

**.3: PROJECT SPECIFICATIONS****AMENDMENTS TO THE STANDARD AND PARTICULAR SPECIFICATIONS**

In certain clauses in the standard, standardized and particular specifications, allowance is made for a choice to be specified in the project specifications between alternative materials or methods of construction, and for additional requirements to be specified to suit a particular contract. Details of such alternative or additional requirements applicable to this contract are contained in this part of the project specifications. It also contains the necessary additional specifications required for this particular contract.

The number of each clause and each payment item in this part of the project specifications consists of the prefix PS followed by a number corresponding to the relevant clause or payment item in the standard specification.

The number of a new clause or payment item, which does not form part of a clause or a payment item in the standard specifications and which is included here, is also prefixed by PS, but followed by a new number which follows on the last clause or item number used in the relevant section of the standard specifications.

PART A: GENERAL**A1 SERVICES**

Provision is made in the bill of quantities for payment for searching and exposing of known or unknown services.

PS2 PROGRAMME OF WORK**(a) General requirements**

The bar-chart programme to be provided by the contractor shall show the various activities in such detail as may be required by the Employer's Agent. Progress in terms of the programme shall be updated monthly by the contractor in accordance with the progress made by the contractor.

In compiling the programme of work, the contractor shall indicate and make do allowance for the following:

- a. Civil works as per the tender drawings, Bill of Quantities and Scope of Works;
- b. Mechanical & Electrical (M&E) Works.

PS3 WORKMANSHIP AND QUALITY CONTROL

The Employer's Agent shall, however, undertake acceptance control tests for the judgement of workmanship and quality, without accepting any obligations vested with the contractor in terms of the contract with specific reference to quality of materials and workmanship. Such acceptance control test done by the Employer's Agent shall not relieve the contractor of his obligations to maintaining his own quality control system.

The Employer's Agent shall, for the purpose of acceptance control on products and workmanship, assess test results and measurements.

Where small quantities of work are involved, a lot shall mean a full day's production for a specific item of work subject to acceptance control testing.

Tenderer

Witness 1

Witness 2

Employer

Witness 1

Witness 2

**PS4 PAYMENT****(b) Rates to be inclusive**

VAT shall be excluded from the rates and provided for as a lump sum in the Summary of Bill of Quantities.

(e) Materials on the site

In addition, the Employer's Agent may at his sole discretion also allow payments under "Materials on Site" in respect of any construction materials if stored off-site providing that:

- (a) The site selected for this purpose is approved by the Employer's Agent;
- (b) Such land is physically separated from any production plant or operation;
- (c) Only materials for use under this contract is stockpiled on such land;
- (d) The contractor has provided proof of an agreement with the owner of such land that the owner has no claim whatsoever on any materials stockpiled on such land;
- (e) Materials obtained by the contractor for or on behalf of emerging subcontractors (SMME's) shall remain the responsibility of the contractor after payment has been made in respect of materials on site;
- (f) A cession form for the material has been provided to the approval of the Employer.

(f) Payments Certificates

With reference to Sub-Clause 6 of the General Conditions of Contract, the Employer's Agent's certificate will be issued only after receipt by him of a draft certificate/ valuation prepared by the Contractor in the form prescribed by the Employer's Agent.

The cost of duplicating and delivering copies of the Employer's Agent's Certificate to the Contractor, the Employer's Agent and the Employer shall be borne by the Contractor. A total of three copies of the certificate (A-4 size) will be required by the Employer's Agent and the Employer.

PS4 EXTENSION OF TIME RESULTING FROM ABNORMAL RAINFALL

Extension of time will not be considered for normal rainfall but only for abnormal rainfall or saturated conditions and will be calculated in accordance with the following method:

- a) The Contractor shall, in his programme, allow for the anticipated number of working days on which work could be delayed - as given in the Schedule below.
- b) Extension of time will be calculated for each calendar month or part thereof over the full period for the completion of the Work, plus any approved extension thereof, as follows:
 - i) A delay caused by abnormal rainfall will only be accepted for extension of time if, in the opinion of the Employer's Agent, it delays an item or items which lie on the critical path determined by the Contractor's programme. Only delays on working days will be considered;
 - ii) Abnormal rainfall will be days, as approved, on which rain delayed operations, less the anticipated number of days given in the Schedule below;

Tenderer

Witness 1

Witness 2

Employer

Witness 1

Witness 2

**CONSTRUCTION OF WESTERN HIGHVELD BULK WATER SUPPLY SCHEME
WORK PACKAGE 2**

- iii) The net extension of time determined for each month, which may be negative, shall accumulate algebraically to determine the net number days for extension of time due to abnormal rainfall, but a negative total at the end of the construction period will not be considered;
- iv) Where a portion of a month is involved, a pro rata number of days shall be calculated.

