construction of the Works and hereby indemnifies and holds harmless the Employer against any such damage. The Contractor shall take such precautions and security measures and other steps for the protection and security of the Works, as he may deem necessary. (a) The Contractor shall at all times proceed immediately to remove or dispose of any debris arising from damage to or destruction of the Works and to rebuild, restore, replace and/or repair the Works. (b) The Employer shall carry the risk of damage to or destruction of the Works and material paid for by the Employer that is the result, whether direct or indirect or proximate or remote, of the excepted risks as set out in Clause 8.6.2. (d) Where the Employer bears the risk in terms of this Contract, the Contractor shall, if requested to do so, reinstate any damage or destroyed portions of the Works and the costs of such reinstatement shall be measured and valued in terms of Clause 6.7 hereof.
8.6.1.1.2	Clause 8.6.1.1.2: Insurance The value of the materials supplied by the Employer to be included in the insurance sum is -Nil.
8.6.1.1.3	Clause 8.6.1.1.3: Insurance The amount to cover professional fees for repairing damage and loss to be included in the insurance sum is -Nil.
8.6.1.3	Clause 8.6.1.3: Insurance The limit of indemnity for liability insurance is R5 000 000.00 for any single claim – the number of claims to be unlimited during the construction.

8.6.1.5	Clause 8.6.1.5: Additional Insurance Additional Insurance is required for the following: a) Where the contract involves manufacturing and/or fabrication of the works or part thereof at premises other than the Site, the Contractor shall satisfy the Employer that all materials and equipment for incorporation in the works are adequately insured during manufacture and/or fabrication. In the event of the Employer having an insurable interest in such works during manufacture or fabrication then such interest shall be noted by endorsement to the Contractor's Policies of Insurance. a) The insurance policy held by the Contractor shall cover "wet risks" because a portion of the works will be in the confines of an existing river.
10.5, 10.6, 10.7	Clause 10.5, 10.6, 10.7: Dispute Resolution Dispute resolution shall be by Arbitration.
11	Clause 12: Confidentiality The Contractor shall treat the details of the Works comprised in this Contract as private and confidential (save in so far as may be necessary for the purposes hereof) and shall not publish or disclose the same or any particulars thereof in any trade or technical paper elsewhere without prior written consent of the Engineer.
12	Clause 13: Amendments in writing No amendments of this Contract or of any provisions or terms hereof and no waiver or relaxation or suspension of any of the provisions or terms of this Contract shall be of any force or effect unless reduced to writing and signed by both the parties hereto.

PART 2: DATA PROVIDED BY THE CONTRACTOR

Clause

1.1.1.9 The Contractor is

1.2.1.2 The Contractor's address for receipt of communications is:

Physical address:

Postal address:

.....

.....

.....

.....

.....

.....

.....

.....

Telephone:

Fax:

Email:

C1.3 Form of Guarantee

PERFORMANCE GUARANTEE

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

GUARANTOR DETAILS AND DEFINITIONS

“Guarantor” means:.....

Physical Address:.....

“Employer” means:.....

“Contractor” means:.....

“Engineer” means:.....

“Works” means:.....

“Site” means:.....

“Contract” means: The Agreement made in terms of the Form of Offer and Acceptance and such amendments or additions to the Contract as may be agreed in writing between the parties.

“Contract Sum” means: The accepted amount inclusive of tax of R.....

Amount in words:.....

“Guaranteed Sum” means: The maximum aggregate amount of R.....

Amount in words:.....

“Expiry Date” means:.....

CONTRACT DETAILS

Engineer issues: Interim Payment Certificates, Final Payment Certificate and the Certificate Completion of the Works as defined in the Contract.

PERFORMANCE GUARANTEE

1. The Guarantor’s liability shall be limited to the amount of the Guaranteed Sum.
2. The Guarantor’s period of liability shall be from and including the date of issue of this Performance Guarantee and up to and including the Expiry Date or the date of issue by the Engineer of the Certificate of Completion of the Works or the date of payment in full of the Guaranteed Sum, whichever occurs first. The Engineer and/or the Employer shall advise the Guarantor in writing of the date on which the Certificate of Completion of the Works has been issued.
3. The Guarantor hereby acknowledges that:

- 3.1 any reference in this Performance Guarantee to the Contract is made for the purpose of convenience and shall not be construed as any intention whatsoever to create an accessory obligation or any intention whatsoever to create a surety ship;
- 3.2 its obligation under this Performance Guarantee is restricted to the payment of money.
4. Subject to the Guarantor's maximum liability referred to in 1, the Guarantor hereby undertakes to pay the Employer the sum certified upon receipt of the documents identified in 4.1 to 4.3:
 - 4.1 A copy of a first written demand issued by the Employer to the Contractor stating that payment of a sum certified by the Engineer in an Interim or Final Payment Certificate has not been made in terms of the Contract and failing such payment within seven (7) calendar days, the Employer intends to call upon the Guarantor to make payment in terms of 4.2;
 - 4.2 A first written demand issued by the Employer to the Guarantor at the Guarantor's physical address with a copy to the Contractor stating that a period of seven (7) days has elapsed since the first written demand in terms of 4.1 and the sum certified has still not been paid;
 - 4.3 A copy of the aforesaid payment certificate which entitles the Employer to receive payment in terms of the Contract of the sum certified in 4.
5. Subject to the Guarantor's maximum liability referred to in 1, the Guarantor undertakes to pay to the Employer the Guaranteed Sum of the full outstanding balance upon receipt of a first written demand from the Employer to the Guarantor at the Guarantor's physical address calling up this Performance Guarantee, such demand stating that:
 - 5.1 the Contract has been terminated due to the Contractor's default and that this Performance Guarantee is called up in terms of 5; or
 - 5.2 a provisional or final sequestration of liquidation court order has been granted against the Contractor and that the Performance Guarantee is called up in terms of 5; and
 - 5.3 the aforesaid written demand is accompanied by a copy of the notice of termination and/or the provisional/final sequestration and/or the provisional liquidation court order.
6. It is recorded that the aggregate amount of payments required to be made by the Guarantor in terms of 4 and 5 shall not exceed the Guarantor's maximum liability in terms of 1.
7. Where the Guarantor has made payment in terms of 5, the Employer shall upon the date of issue of the Final Payment Certificate submit an expense account to the Guarantor showing how all monies received in terms of this Performance Guarantee have been expended and shall refund to the Guarantor any resulting surplus. All monies refunded to the Guarantor in terms of this Performance Guarantee shall bear interest at the prime overdraft rate of the Employer's bank compounded monthly and calculated from the date payment was made by the Guarantor to the Employer until the date of refund.
8. Payment by the Guarantor in terms of 4 or 5 shall be made within seven (7) calendar days upon receipt of the first written demand to the Guarantor.
9. Payment by the Guarantor in terms of 5 will only be made against the return of the original Performance Guarantee by the Employer.
10. The Employer shall have the absolute right to arrange his affairs with the Contractor in any manner which the Employer may deem fit and the Guarantor shall not have the right to claim his release from this Performance Guarantee on account of any conduct alleged to be prejudicial to the Guarantor.

11. The Guarantor chooses the physical address as stated above for the service of all notices for all purposes in connection herewith.
12. This Performance Guarantee is neither negotiable nor transferable and shall expire in terms of 2, where after no claims will be considered by the Guarantor. The original of this Guarantee shall be returned to the Guarantor after it has expired.
13. This Performance Guarantee, with the required demand notices in terms of 4 or 5, shall be regarded as a liquid document for the purposes of obtaining a court order.
14. Where this Performance Guarantee is issued in the Republic of South Africa the Guarantor hereby consents in terms of Section 45 of the Magistrate's Courts Act No 32 of 1944, as amended, to the jurisdiction of the Magistrate's Court of any district having jurisdiction in terms of Section 28 of the said Act, notwithstanding that the amount of the claim may exceed the jurisdiction of the Magistrate's Court.

Signed at

Date.....

Guarantor's signatory (1)

Capacity

Guarantor's signatory (2)

PROJECT TITLE:	INSTALLATION OF A NEW WATER PURIFICATION SYSTEM AT THE HANTAM NATIONAL BOTANICAL GARDEN IN NIEUWOUDTVILLE, NORTHERN CAPE
CONTRACT NO:	Q9243-2023

C2 Pricing Data

1. GENERAL INFORMATION

- a. Bills of Quantities
 The **bills of quantities** forms part of and must be read and priced in conjunction with all the other documents forming part of the **contract documents**, the Standard Conditions of Tender, Conditions of Contract, Specifications, Drawings and all other relevant documentation.
- b. Value Added Tax
 The **contract sum** must include for Value Added Tax (VAT). All rates, provisional sums, etc. in the **bills of quantities** must however be net (exclusive of VAT) with VAT calculated and added to the total value thereof in the Final Summary.
- c. Fixed Price Contract
 Tenderers are to take note that contract price adjustments are not applicable to this contract. Tenderers should therefore make provision in the **contract sum**, schedule of rates, etc., for possible price increases during the contract period, as no claims in this regard shall be entertained.

2. PRICING INFORMATION

1. These schedules of quantities contain sequentially numbered pages as indicated in the contents list. Tenderers are required to check that the pages in their schedules of quantities are complete. If any pages are duplicated or omitted, or if any quantity or typing is unclear or if the schedules of quantities contain any obvious errors, the tenderer shall immediately notify the engineer so that the problem may be rectified. No responsibility for any errors arising from any of the above shall be accepted by the engineer.
2. The schedules of quantities form part of and shall be read in conjunction with the specification, which contains full description of the work required to be performed and the materials and equipment to be supplied and used in the execution of the works. Tenderers shall refer to the specification for the full meaning and description of work to be executed and materials and equipment to be supplied or used in the execution of the work.
3. Tenders shall be submitted with schedules of quantities completed in full. Non or partial completion of the schedules of quantities shall render tenders liable for disqualification.
4. The total tender price as carried forward to the bid form, after correction for arithmetic extension errors, etc. shall be the contract price as awarded to the successful tenderer. Tenderers are requested to check multiplication and addition of the schedules of quantities. The rate submitted shall be regarded as the price offered per item.
5. No changes, additions or omissions to the contents of the schedules of quantities shall be permitted. If any changes, additions or omissions are made these shall not be recognised and the original wording of the schedules of quantities shall apply.
6. The priced schedules of quantities of tender shall be checked by the principal agent. The principal agent reserves the right to request adjustments to one or more individual tender prices and to rectify contradictions and thereby alter the total tender price as submitted. The acceptance of this tender does not preclude the principal agent from querying or requesting of the contractor to adjust the rates at any stage during the contract period or any extension thereto.

7. The responsibility of the accuracy of the quantities included in the schedules, remains with the person who prepared the schedules. The tenderer is relieved from the responsibility of the measurement of quantities at tender stage and the tender amounts shall be for the quantities as listed in the schedules. It is however expected from the tenderer to include for minor construction items such as would be required for the complete execution of works in accordance with the specification.
8. The quantities in these schedules of quantities shall not be used for the ordering of materials.

9. Changes in the scope of works included in the schedule of quantities shall be permitted and shall be measured and priced at the tariffs as included in the schedules of quantities and shall form an addition to or omission from the total of the schedule of quantities. Any changes not covered by any rates in the schedules of quantities shall be agreed and priced as non-schedule items in accordance with the conditions of contract.
10. The extent and value of variations shall be in accordance with the conditions of contract. Variations to the works prior to the execution thereof shall be priced as above. Variations to work already executed shall not necessarily be priced in accordance with the schedule of quantities and shall be judged individually on merit.
11. Except where the separate rate for the material and labour components of any item is specifically called for, the unit price of such item shall be deemed to include the supply and installation of that item.

The description of any items shall, except where otherwise specified, allow for the purchase, delivery, off-loading, storage, packing, lifting, placing, positioning and fixing in position, cutting and wastage, dies and patterns, models and equipment, temporary work, return of packing material, fixing costs, profit or other obligations of the contract arising out of the conditions of contract.
All items prices shall exclude VAT but include any other tax or levy as applicable.

All items are measured to the net final quantity as indicated on the drawings with the completed work in the position as indicated on the drawing. All prices and rates shall allow for wastage for whatever reason, irrespective of any other standard measurement which may be currently used elsewhere.
12. Should the contractor identify any additional issues or items which in his opinion are necessary for the complete and proper execution of the works, he shall identify such items in a covering letter attached to his tender and submit rates for these items. Mistakes in the physical measurement of items in the schedules of quantities shall be rectified but no claim shall be considered for the non-measurement of doubtful or minor items or claims resulting of criticism of method of measurement used or descriptions given. The priced schedule of quantities shall not be adjusted on the grounds of the items which in the opinion of the tenderer should have been brought into account unless so detailed in the accompanying letter.
13. The schedule of quantities shall be adjusted to reflect the quantities of materials used on completion of whole or part of the works as a result of remeasurement, qualification or variations. The remeasured quantities shall form the basis for the calculation of payment certificates. The schedules of quantities are not intended for the ordering of materials, etc. and the contractor is advised to extract the quantities for the ordering of materials directly from the drawings and specification. Any order placed directly from the schedules of quantities shall be solely at the contractor's risk.
14. The unit rates as entered in the schedule of quantities with the exclusion of dayworks items shall in all cases include any present and applicable sales tax or similar statutory duties.

UPGRADING OF THE WATER TREATMENT WORKS AT THE HANTAM NATIONAL BOTANICAL GARDEN.

SCHEDULE OF QUANTITIES

NB TENDERERS MUST COMPLETE THE SCHEDULE OF QUANTITIES IN BLACK INK

SCHEDULE NO 1 BOREHOLE TESTING AND IRRIGATION PUMP

ITEM NO	PAYMENT REFERS TO	DESCRIPTION	UNIT	QUAN- TITY	RATE	AMOUNT
100.00		<u>GENERAL</u>				
100.01		Scheduled fixed-charge and value-related items:				
		.01 Fixed preliminary and general charges	-	-	Sum	
101.00		<u>BOREHOLE TESTING</u>				
	DT.01	.01 Test Pumping of Boreholes Complete inclusive of Establishment, Plant setup, and de-establishment. Installation of test pump up	No	1		
	DT.02	.02 Supplementary work				
	DT.02.01	.03 Remove existing equipment	No	1		
	DT.02.02	.04 Recovery of lost equipment	No	1		
	DT.02.03	.05 Installation of temporary pumps	No	1		
	DT.02.04	.06 Ground water sampling and analysis for risk assessment i.t.o. SANS 241-2: 2015	No	1		
	DT.02.05	.07 Compile Borehole Report	No	1		
	DT.02.06	.08 Standing time	No	1		
	DT.02.07	.09 Reinstallation of pumping equipment including 6mm dia stainless steel cable with cable tie shackles for pump and fixing to mounting flange above ground	No	1		
102.00		<u>REPAIRS, REFURBISHMENT AND ALTERATIONS</u>				
102.01		<u>MECHANICAL</u>				
		Borehole Installation:				
		.01 De-commissioning and removal of borehole pump	No	1		
		.02 Recondition multi-stage, single flow centrifugal pump with radial flow impellers. Pump with duty point of 0.4 l/s at 150 meter total pressure head	No	1		
Stop Fraud, Theft and Corruption without Fear or Favour – Call our Fraud Hotline 0800 160 999 (toll-free) anytime						
Carried forward						

SCHEDULE NO 1 BOREHOLE TESTING AND IRRIGATION PUMP

ITEM NO	PAYMENT REFERS TO	DESCRIPTION	UNIT	QUAN-TITY	RATE	AMOUNT
Brought forward						
102.02		NEW BOREHOLE INSTALLATION Supply, lay and bed, joint build and fix into manholes and structure the following pipe specials and fittings: .01 Pipe number 1 .02 Pipe number 2 .03 Pipe number 3 .04 Pipe number 4 .05 Pipe number 5 .06 Pipe number 6 .07 Pipe number 7 .08 Pipe number 8 .09 Pipe number 9 .10 Pipe number 10 .11 Pipe number 11 .12 Pipe number 12 .13 Reinstallation of refurbished pump, testing and commissioning of borehole pump	No No No No No No No No No No No No No	2 1 1 1 1 1 1 1 1 1 1 1 1		
102.03		IRRIGATION PUMP INSTALLATION .01 De-commissioning and removal of irrigation pump .02 Supply and delivery of Grundfos CMBE Twin 3-93 or similar pump with duty point 2l/s at 40 meter total head pressure .03 Installation, commissioning and testing of irrigation pump	No No No	1 1 1		
102.04		SUPPLY AND INSTALL NEW: THIS SHALL INCLUDE REMOVAL OF OLD AS WELL AS COMMISSIONING AND TESTING OF NEW .01 Pressure switch for borehole start/stop operation. With time delay for restarting borehole .02 '0-1000 kPa Pressure gauge	No No	1 1		
Carried forward						

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SCHEDULE NO 1 BOREHOLE TESTING AND IRRIGATION PUMP

ITEM NO	PAYMENT REFERS TO	DESCRIPTION	UNIT	QUAN- TITY	RATE	AMOUNT
Brought forward						
103.00	PFN 11.07	<u>ELECTRICAL</u>				
		.01 Motor Control Centre for borehole pumps as specified in PFN 08 with controls as specified in PFN 08.01.01.02. The MCC shall be of the free standing weather and water proofed kiosk type mounted on a 100mm dia steel pole 1.5m high	No	1		
	PAB 03.21	.02 Compile complete wiring diagrams for borehole MCC boards	No	1		
.03 Submit Certificate of Compliance (CoC) for all electrical work and infrastructure for borehole MCC		No	1			
36 Stop Fraud, Theft and Corruption without Fear or Favour – Call our Fraud Hotline 0800 160 999 (toll-free) anytime						
TOTAL SCHEDULE NO 1 CARRIED TO SUMMARY: BOREHOLE TESTING AND IRRIGATION PUMP						

UPGRADING OF THE WATER TREATMENT WORKS AT THE HANTAM NATIONAL BOTANICAL GARDEN.

SCHEDULE OF QUANTITIES

NB TENDERERS MUST COMPLETE THE SCHEDULE OF QUANTITIES IN BLACK INK

SCHEDULE NO 2 REVERSE OSMOSIS TREATMENT WORKS

ITEM NO	PAYMENT REFERS TO	DESCRIPTION	UNIT	QUAN-TITY	RATE	AMOUNT
200.00		<u>WATER TREATMENT WORKS</u>				
200.01		Removal of existing (old) water purification plant				
	PDM 07.02	Remove existing pumps and reverse osmosis treatment works, and prepare the area for new reverse osmosis treatment works. Existing (old) works must be placed on site for temporary storage. Measurement and payment refer to PDM 07.02.	-	-	Sum	
200.02	PDM 07.01	Detail design of reverse osmosis water treatment plant with wiring diagram and shop drawings, complete with all equipment, pipework, electrical switchgear as specified in specification PDM with the site specific requirements in PDM 05.07. Model output to be provided to the Engineer for approval. Measurement and payment refers to PDM 07.01. Well water with SDI <3 (after filtration) Raw water Electrical Conductivity 420 mS/m Permeate (potable water) 7.5 m ³ /d Recovery > 30% TDS, Nitrate, Chloride and Sodium must be reduced to SANS 241-1: 2015 limits. Installation of a filter with AFM media for the reduction of the SDI of borehole water. Potable water to be disinfected prior to storage by making use of sodium hypochlorite CIP system must be installed for the cleaning in place of membranes.	-	-	Sum	
200.03	SB 05.01	Compile and supply a complete set of Operating and Maintenance Manuals for the reverse osmosis water treatment works. Measurement and payment refers to SB 05.01	-	-	Sum	
200.04	PDM 07.04	Supply, manufacture and install reverse osmosis water treatment plant and electrical equipment complete for connection to the existing raw water line, connection to the existing storage tanks and the existing irrigation dam. Instrumentation to include a Portable Electrical Conductivity Meter and Chlorine comparator (process control). Measurement and payment refer to PDM 07.04.			Sum	
Stop Fraud, Theft and Corruption without Fear or Favour – Call our Fraud Hotline 0800 160 999 (toll-free) anytime						
Carried forward						

REVERSE OSMOSIS TREATMENT WORKS

Stop Fraud, Theft and Corruption without Fear or Favour
Call our Fraud Hotline 0800 160 999 (toll-free) anytime

SOUTH AFRICAN NATIONAL BIODIVERSITY INSTITUTE

UPGRADING OF THE WATER TREATMENT WORKS AT THE HANTAM NATIONAL BOTANICAL GARDEN.

CALCULATION OF TENDER SUM

SCHEDULE NO 1 BOREHOLE TESTING AND IRRIGATION PUMP R

SCHEDULE NO 2 REVERSE OSMOSIS TREATMENT WORKS R

SUBTOTAL R

VALUE-ADDED TAX (VAT)
 The tenderer shall add 15% of the subtotal for value-added tax R

TOTAL R

PROJECT TITLE:	INSTALLATION OF A NEW WATER PURIFICATION SYSTEM AT THE HANTAM NATIONAL BOTANICAL GARDEN IN NIEUWOUDTVILLE, NORTHERN CAPE
CONTRACT NO:	Q9243-2023

C3 Scope of Work

SCOPE OF WORK

EMPLOYER'S OBJECTIVES

The Employer's objective is Installation of a New Water Purification System at the Hantam National Botanical Garden in Nieuwoudtville, Northern Cape.

OVERVIEW OF THE WORKS

The Installation of a New Water Purification System at the Hantam National Botanical Garden in Nieuwoudtville, Northern Cape. This water purification plant is a 35% recovery reverse osmosis system with NF90-4040 membranes and disinfection of potable water with calcium hypochlorite.

LOCATION OF THE WORKS

The works is located at the following site:

- The Hantam National Botanical Garden (NBG) is located 4km South-East of Nieuwoudtville in the Northern Cape
- Coordinates 31°23'52.73"S, 19°08'27.05"E

DESCRIPTION OF SITE AND ACCESS

The garden is easily accessible via public roads.

TEMPORARY WORKS

All design and the construction of any temporary works must be approved by the Engineer.