SCHEDULE:

Anticipated number of working days on which work could be delayed because of rainfall and saturated conditions.

Month	Days	Month	Days
January	6		
February	9		
March	3		
April	2		
May	2		
June	1		
July	0		
August	0		
September	0		
October	1		
November	2		
December	5		
Total	31		

PS 5 Issuing of Notices to Consumers

The Contractor shall be responsible for the preparation, printing and issuing/distribution of notices to affected consumers as instructed by the Employer/Engineer.

The notices shall be issued to all affected consumers prior to the commencement of any works that may result in disruption to existing services, including, but not limited to, interruptions to water supply, access restrictions, construction activities, service relocations, connections, disconnections and other activities that may directly affect consumers.

The Employer/Engineer shall provide or approve the content of all notices prior to their distribution. The Contractor shall not amend the approved content without the written approval of the Employer/Engineer. The Contractor shall ensure that notices are issued within the period stipulated by the Employer/Engineer and shall take all reasonable measures to ensure that the notices reach the affected consumers.

The Contractor shall maintain a register of all notices issued, indicating, as a minimum:

- (a) the date of issue;
- (b) the area, village, street or property affected;
- (c) the number of notices issued;
- (d) the names/signatures or other appropriate confirmation of receipt, where applicable; and
- (e) details of properties or consumers where delivery could not be effected and the reason thereof.

Tenderer

Witness 1

Witness 2

Employer

Witness 1

Witness 2



The Contractor shall submit the completed notice distribution register and any other required proof of notification to the Employer/Engineer for record purposes.

No notice shall be issued to consumers without prior approval of the Employer/Engineer.

The cost of preparing, printing, issuing and distributing notices to consumers, including all labour, transport, stationery and incidental costs, shall be deemed to be included in the Contractor's rates and prices, unless specifically provided for as a separate item in the Bill of Quantities.

Tenderer

Witness 1

Witness 2

Employer

Witness 1

Witness 2

**PART B PROJECT SPECIFICATION****PSA GENERAL (SABS 1200 A)****PSA 1 STANDARDISATION MARK (CLAUSE 3.1)**

Add the following to the Clause:

All material delivered to the site shall bear the Official Standardization Mark.

PSA 2 CONTRACTOR'S CAMP (CLAUSE 4.2)**PSA 2.1 Restrictions on employee accommodation (Sub-clause 4.2)**

No housing is available for the Contractor's employees. The Contractor shall make his own arrangements to house his employees.

The Employer shall place an area at the disposal of the Contractor to enable him to erect his site offices, workshops and stores. Any temporary housing and facilities shall comply with the requirements of the local authority. The Contractor shall provide his own fencing and site security.

PSA 3 DEALING WITH WATER (SUBCLAUSE 5.5)

In addition to the items as set out in Subclause 5.5 the contractor shall also provide pumping equipment, pipes and other equipment as may be necessary.

PSA 4 MEASUREMENT AND PAYMENT**PSA 4.1 Fixed charge and Value Related Items (Sub-clause 8.2.1)**

Replace the sub-clause with the following:

Payment shall be a lump sum to provide for the Contractor's expenses in connection with:

- (a) setting up and maintaining his organisation, camps and plant on the site;
- (b) effecting the insurances and indemnities required in terms of the General Conditions of Contract
- (c) meeting all other general obligations and liabilities which are not specifically measured for payment in these contract documents.

The lump sum total of items (a), (b) and (c) as measured and Fixed Charge Items and time Related Items shall not exceed 15% of the nett total Tender Amount. If the Tenderer should tender a higher amount for this item it shall be reduced to the amount allowed above and all other tendered prices increased in the proportion required to retain the same Nett Total Tender Amount.

The tendered lump sum shall not be subject to any variation if the actual value of work done under the Contract exceeds, or falls short of, the Tender Amount, or as a result of an extension of time for completion in terms of Clause 5.12 of the General Conditions of Contract.

Tenderer

Witness 1

Witness 2

Employer

Witness 1

Witness 2



Any payment made under this item shall not be taken into account when determining whether the value of a certificate complies with the "minimum amount of monthly certificate" laid down in the Appendix.

Before any payment is made under this item the Contractor shall satisfy the Engineer that he has provided on site an establishment and plant of good quality and in value exceeding that of the first installment. The Contractor may be asked to furnish documented proof that he owns the offices and plant on site, the value of which should exceed the amount claimed in the first certificate. In the event that the Contractor cannot satisfy the Engineer as to the value or ownership, the Engineer shall have the right to withhold part of any payments to be made under this item, until the Works have been completed.

Payment of the lump sum shall be made in three separate installments as follows:

- (a) The first installment, 50% of the lump sum, will be paid in the first payment certificate after the Contractor has met all his obligations under this sub-clause and has made a substantial start on construction in accordance with the approved programme.
- (b) The second installment, 35% of the lump sum, will be paid when the value of the work done reaches one half of the Nett Total Tender Amount.
- (c) The third and final installment, 15% of the lump sum, will be paid when the works have been completed and the Contractor has fulfilled all requirements of this sub-clause. No payment for the scheduled Fixed Charge Items for this contract will not be made until the requirements regarding and the erection of name boards have been met.

PSA 4.2 Time-Related Items (Sub clause 8.2.2)

Replace this sub clause with the following:

Subject to the provisions of 8.2.3 and 8.2.4, payment of item 8.4.1 (time-related item) will take place in equal monthly amounts, calculated on the tendered amount for the item, divided by the contract period in months, with the understanding that the total of the monthly payments which was paid for this specific item does not exceed the proportion that the progress of the works to date bears in relation to the works as a whole.

Should the Engineer grant an extension of time, the Contractor is entitled to an increase in the amount tendered for time related items, and this increase must be kept in the same proportion to the original tender amount as the extension of time is to the original time of the completion of the works.

Payment for such increased amounts will be considered as full compensation for all time related, provisional and general costs which arise as a result of the extension of time.

Tenderer

Witness 1

Witness 2

Employer

Witness 1

Witness 2

**PSA 4.3 Facilities for Engineer (Sub clause 8.3.2.1)**

Change the item descriptions of the following items as follow:

PSA 4.3.1 Item:

a) Engineer's office

Unit: Month

The specifications for the items listed below should be provided in accordance with the "Facilities provided by the Contractor" in C3.1 Scope of Works:

The tendered sum shall provide for the following:

Provide the following units:

- 2 x Airconditioned Offices (minimum 10 m²)
- 1 x Airconditioned Boardroom (accommodating 25 people)
- 1 x Kitchen (7 m²)
- 2 x WC units (male and female)
- 6 x carports with crushed stone floor

Note that the areas surrounding the units in the Engineer's camp must be covers with gravel as specified in Section C3.1 Scope of Works

The Boardroom shall each be furnished with the following:

- Air conditioner
- 1 x conference table to seat 25 people
- 25 x new chairs
- White board mounted to wall (Minimum 1.2 x 2m)
- 1 x 10 kg Fire Extinguisher

The office shall be furnished with:

- Air conditioner
- 2 x office desks and 2 x chairs
- 1 x drawing table
- 2 x steel cabinets
- 1 x A1 drawing rack
- 1 A4/A3 Colour laser printer/Scanner/Copier
- 1 x 10 kg Fire extinguisher

The kitchen shall be furnished with:

- 2 Min 300 l fridge/freezer combination fridge
- Microwave of min 36 l and 1 000 W
- Cordless kettle
- 2 x 1.8 m steel folding table
- A set of 12 x each of knives, forks, spoons and teaspoons
- A set of 12 x each of white ceramic crockery including dinner plates, side plates, bowls, coffee mugs, tea cups and saucers
- A set of 24 x beer glasses
- 1 x large wooden cutting board
- 1 x kitchen knife set in knife block which includes at least a large carving knife, bread knife, medium knife, pairing knife and kitchen scissors

Tenderer

Witness 1

Witness 2

Employer

Witness 1

Witness 2



- 1 x meat casserole with lid
- 1 x 10 kg Fire extinguisher

The contractor must supply the following equipment:

- New Dumpy Level and Staff
- New Dynamic Cone Penetrometer (DCP)
- Measuring wheel with electronic display
- Rain gauge
- 2 x 1m spirit level
- 2 x First Aid Kit

The contractor will provide the following additional services

- Uncapped WIFI coverage for the offices and boardroom (min 6 MBs speed)

PSA 4.3.2 Item:

c) Name board

Unit: month

The tendered sum shall provide for two contract nameboards as specified by the detail drawings.

PSA 4.4 Exposing of existing services

Add the following new pay item:

PSA 4.4.1 Item:

Excavation by hand in all materials to expose existing services Unit: cubic meter (m³)

The tendered sum must include full compensation for all hand excavation as per the dimension approved by the Engineer for the locating, exposing and moving of existing services. Excavation outside of approved dimensions will not be paid. The rate must also include for backfill and compaction to 90% of mod AASHTO density and, if applicable, the removal of excess material not used for backfill, the securing of excavations, for handling surface and subsurface water, for protection of existing services and for any other activity necessary to complete the work. Free haul of 1,0 km will be applicable on the transport of excess material.

No distinction will be made between classes of material or types of services.

Note: The Contractor must provide sufficient supervision over labourers when services are exposed."