DESCRIPTION OF THE WORKS

1.1. GENERAL

Should any requirement or provision of the Project Specification conflict with any requirement or provision of any other specification section or clause that are applicable to the Contract or any drawing, the prevailing specification will be in the following order:

- a. Particular Specification
- b. Project specifications
- c. Drawings
- d. General Specification

1.2. SCOPE OF CONTRACT

The contract shall comprise the supply of all labour, materials, workmanship, machinery, equipment, transport, attendance on others and everything stated or implied which is, or may be, necessary in and for the entire completion of all the following works:

- Establishment
- Installation, testing and commissioning of a New Reverse Osmosis Water Purification System
- Compliance to regulations relating to Health and Safety and the Environmental Management Acts

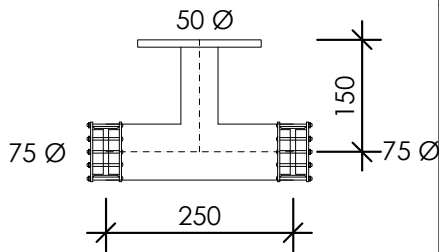
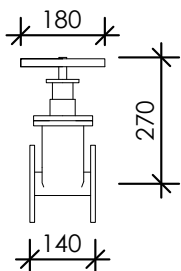
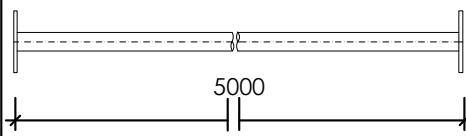
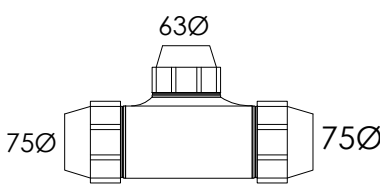
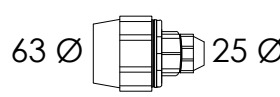
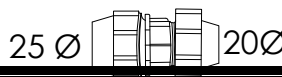
1.3. CONSTRUCTION WORKS SPECIFICATION

PORTION A

Applicable Specifications

- Drawings
- Component List
- DT: Test Pumping of Boreholes
- PDM: Water Treatment Package Plants
- PFN: Pump Installations and Motor Pump Control
- SB: Operating and Maintenance Manuals
- SC: Decommissioning, Testing and Commissioning

3. HANTAM NBG: RO WATER PIPE NETWORK

DWG NR	ITEM NR	PIPE DIA	DESCRIPTION	SANS	SCHEMATIC	QUANTITIES	
						NEW	INSTALLED
03/02	01	75 x 50 x 75	GMS unequal T-piece with 2 x Viking Johnson couplings <i>Water network pipes x1</i>	719		1	0 ON SITE -
03/02	02	50	CI flanged valve with rubbergate and hand wheel <i>Water network pipes x1</i>	6664 665		1	0 ON SITE -
03/02	03	50	GMS flanged pipe flanged both ends <i>Water network pipes x1</i>	719		1	0 ON SITE -
03/02	04	75 x 63 x 75	HDPE 90° reducing T-piece <i>Water network pipes x 3</i>	4427		0	0 ON SITE -
03/02	05	63 x 25	HDPE reducing coupling <i>Water network pipes x 4</i>	4427		0	0 ON SITE -
03/02	06	25 x 20	HDPE reducing coupling <i>Water network pipes x 5</i>	4427		0	0 ON SITE -
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project: 0543:HANTAM NATIONAL BOTANICAL GARDENS

0543-III-03-02_HANTAM RO WATER NETWORK.DWG

date 2022-10-25

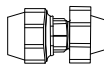
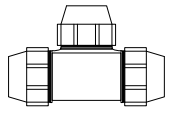
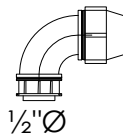
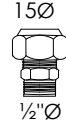
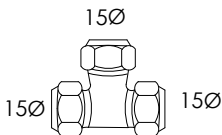
page Pg1-4

drawn LT

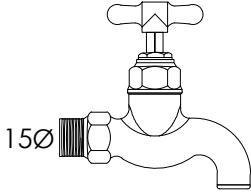
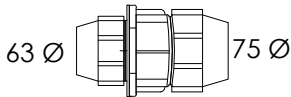
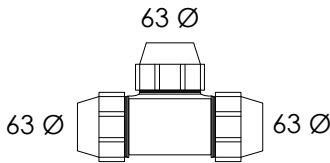
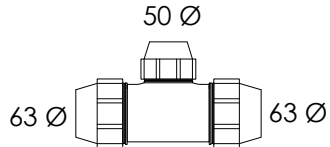
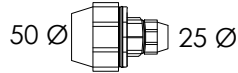
checked

approved JA WILSENACH

3. HANTAM NBG: RO WATER PIPE NETWORK

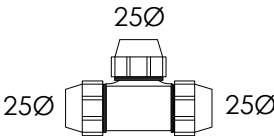
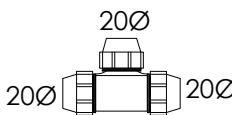
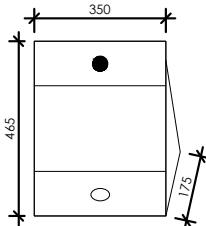
DWG NR	ITEM NR	PIPE DIA	DESCRIPTION	SANS	SCHEMATIC	QUANTITIES	
03/02	07	20 x 16	HDPE reducing coupling <i>Water network pipes x 7</i>	4427	20 Ø  16Ø	NEW	INSTALLED
						0	0
							ON SITE
							-
03/02	08	16 x 16 x 16	HDPE 90° equal T-piece <i>Water network pipes x 3</i>	4427	16 Ø  16 Ø	NEW	INSTALLED
						0	0
							ON SITE
							-
03/02	09	16 x 1/2"	HDPE 90° elbow with threaded female off-take <i>Water network pipes x 21</i>	4427	 16Ø 1/2"Ø	NEW	INSTALLED
						22	0
							ON SITE
							-
03/02	10	15 x 1/2"	Copper compression straight coupler - Copper to male <i>Water Network pipes x 21</i>	460	15Ø  1/2"Ø	NEW	INSTALLED
						22	-
							ON SITE
							-
03/02	11	15 x 15 x 15	Copper to copper equal T-piece <i>Water Network pipes x 21</i>	460	15Ø  15Ø	NEW	INSTALLED
						22	0
							ON SITE
							- -
03/02	12	15	90° Copper to Copper elbow <i>Water Network pipes x 42</i>	460	15Ø  15Ø	NEW	INSTALLED
						38	-
							ON SITE
							-
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project: 0543: HANTAM NATIONAL BOTANICAL GARDENS 0543-III-03-02_HANTAM RO WATER NETWORK.DWG						date: 2022-10-25 page: Pg2-4	drawn: LT checked: — approved: JA WILSENACH

3. HANTAM NBG: RO WATER PIPE NETWORK

DWG NR	ITEM NR	PIPE DIA	DESCRIPTION	SANS	SCHEMATIC	QUANTITIES	
						NEW	INSTALLED
03/02	13	15	Smooth brass stop tap <i>Water Network pipes x 42</i>	226		30	-
							ON SITE
							-
03/02	14	75 x 63	HDPE reducing coupling <i>Water network pipes x 1</i>	4427		2	0
							ON SITE
							-
03/02	15	63 x 63 x 63	HDPE 90° equal T-piece <i>Water network pipes x 2</i>	4427		0	0
							ON SITE
							-
03/02	16	63 x 50 x 63	HDPE 90° reducing T-piece <i>Water network pipes x 12</i>	4427		15	0
							ON SITE
							-
03/02	17	50 x 25	HDPE reducing coupling <i>Water network pipes x 11</i>	4427		15	0
							ON SITE
							-
03/02	18	25 x 16	HDPE reducing coupling <i>Water connection pipes x 13</i>	4427		15	0
							ON SITE
							-

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3. HANTAM NBG: RO WATER PIPE NETWORK

DWG NR	ITEM NR	PIPE DIA	DESCRIPTION	SANS	SCHEMATIC	QUANTITIES	
03/02	19	25 x 25 x 25	HDPE equal T-piece Water network pipes x 3	4427		NEW	INSTALLED
						0	0
							ON SITE
-							
03/02	20	20 x 20 x 20	HDPE equal T-piece Water network pipes x 2	4427		NEW	INSTALLED
						0	0
							ON SITE
-							
03/02	21	15	Stainless Steel recessed prison basin. SS-DF-BAS-COMBO	--		NEW	INSTALLED
						6	0
							ON SITE
-							
						NEW	INSTALLED
							ON SITE
-							
						NEW	INSTALLED
							ON SITE
-							
						NEW	INSTALLED
							ON SITE
-							
Stop Fraud, Theft and Corruption without Fear or Favour – Call our Fraud Hotline 0800 160 999 (toll-free) anytime							ON SITE
project: 0543: HANTAM NATIONAL BOTANICAL GARDENS 0543-III-03-02_HANTAM RO WATER NETWORK.DWG						date: 2022-10-25 page: Pg4-4	drawn: LT checked: -- designed: -- approved: JA WILSENACH

DRAWINGS

 P.O. Box 323 GARDEN OF EDEN 0027 CONSULTING ENGINEERS VIRTUAL	description SITE LAYOUT reference PROFESSIONAL CIVIL, STRUCTURAL, MECHANICAL, ELECTRICAL, ENGINEERING AND ENVIRONMENTAL SERVICES FOR THE DESIGN, PRODUCTION AND PARTIAL IMPLEMENTATION OF A GREEN ENERGY AND WATER CONSERVATION STRATEGY PLAN FOR THE ORGANIZATION	Project number BID NO. SAIBR 08050-2022 drawing title HANTAN NATIONAL BOTANICAL GARDEN: NEW RO PLANT	ref. no. designed by SAIBT scale N.T.S date 00CT22 checked by JA WILHELMICH	revision 0543-III-02-02 number 1
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THE SOUTH AFRICAN NATIONAL BIODIVERSITY INSTITUTE (SANBI)

PLANT.dwg
0543-13-02-02-A HANTAM NBG NEW RD
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name: N/A
 date: N/A
 professional registration no.: N/A

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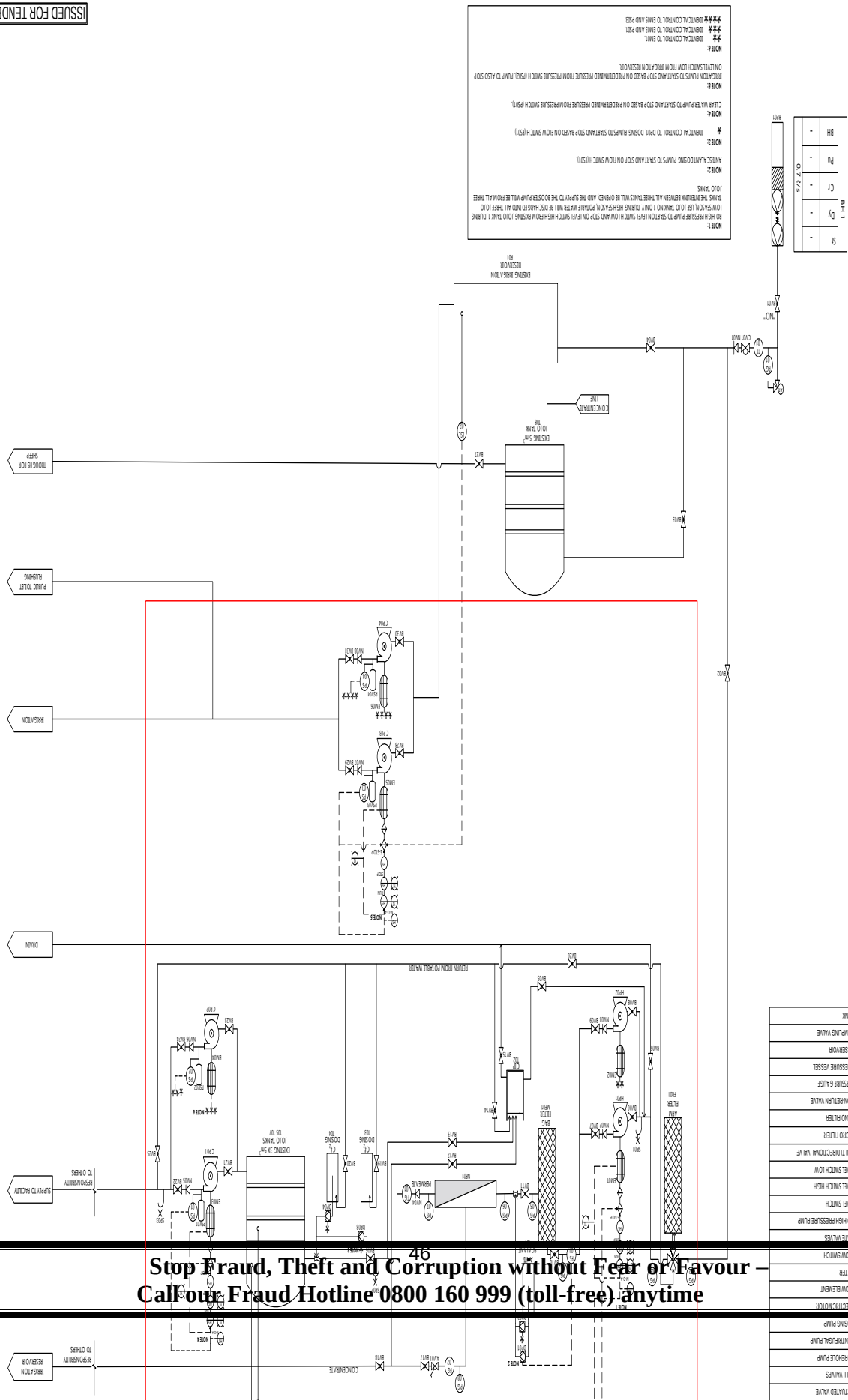
Date: _____

Approved by: _____

Date: _____

Reviewed by: _____

ISSUED FOR TENDER



1	TANK
25	SAMPLE VALUE
3	RESERVOR
35	PRESSURE
4	PRESSURE CHANGE
45	NON-RETURN VALVE
5	MANO PLETER
55	MICRO PLETER
6	MULTI DIRECTIONAL VALVE
65	TEST
7	LEVEL SWITCH LOW
75	LEVEL SWITCH HIGH
8	LEVEL SWITCH
85	NON PRESSURE PUMP
9	SALE VALVES
95	FLOW METER
10	FLOW METER
105	FLOW ELEMENT
11	FLOW ELEMENT
115	SELECTED METER
12	DOORING PUMP
125	CENTRIFUGAL PUMP
13	ROTORICAL PUMP
135	SALE VALVES
14	ACTUATED VALVE

COMPONENT LIST

1 of 27

AFM Filter				Document No	1
AFM Filter - Data				Equipment No	FR01
				Client	Hantam NGB
				Location	Water Treatment Room
				P&ID Reference	0543-III-02-02
				Section	

No	Rev	Quantity	1	
1		P&ID tag numbers	FR01	
2				
3			General Data	
4			Make	
5			Vessel	14X65
6			Approximate flow rate	3000 l/h
7			Maximum Pressure	6 Bar
8			Volume	100 l
9			Media	Activated (Glass) Filter Media
10				Crystal Sand Media
11				
12				
13				
14				
15				
16				
17				
18				
19			Additional Requirements:	
20			System is to be complete with FRP vessel, riser pipe, top and bottom strainers, media, manual backwash valve, inlet and outlet pressure guages.	
21				
22				
23				
24				
25				
26				
27				
28				
29		Additional Information		
30				
31				
32				
33				
34				
35				
36		Specification References		
37				
38				
39				
40				
41				
42				

Rev	Date	Prepared	Checked	Approved

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High-pressure Pump				Document No	2
High-pressure Pump - Data				Equipment No	HP 01 & HP02
				Client	Hantam NGB
				Location	Water Treatment Room
				P&ID Reference	0543-III-02-02
				Section	

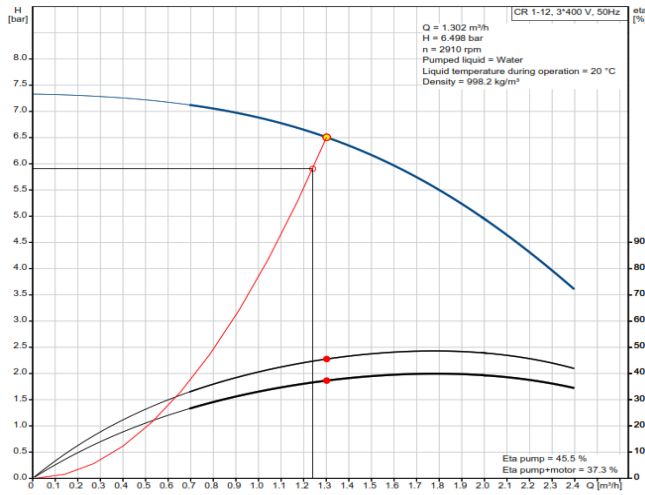
No	Rev	Quantity	1			
1		P&ID tag numbers	HP 01 & HP02			
2			General Data			
3			Make	Grundfos		
4			Model	CR 1-12 or similar approved		
5			Max Head	m	66	
6			Duty Point Pressure			
7			Duty Point Flow Rate	m ³ /h	1.3	
8			Pump Size	m x m x m		
9			Mass	kg		
10			Body	Material	Cast Iron	
11			Base	Material	Cast Iron	
12			Impeller	Material	Stainless steel	
13			Motor shaft	Material	Stainless steel	
14			Bearings	SIC		
15			Electric motor	Single phase 380V - 50 Hz with thermal overload protection incorporated into winding		
16						
17			Additional Requirements - High Pressure Filter Pump to be fitted with:			
18		Pump Inlet ND 25/32mm				
19		Pump Outlet ND 25/32mm				
20		Support plate for pump				
21		Control systems to be linked (P&ID)				
22		Complete with 0.75 kW type 100LC motor				
23						
24						
25						
26						
27						
28						
29		Additional Information				
30		Pump to be located as indicated in drawing 0317/S/01/01				
31						
32						
33						
34						
35						
36						
37						
38		Specification References				
39						
40						
41						
42						

Rev	Date	Prepared	Checked	Approved



High Pressure Filter Pump			Document No	2
Pump Duty Point			Equipment No	HP 01 & HP02
			Client	Hantam NBG
			Location	Water Treatment Room
			P&ID Reference	0543-III-02-02
			Section	0

No	Rev	
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Rev	Date	Prepared	Checked	Approved



Micro Bag Filter				Document No	3
Micro Bag Filter - Data				Equipment No	MF01
				Client	Hantam NBG
				Location	Water Treatment Room
				P&ID Reference	0543-III-02-02
				Section	

No	Rev	Quantity	1		
1		P&ID tag numbers	MF01		
2			General Data		
3					
4					
5			Max Pressure	kPa	1000
6			Duty Point Pressure	kPa	160
7			Duty Point Flow Rate	m³/h	1.4
8			Item Dimensions (approx.)	m x m	630 x 1500
9			Material	Stainless Steel	
10			Inflow condition	See Below	
11			Outflow condition	TSS < 1	
12			Max differential pressure	20 kPa	
13			Outlet SDI ₁₅	<3	
14					
15					
16					
17					
18		Additional Requirements - Micro Filter to be fitted with:			
19		5 Micron ABSOLUTE Bag filter Housing			
20		With stand for filter see drawing			
21					
22					
23					
24		Borehole Water Quality Parameter Range			
25		Chemical Determinant	As	Unit	Range
26		pH		pH units	6.0 - 8.0
27		Electrical conductivity	-	mS/m	160 - 250
28		Total Dissolved Solids	-	mg/l	800 - 1500
29		Turbidity	-	NTU	0.3 - 1.5
30		Alkalinity	-	mg/l as CaCO ₃	300 - 700
31		Chloride	Cl ⁻	mg/l	200 - 300
32		Fluoride as F	F ⁻	mg/l	1.5 - 5.0
33		Nitrate as N	NO ₃ ⁻	mg/l	10 - 25
34		Sodium	Na	mg/l	150 - 300
35		Iron	Fe	µg/l	40 - 200
36		Manganese	Mn	µg/l	40 - 200
37		Calcium	Ca ²⁺	mg/l	40 - 100
38		Magnesium	Mg ²⁺	mg/l	60 - 140
39		Potassium	K ⁺	mg/l	20 - 50
40		Barium	Ba	mg/l	50 - 150
41		Ammonia	NH	mg/l	0.1 - 1.0
42		Sulphate	SO ₄	mg/l	80 - 150

Rev	Date	Prepared	Checked	Approved



Anti-scalant Dosing Tank				Document No	4
Anti-scalant Dosing Tank - Data				Equipment No	T01
				Client	
				Location	Water Treatment Room
				P&ID Reference	0543-III-02-02
				Section	

No	Rev	Quantity	1																																																					
1		P&ID tag numbers	T01																																																					
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17				<table border="1"> <tr> <th colspan="3">General Data</th> </tr> <tr> <td>Make</td> <td colspan="2">Dosing Tank</td> </tr> <tr> <td>Model</td> <td colspan="2">100l</td> </tr> <tr> <td>Volume</td> <td>m³</td> <td>0.09</td> </tr> <tr> <td>Height</td> <td>m</td> <td>0.73</td> </tr> <tr> <td>Max Pressure</td> <td>kPa</td> <td>Atmospheric</td> </tr> <tr> <td>Colour</td> <td>Optional</td> <td>Clear</td> </tr> <tr> <td>Mass (Filled)</td> <td>kg</td> <td>100</td> </tr> <tr> <td>Material</td> <td colspan="2">Polyethylene</td> </tr> <tr><td> </td><td colspan="2"> </td></tr> <tr><td> </td><td colspan="2"> </td></tr> <tr><td> </td><td colspan="2"> </td></tr> <tr><td> </td><td colspan="2"> </td></tr> <tr><td> </td><td colspan="2"> </td></tr> <tr><td> </td><td colspan="2"> </td></tr> <tr><td> </td><td colspan="2"> </td></tr> <tr><td> </td><td colspan="2"> </td></tr> </table>		General Data			Make	Dosing Tank		Model	100l		Volume	m³	0.09	Height	m	0.73	Max Pressure	kPa	Atmospheric	Colour	Optional	Clear	Mass (Filled)	kg	100	Material	Polyethylene																									
General Data																																																								
Make	Dosing Tank																																																							
Model	100l																																																							
Volume	m³	0.09																																																						
Height	m	0.73																																																						
Max Pressure	kPa	Atmospheric																																																						
Colour	Optional	Clear																																																						
Mass (Filled)	kg	100																																																						
Material	Polyethylene																																																							
18		Additional Requirements - Dosing tank to be fitted with:																																																						
19		Dosing Tank for dosing of anti-scalant																																																						
20		Dosing pump to be mounted on top of dosing tank																																																						
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Rev	Date	Prepared	Checked	Approved



Anti-scalant Dosing Pump				Document No	5	
Anti-scalant Dosing Pump - Data				Equipment No	DP01/DP02	
				Client	Hantam NBG	
				Location	Water Treatment Room	
				P&ID Reference	0543-III-02-02	
				Section		

No	Rev	Quantity	2	
1		P&ID tag numbers	DP01/DP02	
2			General Data	
3			Make	
4			Model	6l/h Dosing Pump
5			Max Dosing Rate	l/h 6
6			Max Dosing Pressure	kPa 1000
7			Operating range	l/h 0.1-1
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18			Additional Requirements - Dosing Pump to be fitted with:	
19		Dosing pump for anti-scalant		
20		Complete with injection valve		
21		12W, 50 Hz		
22				
23				
24				
25				
26				
27				
28		Additional Information		
29				
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31				
32				
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38		Specification References		
39				
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41				
42				

Rev	Date	Prepared	Checked	Approved



Pressure Vessel				Document No	6
Pressure Vessel - Data				Equipment No	NF01
				Client	Hantam NGB
				Location	Water Treatment Room
				P&ID Reference	0543-III-02-02
				Section	

No	Rev	Quantity	1		
1		P&ID tag numbers	NF01		
2			General Data		
3			Max Pressure	kPa	2000
4			Duty Point Pressure	kPa	520
5			Duty Point Flow Rate	m³/h	1.24
6			Item Dimensions (Dia)	m	0.2
7			Max differential pressure	kPa	345
8			Filter Size	std	
9			Colour	Optional	White
10			Recovery Rate	%	64.27
11			Material	Fibre-reinforced Plastic	
12			Inflow	m³/h	1.4
13			Rejection	m³/h	0.5
14			Product rate	m³/h	0.9
15					
16					
17					
18			Additional Requirements - Nano Filter to be fitted with:		
19		Frame to hold Nano filter			
20		Water drain ND 40mm			
21		Water inlet ND 40mm			
22		Nano filter to be located as indicated on drawing			
23		To be approved prior to installation			
24		Borehole Water Quality Parameter Range			
25		Chemical Determinant	As	Unit	Range
26		pH		pH units	6.0 - 8.0
27		Electrical conductivity	-	mS/m	160 - 250
28		Total Dissolved Solids	-	mg/l	800 - 1500
29		Turbidity	-	NTU	0.3 - 1.5
30		Alkalinity	-	mg/l as CaCO ₃	300 - 700
31		Chloride	Cl ⁻	mg/l	200 - 300
32		Fluoride as F	F ⁻	mg/l	1.5 - 5.0
33		Nitrate as N	NO ₃ ⁻	mg/l	10 - 25
34		Sodium	Na	mg/l	150 - 300
35		Iron	Fe	µg/l	40 - 200
36		Manganese	Mn	µg/l	40 - 200
37		Calcium	Ca ²⁺	mg/l	40 - 100
38		Magnesium	Mg ²⁺	mg/l	60 - 140
39		Potassium	K ⁺	mg/l	20 - 50
40		Barium	Ba	mg/l	50 - 150
41		Ammonia	NH	mg/l	0.1 - 1.0
42		Sulphate	SO ₄	mg/l	80 - 150

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Pressure Vessel			Document No	6
Pressure Vessel - Data			Equipment No	NF01
			Client	Hantam NGB
			Location	Water Treatment Room
			P&ID Reference	0543-III-02-02
			Section	0

No	Rev	
1		Additional Information
2		
3		Effective removal of all divalent and higher valency ions allowing only mono-valent ions to pass through the nano filter
4		Supplier to submit proof of filter performance based on material specification, original laboratory tests and model output for pre-treated water quality parameters
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Nano Filter				Document No	7
Nano Filter - Data				Equipment No	NF01
				Client	Hantam NBG
				Location	Water Treatment Room
				P&ID Reference	0543-III-02-02
				Section	

No	Rev	Quantity	1		
1		P&ID tag numbers	NF01		
2			General Data		
3			Max Pressure	kPa 2000	
4			Duty Point Pressure	kPa 520	
5			Duty Point Flow Rate	m³/h 1.4	
6			Item Dimensions (Dia)	m 0.2	
7			Max differential pressure	kPa 345	
8			Filter Size	std	
9			Colour	Optional White	
10			Recovery Rate	% 64.27	
11			Material	Fibre-reinforced Plastic	
12			Inflow	m³/h 1.4	
13			Rejection	m³/h 0.5	
14			Product rate	m³/h 0.9	
15					
16					
17					
18			Additional Requirements - Nano Filter to be fitted with:		
19		Frame to hold RO membranes			
20		Water drain ND 40mm			
21		Water inlet ND 40mm			
22		Membrane to be located as indicated on drawing			
23		To be approved prior to installation			
24					
24		Borehole Water Quality Parameter Range			
25		Chemical Determinant	As	Unit	Range
26		pH		pH units	6.0 - 8.0
27		Electrical conductivity	-	mS/m	160 - 250
28		Total Dissolved Solids	-	mg/l	800 - 1500
29		Turbidity	-	NTU	0.3 - 1.5
30		Alkalinity	-	mg/l as CaCO ₃	300 - 700
31		Chloride	Cl ⁻	mg/l	200 - 300
32		Fluoride as F	F ⁻	mg/l	1.5 - 5.0
33		Nitrate as N	NO ₃ ⁻	mg/l	10 - 25
34		Sodium	Na	mg/l	150 - 300
35		Iron	Fe	µg/l	40 - 200
36		Manganese	Mn	µg/l	40 - 200
37		Calcium	Ca ²⁺	mg/l	40 - 100
38		Magnesium	Mg ²⁺	mg/l	60 - 140
39		Potassium	K ⁺	mg/l	20 - 50
40		Barium	Ba	mg/l	50 - 150
41		Ammonia	NH	mg/l	0.1 - 1.0
42		Sulphate	SO ₄	mg/l	80 - 150

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Nano Filter			Document No	7
Nano Filter - Data			Equipment No	NF01
			Client	Hantam NBG
			Location	Water Treatment Room
			P&ID Reference	0543-III-02-02
			Section	0

No	Rev	
1		Additional Information
2		
3		Effective removal of all divalent and higher valency ions allowing only mono-valent ions to pass through the nano filter
4		Supplier to submit proof of filter performance based on material specification, original laboratory tests and model output for pre-treated water quality parameters
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Disinfection Dosing Tank				Document No	8
Disinfection Dosing Tank - Data				Equipment No	T03
				Client	Hantam NBG
				Location	Water Treatment Room
				P&ID Reference	0543-III-02-02
				Section	

No	Rev	Quantity	1	
1		P&ID tag numbers	T03	
2			General Data	
3			Make	Dosing Tank
4			Model	100l
5			Volume	m³ 0.09
6			Height	m 0.73
7			Max Pressure	kPa Atmospheric
8			Colour	Optional Clear
9			Mass (Filled)	kg 100
10			Material	Polyethylene
11				
12				
13				
14				
15				
16				
17			Additional Requirements - Dosing tank to be fitted with:	
18		Dosing Tank for dosing of sodium hypochlorite		
19		Dosing pump to be mounted on top of dosing tank		
20				
21				
22				
23				
24				
25				
26				
27				
28		Additional Information		
29				
30				
31				
32				
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34				
35				
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37				
38		Specification References		
39				
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42				

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Disinfection Dosing Pump				Document No	9	
Disinfection Dosing Pump - Data				Equipment No	DP03 & DP04	
				Client	Hantam NBG	
				Location	Water Treatment Room	
				P&ID Reference	0543-III-02-02	
				Section		

No	Rev	Quantity	2		
1		P&ID tag numbers	DP03 & DP04		
2			General Data		
3			Make		
4			Model	6l/h Dosing Pump	
5			Max Dosing Rate	l/h	6
6			Max Dosing Pressure	kPa	1000
7			Operating range	l/h	0.1-1
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					
18			Additional Requirements - Dosing Pump to be fitted with:		
19		Dosing pump for the dosing of sodium hypochlorite			
20		Complete with injection valve			
21		12W, 50 Hz			
22					
23					
24					
25					
26					
27					
28		Additional Information			
29					
30					
31					
32					
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34					
35					
36					
37					
38		Specification References			
39					
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42					

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CIP Tank		Document No	10
CIP Tank - Data		Equipment No	T02
		Client	Hantam NBG
		Location	Water Treatment Room
		P&ID Reference	0543-III-02-02
		Section	

No	Rev	Quantity	1	
1		P&ID tag numbers	T02	
2			General Data	
3			Make	CIP Tank
4			Model	
5			Volume	m ³ 0.35
6			Height	m
7			Max Pressure	kPa Atmospheric
8			Colour	Optional Clear
9			Mass (Filled)	kg 350
10			Material	Polyethylene
11				
12				
13				
14				
15				
16				
17				
18		Additional Requirements - Dosing tank to be fitted with:		
19		Tank for mixing of CIP treatment chemicals		
20		Drain to be fitted for draining after CIP cycle.		
21				
22				
23				
24				
25				
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27				
28		Additional Information		
29				
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38		Specification References		
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Flow Switch				Document No		11	
Flow Switch - Data				Equipment No		FS01	
				Client		Hantam NBG	
				Location		Water Treatment Room	
				P&ID Reference		0543-III-02-02	
				Section			

No	Rev	Quantity	1	
1		P&ID tag numbers	FS01	
2				
3			General Data	
4			Make	
5			Model	
6			Max Pressure	25 bar
7			Connection	mm
8			Material	S/S
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19		Additional Requirements:		
20		To provide a signal of no flow so the high-pressure pump can be stopped. The same flow switch will stop the antiscalant		
21		and sodium hypochlorite pumps		
22				
23				
24				
25				
26				
27				
28				
29		Additional Information		
30				
31				
32				
33				
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35				
36		Specification References		
37				
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Pressure gauges				Document No	12
Pressure gauges - Data				Equipment No	PG01, PG02, PG03, PG04, PG05, PG06
				Client	Hantam NBG
				Location	Water Treatment Room
				P&ID Reference	0543-III-02-02
				Section	
No	Rev	Quantity	8		
1		P&ID tag numbers	PG01, PG02, PG03, PG04, PG05, PG06, PG07 & PG08		
2			General Data		
3			Make		
4			Model		
5			Pressure Class	Bar	0-10
6			Size	mm	63
7			Connection (ND)	mm	6.36
8			Material	Brass	
9					
10					
11					
12					
13					
14					
15					
16					
17			Additional Requirements - Pressure Gauge to be fitted with:		
18		To be fitted as indicated on P&ID <u>with</u> stopcock			
19					
20					
21					
22					
23					
24					
25					
26					
27					
28		Additional Information			
29					
30					
31					
32					
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35		Specification References			
36					
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Rev		Date	Prepared	Checked	Approved



Flow Meter				Document No	13	
Flow Meter - Data				Equipment No	FG01 and FG02	
				Client	Hantam NBG	
				Location	Water Treatment Room	
		P&ID Reference	0543-III-02-02		Section	

No	Rev	Quantity	2	
1		P&ID tag numbers	FG01 and FG02	
2			General Data	
3			Make	
4			Model	Panel mount flow meter
5			Pressure Class	PN 16
6			Pipe size fitting	mm 20
7			Max Inlet Pressure	kPa 250
8			Measuring Range	l/min 0-50
9			Liquid specific gravity	1
10				
11				
12				
13				
14				
15				
16				
17			Additional Requirements:	
18		Fitted on brine and permeate lines		
19				
20				
21				
22				
23				
24				
25				
26				
27				
28		Additional Information		
29				
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38		Specification References		
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Angle Seatvalve				Document No	14
Angle Seatvalve - Data				Equipment No	AV01
				Client	Hantam NBG
				Location	Water Treatment Room
				P&ID Reference	0543-III-02-02
				Section	

No	Rev	Quantity	1	
1		P&ID tag numbers	AV01	
2			General Data	
3			Make	
4			Material	PVC - U
5			Pressure Class	PN 16
6			Pipe size fitting	mm
7			Max Inlet Pressure	kPa 250
8			Temperature range	°C 0 - 60
9				
10				
11				
12				
13				
14				
15				
16				
17				
18			Additional Requirements:	
19		The angle seat valve		
20				
21				
22				
23				
24				
25				
26				
27				
28		Additional Information		
29				
30				
31				
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37				
38		Specification References		
39				
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50mm Ball Valve					Document No		15		
50mm Ball Valve - Data					Equipment No		BV		
					Client		Hantam NBG		
					Location		Water Treatment Room		
					P&ID Reference		0543-III-02-02		
					Section				
No	Rev	Quantity	8						
1		P&ID tag numbers	BV01, BV02, BV03, BV04, BV05, BV06, BV07 & BV09						
2									
3									
4									
5									
6									
7									
8			General Data						
9			Make						
10			Model						
11			Pressure Class		PN	16			
12			Size (ND)		mm	50			
13			Material		PVC				
14									
15									
16									
17									
18									
19									
20									
21									
22									
23			Additional Requirements - Ball Valve to be fitted with:						
24									
25									
26									
27									
28									
29									
30									
31									
32									
33		Additional Information							
34									
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40		Specification References							
41									
42									
Rev		Date	Prepared	Checked		Approved			

A manual ball valve with a blue T-handle and black body. The valve has two black threaded ports on either side. The handle is positioned horizontally, indicating the valve is open. The body has a ribbed texture for grip.



25mm Ball Valve					Document No		17	
25mm Ball Valve - Data					Equipment No		BV, etc.	
					Client		Hantam NBG	
					Location		Water Treatment Room	
					P&ID Reference		0543-III-02-02	
					Section			
No	Rev	Quantity	5					
1		P&ID tag numbers	BV04, BV06, BV07, BV08 & BV14					
2								
3								
4								
5								
6								
7								
8			General Data					
9			Make					
10			Model					
11			Pressure Class		PN	16		
12			Size (ND)		mm	25		
13			Material		PVC			
14								
15								
16								
17								
18								
19								
20								
21								
22								
23								
24		Additional Requirements - Ball Valve to be fitted with:						
25								
26								
27								
28								
29								
30								
31								
32								
33								
34		Additional Information						
35								
36								
37								
38								
39								
40								
41		Specification References						
42								
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Hanging Probe Level Switches				Document No	17
Hanging Probe Level Switches - Data				Equipment No	LSH and LSL
				Client	Hantam NBG
				Location	Various
				P&ID Reference	0543-III-02-02
				Section	

No	Rev	Quantity	3		
1		P&ID tag numbers	LSL01, LSL02 & LSH01		
2			General Data		
3			Make		
4			Model		
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
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17					
18			Additional Requirements:		
19		LSL to be fitted in the product water tank to start RO system.			
20		LSL to be fitted in the product water tank to start RO system.			
21		LSH to be fitted in the product tank to stop system when product tank is full.			
22					
23					
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25					
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27					
28		Additional Information			
29					
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Flow Element				Document No	18	
Flow Element - Data				Equipment No	FE	
		Client	Hantam NBG			
		Location	Water Treatment Room			
		P&ID Reference	0543-III-02-02			
		Section				
No	Rev	Quantity	1			
1		P&ID tag numbers	FE01			
2			General Data			
3			Make			
4			Model			
5			Pressure Class	PN	16	
6			Size (ND)	mm	25	
7			Material	Brass		
8			Min flowrate	l/h		
9			Indication range	10 ⁵		
10			Max pressure	bar	16	
11			Operating pressure	bar	0.3-16	
12			Pressure loss	bar	0.63	
13			Overload flowrate	m ³ /h	0.63	
14						
15						
16						
17			Additional Requirements - Flow Element to be fitted with:			
18		Meter for the measurement of raw and product water.				
19		Programmable to send pulse per 1,10,100 litres (or other).				
20		Meter standard with a pointer on the dial to activate the HRI sensor. The HRI reproduces the mechanical index exactly, by detecting the direction of rotation of the pointer				
21		The pulse will be used with the dosing pumps for the disinfection.				
22						
23						
24						
25						
26						
27						
28		Additional Information				
29		Flow profile sensitivity class U0, D0				
30						
31						
32						
33						
34						
35		Specification References				
36						
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42						
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Non-Return Valve				Document No	19
Non-Return Valve - Data				Equipment No	NV03
				Client	Hantam NBG
				Location	Water Treatment Room
				P&ID Reference	0543-III-02-02
				Section	
No	Rev	Quantity	2		
1		P&ID tag numbers	NV01, NV02		
2					
3			General Data		
4			Make		
5			Model		
6			Pressure Class	PN	16
7			Size (ND)	mm	32
8			Material	PVC	
9					
10					
11					
12					
13					
14					
15					
16					
17					
18					
19		Additional Requirements:			
20					
21					
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27					
28					
29		Additional Information			
30					
31					
32					
33					
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35					
36		Specification References			
37					
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42					
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Sampling Valves for sampling Sampling Valves for sampling - Data				Document No	20	
				Equipment No	SP	
				Client	Hantam NBG	
				Location	Water Treatment Room	
				P&ID Reference	0543-III-02-02	
				Section		

No	Rev	Quantity	3		
1		P&ID tag numbers	SP01, SP02 & SP03		
2			General Data		
3			Make		
4			Model		
5			Pressure Class	PN	16
6			Size (ND)	mm	25
7			Material	Stainless steel	
8					
9					
10					
11					
12					
13					
14					
15					
16					
17			Additional Requirements - Sampling Valve to be fitted with:		
18		To be fitted as indicated on P&ID for taking of samples. Outlet to be extended with pipe for easy sampling.			
19					
20					
21					
22					
23					
24					
25					
26					
27					
28		Additional Information			
29					
30					
31					
32					
33					
34					
35		Specification References			
36					
37					
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42					

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Ball Check Valve		Document No	21
Ball Check Valve - Data		Equipment No	NV01 & NV03
		Client	Hantam NBG
		Location	Water Treatment Room
		P&ID Reference	0543-III-02-02
		Section	

No	Rev	Quantity	4
1		P&ID tag numbers	NV03, NV04, NV05, NV06
2			

3			General Data		
4			Make		0543-III-02-02
5			Model		
6			Pressure Class		PN 16
7			Size (ND)		mm 50
8			Material		PVC
9					
10					
11					
12					
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17					
18					

19		Additional Requirements:	
20			
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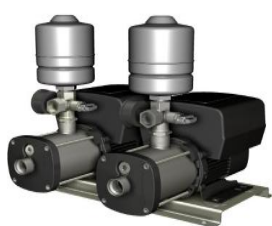
29		Additional Information	
30			
31			
32			
33			
34			
35			

36		Specification References	
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42			

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High-pressure Pump				Document No	22
High-pressure Pump - Data				Equipment No	CP01 & CP02
				Client	Hantam NBG
				Location	Water Treatment Room
				P&ID Reference	0543-III-02-02
				Section	

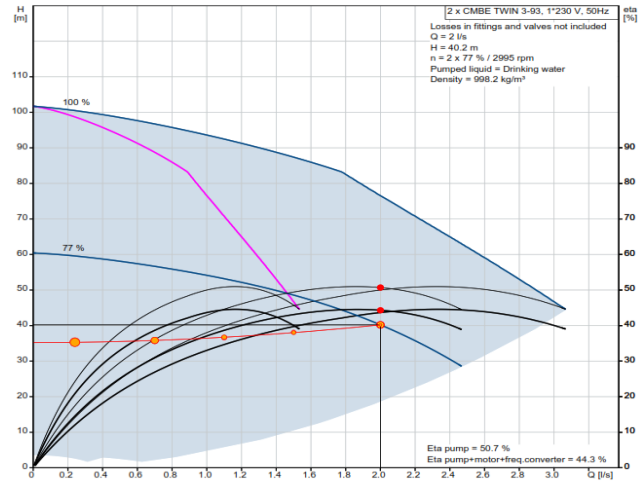
No	Rev	Quantity	2	
1		P&ID tag numbers	CP01 & CP02	
2		CMBE TWIN 3-93 I-U-C-C-D-A 	General Data	
3			Make	Grundfos
4			Model	CMBE TWIN 3-93 or similar
5			Max Head	m 40
6			Duty Point Pressure	
7			Duty Point Flow Rate	m³/h 2
8			Pump Size	m x m x m
9			Mass	kg
10			Body	Material Cast Iron
11			Base	Material Cast Iron
12		Impeller	Material Stainless steel	
13		Motor shaft	Material Stainless steel	
14		Bearings	SIC	
15		Electric motor	Single phase 240V - 50 Hz with thermal overload protection incorporated into winding	
16		Additional Requirements - High Pressure Filter Pump to be fitted with:		
17		Pump Inlet ND 25mm		
18		Pump Outlet ND 25mm		
19		Manifold to be manufactured to have pumps on a common manifold		
20		Support plate for pump		
21		Control systems to be linked (P&ID)		
22				
23				
24				
25				
26				
27				
28				
29		Additional Information		
30		Pump to be located as indicated in drawing 0543-III-02-02		
31				
32				
33				
34				
35				
36				
37				
38		Specification References		
39				
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41				
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High Pressure Filter Pump		Document No	22
Pump Duty Point		Equipment No	CP01 & CP02
		Client	Hantam NBG
		Location	Water Treatment Room
		P&ID Reference	0543-III-02-02
		Section	0

No	Rev	
1		
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DT TEST PUMPING OF BOREHOLES SYSTEMS

CONTENTS

DT 01	SCOPE
DT 02	STANDARD SPECIFICATIONS
DT 03	EXECUTION OF REPAIR WORK
DT 04	MEASUREMENT AND PAYMENT

DT 01 SCOPE

This specification covers the test pumping of a borehole inclusive of the establishment on-site, equipment removal and re-installation, data recording and sampling of an existing borehole. It also includes the determination of the borehole yield and the recommended extraction rate of each borehole.

DT 02 STANDARD SPECIFICATIONS

DT 02.01 GENERAL STANDARD SPECIFICATIONS, REGULATIONS AND CODES

The latest edition, including all amendments up to date of tender, of the following specifications, publications and codes of practice shall be read in conjunction with this specification and shall be deemed to form part thereof:

- BS 5316, Part 1 - Acceptance tests for centrifugal, mixed flow and axial pumps
- SANS 948 - Three-phase induction motors
- SANS 1222 - Enclosures for electrical equipment (classified according to the degree of protection that the enclosure provides)
- BS 4999 - General requirements for rotating electrical machines
- ISO 281/1 - Rolling bearings – dynamic load ratings and rating life.

DT 02.02 OCCUPATIONAL HEALTH AND SAFETY

The Contractor shall be required to comply with the Occupational Health and Safety Act 85 of 1993, Construction Regulations 2014 and related regulations. Non-compliance with these regulations, in any way whatsoever, will be an adequate reason for suspending the Works.

DT 02.03 MANUFACTURERS' SPECIFICATIONS, CODES OF PRACTICE AND INSTALLATION INSTRUCTIONS

All equipment and materials shall be installed, serviced and repaired strictly in accordance with the manufacturers' specifications, instructions and codes of practice.

DT 02.04 MUNICIPAL REGULATIONS, LAWS AND BY-LAWS

All municipal regulations laws, by-laws and special requirements of the Local Authority shall be adhered to unless otherwise specified.

DT 03 **EXECUTION OF REPAIR WORK**

DT 03.01 **GENERAL**

The services of a professional hydrogeologist are required for the work to be executed for the test pumping of boreholes. The work shall include the establishment on site, borehole equipment removal and re-installation, data recording and compilation and submission of a borehole report indicating the safe yield extraction and all relevant borehole management procedures.

Samples shall be taken as prescribed and submitted to an accredited laboratory for analysis. The analysis shall be in accordance with Tables 1 and 2 of SANS 241-1: 2015 to produce a water quality risk assessment.

DT 03.02 **TEST PUMP OF BOREHOLES**

(a) Test pump installation

The conduit tube shall be attached and secured to the first section of pump column behind the pump element and the test pump installed to the required depth, attaching and securing the conduit tube to the riser main every 2 to 3 meter. If the pump installation depth has not been specified by the Engineer beforehand, then the depth must be determined on the basis of the guidelines provided in table DT 03.02/01.

The Contractor will be remunerated for the installation of a test pump per linear meter of depth installed at the rate tendered as set out in the Schedule of Quantities.

TABLE DT 03.02/01 GUIDELINES FOR TEST PUMP INSTALLATION DEPTH IF NOT SPECIFIED

DEPTH OF WATER IN BOREHOLE	TEST PUMP INSTALLATION DEPTH
Less than 5m	Do not install the test pump
Between 5m and 30m	± 2m above the bottom of the borehole
Between 30m and 60m	± 3m above the bottom of the borehole
Between 60m and 90m	± 4m above the bottom of the borehole
More than 90m	± 5m above the bottom of the borehole
NOTE: 1. Depth of water in borehole is calculated as the difference between the total depth of the borehole and the depth to the ground-water rest level as measured. 2. ± Denotes a variation of not more than 0,5m either way.	

(b) Equipment set-up and pre-test actions

Where possible, the discharge pipe must be laid in a downhill direction from the borehole to be tested, provided this will take the pipe in the direction of or past another borehole located in the vicinity of the borehole to be tested. In such instances, lay the discharge pipe in a downhill direction that will take its furthest end as far as possible away from any other borehole in the vicinity.

In field situations where the terrain is extremely flat, the length of the discharge pipe shall be extended from 50m to at least 300m if any possibility exists that the discharged water may infiltrate to the groundwater resources within the radius of influence of the test. The dip meter should be inserted into the installed conduit tube and run down this tube to the bottom. Make sure that it passes freely down the full length of the tube. If the dip meter used is not graduated to an accuracy of 0,01m, the position is to be marked on the dip meter cable indicating the depth to the groundwater rest level, and the end of the graduated tape attached at this position on the cable ensuring that the zero mark of the graduated tape corresponds exactly to this mark. Slowly lower the dip meter and graduated tape down the conduit tube, in the process securing the tape to the dip meter cable every 2 to 3 meters. Ensure that there is no slack between each point where the tape is secured to the dip meter cable. Also make sure that the dip meter cable and graduated tape combination passes freely along the full length of the conduit tube.

The Contractor will be remunerated for this work per set-up at the rate tendered for one such activity as set out in the Schedule of Quantities.

(c) Final pre-test measurements

The Contractor shall ensure that all the basic information required on the field data sheet is collected and recorded as completely as possible. The basic information data entry fields can be used as a checklist for the information to be measured/collected and recorded.

Payment for this work shall be incorporated into the payment for data recording as described below.

(d) Data Recording

i. Discharge measurements

The measurement of discharge (yield or pumping rate) must be consistently accurate and reliable and shall be appropriate to meet this requirement. Where volumetric calculation methods are applied, time will be measured using a stopwatch and the container volume must be accurately known. The volumetrically measured yields recorded on the field data sheets shall be based on the average obtained from a set of three sequential measurements. Guidelines for the number and periodicity of discharge rate measurements for each type of test are given in Table DT 03.02/02

TABLE DT 03.02/02 NUMBER OF PERIODICITY OF DISCHARGE RATE MEASUREMENTS

TYPE OF TEST	DISCHARGE RATE MEASUREMENTS	
	Number	Periodicity
Calibration test	2 per step	At ± 5 and ± 10 minutes into each step
Stepped discharge test	5 per step	At ± 5 , ± 15 , ± 30 , ± 60 and ± 90 minutes into each step
Constant discharge test	See periodicity column	At ± 5 , ± 15 , ± 30 , ± 60 , ± 90 and ± 120 minutes into test and

		every 60 minutes thereafter for the full duration of pumping
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ii. Water-level measurements

Rigid guidelines for the periodicity of water-level measurements for each type of test are given in Table DT 03/02/03. This information can be found duplicated on the field data sheets which must be filled in as a record of all data collection activities carried out for a pumping test. The type of water-level measurement values required to be recorded on the field data sheets are the actual (or true) draw down values. These values represent measurements which reflect the depth of the water level below the groundwater rest level depth, i.e. which already take into account the groundwater rest level depth below the reference measuring point. It shall be noted that the more basic type of measurement which reports the depth of the dynamic water level as a distance below the reference measuring point, i.e. which combines the depth of the water level below the groundwater rest level depth and the depth of the groundwater rest level below the reference measuring point, measurements must be measured to an accuracy of at least 0,01m (10mm). The water level data shall be plotted on the semi-logarithmic graph paper provided with each set of field data sheets.