PSA 4.5 Occupational Health and Safety

Add the following new pay items:

Provision for the cost related to the Occupational Health and Safety Act, 85 of 1993, and the relevant Regulations:

- a) Preparation of a Health & Safety Plan. Unit: Sum
- b) Compilation of a Risk Assessment prior to Construction. Unit: Sum

Tenderer

Witness 1

Witness 2

Employer

Witness 1

Witness 2



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|----|---|-------------|
| c) | Health & Safety induction Training of employees. | Unit: Sum |
| d) | Compilation and keeping up to date the Health & Safety file which shall include all documentation required in terms of the act. | Unit: Sum |
| e) | Implementation of the Health and Safety Plan over the entire construction period. | Unit: Sum |
| f) | Appointment of Safety Officer | Unit: Month |

The tendered sum shall include full compensation for providing the above services as required from the Occupational Health & Safety Act. The rate shall include all related costs incurred by the Act, remuneration of personnel, trainers, etc. and equipment required for the execution of the required services as depicted by the Act. The tendered amount for items a, b, c, d and e shall only be paid on the successful completion of the task as approved by the client. The tendered amount for item shall be paid on a monthly basis.

Tenderer

Witness 1

Witness 2

Employer

Witness 1

Witness 2

**PSA 4.6 SUMS STATED PROVISIONALLY BY THE ENGINEER**

Add the following new pay items:

PSA 4.6.1 Item:

Project Liaison Officer

Unit: Prov Sum

The total cost is for the duration of the project.

PSA 4.6.2 Item:

Project Liaison Committee

Unit: Prov Sum

The total cost is for the duration of the project.

PSA 4.6.3 Item:

Additional laboratory testing

Unit: Prov Sum

PSA 4.6.4 Item:

As-Built Survey

Unit: Prov Sum

The rate shall cover the cost for a surveyor to conduct an AS BUILT survey of the works as required by the Clients Agent

PSA 4.6.5 Item:

Provision of Accredited Training

(a) Generic skills

Unit: Prov Sum

(b) Entrepreneurial skills

Unit: Prov Sum

(c) Engineering skills

Unit: Prov Sum

PSA 4.6.6 Item:

Remuneration of a trainee student x 3

Unit: Prov Sum

PSA 4.7 Security Services

The Contractor shall provide adequate security services for the protection of the Works, construction sites, temporary facilities, plant, equipment, materials and other property under the Contractor's control for the duration of the Contract.

The Contractor shall be responsible for the provision, management and supervision of suitably trained and competent security personnel at all locations where security is required, including construction sites, storage areas, site establishments, access points, temporary facilities and other areas designated by the Employer/Engineer.

The security services shall include, but not be limited to, the following:

Tenderer

Witness 1

Witness 2

Employer

Witness 1

Witness 2



- (a) controlling and monitoring access to the construction site and other secured areas;
- (b) preventing unauthorised persons from entering the construction site or accessing construction plant, equipment, materials and facilities;
- (c) monitoring the movement of personnel, vehicles, plant and materials into and out of the site;
- (d) maintaining an accurate register of visitors, personnel, vehicles and deliveries where required;
- (e) undertaking regular patrols and inspections of the site and secured areas;
- (f) protecting construction materials, plant, equipment, tools and temporary works against theft, damage or unauthorised removal;
- (g) immediately reporting incidents of theft, vandalism, trespassing, damage, fire, accidents, security breaches or other unusual occurrences to the Contractor's Site Representative and the Employer/Engineer;
- (h) maintaining daily security occurrence registers and submitting such records to the Employer/Engineer when requested;
- (i) assisting the Contractor in maintaining orderly and controlled access to the site; and
- (j) providing additional security measures where reasonably required by the Employer/Engineer due to the nature, location or circumstances of the Works.

The Contractor shall ensure that all security personnel are suitably trained, appropriately identifiable and competent to perform the duties assigned to them. Security personnel shall conduct themselves professionally and shall comply with all applicable legislation and site rules.

Where security services are provided by a subcontracted security service provider, such service provider shall comply with all applicable legal and regulatory requirements relating to the provision of security services.

The Contractor shall submit details of the proposed security arrangements to the Employer/Engineer for information prior to commencement of the Works. The security arrangements shall include the proposed number and deployment of security personnel, access-control arrangements, patrol arrangements and emergency contact details.

The Contractor shall remain fully responsible for the security of the Works notwithstanding the appointment of a specialist security service provider.

The Employer shall not be liable for any loss of or damage to the Contractor's plant, equipment, materials, temporary works or other property arising from theft, vandalism or other security-related incidents, except where such loss or damage is attributable to the Employer's proven negligence or default.

The cost of providing security services, including security personnel, supervision, transport, communication, registers, equipment and all other resources necessary for the proper execution of the security services, shall be deemed to be included in the Contractor's rates and prices, unless a separate item is provided in the Bill of Quantities.