The plotting of the data shall be done as the test proceeds, i.e. each water level measurement shall be plotted on the graph as soon as possible after measuring. The field data sheets and accompanying water level graphs shall be shown to authorised supervisory personnel at request and shall be up-to-date at the time of such request.

iii. Other information

The Contractor shall also record any extraordinary observations made during the test. These may include:

- 1) Changes in the colour of the discharged water;
- 2) Changes in the turbidity of the discharged water;
- 3) The presence of air in the discharged water, and
- 4) Rainfalls events which occur during a test.

Remuneration for all data collection and recording activities by the Contractor in the course of a pumping test shall be incorporated into a hourly rate as set out in the Schedule of Quantities.

TABLE DT 03.02/3 PERIODICITY (IN MINUTES) OF WATER-LEVEL MEASUREMENTS DURING PUMPING TESTS

CALIBRATION TEST	STEPPED DISCHARGE TEST	CONSTANT DISCHARGE TEST	RECOVERY TEST
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4



5	5	5	5
7	7	7	7
9	9	9	9
12	12	12	12
15	15	15	15
	20	20	20
The above periodicity (measured in minutes)	25	25	25
after the start of each increased pumping	30	30	30
rate) must be followed for each step of the	40	40	40
calibration test	50	50	50
	60	60	60
	70	70	70
	80	80	80
	90	90	90
	100	120	120
		150	150
	The above periodicity (measured in minutes)	180	180
	after the start of each increased pumping rate)	210	210
	must be followed for each step of the stepped	240	240
	discharge test	Every 60 minutes to end of pumping	Every 60 minutes to end of recovery

(e) Test pumping of boreholes

The Contractor may be required to test existing "older" boreholes which may or may not already be equipped with pumping installations.

Test pumping serves two primary objectives. The first of these is an assessment of the productive capacity (yield potential) of the borehole. The second objective addresses the productivity of the ground-water resource. These objectives are met by various types of borehole tests performed separately and often sequentially.

These tests are identified as:

- (i) the slug test
- (ii) the calibration test
- (iii) the stepped discharge test
- (iv) the constant discharge test
- (v) the recovery test.

Factors determining which of these tests shall be performed include:

- The potential yield of the borehole, and
- the amount of water which it will be required to supply.

(i) The slug test

The slug test provides a rapid means of assessing the potential yield of especially low yielding (less than 1 litre/s) boreholes (Vivier *et al*, 1995). The results may indicate whether it is feasible and warranted to perform other tests on the borehole. As with any of the other tests, a slug test can be executed in any borehole and not necessarily only newly drilled boreholes.

The test involves measuring the water-level response in a borehole to the rapid displacement of water therein. This displacement might cause either -

- (1) a rise in water level, as would result from the introduction of a slug below the rest water level, or
- (2) a drop in water level, as would be caused by the removal of a quantity of water from the borehole.

In instances where a slug is introduced, the water level will recede to its original level. The sudden removal of a quantity of water from the borehole will cause the water level to rise to its original level. The rate of recession or rise provides an indication of the yield of the borehole. In qualitative terms the more rapid this is, the higher the potential yield of the borehole.

(ii) The calibration test

A calibration test requires that water be pumped from the borehole at three or more different rates over short (15 minutes) sequential periods. The response of the water level to each known pumping rate is measured and recorded. The calibration test provides a means of assessing the yield potential of borehole according to the magnitude of the water-level decline associated with each pumping rate. This information is used to select appropriate pumping rates at which to perform a stepped discharge test or a pumping rate at which to perform a constant discharge test.

The stepped discharge test

Also known as a step draw down test, this test is performed to assess the productivity of a borehole. It also serves to more clearly define the optimum yield at which the borehole can be subjected to constant discharge testing if required. The test involves pumping the borehole at three or more sequentially higher pumping rates, each maintained for an equal length of time, generally not less than 60 minutes and seldom longer than 120 minutes. A step length of 100 minutes is recommended.

The magnitude of the water-level draw down in the borehole in response to each of these pumping rates must be measured and recorded in accordance with a prescribed time schedule. The actual pumping rate maintained during each "step" must also be measured and recorded. As a rule, the rate of water-level recovery for a period of time immediately following the period of pumping should also be monitored according to the same time schedule as during pumping.

(iv) The constant discharge test

A constant discharge test is performed to assess the productivity of the aquifer according to its response to the abstraction of water. This response can be analysed to provide information in regard to the hydraulic properties of the ground-water system and arrive at an optimum yield for the medium to long-term utilisation of the borehole. This test entails pumping the borehole at a single pumping rate which is kept constant for an extended period of time. The test duration shall not be less than 12 hours and, in some instances, might last up to 72 hours or more. The duration is generally determined by the importance which is attached to the borehole and ground-water resource not only in terms of its yield potential but also in terms of its intended application.

The pumping rate is set at a yield which it is considered the borehole and ground-water system will be able to maintain for the entire planned duration of the test and, in the process, utilising better than 70 per cent but not exhausting the available draw down. It is critical that the pumping rate during the entire duration of the test be kept as constant as possible. The draw down in water level in the borehole during the course of the test is again measured and recorded according to a prescribed time schedule. In the case of this type of test, it is imperative that water-level measurements be made during the recovery period following the end of pumping.

(v) The recovery test

This test provides an indication of the ability of a borehole and ground-water system to recover from the stress of abstraction. This ability can again be analysed to provide information with regard to the hydraulic properties of the ground-water system and arrive at an optimum yield for the medium to long-term utilisation of the borehole. Although referred to as a test, it rather represents a period of monitoring activity following a period of pumping. The rate at which the water level in the tested borehole (or any other borehole affected by the abstraction) recovers towards its starting level (the ground-water rest level before pumping started) is monitored in this period. The duration of this monitoring is generally equal to that of the preceding period of pumping unless the rate of recovery is sufficiently rapid so that the starting water level is reached in a shorter period of time.

(f) General approach and methodology

The Engineer will formulate a test pumping schedule for each borehole. The flow diagram presented overleaf provides an indication of the considerations which determine the scope of test pumping based on a logical decision-making process.

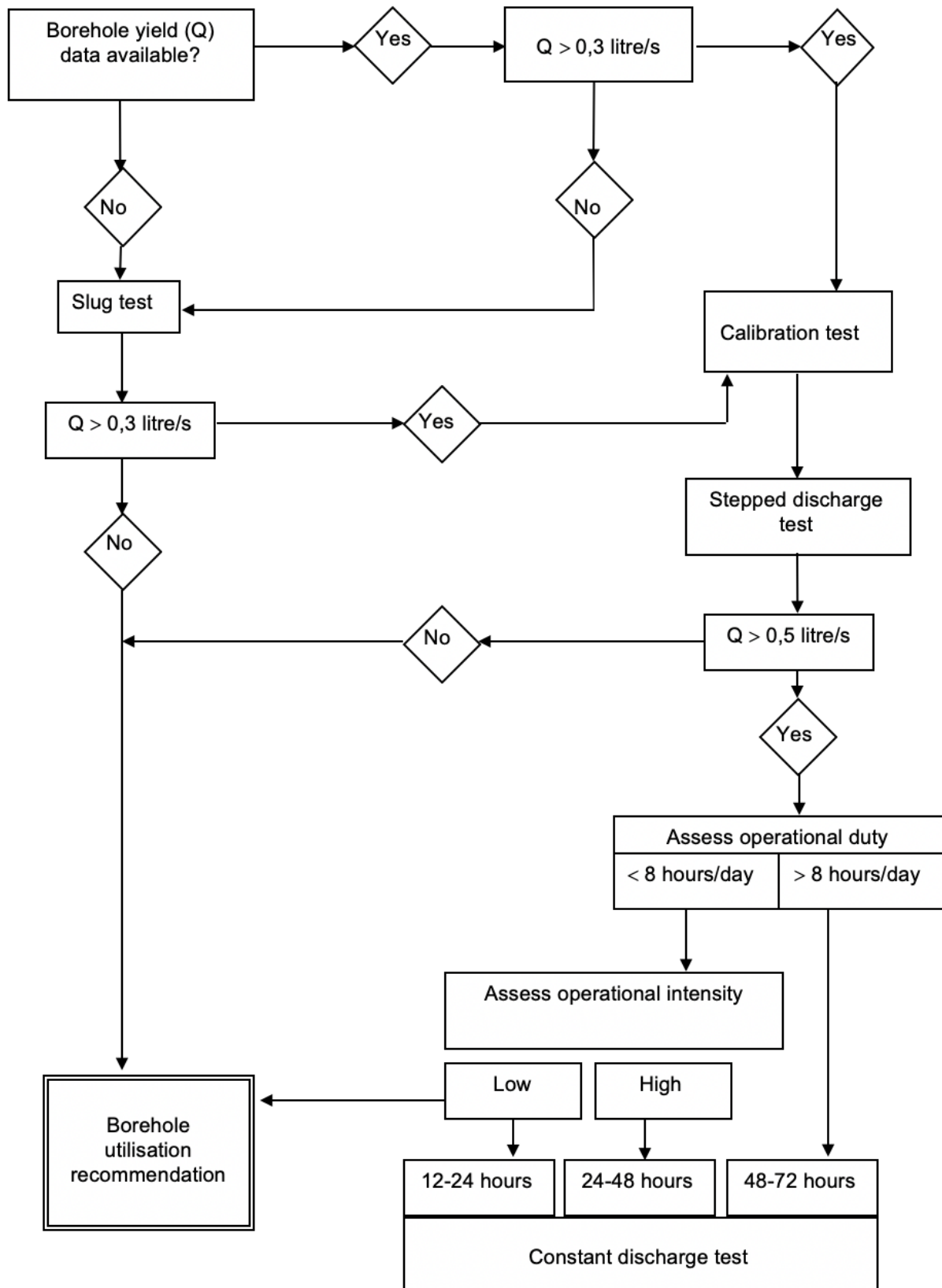
All project-related test pumping activities will also be carried out under the direct supervision of the Engineer. The execution of a pumping test in accordance with established scientific protocols must be undertaken by a suitably experienced and equipped testing contractor. The South African Bureau of Standards (SANS) is finalising a Standard Code of Practice titled *The test-pumping of water boreholes*.

A draft of this Standard has been considered in the compilation of this document. It will be the task of the Engineer to evaluate and analyse the data, draw conclusions with regard to the productivity of the borehole and the aquifer, and make recommendations with regard to a suitable operating schedule for the borehole and the optimum exploitation of the ground-water resource.

Both the practical and analytical aspects of test pumping benefit greatly from prior information regarding the borehole and the aquifer which it taps into. This information is gleaned during the drilling and the construction of the borehole. It includes knowledge of:

- (1) The amount of water blown out of the borehole during drilling operations;
- (2) the depth(s) at which water was struck in the borehole;
- (3) the construction of the borehole in terms of the setting of especially perforated (slotted) casing, and
- (4) the nature of the rock formation at the depth(s) where water was struck.

This information will be communicated to the testing contractor by the Engineer prior to the testing of any borehole.



The Contractor shall keep a full record of the test pumping which is undertaken and submit the record on completion of the test. This record must include the following basic information:

- (1) The depth to water level before the start of testing;
- (2) the depth at which the test pump was installed;
- (3) the type, make and model of the test pump used;
- (4) the pumping rate as measured at regular intervals during the test, and
- (5) the water level in the borehole as measured according to a prescribed time schedule both during and after pumping.

The Contractor must be sufficiently well-equipped to gather this information with acceptable accuracy.

The rationale behind the flow diagram is explained as follows. A slug test should be performed on a borehole in instances where there is no prior indication of its possible yield. The result of the slug test will indicate whether additional test pumping is warranted. A slug test shall also be performed in instances where the possible yield of a borehole from prior information is indicated to be less than 0,3 litre/s. The result of the slug test will again indicate whether additional test pumping is warranted. In instances where the possible yield of a borehole from prior information is indicated to be equal to or greater than 0,3 litre/s, then a calibration test followed by a stepped discharge test shall be performed.

The result of the stepped discharge test will indicate whether further test pumping in the form of a constant discharge test is warranted or whether the borehole is judged to be sufficiently weak (potential production yield less than 0,5 litre/s) to make a utilisation recommendation without further testing. Should the result of the stepped discharge test indicate that a constant discharge is warranted, then the Engineer will need to make an assessment of the possible operational duty to which the borehole might be subjected.

The operational duty describes the number of hours per day for which the borehole must operate in order to meet the local water demand. By implication, the potential production yield of the borehole must be compared to the water demand. In qualitative terms, a lower yielding borehole would need to operate for a longer period per day to meet a given demand than a higher yielding borehole would need to. Further, the water demand is often too great for even a high yielding borehole pumping continuously to meet. The flow diagram indicates, however, that any borehole which reveals the potential to yield more than 0,5 litre/s and which will operate for a period in excess of 8 hours per day must be subjected to a constant discharge test of 48 to 72 hours duration. A borehole which does not fit this category requires an assessment of its possible operational intensity.

The operational intensity describes the yield at which a higher yielding borehole must operate in order to meet a water demand in a pumping period of eight hours or less per day. By implication, a high operational intensity requires the borehole to be pumped at a yield approaching its maximum, whereas a low operational intensity will place less stress on the borehole. These considerations will indicate whether a 24 to 48 hour or a 12 to 24 hour duration constant discharge test respectively will be performed.

The final step in the flow diagram requires the Engineer to make a borehole utilisation recommendation.

DT 03.03

EQUIPMENT AND MATERIALS

This represents the test unit and all ancillary equipment and materials required to accurately and efficiently perform borehole testing. Details are provided below.

(a) Test unit

The test unit shall comprise a positive displacement (PD) type pump element and a pump head driven by a motor fitted with an accelerator, gearbox and clutch. The unit must be in good working order and capable of maintaining a minimum of 72 hours of continuous operation.

The unit must be capable of delivering water at a rate in excess of the expected maximum yield of the borehole to be tested. It may be acceptable under certain circumstances to employ a submersible pump for testing purposes. This must, however, be identified in the tender enquiry document. It is imperative that any submersible pump used for testing purposes be equipped with a non-return valve fitted at the bottom of the pump column (rising main).

(b) Discharge piping

Discharge piping comprises both the pipe (rising main or pump column) which brings the water to surface and the pipe (discharge hose) used to lead the pumped water away from the borehole being tested. The Contractor shall supply sufficient rising main to set the test pump at a depth of at least 100 m below the surface. It may, however, be required under certain circumstances to set the test pump at a greater depth in the borehole. Where necessary it shall be discussed with the Engineer prior to the installation of the test pump. The pump column must be of uniform diameter throughout. The Contractor shall also provide at least 50 m discharge piping. This must be free of leaks for its entire length. It may again, under certain circumstances, be required to discharge the pumped water at a point further away than 50 m (possibly in excess of 300 m) from the borehole being tested. In such instances, a similar procedure to that discussed above in regard to the rising main must be followed.

(c) Discharge measuring equipment/Instrumentation

This equipment/instrumentation must be adequate to accurately measure the pumping rate within the range of yields expected from successful project boreholes. If volumetric methods are used, a stopwatch for measuring time to an accuracy of at least one-tenth of a second is required. The full capacity of each container shall be determined accurately. The Contractor shall also ensure that a container stands level when used for discharge measurements. Guidelines regarding the use of different size containers for volumetric discharge rate measurements in specific yield ranges are given in Table **DT 03.03/1**. Other acceptable instruments that may be used for discharge measuring are: (1) an orifice weir and (2) a flow meter. The use of these instruments is subject to various application criteria.

(i) Orifice weirs

These must be installed in a horizontal position at the end of the discharge pipe. The orifice plate opening must be sharp, clean, bevelled to 45 degrees and have a diameter less than 80 per cent of the diameter of the approach tube to which it is fixed. The orifice plate must be vertical and centred on the end of the approach tube. There must be no leakage around the perimeter of the orifice plate mounting. The piezometer tube must not contain entrained air bubbles at the time of pressure head measurement. The latter measurement must be at least three times the diameter of the orifice.

TABLE DT 03.03/1 YIELD RANGE VERSUS CONTAINER SIZE FOR VOLUMETRIC MEASUREMENTS

YIELD RANGE	CONTAINER SIZE
Less than 2 litre/s	20 litre
2 litre/s to 5 litre/s	50 litre
5 litre/s to 20 litre/s	210 litre
20 litre/s to 30 litre/s	500 litre
30 litre/s to 50 litre/s	1000 litre
More than 50 litre/s	Other suitable methods

The orifice weir equipment must be calibrated for various combinations of approach tube and orifice diameters so that pressure head readings can be converted to accurate discharge measurements.

(ii) Flow meters

Flow meters must be calibrated and of a similar diameter to that of the discharge pipe. The latter must be straight and of uniform diameter for a distance of four times the diameter of the pipe before the position of the meter. There must be no turbulent flow or entrained air in the discharge pipe before the meter. The discharged water must be free of solid material carried in suspension.

It is recognised that some water leakage will generally occur, especially at the bore head during pumping. This is acceptable provided that: (1) such leakage does not interfere with any water-level monitoring and (2) the total amount of leakage to the end of the discharge pipeline does not exceed one per cent of the pumping rate as measured at the end of this pipeline.

(d) Water-level measuring equipment/instrumentation

The Contractor shall provide at least three water-level measuring devices which are each capable of providing an accuracy of at least 0,01 m (10 mm) and are of sufficient length to match the pump installation depth. If ungraduated electrical contact meters (dip meters) are used for this purpose, each such instrument must be equipped with a measuring tape of an acceptable length and approved standard and which is graduated to an accuracy of at least 0,01 m (10 mm). These instruments must be in good working order and number at least one spare for each two on site.

The Contractor shall further provide conduit tubing of sufficient length to match the pump installation depth. The diameter of this tube must be large enough (minimum 15 mm) to allow free movement of the dip meter probe and cable therein. The tubing must be made of material strong enough to withstand reasonable pressure on its sidewall which might cause a constriction. The tube must be open at its lower end to allow the free entrance of water into the tube. This is facilitated by perforating the bottom section of the conduit tube sidewall. Precautions shall also be taken to prevent the dip meter probe from passing beyond the bottom end of the conduit tube and, as a result of entanglement, not able to be withdrawn.

(e) Other materials

No pumping test should commence without field data sheets on which to record all data and information relevant to the test pumping activities in an acceptable format. These can either be provided by the Contractor or the Engineer.

DT 03.04

GROUND-WATER SAMPLING

(a) Sampling for macro-element analysis

A water sample shall be collected from the end of the discharge pipeline no sooner than 15 minutes before the scheduled end of a pumping test, whether of a calibration, stepped discharge or constant discharge nature. This will ensure that a water sample is collected in case testing does not proceed to include either one or both of the latter two types of test. The standard amount of sample normally collected is in a clean, sterilised plastic bottle of capacity 2000 millilitre with a watertight screw-on cap. The Hydrogeologist will advise on this matter in instances where the Contractor is required to collect samples, in which case the Hydrogeologist will provide sample bottles containing preservative chemicals if required. All other materials such as tie-on labels and sample custody forms are to be provided by the Hydrogeologist.

(i) Sampling procedure

Rinse the sample bottle three times with the water to be samples, i.e. the water being pumped from the borehole. Fill the bottle so that a space of five to ten millimetres is left at the top. Add the preservative as instructed.

(ii) Sample custody

Fill in the information requested on the tie-on label and attach this securely to the neck of the sample bottle. Place the sample bottle in a cooler or ice-box and keep it stored under chilled conditions. Complete the sample custody form (DWAf form DW45). The water sample and its custody form will be collected by the Hydrogeologist. The above procedures shall be adhered to and complied with to the satisfaction of the Hydrogeologist.

DT 03.05

ABORTED TESTS AND BREAKDOWNS

The Hydrogeologist may at any stage during the execution of a pumping test request the testing contractor to abort a test if, in the opinion of the Hydrogeologist, continuation of the test is not in the interests of the project. Factors which may contribute to such a decision by the Hydrogeologist are:

- Sufficient data having been collected for an adequate scientific evaluation thereof;

- the execution of the test not meeting project criteria and requirements (such as for constancy of yield, accuracy of yield measurements or accuracy of water-level measurements, sufficiency of discharge line length, etc), or
- a mechanical breakdown occurring during pumping which causes a test to be interrupted or aborted.

(a) Tests aborted due to sufficiency of data

The Hydrogeologist will fully motivate his decision to abort the test in a written statement to the User Client. In such instances, the testing contractor will be remunerated for the actual duration of testing (including recovery testing) at the hourly rates set out in the Schedule of Quantities.

(b) Tests aborted due to incorrect execution

The testing contractor will be required to remedy the cause(s) for an abort decision by the Hydrogeologist. The test shall be restarted, as if it were the first attempt, after the water-level has recovered to within five per cent of the pre-test rest water-level or the contractor is instructed thereto by the Hydrogeologist. The testing contractor shall not be entitled to remuneration for any test which is aborted under these circumstances irrespective of the time elapsed up to receipt of the instruction to abort.

(c) Tests aborted due to breakdowns

The following procedures are recommended when a mechanical breakdown occurs during pumping which causes a test to be interrupted or aborted.

(i) Calibration test

Start immediately with the measurement and recording of the water-level recovery rate according to the periodicity given in Table **DT 03.05/1**. Irrespective of how long after the start of pumping the breakdown occurs or how rapidly the breakdown can be fixed, continue with water-level recovery measurements until the water level is within five per cent of the pre-test rest water level or, at the discretion of the Engineer, may be discontinued. Restart the calibration test as if it is the first attempt. The Testing Contractor shall not be entitled to remuneration for a calibration test which is aborted under such circumstances.

(ii) Stepped discharge test

Record the time of the breakdown and start immediately with the measurement and recording of the water level recovery according to the periodicity given in Table **DT 03/05/1**. If the breakdown occurs during the first or second steps of the test, continue with water-level recovery measurements until the water-level is within five per cent of the start rest water level and then restart the stepped discharge test as if it is the first attempt. If the breakdown occurs during the third step of the test, can be fixed and the pump restarted to produce the same yield (as before the breakdown) within five minutes of the breakdown occurring, continue with the test at this yield after measuring and recording the water level immediately before restarting the pump. Only one such breakdown event is allowed.

If a second breakdown occurs, proceed as described for a first step breakdown. If the breakdown occurs during the fourth or later step of the test, can be fixed and the pump restarted to produce the same yield (as before the breakdown) within five minutes of the breakdown occurring, continue with the test and complete it at this yield after measuring and recording the water level immediately before restarting the pump. If a breakdown at this stage can not be fixed within five minutes, continue with water-level recovery measurements as if the test has been fully completed.

The Contractor shall not be entitled to remuneration for a stepped discharge test which is aborted: (1) within the first or second step, or (2) within the third step and can not be restarted within the time allowed for repair.

(iii) Constant discharge test

Note the time of the breakdown and start immediately with the measurement and recording of the water-level recovery according to the periodicity given in Table **DT 03.05/1**. If the breakdown occurs within the first two hours after the start of pumping, continue with water-level recovery measurements until the water-level is within five per cent of the pre-test (start) rest water level and then restart the test. If the breakdown occurs later than two hours into the test, can be fixed and the pump restarted to produce the same yield as before the breakdown within the time periods (after the breakdown occurring) given in

Table **DT 03.05/1**, continue with the test at this yield after measuring and recording the water level immediately before restarting the pump.

If the breakdown can not be fixed and the pump started within one hour of the breakdown occurring, continue with water-level recovery measurements until the water level is within five per cent of the pre-test rest water level and then restart the constant discharge test as if it is the first attempt unless the following condition has been met. If the breakdown occurs after approximately 80 per cent of the planned duration of the constant discharge test has been successfully completed, continue with water-level recovery measurements as if the test has been fully completed. The allowable elapsed time (in hours) with regard to selected constant discharge test total durations in order for this specification to be acceptable is given in Table **DT 03.05/2**.

TABLE DT 03.05/1 PERIOD ALLOWED FOR BREAKDOWN REPAIR AND CONTINUATION OF TESTING

TIME BREAKDOWN AFTER START OF TEST	PERIOD ALLOWED FOR REPAIR
2 hours to 4 hours	6 minutes
4 hours to 6 hours	12 minutes
6 hours to 8 hrs hours	18 minutes
8 hours to 10 hours	24 minutes
10 hours to 12 hours	30 minutes
12 hours to 14 hours	36 minutes
14 hours to 16 hours	42 minutes
16 hours to 18 hours	48 minutes
18 hours to 20 hours	54 minutes

Longer than 20 hrs	60 minutes
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TABLE DT 03.05/2 PERIOD ALLOWED FOR BREAKDOWN REPAIR AND CONTINUATION OF TESTING

CONSTANT DISCHARGE TEST DURATION	ALLOWABLE TIME ELAPSED TO BREAKDOWN
24 hours	20 hours (equivalent to 80 % of total time)
36 hours	30 hours (equivalent to 83 % of total time)
48 hours	38 hours (equivalent to 79 % of total time)
72 hours	60 hours (equivalent to 77 % of total time)

The Contractor shall not be entitled to remuneration for a constant discharge test which is aborted under circumstances which preclude its restart within the time allowable for repair and continuation. The contractor will, however, be entitled to remuneration for a constant discharge test which is aborted after approximately 80 per cent of the planned duration of the constant discharge test (refer to Table DT 03.05/2) has been successfully completed, payment being made for the actual duration of the test (including the recovery test) at the hourly rates set out in the Schedule of Quantities.

DT 04 **MEASUREMENT AND PAYMENT**

DT.01 **TEST PUMPING OF BOREHOLES**Unit: number

The unit of measurement shall be the number of boreholes tested on the written instructions of the Hydrogeologist / Engineer.

The tendered rate shall include full compensation for all labour, equipment and material required for the complete testing of the boreholes in accordance with the specification.

DT.02 **SUPPLEMENTARY WORK:**

DT.02.01 Removal of existing pumping equipmentUnit: number

The unit of measurement shall be the number of boreholes from which equipment is removed prior to testing the borehole. The tendered rate shall cover the removal of existing pumping equipment from a borehole to be tested. Payment for removal up to an installed depth per meter shall be made at the unit rate tendered for in the Schedule of Quantities.

DT.02.02 Recovery of lost equipmentUnit: number

The unit of measurement shall be the number of boreholes from which all the lost equipment is retrieved. The tendered rate shall cover the recovery of lost pumps and pipework for boreholes.

DT.02.03 Installation of temporary pumpsUnit: number

The unit of measurement shall be the number of temporary pumps installed and later retrieved. The tendered rate shall be fully inclusive of the pump and pipes required to effectively test the boreholes in accordance with the specifications.

DT.02.04 Ground-water sampling Unit: number

The unit of measurement shall be the number of boreholes of which the water is sampled. The tendered rate shall be fully inclusive of the requirements of the specification irrespective of the number of samples taken from a borehole.

DT 02.05 Compilation of borehole report Unit: number

The unit of measurement shall be the number of boreholes regarding which approved reports is compiled. The tendered rate shall be fully inclusive of the work required to compile and produce two copies of each borehole recommendation report.

DT.02.06 Standing time Unit: day

The unit of measurement shall be the number of days no work could be carried out. This will cover periods when the test pumping rig and crew or, if more than one rig and crew are fielded, when all rigs and crews are idle, waiting for decisions by the Engineer where those decisions or whose presence is required before the commencement or continuation of the work instructed. Under no circumstances will standing time be payable for any delays other than those incurred by the Engineer's decisions. Except only for abnormal weather conditions as provided for in PS14 of Portion 1 of the Project Specifications, no standing time will be payable due to inclement weather or prevention of access to a site by the Contractor due to inclement weather.

DT.02.07 Reinstallation of existing pumping equipment Unit: number

The unit of measurement shall be the number of boreholes in which removed equipment is re-installed. The tendered rate shall cover the reinstallation of existing pumping equipment in a borehole following test pumping of the borehole. Payment for installation up to a depth of 100 m shall be made at the unit rate tendered for in the Schedule of Quantities. Reinstallation depths in excess of 100 m shall be remunerated for the first 100 m at the tendered unit rate and, for each full metre thereafter, at the rate per metre tendered in the Schedule of Quantities.

The existing pumping equipment shall be reinstalled and left in working condition as it was found before removal unless the Contractor is instructed otherwise by the Hydrogeologist / Engineer.

PDM **WATER TREATMENT PACKAGE PLANTS**

CONTENTS

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PDM 01 **SCOPE**

This specification covers the materials, equipment, methods, testing and work required for the construction, repair and maintenance of water treatment package plants for domestic use, making use of reverse osmosis-type light industrial plants to treat borehole water.

For the purpose of this specification, a water treatment package plant shall be seen as a small-scale self-contained water treatment plant (a plant that produces less than 500 kℓ water of the required quality per day from the raw water source) with movable units that are assembled in a container or building.

PDM 02 **STANDARD SPECIFICATIONS**

PDM 02.01 **GENERAL STANDARD SPECIFICATIONS, REGULATIONS AND CODES**

The latest edition, including all amendments up to date of tender, of the following specifications, publications and codes of practice shall be read in conjunction with this specification and shall be deemed to form part thereof:

SANS 1200	-	Standardised specification for civil engineering construction
SANS 667-2	-	Water quality sampling, part 2: Guidance on sampling Techniques
SANS 241-1: 2015	-	Microbiological, physical, aesthetic, and chemical determinants
SANS 241-2: 2015	-	Application of SANS 241-1
SANS 948	-	Three-phase induction motors
SANS 1222	-	Enclosures for electrical equipment (classified according to the degree of protection that the enclosure provides)

SANS 10142-1 - The wiring of premises – Part 1: Low-voltage installations (Edition 3: 2020)

PDM 02.02 OCCUPATIONAL HEALTH AND SAFETY ACT OF 1993

The Contractor shall be required to comply with the Occupational Health and Safety Act 85 of 1993, Construction Regulations 2014 and related regulations. All relevant regulations and statutory requirements, as laid down in the latest edition of the following acts, shall be adhered to:

Occupational Health and Safety Act, 1993 (No. 85 of 1993)
 Construction Regulations 2014
 National Water Act (No. 36 of 1998).
 Water Services Act (No. 108 of 1997).
 Environment Conservation Act (No. 73 of 1989).
 National Environmental Management Act (No. 107 of 1998).

Non-compliance with these regulations, in any way whatsoever, will be an adequate reason for suspending the Works.

PDM 02.03 MANUFACTURERS' SPECIFICATIONS, CODES OF PRACTICE AND INSTALLATION INSTRUCTIONS

All equipment and materials shall be installed, serviced and repaired strictly in accordance with the manufacturers' specifications, instructions and codes of practice.

PDM 02.04 MUNICIPAL REGULATIONS, LAWS AND BY-LAWS

All municipal regulations laws, by-laws and special requirements of the Local Authority shall be adhered to unless otherwise specified.

PDM 03 OPERATING AND MAINTENANCE MANUALS

The Contractor shall be responsible for the inclusion of the operation and maintenance procedures of the water treatment package plant. As per the requirements of additional specification SB: OPERATING AND MAINTENANCE MANUALS.

PDM 04 CENTRIFUGAL PUMP DESIGN AND REQUIREMENTS

- (a) The pump shaft shall be manufactured from stainless steel and shall be sealed where it enters the casing with double mechanical face seals.
- (b) The impeller shall be suitable for pumping the type of clear water as specified in Clause FN 08 (Detail of work) of this specification.
- (c) The impeller shall be manufactured from stainless steel, or, in the case of other materials, it shall be coated with an approved material resistant to abrasion and corrosion prevalent to the conditions under which the impeller shall operate. For pumps rated below 2 kW, non-metallic impellers may be utilised.
- (d) The impeller shall be statically, dynamically and hydraulically balanced. No holes may be drilled in the impeller to balance it with regard to mass distribution.
- (e) Only permanently sealed ball or roller bearings shall be installed.
- (f) Bearings shall have a B-10 life rating of 100 000 hours.

- (g) The pump shall be a currently catalogued product.
- (h) Performance curves shall be based on a reproducible and certified test carried out in an approved testing facility, such as the SABS.
- (i) The flow rate at break-off point of the curve for the impeller selected shall be at least 1.5 times that of the maximum flow rate specified.
- (j) Each pump shall be clearly labelled. The label shall be a 0.5 mm thick stainless-steel plate of dimensions 100 mm x 50 mm. The label shall be fixed to the pump exterior with an approved adhesive or other methods after the completion of corrosion protection on the pump. It may be bent to follow the shape of the pump exterior but shall not be bent to accommodate sharp folds. Under no circumstances shall the stainless-steel plate of the label influence, damage or otherwise have a detrimental effect on the corrosion protection system. The label shall include the following information:
 - Pump flow rate (l/s)
 - Pump head (m)
 - Power required (kW)
 - Rotational speed NPSH (r)
 - Impeller detail.
- (k) All new submersible pumps shall be supplied with a length of the power cable to suit the installation shown on the drawings.
- (l) All new pumps shall be fitted with double flush mechanical seals, which shall be included in the cost of the pumps. The pump shafts shall be hardened and accurately ground where the seal bears on the shaft. The rotating seal face shall be mounted on a flexible member, sealing on the shaft as well. The flexible member shall be manufactured from rubber, PTFE or equivalent material suitable for the operating environment.
- (m) Centrifugal pumps shall comply with relevant and applicable items under the clause on technical requirements regarding all pump types, as well as the following:
 - (i) Preference shall be given to pumps of the self-regulating type and where the power consumption characteristic is such that the power consumption decreases with an increase in delivery to beyond a certain limit, thus ensuring that the motor is not overloaded in the event of a large reduction in pumping head.
 - (ii) The casing for centrifugal pumps shall be horizontally or vertically split to allow the removal of parts.
 - (iii) The efficiency of the pump shall not be less than 95 % of its maximum efficiency at the selected operating point, where the latter shall not be less than 80 %.
- (n) Materials:

Materials in general

All parts of the pump shall be manufactured of the most suitable material to prevent wear as far as possible. The full specification in this respect shall accompany the tender.

Design in general

All parts of the pump shall be designed so as to ensure easy dismantling for inspection and repair.

Casings

Pumps casings shall be of high-grade cast iron or steel rigidly secured to a bed plate or base.

Impellers

The pump impellers shall be manufactured from hard-wearing high chrome cast steel or similar materials and shall be carefully bored and keyed. All parts inaccessible to machining shall be finished smoothly.

Pump seals

The pump seals shall be fitted with mechanical seals with tungsten carbide or ceramic seats.

Bearings

Preference will be given to ball or roller bearings. In designing bearings, conservative loadings shall be applied to ensure absolute dependability and freedom from heating troubles.

Pump Shafts

Pump shafts shall preferably be manufactured from stainless steel. They shall be statically and dynamically balanced with their respective rotors and impellers.

PDM 04.01 MOTOR DESIGN AND REQUIREMENTS

- (a) Electric motors shall comply with the requirements of SANS 1804.
- (b) Imported motors forming an integral part of the pump shall be submitted to the South African Bureau of Standards to be tested in accordance with the requirements of SANS 1804.
- (c) All motors shall be standard catalogue models and shall be readily available.
- (d) All motors shall, where possible, be from the same manufacturer and shall have the same interchangeable frames. Variations in type and size shall, where possible, be limited to make stocking a variety of special spares unnecessary.

- (e) All motors shall have dynamically balanced rotors supported by maintenance-free, sealed-for-life ball bearings.
- (f) All motors shall be suitably coated to ensure the satisfactory operation of the motor under the specified class of service.
- (g) All terminal boxes shall be waterproof and suited for submersion up to the depth specified for the pumps.
- (h) An adequate length of waterproof cable, purpose-made for submerging, shall be supplied with each submersible motor. The coupling of this cable to the normal power-distribution cable, which usually is of the PVC type with steel-wire armour, shall be placed at least 1.0 m above the maximum water level by means of a purpose-made, weatherproof outdoor junction box. The submerged cable shall be supported to minimise any movement of the cable which results from turbulence caused by the operation of the equipment or the flow of the water.
- (i) Thermistor protection or Klaxon-type temperature switches shall be provided for submersible motors.
- (j) Seal monitors shall be provided for submersible motors, together with the required seal monitor relays. The cost for the seal monitor relays shall be deemed to be included in the rates tendered for the equipment.

PDM 04.02

WORKING VOLTAGE AND SUPPLY SYSTEMS

The motors shall be capable of operating within $\pm 10\%$ of the nominal supply voltage without risk of damage. All motors shall be suitable for operating continuously at the specified three-phase voltage system under actual service conditions, including the $\pm 10\%$ voltage tolerance, without exceeding the specified temperature rise determined by the resistance on a basic full-load heat run.

All motors shall be capable of operating continuously under actual service conditions at any supply frequency between 48 and 51 Hz together with any voltage between $\pm 5\%$ of the nominal supply voltage.

The slip-in speed of any motor at 80 % of the nominal voltage at 50 Hz shall not exceed a percentage agreed upon by the Engineer, and the motors shall be capable of operating at this voltage for a period of five minutes without deleterious heating.

PDM 04.03

MOTOR CONTROL CENTRE DESIGN

The supply for the NF water treatment plant will be provided from an existing distribution board (DB) in the water treatment room. The existing DB is to be fitted with a 60A 6kA 3 Pole Circuit Breaker to supply the NF Plant. The new 16mm² 4core armoured supply cable from the existing DB must be installed on a 50mm cable tray supported with unistrut brackets to the NF water treatment works.

The high-pressure pumps will be controlled by the Motor Control Centre (MCC). Float switches shall be used to switch the high-pressure pump motor on and off according to the applicable water levels in the feed and product tanks. The dosing pumps for the antiscalant and the disinfectant will be switched on and off by a flow switch.

- (a) New MCC for the NF Water treatment works shall be wired to comply with the requirements as set out in this clause.

(i) Wiring

Allowance shall be made for the entire electrical installation and wiring of the pumps and controls, including level control probes. Three-phase supply cables must be supplied to the control boards of the pumping plants. The cable needed to supply power to the pump house from the nearest convenient point will be measured separately.

(ii) Control Boards

The control boards housing the starting and control equipment shall be of the free-standing, weatherproof, corrosion-resistant kiosk type.

Control boards shall be properly sealed by suitable rubber gaskets or similar materials.

The material must be of 2.0mm thick IP65, 3CR12, coated steel.

The face plate of the motor control centre must be inside the complete panel, and the complete panel must have a lockable door capable of locking with a padlock.

The faceplate of the motor control centre must have a lockable isolator to ensure that the panel is off when the face plate cover is opened.

Engraved labelling must be used on the door of the Control Board with the relevant MCC number on it. The label shall be secured with screws and nuts.

All labelling on the face plates of the control board shall be engraved and must indicate all the functions of the Control Board in each section.

(iii) Hour meters

Hour meters for the High-Pressure Pump.

(iv) Earth leakage protection

The electrical motors for the pumps are not to be equipped with earth leakage protection. All other electrical fittings, however, must be provided with earth leakage protection.

(v) Flexible cables

Flexible cables between control boards and pumps shall have sufficient slack to enable the pumps to be withdrawn from the castings by at least 1m, without the necessity of disconnecting the cable.

(vi) Float switches

The float switches to be used in the contract shall be of the hermetically sealed, mercury switch type.

(vii) Motor

The motor shall have a speed not exceeding 1500 r/min and shall be suitable for the pump offered. It shall be of sufficient capacity to bring the unit up to maximum speed against full load and shall have a rating of not less than 25% in excess of the maximum power required to drive the unit when working under normal maximum load.

(viii) Lightning arrester

The control boards shall be equipped with Dehn DG modular lightning/surge arrester.

(ix) Lightning and socket point

For external motor control, board lightning with an illumination of 200 lux and one industrial 3-pin outlet point is to be provided.

(x) Volt and Amp meter

Each MCC shall be equipped with one interchangeable (between L1, L2 & L3) voltmeter. Each electrical motor shall be equipped with one amp meter.

(xi) Adjustable 24-Hour Quarts Clock

If specified, the electrical control panel is to be equipped with an adjustable (at half an hour intervals) 24-hour cycle quarts clock/time switch, which must be capable of activating the pump any number of timers per day (48 minimum) at any preselected time intervals. The timer shall only provide an on-impulse when each of the preselected times is reached. If the pumps have not switched off and are still running when the next preselected time is reached, it must only be confirmed by the timer that the pump should be running. The quarts clock unit shall have its own nickel-cadmium battery unit incorporated and must power itself for at least 72 hours in case of a power failure. The clock and battery unit shall be as MICOREX QT, R150 HOUR with reference no.926401 or similar approved (dimensions 52 x 102mm).

(b) Provide an engraved label on the door of the MCC with the relevant MCC number on it. The label shall be secured with screws and nuts.

(c) Switchgear and equipment shall be installed in the MCC to:

- Automatically regulate the start and stop of the pump
- Indicate the time that the pump has been operating since commissioning (hour meters)
- Start/ stop the pump manually.
- Indicate that the pump is running
- Indicate that the pump has tripped
- Manually override the pump
- Indicate Main Supply Voltage (L1, L2 & L3) & ((L1/L2, L2/L3 & L3/L1)
- Ensure Phase failure protection
- Ensure Voltage Monitor (over/under voltage) protection
- Switchgear and equipment shall be installed in the MCC to operate and control all the equipment effectively.

(d) Test for correct functioning on completion of electrical repair work.

PDM 04.04 CONTROL OF THE HIGH-PRESSURE PUMP

- (a) The high-pressure pumps shall be controlled by both a pump selector switch and a mode selector switch, as illustrated in **Figure 1**.
- (b) The high-pressure pumps shall be able to operate in both manual (CIP) and automatic (NF) modes. In the manual mode, the pump shall operate by means of the push-button START/STOP switches incorporating LED panel displays. However, the pump shall be stopped by means of a flow switch to prevent the high-pressure pump from running dry.
- (c) In the automatic mode (NF) the high-pressure pump shall be started by means of the low-level switch in the product water tank and stopped by the high-level switch in the product water tank. The high-pressure pump will also be stopped when the level in the feedwater tank drops to the minimum level by the low-level switch in the feedwater tank.
- (d) In the automatic mode (NF) the antiscalant pump and the chlorine pump would be powered for dosing of antiscalant and disinfectant.

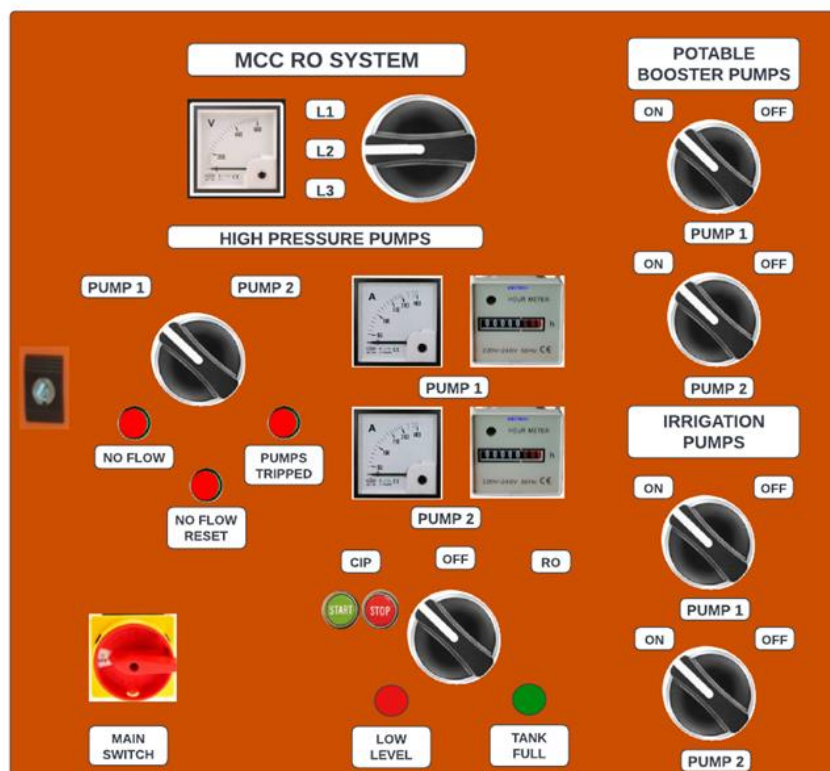


FIGURE 1: MCC - NF SYSTEM

- (e) The antiscalant pump and disinfection dosing pumps would consist of duty and standby pumps. A local selector switch will be used at the pumps to select either pump 1 or pump 2.

PDM 04.05 CONTROL OF THE DOSING PUMPS

- (a) There are two (2) antiscalant and two (2) calcium hypochlorite dosing pumps. The pumps can be selected as either No 1 or Number 2 as per **Figure 2**.



FIGURE 2: DOSING PUMP SELECTOR

- (b) The antiscalant and the calcium hypochlorite pumps will be powered whenever one of the high-pressure pumps starts.
- (c) The antiscalant dosing is set based on the properties of the feedwater and the flow rate.
- (d) The dosing of the calcium hypochlorite is set based on the chlorine demand and the flow rate of the water.

PDM 05 REFURBISHMENT AND NEW INSTALLATION

PDM 05.01 GENERAL

The decommissioning, testing and commissioning procedures as specified in Additional Specification SC shall be applicable. The equipment, as specified in the equipment sheets, shall be used in selecting the required components, where applicable.

All materials and equipment shall comply fully with the requirements specified for each installation.

The proposed system will be modelled, by the contractor/supplier, with readily available modelling software for reverse osmosis plants, and the output of the model would be provided with a detailed design for approval by the Engineer.

The system shall be installed in the existing water treatment building. Provision has to be made to connect to the existing raw water connection, the existing treated or product water connection and the existing brine connection.

All new equipment, materials and systems shall be furnished with a written guarantee with a defects liability period of 12 months from the date of completion of repair work. These

guarantees shall be furnished in favour of the South African National Biodiversity Institute (SANBI).

PDM 05.02 FILTRATION

The water will require filtering to reduce the SDI of the feedwater to the NF process.

- A 14x65 fibreglass filter vessel with AFM media will be used with an automatic filter header valve for the filtering of the feedwater.

PDM 05.03 NANOFILTRATION PLANT

Nanofiltration water treatment plants are constructed where water needs to be desalinated.

- The Nanofiltration (NF) plant shall have a full- or side-stream configuration, depending on the water quality and water specification.
- The NF plant shall include two high-pressure pumps, a pressure vessel array and a cleaning-in-place (CIP) system.
- Pre-treatment for the NF process, including antiscalant addition and bag filtration, shall be included.
- The NF membrane shall be from cellulose acetate or composite polyamide, depending on the water quality and water need. A copy of the expected results must be provided with the cost proposal.
- The NF membrane shall be spiral wound or hollow-fine fibres depending on the water quality and water need.
- The final water will be disinfected before storage, prior to distribution.
- Process control instrumentation (handheld electrical conductivity meter and chlorine comparator) shall be provided.
- The system would connect to a 50mm Ø feed water line and a 32mm Ø product water and brine lines.