The Contractor shall ensure that the security services are maintained continuously for the period during which the Works or the Contractor's property require protection, including outside normal working hours, weekends and public holidays where necessary.

PSA 4.8. Permanent Description Board

Tenderer

Witness 1

Witness 2

Employer

Witness 1

Witness 2



The Contractor shall make provision for the supply, manufacture, delivery and erection of a permanent description board at each completed reservoir and elevated tank, at locations designated by the Employer/Engineer.

The description board shall provide permanent identification of the completed infrastructure and shall include, as a minimum, the following information:

- (a) name of the Municipality/Employer;
- (b) name of the project;
- (c) name and description of the reservoir/elevated tank;
- (d) capacity of the reservoir/elevated tank;
- (e) project completion year; and
- (f) any other information required by the Employer/Engineer.

The final wording, layout, dimensions, colours, logos and general appearance of the description board shall be submitted by the Contractor to the Employer/Engineer for approval prior to manufacture.

The description board shall be manufactured from durable, weather-resistant and corrosion-resistant materials suitable for permanent outdoor installation and shall be capable of withstanding the prevailing environmental conditions at the site.

The board shall be securely mounted on suitable permanent supports and foundations. The Contractor shall ensure that the supports, fixings and foundations are structurally adequate and resistant to corrosion, vandalism and deterioration.

The Contractor shall be responsible for all associated works necessary for the satisfactory completion of the description board, including:

- preparation of the site;
- setting out;
- excavation;
- concrete foundations;
- supply and installation of support posts;
- supply and fixing of the board;
- lettering, graphics and approved municipal/project logos;
- protective coatings and finishes;
- backfilling and reinstatement; and
- removal of all surplus material and construction debris.

The completed description board shall be positioned in a prominent and accessible location as directed by the Employer/Engineer, without obstructing access to, or operation and maintenance of, the reservoir/elevated tank.

The Contractor shall submit shop drawings and/or artwork showing the proposed dimensions, materials, support arrangement, foundation details, wording and graphical layout for approval prior to fabrication.

The Contractor shall rectify, at his own cost, any defects, damage, poor workmanship, incorrect information or deterioration attributable to inadequate materials or installation during the Defects Liability Period.

Tenderer

Witness 1

Witness 2

Employer

Witness 1

Witness 2

**PSA 5.1 Survey**

The Contractor shall verify survey control and benchmarks before construction, undertake setting out and carry out regular checks of alignment, levels and dimensions.

Survey control points shall be protected. Disturbed control shall be reported immediately and re-established using an approved procedure before affected work continues.

The Contractor shall record the positions and levels of completed works, including buried services before covering, and submit as-built survey information in the coordinate system and formats specified in the Contract.

PSA 5.4 Protection of Overhead and Underground Services

Before excavation, the Contractor shall obtain available service information, consult relevant service owners and verify service positions using appropriate detection methods and authorised trial excavations.

Existing services shall be identified, marked, supported and protected during construction. Relocation, interruption or disconnection shall require prior authorisation from the service owner and Employer's Agent.

Damage shall be reported immediately. Responsibility for repairs and associated costs shall be determined in accordance with the Contract.

PS 8.3.5.2: Occupational Health and Safety Act Obligations

The Contractor shall comply with the Occupational Health and Safety Act, 1993 (Act No. 85 of 1993), as amended, all applicable regulations issued thereunder, and the Employer's project health and safety specification.

The tendered sum shall cover the initial establishment of the Contractor's health and safety arrangements, including preparation and submission of the site-specific health and safety plan; initial risk assessments and safe work procedures; statutory appointments; establishment of the health and safety file; initial induction and training; and provision of the initial protective equipment, safety notices and emergency arrangements required for the Works.

Measurement and payment**Unit: Sum**

Payment shall be made upon completion of the initial health and safety establishment, submission of the required documentation and acceptance of the health and safety plan by the Employer or its authorised health and safety agent.

The sum shall include all labour, professional services, equipment, materials and incidental costs necessary for these initial obligations. Continuing supervision, inspections, training, replacement equipment and maintenance of health and safety arrangements shall be measured under the separately scheduled time-related OHS item

PSA 8.4.6.1 Continuing Occupational Health And Safety Obligations

The Contractor shall implement the accepted Health and Safety Plan throughout construction, maintain the Health and Safety File, update activity-specific risk assessments and provide the required competent safety personnel.

The Contractor shall conduct continuing inductions, toolbox talks, inspections and audits, maintain incident and corrective-action records and submit monthly compliance reports.

Tenderer

Witness 1

Witness 2

Employer

Witness 1

Witness 2



Unit: Month

The rate shall include continuing safety personnel, administration, training, inspections, records and measures allocated to this item by the Contract.