PDM 05.04 ELECTRICAL INFRASTRUCTURE

The following electrical infrastructure is required:

- One surface mounted IP55 distribution board (supplied by others). Install a 60A 6kA 3 Pole Circuit Breaker for power supply to the motor control centre for the NF water treatment plant in the existing distribution board.
- A MCC for the high-pressure pump, level controls and flow switch and the electrical supply to the dosing pumps.
- All wiring to be PVC wiring. All cabling from motor control centres to equipment to be PVC armoured cables.
- All cables are to be installed on a light-duty cable tray, suspended away from the walls with OL2000 Unistrut.
- Install IP65 Isolators at all motors/pumps.
- Install 16mm² 4 core armoured cable with 10mm² BCEW wire between DB and NF Plant MCC.
- Earthing to be provided.
- Certificate of Compliance to be provided.

PDM 05.06 STANDARD EQUIPMENT FOR THE CONSTRUCTION OF A NANO FILTRATION PLANT

- Borehole water is fed through the AMF filter to the NF plant.
- Two Multistage high-pressure feed pumps - Provides the high pressure to NF membranes.
- Anti-scalant dosing system.
- Cartridge filter - Prevents any deposition of large particles, most of the bacteria, and viruses onto the NF membrane. The pore size is normally $\pm 5\mu\text{m}$.

- FRP pressure vessels and NF membranes - The NF membranes remove dissolved solids from the feed water and produce desalinated water. (Product water)
- **Existing** product water storage tank (provided by others).
- Water meters and pressure gauges in NF system pipework.
- CIP System.
- Calcium Hypochlorite dosing for disinfection of the potable water.

PDM 05.07 STANDARD PROCESSES IN NANOFILTRATION REQUIREMENTS

- Pre-treatment for NF process (where applicable), including antiscalant addition and cartridge filtration
- Nanofiltration, including high-pressure pumps, pressure vessel array (NF membranes) and cleaning (CIP) system.
- Post-treatment (stabilisation) where applicable.
- Brine disposal/management.

PDM 05.06 MEMBRANE SYSTEM SPECIFICATIONS

The general design philosophy of the nanofiltration plant for Hantam NBG shall be to produce desalinated water for drinking and cooking purposes, returning the concentrate (brine) to the irrigation dam. The brine will be used as irrigation water.

This shall be achieved by regulating the pressure differential over the membrane by an orifice or a pressure control valve.

The membrane features and operating limits shall be as follows:

TABLE 1: MEMBRANE SPECIFICATIONS

Membrane type	Spiral wound thin film composite polyamide
Maximum operating temperature	45°C
Free chlorine tolerance	< 0.1 ppm
pH range, continuous operation	2 - 11
pH range, short-term for CIP (30 min.)	1 - 13
Applied pressure	To suit volume of permeate
Salt Rejection	>95%

PDM 05.07 SITE-SPECIFIC REQUIREMENTS

The **chemical analysis of the borehole water** indicated that the numerical limits, as listed below, were exceeded:

TABLE 2: WATER QUALITY PARAMETERS EXCEEDING SANS 241: 2015

Chemical analysis	SANS Standard limit	Hantam NBG
Electrical Conductivity, mS/m	≤ 170	415
Total Dissolved Solids, mg/l	1 200	2324
Turbidity NTU	≤ 1 Operational	6.5

Chemical analysis	SANS Standard limit	Hantam NBG
	≤ 5 Aesthetic	
Nitrate as N, mg/l	≤ 11	26
Chloride as Cl ⁻ , mg/l	≤ 300	1 155
Sodium as Na, mg/l	≤ 200	231

PDM 06 OPERATION AND MAINTENANCE

PDM 06.01 GENERAL

The maintenance work to be performed and executed shall be done strictly in accordance with the manufacturer's specifications.

The said operation and maintenance work shall be executed in accordance with the relevant codes of practice, standards, regulations, municipal laws and by-laws and the manufacturer's specifications and codes of practice.

All new equipment, components and materials supplied and installed under the maintenance contract shall be furnished with the prescribed manufacturer's guarantees.

PDM 06.02 OPERATION AND ROUTINE PREVENTATIVE MAINTENANCE

The tasks related to the operation and routine preventative maintenance work shall include but not be limited to the GENERAL actions listed in table PDM 05.02/1 below.

These actions and findings shall be logged and reported on the relevant approved schedules and reports.

TABLE PDM 05.02/1

NO	ROUTINE PREVENTATIVE MAINTENANCE OF WATER TREATMENT PACKAGE PLANTS	MAINTENANCE FREQUENCY
1	Visually inspect and report on the complete system.	Daily
2	Clean complete installation thoroughly so that leaks would be obvious and clear when they occur.	Weekly
3	Check, service, repair and clean dosing apparatus from blockages.	Monthly
4	Corrosion protect all equipment and ancillaries.	Whenever necessary
5	Check for and repair all leaks. Report leaks.	Monthly
6	Check dosing rate and reset regulators if necessary.	Monthly
7	Measure residual chlorine in the drinking water system (DPD 1 or similar).	Daily
8	Inspect and service all pumping equipment	3-monthly
9	Check and repair pressure gauges	3-monthly

PDM 06.04 SAFETY PROCEDURES AND PRECAUTIONS

SANS 10298 specifies operational safety in terms of general safety requirements, emergency action plans, personal protective equipment and handling of containers, which shall at all times be adhered to. Only personnel who are adequately trained shall be allowed to operate and maintain the water treatment package plants.

PDM 07 MEASUREMENT AND PAYMENT

PDM 07.01 PREPARATION OF SHOP DRAWINGS, ITEM SPECIFICATION SUBMISSION DRAWING SUBMISSIONS.....Unit: Number

The tendered rates shall include full compensation for the design, labour, intellectual property developed, patent rights, software, computers, computer time, meetings, delivery, approval of the structure, based on the Engineers Piping and Instrumentation Diagram. Submission is complete upon:

- Submission of item spec, the motivation for major components for approval by Engineer.
- Detailed P&ID including the proposed unit and/or changes.
- General arrangement drawing.
- Isometric drawing of piping.
- Planned wiring diagram.
- Submission of control philosophy document indicating the relation of level switches, pumps, flow switches, sensors, alarms, switches, interaction with MCC and operators.
- Approval of all drawings and submissions by Engineer.

PDM 07.02 SUPPLY AND DELIVERY OF NANO FILTRATION WATER TREATMENT PLANT AND EQUIPMENT.....Unit: number

The tendered rates shall include full compensation for factory acceptance testing, design, manufacture, procurement, corrosion protection, patent rights, pre-delivery testing and test certificates, test for quality and quantity, transport for delivery to site and off-loading, including all handling of the equipment. Complete installation may consist of:

- 1 x 14X65 Filter, complete with distributor, riser pipe, filter, automatic filter header valve and AFM media.
- 2 x High pressure pumps suitable for NF membranes.
- Micro-filter. The pore size 5µm.
- Antiscalant dosing with 2 dosing pumps.
- Pressure vessels and NF membranes
- Cleaning (CIP) system.
- Disinfection system with 2 dosing pumps.
- Electrical power cables for pumps and motors. CoC for the treatment works up to the electrical connection.
- Supply and coupling of all required pipes flanges, including all required gaskets, nuts, bolts and washers.
- Water meters and pressure gauges in NF system pipework

- All required installation materials, labour and consumables to render a complete and working installation.
- The feed water to be connected to an existing raw water line inside the water treatment building.
- The product water line must be connected to an existing product water line inside the water treatment building.
- The brine line to be connected to an existing line inside the building.
- The MCC for the treatment works must be connected to the existing DB inside the water treatment works.
- Process control instruments (portable electrical conductivity meter and chlorine comparator).

The plant must be **constructed on a skid** and then shipped to the site.

PDM.07.03 TESTING AND COMMISSIONING OF THE NANOFILTRATION WATER TREATMENT PLANT.....Unit: number

The unit of measurement shall be for the installation, testing and commissioning of the nanofiltration water treatment plant in accordance with the Requirements of Additional Specification SC: decommissioning, testing and commissioning.

The tendered rates shall include full compensation for the site handling and positioning of the Nanofiltration equipment, including the fastening of the equipment in designated positions. The following shall also be included in the tendered rates:

- (a) Installation of all equipment, ancillaries and all other necessary appurtenances required to render a fully functional nanofiltration treatment plant.
- (b) Coupling of all required pipes flanges, including all required gaskets, nuts, bolts and washers.
- (c) Routing and fastening of all power cables, connecting all electrical material and switchgear.
- (d) All required installation materials, labour and consumables to render a complete and working installation.
- (e) Testing of the process to certify the quantity of water produced as well as the quality of water produced over the 30-day commissioning period.

The tendered rates shall also include full compensation for all preliminary tests, delivery and efficiency tests if required and commissioning tests to ensure a leak-free system and the correct settings of regulators to ensure accurate dosing.

PFN **PUMP INSTALLATIONS AND MOTOR AND PUMP CONTROL**

CONTENTS

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PFN 5	THE DIESEL ENGINE IN GENERAL
PFN 6	MOTOR DESIGN AND REQUIREMENTS
PFN 7	WORKING VOLTAGE AND SUPPLY SYSTEMS
PFN 8	PROTECTION AND CONTROL DEVICES MOTOR CONTROL CENTRES
PFN 9	TESTING AND COMMISSIONING
PFN 10	MAINTENANCE
PFN 11	MEASUREMENTS AND PAYMENT

PFN 01 **SCOPE**

This specification covers the installation, testing, commissioning and maintenance of pumping equipment, motor control devices, telemetric systems and low-voltage cables. The function of systems, installations and equipment indicated shall be for the processing and delivery of water and the treatment of wastewater at the domestic and piggery treatment plants.

PFN 02 **STANDARD SPECIFICATIONS**

PFN 02.01 **GENERAL STANDARD SPECIFICATIONS, REGULATIONS AND CODES**

The latest edition, including all amendments up to date of tender, of the following specifications, publications and codes of practice shall be read in conjunction with this specification and shall be deemed to form part thereof:

BS 5316, Part 1	Acceptance tests for centrifugal, mixed flow and axial pumps Three-phase induction motors Enclosures for electrical equipment (classified according to the degree of protection that the enclosure provides) General requirements for rotating electrical machines
BS 1486, Part 2	Heavy duty lubrication nipples Rolling bearings – dynamic load ratings and rating life

PFN 02.02 **OCCUPATIONAL HEALTH AND SAFETY**

The Contractor shall be required to comply with the Occupational Health and Safety Act 85 of 1993, Construction Regulations 2014 and related regulations. Non-compliance with these regulations, in any way whatsoever, will be adequate reason for suspending the Works.

PFN 02.03 MANUFACTURERS' SPECIFICATIONS, CODES OF PRACTICE AND INSTALLATION INSTRUCTIONS

All equipment and materials shall be installed, serviced and repaired strictly in accordance with the manufacturers' specifications, instructions and codes of practice.

PFN 02.04 MUNICIPAL REGULATIONS, LAWS AND BY-LAWS

All municipal regulations laws, by-laws and special requirements of the Local Authority shall be adhered to unless otherwise specified.

PFN 03 AS-BUILT INFORMATION AND OPERATING AND MAINTENANCE MANUALS

The Contractor shall be responsible for the compilation of an inventory list and operating and maintenance manuals.

This shall be done in accordance with Additional Specification SB: Operating and Maintenance Manuals.

PFN 04 PUMP DESIGN AND REQUIREMENTS

- (o) The pump shaft shall be manufactured from stainless steel and shall be sealed where it enters the casing with double mechanical face seals.
- (p) The impeller shall be suitable for pumping the type of clear water as specified in Clause FN 08 (Detail of work) of this specification.
- (q) The impeller shall be manufactured from stainless steel or, in the case of other materials; it shall be coated with an approved material resistant to abrasion and corrosion prevalent to the conditions under which the impeller shall operate. For pumps rated below 2 kW non-metallic impellers may be utilised.
- (r) The impeller shall be statically, dynamically and hydraulically balanced. No holes may be drilled in the impeller to balance it with regard to mass distribution.
- (s) Only permanently sealed ball or roller bearings shall be installed.
- (t) Bearings shall have a B-10 life rating of 100 000 hours.
- (u) The pump shall be a currently catalogued product.
- (v) Performance curves shall be based on a reproducible and certified test carried out in an approved testing facility, such as the SABS.
- (w) The flow rate at break-off point of the curve for the impeller selected shall be at least 1,5 times that of the maximum flow rate specified.
- (x) The head at zero delivery of the curve of the impeller selected shall be at least 12 times the maximum head in the pump's operational range.
- (y) Each pump shall be clearly labelled. The label shall be a 0,5 mm thick stainless steel plate of dimensions 100 mm x 50 mm. The label shall be fixed to the pump exterior

with an approved adhesive or other method after the completion of corrosion protection on the pump. It may be bent to follow the shape of the pump exterior but shall not be bent to accommodate sharp folds. Under no circumstances shall the stainless steel plate of the label influence, damage or otherwise have a detrimental effect on the corrosion protection system. The label shall include the following information:

- Pump rate
 - Pump head
 - Power required
 - Rotational speed NPSH (r)
 - Impeller detail.
- (z) All new submersible pumps shall be supplied with a length of power cable to suit the installation shown on the drawings.
- (aa) All new pumps shall be fitted with double flush mechanical seals, which shall be included in the cost of the pumps. The pump shafts shall be hardened and accurately ground where the seal bears on the shaft. The rotating seal face shall be mounted on a flexible member, sealing on the shaft as well. The flexible member shall be manufactured from rubber, PTFE or equivalent material suitable for the operating environment.
- (bb) Centrifugal pumps shall comply with relevant and applicable items under the clause on technical requirements regarding all pump types, as well as the following:
- (iv) Preference shall be given to pumps of the self-regulating type and where the power consumption characteristic is such that the power consumption decreases with an increase in delivery to beyond a certain limit, thus ensuring that the motor is not overloaded in the event of a large reduction in pumping head.
 - (v) The casing for centrifugal pumps shall be horizontally or vertically split to allow removal of parts.
 - (vi) The efficiency of the pump shall not be less than 95 % of its maximum efficiency at the selected operating point, where the latter shall not be less than 80 %.
- (cc) Materials:

Materials in general

All parts of the pump shall be manufactured of the most suitable material to prevent wear as far as possible. Full specification in this respect shall accompany the tender.

Design in general

All parts of the pump shall be designed so as to ensure easy dismantling for inspection and repair.

Casings

Pumps casings shall be of high grade cast iron or steel rigidly secured to a bed plate or base.

Impellers

The pump impellers shall be manufactured from hard wearing high chrome cast steel or similar materials and shall be carefully bored and keyed. All parts inaccessible to machining shall be finished smooth.

Pump seals

The pump seals shall be fitted with mechanical seals with tungsten carbide or ceramic seats.

Bearings

Preference will be given to ball or roller bearings. In designing bearings, conservative loadings shall be applied to ensure absolute dependability and freedom from heating troubles.

Pump Shafts

Pump shafts shall preferably be manufactured from stainless steel. They shall be statically and dynamically balanced with their respective rotors, and impellers

PFN 05

THE DIESEL ENGINE IN GENERAL

It is an important requirement that spares will be available for a long period in the future and Tenderers must satisfy the Department that this would be the case. Engine having a high local content in their manufacture will receive preference.

The engine must be a well-designed and proved air-cooled diesel engine. The cooling must be effected by an axial blower driven via a double V-belt from the front crankshaft end. An air duct incorporated in the blower must direct the cooling air to the cylinders and the cylinder head. The hot air shall be duct to the outside of the pump house in an approved manner and of which full particulars are to be included in the tender. The V-belts must run on double V-pulleys. The belts must be of the highest quality and each belt must be strong enough to carry the full load so that the duplicate belt may be looked upon as a standby safety measure.

The engine shall have a pressure feed lubrication system for the main and crankpin bearings, timing gear, camshaft and valve gear.

The engine shall be equipped with a 12 Volt axial flywheel engaging starter motor and an oil pressure actuated safety starter motor disengagement. The pinion of the starter shall engage with the starter ring on the flywheel before the rotor revolves.

The engine shall also be equipped with a governor of the mechanical all-speed type, integral with the injection pump, and a stop control lever on the governor.

The rating of the engine shall be 10% more than the full load power absorbed by the pump when operating under any of the specified conditions.

Power absorbed by the plant in meeting the maximum duty required of the pump, must be taken into account in selecting a suitable diesel engine for this service, to ensure that it complies in all respects with the specification.

The engine shall be fitted with a flywheel coupling and guard or cover, fuel tank of 6 hours full load capacity, and exhaust pipe fitted with silencers. The exhaust shall be taken outside the pump house or terminate as specified elsewhere.

It must be the most reliable of its type, capable of running under full load for a minimum period of 6 hours. To ensure that it shall do so, it must therefore be rated in accordance with specifications B.S 649 or A to DIN 6270 for Internal Combustion Engines continuous rating + 10% overload).

PFN 06

MOTOR DESIGN AND REQUIREMENTS

- (k) Electric motors shall comply with the requirements of SANS 1804.
- (l) Imported motors forming an integral part of the pump shall be submitted to the South African Bureau of Standards to be tested in accordance with the requirements of SANS 1804.
- (m) All motors shall be standard catalogue models and shall be readily available.
- (n) All motors shall, where possible, be from the same manufacturer and shall have the same interchangeable frames. Variations in type and size shall, where possible, be limited to make stocking a variety of special spares unnecessary.
- (o) All motors shall have dynamically balanced rotors supported by maintenance-free, sealed-for-life ball bearings.
- (p) All motors shall be suitably coated to ensure the satisfactory operation of the motor under the specified class of service.
- (q) All terminal boxes shall be waterproof and suited for submersion up to the depth as specified for the pumps.
- (r) An adequate length of waterproof cable, purpose-made for submerging, shall be supplied with each submersible motor. The coupling of this cable to the normal power-distribution cable, which usually is of the PVC type with steel-wire armour, shall be placed at least 1.0 m above the maximum water level by means of a purpose-made, weatherproof, outdoor junction box. The submerged cable shall be supported to minimise any movement of the cable, which result from turbulence caused by the operation of the equipment or the flow of the water.
- (s) Thermistor protection or Klaxon type temperature switches shall be provided for submersible motors.

- (t) Seal monitors shall be provided for submersible motors, together with the required seal monitor relays. The cost for the seal monitor relays shall be deemed to be included in the rates tendered for the equipment.

PFN 07

WORKING VOLTAGE AND SUPPLY SYSTEMS

The motors shall be capable of operating within $\pm 10\%$ of the nominal supply voltage without risk of damage. All motors shall be suitable for operating continuously at the specified three-phase voltage system under actual service conditions, including the $\pm 10\%$ voltage tolerance, without exceeding the specified temperature rise determined by the resistance on a basic full load heat run.

All motors shall be capable of operating continuously under actual service conditions at any supply frequency between 48 and 51 Hz together with any voltage between $\pm 5\%$ of the nominal supply voltage.

The slip-in speed of any motor at 80 % of the nominal voltage at 50 Hz shall not exceed a percentage agreed on by the Engineer, and the motors shall be capable of operating at this voltage for a period of five minutes without deleterious heating.

PFN 08

MOTOR CONTROL CENTRE DESIGN

All pumps will be controlled by the Motor Control Centre (MCC). Float- and pressure switches shall be used to switch the pump motors on and off, according to the applicable water levels.

- (e) New MCC for water pumps, sewer pumps, aerators, borehole pumps, mixers, motor drive valves etc. shall be wired to comply with the requirements as set out in this clause.

- (i) Wiring

Allowance shall be made for the entire electrical installation and wiring of the pumps and controls, including level control probes. Three phase supply cables must be supplied to the control boards of the pumping plants. The cable needed to supply power to the pump house from the nearest convenient point will be measured separately.

- (ii) Control Boards

The control boards housing the starting and control equipment shall be of the free standing, weatherproof, corrosion resistant, kiosk type.

Control boards shall be properly sealed by suitable rubber gaskets or similar materials.

The material must be of 2.0mm thick IP65, 3CR12, coated steel.

The face plate of the motor control centre must be inside the complete panel and the complete panel must have a lockable door, capable of locking with a padlock.

The faceplate of the motor control centre must have a lockable isolator to ensure that the panel is off when the face plate cover is opened.

An engraved labelling must be used on the door of the Control Board with the relevant MCC number on. The label shall be secured with screws and nuts.

All labelling on the face plates of the control board shall be engraved and must indicate all the functions of the Control Board on each section.

- (iii) Hour meters

Hour meters as per clause 9.7 of the Standard Specifications for Electrical Equipment and Installation for Mechanical Services shall be provided for each pump

- (iv) Earth leakage protection

The electrical motors for the pumps are not to be equipped with earth leakage protection. All other electrical fittings however must be provided with earth leakage protection as per clause 7.3 of the Standard Specifications.

(v) Flexible cables

Flexible cables between control boards and pumps shall have sufficient slack to enable the pumps to be withdrawn from the castings by at least 1m, without the necessity of disconnecting the cable.

(vi) Float switches

The float switches to be used in the contract, shall be of the hermetically sealed, mercury switch type.

(vii) Motor

The motor shall have a speed not exceeding 1500 r/min and shall be suitable for the pump offered. It shall be of sufficient capacity to bring the unit up to maximum speed against full load and shall have a rating of not less than 25% in excess of the maximum power required to drive the unit when working under normal maximum load.

(viii) Lightning arrester

The control boards shall be equipped with lightning/surge arresters.

(ix) Lightning and socket point

For external motor control a board lightning with an illumination of 200 lux and one industrial 3 pin outlet point is to be provided.

(x) Volt and Amp meter

Each MCC shall be equipped with one interchangeable (between L1, L2 & L3) voltmeter. Each electrical motor shall be equipped with one amp meter.

(xi) Adjustable 24 Hour Quarts Clock

If specified the electrical control panel is to be equipped with an adjustable (at half an hour intervals) 24 hour cycle quarts clock/time switch, which must be capable of activating the pump any number of timers per day (48 minimum) at any preselected time intervals. The timer shall only provide an on impulse when each of the preselected times is reached. If the pumps have not switched off and are still running when the next preselected time is reached, it must only be confirmed by the timer that the pump should be running. The quarts clock unit shall have its own nickel cadmium battery unit incorporated and must power itself for at least 72 hours in case of a power failure. The clock and battery unit shall be as MICOREX QT, R150 HOUR with reference no.926401 or similar approved (dimensions 52 x 102mm).

(xii) Electrical control panel and batteries for the diesel engines

The nickel cadmium batteries shall be capable of ten consecutive starts, each at least 5 seconds in duration, without recharging, against full compression.

The control panel shall be of the totally enclosed, floor mounted type incorporating 12 volt semi-sealed nickel cadmium battery, double wound air cooled transformer 220V/12V, full wave silicon rectifier, smoothing choke, low rate charging resistor, 12 Volt A.C. signal lamp to indicate "Mains On", 12 Volt D.C. signal lamp to indicate "High Charging Rate". The control equipment must have the necessary relays and electronic features to accommodate any of the requirements as specified.

The nickel cadmium battery offered is to be steel cased of the semi-sealed high power type as "SAFT KPH 50" or other approved.

The battery is to be provided with suitable approved sensing devices to monitor the battery voltage to ensure that the trickle charger automatically selects the correct high or low charging rate required to maintain the battery in perfect condition. The tenderer must submit a certificate from the battery supplier stating that he is fully aware of the requirements for the correct maintenance of the battery and that he is satisfied that all apparatus incorporated in the control equipment for monitoring and charging this battery, is suitable and fully approved by him.

It is essential that Performance Data for the battery offered be submitted for information of the Department, indicating clearly its discharge characteristics under peak load starting conditions when fully and 50% discharged, i.e. simulated repeat starting in accordance with the specification.

- (f) In the event of an existing MCC being replaced by a new MCC, the power supply cable from the MCC to the pump shall be tested for conformity to be re-used. In the event that the cable might not pass such testing by the Contractor, the Contractor shall inform the Engineer in writing. The Engineer will instruct the Contractor with regard to a new cable to be installed. Remuneration, in the event of a new power supply cable being required from the MCC to the borehole pump, will be measured under the re-measurable electrical repair quantities and must not be included in the payment item for the replacement and equipping of the MCC.
- (g) Provide an engraved label on the door of the MCC with the relevant MCC number on. The label shall be secured with screws and nuts.