Payment shall be based on the period for which the specified services are provided, supported by monthly records. Part-month valuation and adjustments for extensions of time shall follow the Contract. Initial obligations paid under PSA 4.5 shall be excluded.

PSA 8.4.6.4 Environmental Management Plan Compliance

The Contractor shall implement the applicable Environmental Management Plan and environmental authorisation conditions throughout construction.

The work shall include the required environmental supervision, inspections, reporting, waste management, spill prevention and response, erosion control, dust suppression and protection of designated sensitive areas.

Unit: Month

The rate shall include continuing personnel, administration, routine monitoring and environmental measures allocated to this item. Payment shall be supported by monthly compliance records.

Specialist monitoring, independent Environmental Control Officer services and permanent rehabilitation shall be excluded where separately scheduled. Part-month valuation and extensions of time shall be governed by the Contract.

PSA 6.2.1 Accredited Training (New sub-clause 8.4.6)

New sub-clause 8.4.6:

“The sum tendered under this item shall allow for the Contractor’s cost involved in paying for accredited off site training of local employees including transport to the training venue and accommodation of trainees and shall be paid in monthly instalments.”

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Tenderer

Witness 1

Witness 2

Employer

Witness 1

Witness 2

**PSC SITE CLEARING (SABS 1200 C)****PSC 1 GENERAL**

The areas where work is to be carried out must be kept clean for the duration of the contract. All rubbish must be removed without delay, and the site must be left clean and tidy on completion of the service.

PSC 2 DUMPING SITE

No dumping is allowed on site other than at the designated and approved fill areas. Dumping will only be allowed for filling sinkholes and dolines and may not be detrimental to the natural storm water drainage of the area. Only soil, rock, clean masonry and concrete rubble may be dumped in the designated dump areas.

PSC 3 REMOVAL OF TREES

No trees may be removed without written permission from the Engineer.

PSC 4 MEASUREMENT AND PAYMENT**PSC 4.1 Item:**

Clear & Grub (Clause 8.2.1)

Unit: ha or m or km

Add the underlined text to the second sentence of the item description to read as follows:

“The rate shall cover the cost of clearing the surface, removing boulders of size up to 0,15 m³, grubbing of trees and tree stumps (except large trees (**with girth over 1m**) and stumps as specified in 8.2.2 below), cutting of trunks and branches exceeding 0,5m **up to 1,0m** in girth into transportable lengths.....”

Add the following to the pay item description:

“The rate shall include for transport and disposal of material and debris to unspecified site and disposal thereof.”

“The area (in ha) shall comprise the entire site to be cleared and grubbed within the limits to be indicated by the engineer on site in writing.

The area of clear and grub measured in linear meter (or km) shall be the sections outside the initial cleared area (measured in hectares), specifically applicable to pipeline routes outside the original cleared site area. The width and length shall be indicated by the engineer on site in writing.”

Tenderer

Witness 1

Witness 2

Employer

Witness 1

Witness 2

**PSD SABS 1200 D: EARTHWORKS****PSD 1 MATERIALS (CLAUSE 3)****PSD 1.1 Classification (Clause 3.1)**

Notwithstanding the provisions of Sub-clause 3.1 of SANS 1200 D, the unit rate for excavation shall cover excavation in all materials other than hard rock.

PSD 2 CONSTRUCTION (CLAUSE 5)**PSD 2.1 Excavations (Subgrade Preparation) (Sub-clause 5.2.2)**

The Contractor shall allow 6 weeks in his programme for when bulk excavation has been completed for the Engineer to review the founding conditions and to instruct the Contractor to commence with soil improvement and implement these soil improvements, if required, before commencing with construction activities.

Bulk and restricted excavations shall be taken down to the underside of the concrete blinding layers for the various structures. After the earthworks operations have been carried out, the surface shall be watered so that the top 300mm is at optimum moisture content, and this layer shall then be compacted to 100% Mod AASHTO density. The subgrade shall then be carefully levelled and prepared to receive the concrete blinding. Surplus excavated materials shall be removed and spoiled as indicated by the Engineer. Payment for preparation of subgrade and compaction shall be included in the rate for excavations.

PSD 2.2 Excavation for working space (Sub-clause 5.2.2.1 b) and c))

Add the following to the clause:

Other than for the sides of strip or pad footings or where specifically authorized by the Engineer, no concrete shall be placed against the sides of excavations.

For external concrete faces below ground level, (other than concrete placed against the sides of excavations as above) the Contractor shall over-excavate to provide sufficient working space for the erection of formwork.

Tenderers shall allow in their rates for excavation for any over-excavation required for working space.

Excavation volumes for structures will be calculated as the nett volume of the structure below ground level after general site excavations have been completed. No additional payment shall be made for working space.