- (h) Switchgear and equipment shall be installed in the MCC to:
- Automatically regulate the start and stop of the pump
 - Indicate the time that the pump has been operating since commissioning (hour meters)
 - Start/ stop the pump manually.
 - Indicate that the pump is running
 - Indicate that the pump has tripped
 - Manually override the pump
 - Timer in order to alternate the pumps every 8 hours
 - Indicate Amps for each pump
 - Indicate Main Supply Voltage (L1, L2 & L3) & ((L1/L2, L2/L3 & L3/L1)
 - Ensure Phase failure protection
 - Switchgear and equipment shall be installed in the MCC to:
- (i) Submersible equipment protection devices are installed separately to ensure the following:
- Insulation resistance before start-up
 - Temperature (Tempcon, Pt sensor and PTC/thermal switch)
 - Overload/under load
 - Overvoltage/under voltage
 - Phase sequence
 - Power factor
 - Power consumption
 - Harmonic distortion
 - Run and start capacitor (single-phase)
 - Operating hours and number of starts
 - Lightning and surge protection
- (j) Test for correct functioning on completion of electrical repair work.
- (k) Emergency stop buttons shall be installed at the borehole installation in all-weather boxes for emergency stop functions.

PFN 08.01 SPECIFIC DESIGN REQUIREMENTS FOR ELECTRICAL EQUIPMENT

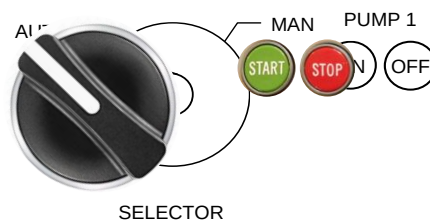
PFN 08.01.01 MIXERS, SUBMERSIBLE SEWAGE PUMPS, WATER SUPPLY PUMPS FOR WATER PURIFICATION, BULK SUPPLY IRRIGATION AND BOREHOLES

Where equipment forms part of one installation all of the relevant equipment will be housed in the same type of MCC's, which shall be of the free standing weather and waterproofed kiosk type. The controls will be accessible from a single opening door and the panel will be divided in two halves one section of the control panel must be allocated for the incoming breaker and cables and the other section for selector switches specified controls. A typical example of a Motor Control Cabinet is shown below.



PFN 08.01.01.01 SUBMERSIBLE CENTRIFUGAL BOREHOLE PUMPS (UP TO 3 KW)

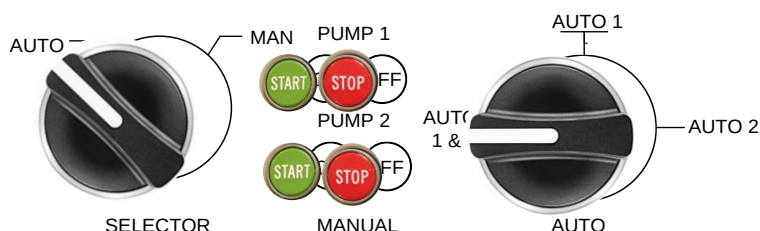
- (a) The pumps shall be controlled by both a pump selector switch and a mode selector switch mounted on the switchboard panel. These switches are shown below.



- (b) The pump shall be able to operate in both manual and automatic mode. In the manual mode the pump selected shall operate by means of push button ON/OFF switches incorporating LED lights. In addition the pumps shall however be stopped by means of a low level float control preventing the pumps from running dry.
- (c) In the automatic mode the pumps shall be activated by means of a 24 hour timer adjustable in 24 hour increments.

PFN 08.01.01.02 CONTROL OF INSTALLATIONS FOR SETS OF TWO CLOSE COUPLED CENTRIFUGAL PUMPS FOR VARIOUS APPLICATIONS 2.5Kw

- (a) The pump set shall be controlled by both a pump selector and mode selector switch mounted on the control panel. Each installation consist of two electrical pumps, and the switches for each of these pump sets are as follow:



- (b) The pumps shall be able to operate in both manual and automatic mode. In the manual mode the pumps shall be operated by means of push buttons incorporating LED lights. The pumps will be switched off if the water level in the supply tank reaches a minimum level to prevent the pumps from running dry.
- (c) In the automatic mode both pumps shall be activated by means of a 24-hour time switch capable of switching the pumps ON and OFF at hour intervals.
- (d) The timer shall have the function to override the hour intervals to enable continuous 24-hour operation in the automatic mode if so required.
- (e) Due to the design of the purification process the pumps could operate continuously.

To prevent on-going operation of one pump, in addition to normal stopping and starting the pump shall be controlled by means of a 24-hour time switch adjustable in 1 hour increments.

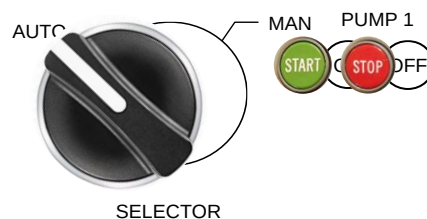
In automatic mode the pump running after 10 hours continuous operation must be switched OFF, immediately starting the other pump to continue operation.

- (f) Due to on-going stopping and starting in automatic mode, automatic stepping between the pumps shall occur when the mode selector switch is set at AUTO Pump 1 and Pump 2. In the event of one pump failing to switch on, the other pump must automatically be switched on again.

PFN 08.01.01.03 IRRIGATION PUMP INSTALLATION (2.5 KW)

The control board must be a free standing weather and waterproofed kiosk type.

- a) The pumps shall be controlled by a mode selector switch mounted on the switch board panel. The switches are shown below:



- b) The pump shall be able to operate in both manual and automatic modes. In the manual mode the pump can be operated by means of push button ON/OFF switches incorporating LED lights.

In addition the pump shall however be switched off at the low level probe in the storage tank to prevent the pump from running dry.

- c) In the automatic mode the pump shall be switched on by means of a 24-hour time switch capable of switching the pump ON and OFF at half hour intervals.

In addition the pumps shall be switched off at the low level in the existing storage tank controlled by float switch. If the timer is in the switch on mode the pump will restart as soon as the water level in the sump reaches high level norm. The pump will keep on pumping until the set time period has run out.

PFN 09 TESTING AND COMMISSIONING

PFN 09.01 TEST TO BE PERFORMED

- (a) All pumping equipment shall be subject to the commissioning tests as described in the applicable specification.
- (b) At least one of each type or size of pump supplied, repaired or reconditioned shall be subject to a delivery flow rate test. The Contractor shall supply flow rate or volumetric flow testing facilities.
- (c) The operating point of each pump shall be determined.

(d) Efficiency tests shall be performed.

(e) NPSH tests shall be performed

PFN 09.02 PUMP OPERATING POINT

During the Day 1 commissioning tests, the pump operating point shall be determined by observing the following:

- (a) pump delivery and suction pressures, and
- (b) electric motor power consumption.

If no efficiency tests are required, then the motor power consumption shall be calculated from the voltage and current measurements obtained during the commissioning test.

The Contractor shall supply the necessary adaptors, fittings and pressure gauges to measure the suction and delivery pressures. If no gauge fittings exist on the suction side, then the suction pressure conditions will be calculated from the system properties.

PFN 09.03 FLOW RATE (DELIVERY), EFFICIENCY AND NPSH TESTS

- (a) Testing shall be done in accordance with BS 5316 Part 1, Class C tests.
- (b) Power consumption of electric motors shall be as determined by the three-wattmeter method where efficiency tests are required in the detail specification.

PFN 09.04 TEST CONDITIONS

- (a) All tests shall be performed in situ.
- (b) The pumped medium or liquid shall be water.

PFN 09.05 ADDITIONAL TESTS

Additional tests may be specified in the detail of work.

PFN 10 MAINTENANCE

PFN 10.01 GENERAL

All pumping equipment and systems shall be serviced and repaired, following practical completion of the installation of which it forms part, to maintain it in perfect functional condition.

Maintenance shall be carried out and shall include routine preventative maintenance according to the manufacturer's specification to be set out in the operating and maintenance manual, as well as unforeseen repair work or replacement.

The remuneration for monthly maintenance of pumping equipment and systems shall be deemed included in the tendered rate for 10 points of the installation of which the system forms part. Installations are specified in Additional Specification SA: General Maintenance and illustrated in detail on the mechanical flow diagram.

PFN 10.02 ROUTINE PREVENTATIVE MAINTENANCE

The routine preventative maintenance work to be carried out shall include but not be limited to the items listed in table FN 10.2/1 below.

These actions and findings shall be logged and reported on the relevant approved schedules and reports.

NO	TABLE PFN 10.02/1 ROUTINE PREVENTATIVE MAINTENANCE OF CLEAR-WATER PUMP SYSTEMS	MAINTENANCE FREQUENCY
1	Visually inspect and report on the complete system	Monthly
2	Check, inspect, report and repair all leaks	Monthly
3	Log and record all meter readings for AMP, VOLTS, HOURS, ETC	Monthly
4	Check and verify the working conditions of floats switches and control devices.	Monthly
5	Check and verify the working condition of indication lights and replace if required	Monthly
6	Check and verify the working condition of selector switches and replace if required	Monthly
7	Internal inspection of all motor control and power distribution panels and cleaning.	Monthly
8	Check and lubricate moving parts on pumps and motors and related equipment where required.	Four-monthly
9	Check and tighten all electrical connections on motor control centres	Four-monthly
10	Check, service, repair and clean all types of pumps and motors	At least Six-monthly
11	Check, service, repair and clean all types of pump and motor bearings, couplings, mountings and seals.	At least Six-monthly
12	Corrosion protect pumps, motors and surface piping	Annually

PFN 11 MEASUREMENT AND PAYMENT

PFN 11.01 SUPPLY, DELIVERY AND INSTALLATION OF EQUIPMENT Unit: number

The unit of measurement shall be the number of pumping and other equipment units supplied, delivered and installed.

The tendered rates shall include full compensation for the design, manufacture, corrosion protection, patent rights, pre-delivery testing and test certificates, transport for delivery to the

site and off-loading, including all handling of the equipment. The equipment shall include the following:

- (a) The pump and motor as an integrated unit
- (b) Electrical power cable.
- (c) Installation of the guide rails and sealing frame;
- (d) Coupling of all required pipes flanges, including all required gaskets, nuts, bolts and washers;
- (e) Routing and fastening of the power cable up to the isolator box;
- (f) All required installation materials, labour and consumables to render a complete and working installation.

Separate items will be listed in the Schedule of Quantities for different types and sizes of equipment.

PFN 11.02 REPAIR, SERVICE, TESTING AND COMMISSIONING OF EQUIPMENT
 Unit: number

The unit of measurement shall be the number of pumping equipment unit's air blowers, dosing units, level switching controls etc. tested and commissioned.

The tendered rates shall include full compensation for the site handling and positioning of the equipment, including the fastening of the equipment in its designated position.

The tendered rates shall include full compensation for all preliminary tests, efficiency tests if required and commissioning tests. Commissioning tests shall comply with the section dealing with testing and commissioning.

Separate items will be listed in the Schedule of Quantities for different types and sizes of equipment.

PFN 11.03 DECOMMISSIONING AND REMOVAL OF EQUIPMENTUnit: number/meter

The unit of measurement for the decommissioning and removal of pumping equipment shall be as follows:

Motors, pumps, valves, non-return valves.....Unit: number
 Pipes, rods, cables.....Unit: meter

The tendered rates shall include full compensation for all labour, machinery, tools, transport and site handling necessary for the decommissioning and removal of pumping equipment.

Separate items will be listed in the Schedule of Quantities for different types and sizes of equipment.

PFN 11.04 SUPPLY AND INSTALLATION, TESTING AND COMMISSIONING OF MCC BOARDS OR OTHER ELECTRICITY BOARDS..... Unit: number

The unit of measurement shall be the number of MCC boards or other electricity boards manufactured and installed. The tendered rates shall include the compilation of shop drawings and line diagrams prior to delivery of the Control Board.

The tendered rates shall include full compensation for all components and materials and for tools, transport, site handling and labour necessary for the complete installation of all components of the board.

The unit of measurement shall be the number of MCC boards or other electricity boards tested and commissioned. Commissioning must be carried out as described in specification SC General Decommissioning, Testing and Commissioning Procedures.

Separate items will be listed in the Schedule of Quantities for different motor control systems.

PFN 11.05 COMPILATION OF WIRING DIAGRAMS Unit: number

The unit of measurement shall be the number of wiring diagrams compiled.

The tendered rates shall include full compensation for drawing, printing, computer time and any other associated costs necessary for the compilation of a wiring diagram.

PFN 11.06 RECONDITIONING OF TELEMETRIC SYSTEMS Unit: number

The unit of measurement shall be the number of telemetric systems repaired/ reconditioned.

The tendered rates shall include full compensation for the replacement of components and materials and for tools, transport, site handling and labour necessary for the complete reconditioning/repair of all components of the telemetric system.

PFN 11.07 DECOMMISSION, RECONDITION, TEST AND COMMISSION MCC BOARDS OR OTHER ELECTRICITY BOARDS AND RELATED EQUIPMENT Unit: number

The unit of measurement shall be the number of MCC boards or other electricity boards reconditioned/serviced.

The tendered rates shall include full compensation for the replacement of components and materials and for tools, transport, site handling and labour necessary for the complete reconditioning of all components of the board.

The tendered rate shall further include full compensation for the cleaning and opening of MCC or kiosk, vermin protection, checking of MCBs, checking and tightening of wire terminations, and fitting of labels and blank covers.

The tendered rate shall include for replacement of all defective components and parts on the face of the motor control centre which shall include selector switches, hour meters, AMP meters, Volt Meters, Pilot lights, push buttons, door control, hinges, rubbers and labels.

The replacement of electrical/electronic equipment within the motor control centre interior components shall be limited to all types of relays (time sequencing, level control, pump sequencing, on/off control, protection, monitoring, etc), wiring, phase sequencing and phase failure protection.

Contactors, PLCs, circuit breakers and all types of medium and low-voltage circuit breakers and contactors shall not be included in the rate.

Separate items will be listed in the Schedule of Quantities for different types and sizes of equipment or the location of the motor control centre. The condition of the existing motor control centre will be made evident during the compulsory site inspection but shall not limit the requirements of work to be executed to render the motor control centre in a complete working condition as per the intended design requirement.

SB OPERATING AND MAINTENANCE MANUALS AND SITE LAYOUT PLAN(S)

CONTENTS

SB 01	SCOPE
SB 02	PROCEDURE FOR SUBMISSION OF MANUALS
SB 03	FORMAT OF OPERATING AND MAINTENANCE MANUALS
SB 04	OPERATING AND MAINTENANCE MANUALS
SB 05	MEASUREMENT AND PAYMENT

SB 01 SCOPE

The Contractor shall be responsible for the compilation of an Operating and Maintenance Manual and site layout plan.

SB 02 PROCEDURE FOR SUBMISSION OF MANUALS

SB 02.01 SUBMISSION OF DRAFT MANUALS

A draft copy of the Operating and Maintenance Manual shall be submitted to the Engineer prior to a safety inspection of the installation. Approval of the draft Operating and Maintenance Manual shall be a prerequisite for the commencement of the safety inspection in terms of the Occupational Health and Safety Act, 1993 (Act No. 85 of 1993)

The manual will be reviewed and checked by the Engineer and returned to the Contractor with comments, where necessary. The Contractor shall make the necessary changes and amendments to the manual to incorporate the Engineer's comments.

SB 02.02 DEVELOPMENT OF FINAL MANUALS

A final draft copy of each Operating and Maintenance Manual shall be submitted to the Engineer at least one week prior to the commencement of Day 1 tests on commissioning. This set of manuals will not be accepted without the Contractor's verification of the information contained in the manual and the professional language editing thereof. The Engineer shall return the manual to the Contractor, who shall make the final corrections. The Engineer will, however, not be responsible for the quality control of the manual. Approval of the final Operating and Maintenance Manual shall be a prerequisite for issuing of a Certificate of Practical Completion for the repair of the installation.

After the Engineer has approved the final Operating and Maintenance Manual, the Contractor shall provide the Engineer with three (3) sets of the manual. Approval of the final Operating and Maintenance Manual shall be a prerequisite for issuing of a Certificate of Completion.

SB 03

FORMAT OF OPERATING AND MAINTENANCE MANUALS

- (a) The manual shall be bound in hardcover lever-arch files with plastic coatings. The file shall be clearly labelled on the front cover, as well as on the back band, with the following information:
 - (i) The title "Operating and Maintenance Manual"
 - (ii) Name of the installation
 - (iii) Name of the contract and contract number
 - (iv) The Contractor's name, address and contact telephone number and fax (logo optional)
 - (v) Month and year in which the manuals are finally handed over to the Employer
 - (vi) Name of the User Client.
- (b) Pamphlets and bound leaflets/booklets from suppliers or manufacturers shall be placed in plastic pockets.
- (c) Drawings and diagrams larger than A3 shall be folded and placed in plastic pockets to be easily removed or stored.
- (d) The sections of the manuals specified below shall be clearly partitioned.
- (e) Cross-referencing between drawings/diagrams and text shall be in a clear and consequent format.
- (f) The Operating and Maintenance Manuals shall be supplied in English.

SB 04

CONTENTS

SB 04.01

TABLE OF CONTENTS

The table of contents shall appear on the second page and shall consist of the headings of the various sections in the manual and the relevant page numbers.

The table of contents shall essentially contain at least the following:

1. Introduction
 - 1.1 Scope of the manual
 - 1.2 General arrangement of the manual
 - 1.3 Description of installation
 - 1.4 Specifications
2. List of drawings and diagrams
3. Parts and components
4. Operating procedures
5. Maintenance

- 5.1 Purpose of maintenance
- 5.2 Preventative maintenance
- 5.3 Troubleshooting

6. Breakdown maintenance and repair

7. List of Appendices.

SB 04.02 **INTRODUCTION**

The introduction shall contain at least the following:

SB 04.02.01 **Scope of the manual**

A summary shall explain the scope of the contents.

SB 04.02.02 **General arrangement of the manual**

A brief description shall explain the way in which the manual is arranged.

SB 04.02.03 **Description of installation**

This section shall give a functional description of the complete installation covered by the manual, including all systems and/or functional units deemed to form part thereof.

SB 04.02.04 **Specifications**

A summary shall be given of the specifications applicable to the particular part of the Contract.

SB 04.03 **DRAWINGS AND DIAGRAMS**

SB 04.03.01 **Mechanical flow diagrams (MFDs) and single-line diagrams**

Mechanical flow diagrams (for mechanical systems) or single line diagrams (for electrical systems) of the system and/or functional unit shall be included in the Operating and Maintenance Manuals for easy reference by the operators of the installation. Diagrams shall be drawn not only for parts of an installation that has been repaired but also for the complete installation, including all the components.

SB 04.04 PARTS AND COMPONENTS

SB 04.04.01 Equipment data sheets

A data sheet shall be drawn up for each piece of equipment and/or machine forming part of the installation and shall contain the following information:

- (a) Equipment tag number
- (b) Equipment description
- (c) Model/make/manufacture
- (d) Supplier/Reconditioning details
- (e) Ordering details
- (f) Details of fixed components
- (g) Details of lubrication
- (h) Maintenance references (refer to supplier/reconditioning technical manual).

SB 04.04.02 Technical equipment manuals

For each piece of equipment and/or machine forming part of the installation, the following information shall be included in this section of the Operating and Maintenance Manuals:

- (a) the supplier or reconditioning manual and/or standards of operating and maintenance instructions.
- (b) illustrated parts breakdown and/or group assembly drawings as agreed with the Engineer.
- (c) parts lists and data sheets, including all characteristic curves for machines indicating operation point, efficiency, power consumption, etc.
- (d) calibration charts, and
- (e) test certificates for hydraulic pressure tests, flame-proof grading, materials, non-destructive examinations, coating and lining details, etc.

Each detailed description shall be accompanied by a set of engineering drawings. From the drawings, the functionality of each part or component used, as well as the special characteristics associated with the part or component, shall be very clear.

SB 04.04.03 **Parts and components list**

A detailed description shall specify all the parts and components used for the duration of the Contract. This description shall include new parts and components, as well as existing parts and components that have either been reconditioned or used as specified in the Contract.

The description shall state at least the part or component number, part or component name, the size of the part or component, an explanatory description, the quantity used, the material of which the part or component is made, the coating (if any), date of purchase, as well as any relevant remarks as to the application thereof.

Details of the manufacturer of the part or component shall also be listed. This shall at least state the name, address, telephone number, fax number and name of a contact person.

The supplier of the part or component shall also be stated and shall include at least the name, address, telephone number, fax number, name of a contact person and an alternative supplier (if available).

SB 04.04.04 **Drawings**

Drawings shall contain a descriptive heading, an explanatory key, and relevant comments. Drawings shall be done on a computer-aided design package approved by the Engineer.

A compound drawing for all subassemblies shall clearly indicate how and where the various parts fit in the subassembly. The compound drawing shall be linked to the equipment data sheets and parts and components list and shall clearly specify the parts or components used, their model numbers, their sizes and the quantities used. The compound drawings shall also be accompanied by a brief description explaining the workings of the subassembly, as well as the assembly of the parts or components to complete the subassembly.

SB 04.05 **OPERATING PROCEDURES**

The operating instructions shall be a step-by-step description of the manual start-up and shut-down procedure for every piece of equipment and/or process reconditioned, repaired or supplied with references to the MFDs. For automatic operation, the operators shall be referred to the automatic control manual (if applicable).

The functioning of the installation shall be clearly described using a flow diagram depicting the interrelationships among the various subassemblies. The subassemblies shall be described by descriptive drawings.

Each mechanical or process flow diagram shall contain at least a heading, relevant comments and a key.

Every subassembly shall also have its own flow diagram explaining the operation of the subassembly, as well as the application of each part and component. The application of the subassembly shall also be very clear. The flow diagram shall consist of at least a heading, relevant comments and an explanatory key.

A detailed description shall be given of all operational systems forming part of the installation, explaining the operation and functioning of the system and the number of operations personnel required for performing the operation successfully.

The preparations, which are required before the system can be operational, shall be clearly stated and explained.

The operation tasks shall be clearly explained with reference to dangerous situations that might occur. Hazardous operations shall be explained in detail and cover all the applicable safety precautions.

SB 04.06 **MAINTENANCE**

SB 04.06.01 **Purpose of the maintenance**

The maintenance process shall be explained, and the main responsibilities described.

SB 04.06.02 **Preventative maintenance**

A preventative maintenance and lubrication schedule shall be included in this section. This schedule shall be in table format and shall include a summary of all the maintenance actions required for each different system and/or functional unit covered by this manual to give a single summary of all routine preventative maintenance actions required for the complete installation.

The schedule shall indicate daily, weekly, fortnightly, monthly and yearly maintenance actions. A lubrication schedule summary shall also be included in this section.

The frequency of routine preventative maintenance actions shall be indicated very clearly.

The Contractor shall provide the maintenance requirements as prescribed by the manufacturer. The type of maintenance shall be clearly indicated. The description of the maintenance to be performed shall include at least the part name, the location of the part in either the assembly or subassembly, the model number, the quantity of the particular part or component to be maintained, the type of maintenance, and notes on the maintenance procedure.

A brief description shall accompany the maintenance schedule, indicating special tools to be used, maintenance and test equipment required for the test procedures. Any special tools necessary for maintenance shall be specified in terms of name, model, size, manufacturer, supplier (name, telephone number, fax number, contact person), coating (if any) and notes on the use of the equipment.

Remarks on the system readiness checks of each subassembly shall be explained in detail. Routine inspection and maintenance processes shall be described. It shall be very clear what needs to be done, how to perform the necessary task and any dangers that are present.

SB 04.06.03

Troubleshooting

An explanation shall be given to assist the maintenance personnel in analysing and resolving malfunctions that might occur. Various scenarios with possible causes and rectification procedures shall be explained.

The scenarios shall be accompanied by drawings indicating the position of the part that is faulty. Each of these drawings shall have a heading, comments and an explanatory key.