All water retaining structures shall be shuttered externally on vertical and on other faces inclined within 45° from the vertical.

PSD 2.3 Inspection (Sub-clause 5.2.2.1 d))

Add the following to the clause:

Excavation to final level soil improvement, ready to achieve a binding layer or concrete footing, shall be completed less than 24 hours before such layer or footing is cast.

Tenderer

Witness 1

Witness 2

Employer

Witness 1

Witness 2



The Contractor shall arrange for the inspection by the Engineer or his Representative of all surfaces immediately before casting concrete.

PSD 2.4 Over-excavation to sides of excavation (Sub-clause 5.2.2.1 e))

Add the following to the clause:

Where the sides of excavations are over-excavated to establish safe slopes, provide access to excavations, or for other purposes not specifically required by the Engineer, such over-excavation shall be backfilled with material as required by the Engineer and compacted to a minimum density of 95% Mod AASHTO.

No separate payment will be made for this work.

PSD 2.5 Over-excavation (Sub-clause 5.2.2.1 e))

Add the following to the clause:

If the material in the bottom of an excavation is loosened, or if there is any over-excavation, any loose or disturbed soil shall be removed, and the over-excavation shall be replaced by mass concrete mix 15 MPa.

No separate payment will be made for replace over-excavation with concrete. No separate payment will be made for over excavation as defined in PSD 2.4 and PSD 2.5.

PSD 2.6 Trimming of surface of bulk earthworks (add the following sub-clause 5.2.2.1 f))

Where blinding, mass or structural concrete is to be cast or where precast elements are to be placed on surfaces established by bulk earthworks, the Contractor shall:

- Arrange his bulk excavation operation so that over-excavation is avoided, taking into account the requirements in PSD 2.4.
- Over-fill embankments while placing fills as necessary to allow for trimming and arrange his compaction operations to ensure that the specified density is achieved throughout the finally trimmed embankment; and
- Shortly before casting concrete or placing precast elements, carefully remove the final layer and trim such surfaces to the design levels and profiles within Grade II degree of accuracy.

PSD 2.7 Disposal of surplus material (Sub-clause 5.2.2.3)

Add the following to the clause:

All surplus material from bulk excavation for concrete units and for pipework shall be dumped, leveled and spread on site at the areas as indicated by the Engineer. No dumping shall be undertaken prior to obtaining detailed instructions from the engineer.

PSD 2.8 Freehaul (Sub-clause 5.2.5.1)

Replace the sub-clause with the following:

All haul within the site of works or within a distance of 1.0 km outside the extremities of the boundaries of the contract as indicated on the drawings shall be regarded as freehaul.

Tenderer

Witness 1

Witness 2

Employer

Witness 1

Witness 2

**PSD 3 MEASUREMENT AND PAYMENT (CLAUSE 8)****PSD 3.1 Restricted excavation (add the following to sub-clause 8.3.3)**

Add the following to this item:

The volume of restricted excavation will be calculated from the net plan dimensions and the difference between the original ground profiles (or terraces), and the blinding layer (or no-fines) levels shown on the drawings. On the sides, the volume will only be calculated to the outside dimensions of the concrete structures. No additional payment will be made for the provision of working space, although it will be provided.

PDS 3.2 Additional Lateral Support / Shoring (Sub-clause 8.3.7)

The contractor must at all times ensure that excavations are safe to work in. Should the excavations exceed 2 meters and appear unstable shoring must be installed. Allowance in the Bill of Quantities has been made for shoring. No claims for extension of time, additional costs or damages for doing shoring will be entertained.

The unit in the Bill of Quantities is m².d. the Contractor shall submit his shoring design proposal to the Engineer for approval. The unit rate shall cover the product of the surface area of the shoring and the number of days it is required.

Tenderer

Witness 1

Witness 2

Employer

Witness 1

Witness 2

**PSDB SABS1200DB: EARTHWORKS - PIPE TRENCHES****PSDB 1 CONSTRUCTION****PSDB 1.1 Freehaul Distance**

All haul within the site of works or within a distance of 1.0 km outside the extremities of the boundaries of the contract as indicated on the drawings shall be regarded as freehaul.

PSDB 2 MEASUREMENT AND PAYMENT**PSDB 2.1 Dewatering (Sub clause 8.1.1)**

Add the following to this item:

The scheduled rates for excavation shall include dewatering of trenches.

PSDB 2.2 Excavations (Sub clause 8.3.2b)

Replace the clause with the following:

Extra-over item:

Only two types of excavations are defined and paid for under this contract. These items are soft excavation and hard rock excavation. No intermediate excavations will be paid for. Hard rock excavations qualifies when blasting or mechanical breaking are applied to break the rock.