SB 04.07

BREAKDOWN MAINTENANCE AND REPAIR

The Contractor shall describe the complete procedure to be followed in the event of a breakdown. It shall be very clear what the operating personnel should look for, how to eliminate any dangers due to the breakdown (e.g., electricity must be shut off in the event of problems with the wiring) and who should be contacted. The Contractor shall supply the names and telephone numbers of at least two contact persons who may be contacted in the event of a breakdown.

Repair instructions shall provide the maintenance personnel with detailed instructions for the removal and/or replacement of any item requiring replacement due to malfunctioning. Contact numbers shall also be given to assist maintenance personnel should a breakdown occur.

The Contractor shall specify the actions expected of maintenance personnel in the event of a breakdown.

The Contractor shall also specify the testing procedures to be followed before the system can be put into operation again. Every procedure shall be described clearly, and all the potential dangers pointed out, as well as the precautions that must be taken.

The testing procedures shall be accompanied by drawings illustrating the process to be performed. Every drawing shall have a heading, comments and an explanatory key.

SB 05

MEASUREMENT AND PAYMENT

SB 05.01

Compile and supply a complete set of Operating and Maintenance Manuals

..... Unit : sum

The unit of measurement shall be a sum for each complete set (three copies) of Operating and Maintenance Manuals.

The tendered sum shall include full compensation for all technical research, gathering of information, compilation of manufacturer's instructions, compilation of drawings and diagrams, and for writing of all the descriptions, instructions and functional procedures, as well as language editing, in order to provide a clear and correct set of Operating and Maintenance Manuals.

The tendered sum shall also include full compensation for all expenses such as paper, copy work, binding and printing necessary for the completion of the manuals.

The tendered sum shall also include full compensation for the compilation of draft sets of operating and maintenance manuals in accordance with the specification, and for incorporation of all comments and corrective requirements.

SC GENERAL DECOMMISSIONING, TESTING AND COMMISSIONING PROCEDURES

CONTENTS

SC 01	SCOPE
SC 02	PHASED REPAIRS AND UPGRADING OF THE INSTALLATION
SC 03	DETAILED COMMISSIONING PROGRAMME
SC 04	COMMISSIONING COMMUNICATION CHANNELS
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SC 07	MATERIAL AND EQUIPMENT PROCUREMENT AND PROTECTION
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SC 09	TESTING OF MATERIAL AND EQUIPMENT SPECIFICATIONS AND WORKMANSHIP
SC 10	DECOMMISSIONING
SC 11	RECOMMISSIONING, COMMISSIONING AND COMPLETION OF INSTALLATIONS
SC 12	MEASUREMENT AND PAYMENT

SC 01 SCOPE

This specification encompasses all aspects of the repairs of systems and services that form part of an installation, including the factory and on-site testing, decommissioning, installation and commissioning of all equipment, instrumentation and materials reconditioned, supplied and installed as part of an installation.

The specified procedures are the minimum requirements to be supplemented by various technical and particular specifications in this document. These requirements shall apply to all commissioning work scheduled as part of the initial repair work on installations, as well as commissioning work that is part of the routine preventive and corrective maintenance.

SC 02 PHASED REPAIRS AND UPGRADING OF THE INSTALLATION

When an installation consists of parallel systems or components, the complete installation and all its components shall be repaired without taking the complete installation out of commission at any time unless otherwise specified in the Technical Specifications.

In order to schedule the repairs of an installation, all work shall be done in phases as specified in the Technical Specifications and illustrated in detail on the Drawings. Repairs of each part shall terminate with the successful reconditioning of that part. Each part of the system shall be decommissioned and recommissioned in the sequence specified in the Technical Specifications and on the Drawings.

The Contractor shall install all the necessary temporary specials, spool pieces, supporting frames and brackets to provide a functional link between each repaired and upgraded part of the system and the part of the installation that has not yet been repaired and upgraded during recommissioning. Electrical and instrumentation Contractors and subcontractors shall ensure that the system remains operational as specified, using either existing or newly installed instruments, cables and controls.

Payment is based on the successful recommissioning of a specific part of the installation.

SC 03

DETAILED COMMISSIONING PROGRAMME

No work of any kind on any part of the existing installation shall take place prior to the Engineer's approval of a detailed commissioning programme. This programme shall be submitted in addition to the general programme for planning and monitoring contract progress at least two weeks prior to any programmed shutdown. The programme shall be the coordinated product of the Engineer and the User Client. Commissioning programmes shall take all process requirements into account. The detailed commissioning programme shall indicate all actions necessary for:

- (a) Decommissioning
- (b) Recommissioning parts of the installation
- (c) Commissioning of the installation as a whole.

All work deemed necessary for the practical completion of the installation shall be indicated on the commissioning programme.

The programme shall indicate the milestones to be achieved before shutdown and decommissioning as activities of zero duration, all of which shall be prerequisites linked to the "start" of decommissioning.

The following specific actions shall be included in the programme, clearly indicating the time allowed for:

- (a) Communication, including the time for confirmation of the official shutdown.
- (b) Draining parts of the installation to sumps, where available, or to other storage facilities provided by the Contractor.
- (c) Installation of temporary blanked flanges or other means of isolation where necessary.
- (d) Partial decommissioning and removal of existing material and equipment to perform work, including protection of pipework against hot work, cutting into the pipework, loosening bolts, flanges and all other work necessary for recommissioning.
- (e) Installation of temporary functional links (pipe specials) between any two parts of the installation.
- (f) Each individual field weld is subject to the Engineer's approval.
- (g) Non-destructive testing of materials for manufacturing/construction quality and for producing test results.
- (h) Installation of all instruments and their connection to SCADA systems.
- (i) Installation and connection of all power cables.
- (j) De-aeration of all pipe sections.
- (k) Communication between the Contractor, the Engineer, the Employer and the User Client.
- (l) Start-up of the complete system, indicating start-up procedures.

Inspection of the prefabricated installation, testing of all equipment prior to final commissioning, pressure testing and non-destructive testing shall be clearly scheduled in the project progress programme.

Day 30 tests and instruction/training sessions with the User Client shall be scheduled in the project progress programme.

SC 04 COMMISSIONING COMMUNICATION CHANNELS

The Contractor shall communicate with the User Client's operating and maintenance managers via the Engineer to finalise start-up after decommissioning in accordance with the specified procedures.

The following key parties shall be involved before and during the shutdown and decommissioning of any part of the system:

Contractor: Site Agent
 Engineer: Engineer Representative
 Employer: Representative of Area Manager
 User Client: Operating and Maintenance Manager.

SC 05 COMMISSIONING RISK CONTROL AND PENALTIES

- (a) The safety instructions stipulated by the Occupational Health and Safety Act 85 1993 (Act 85 of 1993) shall be adhered to at all times.
- (b) The Contractor shall not be allowed to work on any part of the installation without obtaining a commissioning check permit on the day of the shutdown. A typical example of a commissioning check permit is included in this document, referring to the minimum required milestones to be achieved prior to decommissioning.
- (c) Payment reductions for exceeding the maximum permissible downtime during maintenance shall apply as stipulated in the General Conditions of Contract and the Contract Data. This stipulation does not include shutdowns during programmed routine preventive maintenance work.

SC 06 DELAYS OF SCHEDULED SHUTDOWNS

Specific dates on which an installation shall be shut down for decommissioning shall be finalised during coordination meetings of all the parties involved, including the Engineer, the Employer, the User Client and the Contractor.

Although a date for each shutdown will be scheduled at the coordination meetings, the actual date of the shutdown shall be determined by the process requirements and user demands, allowing for a window of seven (7) calendar days from the date of the planned shutdown.

Prospective bidders shall make allowances in their bid rates for the shutdown to occur at any time during this seven-day period. No additional payment shall be due if the shutdown occurs within this seven-day period.

If the Contractor fails to commence with the shutdown and decommissioning of the installation within the scheduled period, all additional costs arising from the shutdown at a later stage shall be for the Contractor's account.

SC 07 MATERIAL AND EQUIPMENT PROCUREMENT AND PROTECTION

It is the responsibility of the Contractor to ensure the functionality of all units of new equipment prior to decommissioning and before installation of any specific part of the system. If the equipment, whether free-issued or not, does not conform to the functionality specifications during pre-installation testing, the Contractor shall notify the Engineer in writing without delay.

SC 08 TESTING OF EQUIPMENT PRIOR TO RECOMMISSIONING

The equipment shall be tested for functionality after the pre-installation of equipment in parts of the installation.

- (a) The Contractor shall inform the Engineer well in advance of his intention to perform the first tests and start-up of equipment in order to allow a representative of the Engineer to witness the tests. The extent of all pre-commissioning tests and checks shall be agreed upon with the Engineer prior to commencement.
- (b) The Contractor shall first conduct his own tests of the equipment. When he is satisfied that the equipment complies with the specifications, he shall notify the Engineer that he is ready for the official tests on completion. The Contractor shall not conduct an official test without the Engineer's presence or approval. All equipment shall conform to the specified requirements.
- (c) Before starting up any part of the installation or filling the tanks and sumps with liquid, the Contractor shall clean out the tanks, pipes, fittings, equipment or structures and, if necessary, make arrangements with other Contractors to remove their building rubble from the structures, check that all safety devices and alarms have been set and activated, all nuts have been tightened correctly, that all the equipment is complete and ready for start-up, that the plant has been installed correctly, and that copies of the operating manuals have been handed to the Engineer.
- (d) The Contractor shall start up each section of equipment after ensuring that oil fillings, lubrication, vibration monitoring, cable termination and so on have been correctly completed. He is also responsible for the first refilling of all lubricating oils and for adjusting the plant to operate according to the specifications. Before any equipment is started or energised, the Contractor shall ensure that it is safe in terms of the personnel and equipment on the site to do so. The Contractor's tendered rates and sums shall allow for these costs.

All equipment shall be tested according to the relevant specifications that form part of this document.

No shutdown or decommissioning of any part of the system shall take place unless all the equipment to be installed has been tested by the Contractor and approved by the Engineer.

SC 09 TESTING OF MATERIAL AND EQUIPMENT SPECIFICATIONS AND WORKMANSHIP

All results of the required non-destructive, pre-commissioning and manufacturing testing shall be submitted to the Engineer well in advance of testing the equipment on recommissioning. All such test results shall be submitted before Day 1 commissioning tests, and no certificate of practical completion shall be issued prior to receipt of the required test results.

SC 10 DECOMMISSIONING

The decommissioning period shall commence on the instant of the entire system shutdown. The recommissioning period shall start in parallel with decommissioning.

Shutdown and decommissioning shall not proceed without compliance with all the milestones in the detailed commissioning programme. The list of milestones in this document is not complete but indicates the minimum requirements. Milestones to be achieved prior to shutdown and decommissioning may be added to the programme at the Engineer's discretion.

The Contractor is responsible for the safe decommissioning of all material, equipment, components and instrumentation to avoid damage to parts or components of the installation.

SC 11 RECOMMISSIONING, COMMISSIONING AND COMPLETION OF INSTALLATIONS

SC 11.01 RECOMMISSIONING

Recommissioning means the commissioning of all sections or systems that form part of the installation to meet the required functional specifications for the individual section or system prior to the commissioning of the repaired and upgraded installation.

The Contractor is responsible for the recommissioning of all parts of the system, and he shall perform the tasks listed below.

- (a) Prior notice shall be given to, and proper arrangements shall be made for recommissioning with the Employer, the Engineer, the User Client and the suppliers of equipment that is affected by recommissioning and testing.
- (b) If plant and equipment supplied by others are to be commissioned, the supplier's specific permission, together with all requirements related to commissioning, shall be obtained prior to recommissioning without in any way altering the General Conditions of the Contract and the Contract Data with reference to the Contractor's liability in terms of defects.
- (c) The new and reconditioned parts of the installation shall be thoroughly inspected by a responsible representative of the Contractor to ensure that manufacture/construction and installation work have been completed according to the specifications.

SC 11.02 COMMISSIONING AND COMPLETION OF REPAIRS AND UPGRADING WORK

Commissioning means commissioning the repaired and upgraded installation as a whole to perform in perfect working order.

- (a) The commissioning period for each installation as a whole:
 - (i) Commences with the Day 1 tests of the complete repaired and upgraded installation.
 - (ii) Includes commissioning of all sections and systems that have been recommissioned prior to the Day 1 tests.
 - (iii) Includes training of the User Client's operating personnel and the maintenance teams.
 - (iv) Terminates with a Day 30 test in compliance with the commissioning report.
- (b) The purpose of the Day 1 tests is to ensure that:
 - (i) The electronic, electrical and mechanical equipment and materials are functional and in perfect working order with respect to each other and the installation as a whole.
 - (ii) The commissioning period, including training, commences on successful completion of the Day 1 tests.
 - (iii) The Contractor is entitled to a certificate of practical completion for the repairs and upgrading of the installation on successful completion of the Day 1 tests.
 - (iv) The Contractor becomes responsible for maintenance of the installation and is entitled to performance-based payments in compliance with Additional Specification SA: General Maintenance.
- (c) Commissioning shall be undertaken over a trouble-free period up to Day 30. During this period, the Contractor shall train the User Client's operators and his maintenance team for operating and maintaining the installation. This training shall allow for all possible operational conditions, including emergency conditions, the correct servicing of every part, the type of oil or grease to be used, and similar tasks. The training shall take place by means of demonstrations, and the operating and maintenance manuals shall be referred to for this purpose.
- (d) Day 30 commissioning tests shall be performed thirty calendar days after the successful completion of the Day 1 tests. The commissioning period of the installation terminates upon the successful completion of the Day 30 tests.
- (e) The Contractor shall conduct all the tests required to satisfy the Engineer that the installation is performing according to the specification and shall make allowance for these tests in his bid rates and prices. These tests shall be conducted to certify that the installation, as repaired, upgraded and installed, is in perfect working order in terms of the specified functional requirements. The Contractor shall note that all equipment is to be tested as part of an installation, where appropriate, and will not be passed if all protection devices, interlocking with other equipment, etc, are not fully functional.
- (f) The Engineer shall provide commissioning sheets to the Contractor at least three weeks before the commissioning period commences for all the equipment supplied, reconditioned and installed by the Contractor. The Contractor shall complete the commissioning sheets during the commissioning period and all items listed shall be

entered. No completion certificate will be issued for an installation of which the equipment has incomplete commissioning reports. Information that is not available or applicable, or instances where certain tests have not been carried out, are subject to the Engineer's decision.

- (g) Commissioning of the plant (which includes the thirty days between the Day 1 and Day 30 tests) includes operating under conditions that adequately prove that all the specifications have been met. All safety devices, standby plant, automatic controls and protective devices shall be adequately tested for reliability and correct functioning. The Contractor may be called upon to repeat testing during the maintenance period if the performance of the equipment is suspected to be substandard. Costs related to such tests shall be for the Contractor's account and shall comply with the specified requirements. Copies of updated commissioning reports shall be provided to the Engineer within two days after a test has been performed.
- (h) The Contractor is responsible for providing all labour and materials (including testing equipment) during the commissioning period and shall carry out all the servicing and adjustments to ensure that the installation operates as specified. Valid calibration certificates shall be available for all testing equipment on the site during the commissioning period.
- (i) Programmes for the Day 1 tests, Day 30 tests and instruction/training sessions with the User Client's operators and maintenance team shall be prepared by the Contractor and submitted to the Engineer at least two weeks before the commissioning period commences. The Contractor shall provide weekly updates of these schedules for the duration of the commissioning period.
- (j) The Contractor shall note that if any equipment fails during the commissioning period, the equipment shall be repaired or replaced by the Contractor, and testing and commissioning shall commence from scratch.
- (k) Successful commissioning of an installation entitles the Contractor to a certificate of completion for the installation.

SC 12 MEASUREMENT AND PAYMENT

SC 12.01 DECOMMISSIONING AND REMOVING PARTS OF THE INSTALLATION Unit: sum

The unit of measurement shall be a sum.

The sum bid shall include full compensation for all actions and labour required for shutdown and decommissioning of the entire installation as specified to enable decommissioning and removal of parts of the installation as listed in the Bill of Quantities.

The sum bid shall include full compensation for the decommissioning and removal of the parts and components of an installation as listed individually in the Bill of Quantities, including actions and/or costs resulting from such work, to enable the recommissioning of parts of the repaired and/or upgraded installation.

The sum bid shall include full compensation for final dismantling of decommissioned materials and equipment and the removal of all such items to stores on site, as directed by the Engineer.

SC 12.02 COMMISSIONING AND TESTING OF PARTS OF THE

INSTALLATION Unit: sum

The unit of measurement shall be a sum.

The sum bid shall include full compensation for commissioning and testing parts of the installation to be operational while still incomplete in relation to the entire repaired and/or upgraded system or installation.

Separate payment items shall be billed for separate parts of the system.

SC 12.03 **COMMISSIONING AND TESTING OF THE**
INSTALLATION Unit: sum

The unit of measurement shall be a sum.

The sum bid shall include full compensation for commissioning the upgraded installation as a whole and for all costs and expenses related to labour, removal, repair, reinstallation and testing of material and equipment during the commissioning period for each part of the installation. The sum bid shall include full compensation for the final commissioning and testing, including Day 1 and Day 30 tests, of all parts and components of the installation to the specified functional condition.

Payment shall be based on the successful completion of the Day 30 tests.

SC 12.04

**PROVISION FOR SAFETY AND HOT WORK REQUIREMENTS
 DURING SHUTDOWN**..... Unit: sum

The unit of measurement shall be the number of shutdowns during which all the required safety and hot work requirements are provided.

The bid rates shall include full compensation for all the required safety and hot work requirements and arrangements in accordance with the specifications during a shutdown period, including all labour, personnel, equipment, materials and consumables required.

PORTION B

PA HEALTH AND SAFETY SPECIFICATION

PA1 DESCRIPTION OF WORK

The Contract shall comprise the supply of all labour, materials, workmanship, machinery, equipment, transport, attendance on others and everything stated or implied which is, or may be, necessary in and for the entire completion of all the following works:

- Establishment
- Installation, testing and commissioning of a New Reverse Osmosis Water Purification System
- Compliance to regulations relating to Health and Safety and the Environmental Management Acts

PA2 DESCRIPTION OF THE SITE

- The Hantam National Botanical Garden (NBG) is located 4km South-East of Nieuwoudtville in the Northern Cape
- Coordinates 31°23'52.73"S, 19°08'27.05"E

PA3 APPLICATION OF CONSTRUCTION REGULATIONS 2014

The intended construction work falls within the scope of "construction work" as defined in the Construction Regulations, 2014 made under the Occupational Health and Safety Act no. 85 of 1995, as amended ("the Act").

PA4 POTENTIAL SOURCES OF RISK

The following potential sources of risk to the health and safety of persons on the site have been identified, and must, as a minimum, be appropriately addressed by the Principal Contractor in the Principal Contractor's Health and Safety Plan. In addition, the Principal Contractor must perform its own risk assessments to enable it to take the necessary precautions to protect the health and safety of persons on the site, to comply with the Principal Contractor's obligations under the Act and all Regulations made there under, including the Construction Regulations. All such precautionary measures and procedures must be included in the Principal Contractor's Health and Safety Plan, which must be submitted to the Client for review and approval and where applicable should include:

- Excavation work
Ground conditions for the purposes of safe excavation shall be assessed by a competent person. The ground type and condition and water table shall be logged in accordance with Civil Engineering practice.
- Scaffolding
- Material hoists
- Construction vehicles and mobile equipment
- Electrical installations and electrical machinery
- Use and temporary storage of flammable liquids
- Housekeeping
- Stacking and storage practices
- Fire risks and fire precautions
- Welfare facilities on the site
- Air compressors
- Hot work (steel cutting and welding)
- Noise
- Portable electrical tools
- Compressed gases and vessels under pressure

- Intoxicated persons on site
 - Existing underground water, electricity and other services
 - Use of ladders
 - Dust
 - Inadequate or fragile coverings
 - Explosives
 - Testing of pipelines
- The contractor's attention is drawn to large forces existing on pipelines, specials and supports during pressure testing, and shall ensure that structures are properly secured during testing to withstand the pressures and forces.

PA5 HEALTH AND SAFETY MANAGEMENT SYSTEM

Health and Safety Philosophy

The Client is required to ensure a working environment which, as far as reasonably practicable, is safe and without risk to the health of persons on the site.

PA5.1 Contractor Health and Safety Management System

The Principal Contractor will ensure and demonstrate to the Client that he, and all contractors to be appointed on this construction project, has adequately allowed for the cost of health and safety measures which may be required during the construction work.

PA5.2 Appointment of Client's Health and Safety Adviser

The Client will appoint a Health and Safety Adviser who will visit the site regularly to monitor and audit the execution of the contractor's Health and Safety Plans on behalf of the Client, without thereby limiting the contractor's own responsibility for health and safety, or attracting any vicarious responsibility or liability for the contractor's acts or omissions.

PA5.3 Occupational Health and Safety Act Section 37(2) Agreements

The Principal Contractor, as well as all contractors, must sign the Client's Section 37(2) agreement before commencement of their particular work.

For purposes of general communication regarding construction work progress, the Client appoints the Engineer.

PA6 CONTRACTOR HEALTH AND SAFETY PLANS

Each contractor and sub-contractor working on the site must prepare a Health and Safety Plan to address and manage all applicable sources of risk as per items under point 4 of this specification as well as any other sources of risk which are identified during the contractor's own risk assessments. The Principal Contractor shall incorporate these into a single Health and Safety Plan for the execution of the entire contract works ("the Health and Safety Plan"). Should any further risks be identified in the course of the construction work, such risks must be assessed and addressed in amended Health and Safety Plans which must then be submitted to the Client for approval.

The Health and Safety Plan must also address the following matters:

- i) Legal appointments required by the Act and any Regulations under the Act.
- ii) Procedures for compliance with all requirements of the Act and in particular Sections 8 and 9 of the Act.
- iii) Undertaking and procedure to stop any work which endangers the safety or health of any person.
- iv) System for recording and reporting of incidents both internal and external to the Department of Labour.
- v) Copy of the Act and its Regulations to be kept on the site and to be readily available to employees.
- vi) Incident register to be kept on the site.
- vii) Employment of only persons who are competent and have the necessary knowledge, training, qualifications and experience to perform the required construction work safely and effectively.
- viii) Appointment of only competent, knowledgeable, trained, qualified and experienced persons to supervise the construction work.

- ix) Procedures and arrangements for first aid facilities on the site.
- x) Procedures and arrangements for prompt reporting of injuries and other losses / incidents.
- xi) Emergency plans to deal effectively with potential site emergencies.
- xii) Use of effective processes for the identification and close out of root causes of incidents and accidents.
- xiii) Attendance by all contractors of monthly site health and safety meetings.
- xiv) Demonstration by all contractors of their health and safety monitoring and auditing systems to ensure compliance with their Health and Safety Plans, as part of their Health and Safety Plans.
- xv) Effective site health and safety induction programme for all workers on the site.

PA7 ADDITIONAL DUTIES OF PRINCIPAL CONTRACTOR

- i) The Principal Contractor must notify the Department of Labour of the intention to carry out construction work.
- ii) The Principal Contractor must coordinate the activities of all contractors and sub-contractors in the interest of health and safety.
- iii) The Principal Contractor must carry out all other duties described in Regulation 5 of the Construction Regulations 2003.
- iv) The Principal Contractor must register in terms of the Compensation for Occupational Injuries and Diseases Act or any other compensation funds approved by the Commissioner for its workmen, and provide to the Client proof thereof and also that it is in good standing with the Compensation Commissioner or approved insurer.

PA8 GENERAL

- i) Nothing contained in or omitted from this Health and Safety Specification, or the Health and Safety Plan based on this specification, shall relieve the Principal Contractor of any of its obligations or liabilities.
- ii) The Client shall not be liable for any civil claim because of anything contained in or omitted from this Health and Safety Specification.

PA9 MEASUREMENT AND PAYMENT

In addition to the allowance that the contractor would normally make in his rates for Health and Safety Aspects, the contractor shall price for all things necessary required to fulfil the requirements of the OHS Act and Regulations in the items scheduled in Schedule 1, General A.