PSDB 2.3 Shoring (Sub-clause 8.3.4(a))

The contractor must at all times ensure that excavations are safe to work in. Should the excavations exceed 2 meters and appear unstable shoring must be installed. Allowance in the Bill of Quantities has been made for shoring. No claims for extension of time, additional costs or damages for laying pipes in shored trenches will be entertained.

Tenderer

Witness 1

Witness 2

Employer

Witness 1

Witness 2

**PSG SABS 1200 G: CONCRETE (STRUCTURAL)****PSG 1 SCOPE OF WORKS**

This specification covers the construction of all structural concrete elements.

PSG 2 MATERIALS (CLAUSE 3)**PSG 2.1 Concrete****PSG 2.1.1 Cement (Sub-clause 3.2.1)**

Add the following to the sub-clause:

The type of cement to be used for concrete structures shall be approved by the Engineer.

PSG 2.1.2 Storage of cement (Sub-clause 3.2.3)

Add the following to the sub-clause:

Cement shall not be kept in storage for longer than eight weeks without the Engineer's permission.

Cement which has been damaged in any way or which has been stored on site for a period exceeding three months shall be condemned and removed from site.

PSG 2.1.3 Aggregates (Sub-clause 3.4)

Add the following to the sub-clause:

Concrete with reactive aggregates:

The Contractor shall supply a test certificate for the aggregate confirming that it is not reactive.

With each delivery of materials under this clause the Contractor shall supply acceptable written evidence that this clause is being complied with.

PSG 2.1.5 Use of plumbs (Sub-clause 3.4.2)

Add the following to the sub-clause:

The use of plumbs shall not be permitted.

PSG 2.1.6 Admixtures (Sub-clause 3.5)

Replace this sub-clause with the following

Tenderer

Witness 1

Witness 2

Employer

Witness 1

Witness 2



Admixtures may only be used with the prior approval of the Engineer. No air-retaining properties will be tolerated.

PSG 2.2 Joint materials (add the following new sub-clause 3.9)

All primers, fillers, sealers, admixtures and breakers shall be suitable for use on potable water.

PSG 2.2.1 Primer

An approved primer, fully compatible with and/or manufactured for the specified jointing and sealing materials shall be applied to the joint surfaces.

PSG 2.2.2 Filler

Fillers shall be closed-cell expanded polyethylene.

Fillers shall be pre-cut to suit the application with a tear-out strip for forming the specified recess for the bondbreaker and sealant.

PSG 2.2.3 Sealer and breaker

The elastomeric sealant shall be a two-pack polyurethane type (gun grade for vertical joints) generally conforming with the physical properties specified in SABS 110 and used with primers as specified above.

The bondbreaker placed immediately prior to application of the sealant shall be a self-adhesive vinyl type (or similar approved material) with a width the same as the joint recess into which it is to be applied.

PSG 3 CONSTRUCTION (CLAUSE 5)

PSG 3.1 Classification of finishes (Sub-clause 5.2.1)

Add the following to the sub-clause:

Concrete surfaces which will be in contact with the natural ground or which will otherwise be covered on completion of the works, shall have a rough finish as specified in sub clause 5.2.1 (a).

Horizontal surfaces and surfaces with a slope not exceeding one vertical to two horizontal shall be finished to a wood float finish. For this finish the surface must be given a finish as specified in sub-clause 5.5.10.1 and after the concrete has hardened sufficiently, it shall be floated to a uniform surface free of trowel marks.

The finished concrete surfaces shall be accurate to degree 1 as defined in sub-clause 6.2.


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2



The visible vertical or near vertical surfaces of valve chambers, and culvert head walls or parapets shall be finished to a smooth surface, repaired and rubbed to remove projections.

The bagging of concrete surfaces to repair defects will not be permitted.

All concrete edges shall be provided with 25 mm x 25 mm chamfers.

PSG 3.2 Cover (Sub-clause 5.1.3 and 5.5.1.5)

Add the following to the sub-clauses:

The exposure conditions for all structures in the works shall be deemed to be "severe". The minimum cover to reinforcement shall be 50 mm for water retaining concrete and 50 mm for all other concrete, unless otherwise specified on the Engineers drawings and bending schedules.

PSG 3.2.1 Spacers for reinforcement (sub-clause 5.1.3)

Add the following to the sub-clause:

Spacers of approved design include purpose made precast mortar blocks. No plastic spacer blocks will be allowed.

Where mortar blocks are used, they shall be properly shaped so as not to slip out of position and shall be made of the same mix as the mortar of the concrete in which they are to be placed.

The mortar shall be well compacted by approved means into the moulds to result in blocks with a density of at least 2 300 kg/m³; and which are free from honeycombing. They shall be cured in water for at least seven days. Mortar blocks which have not been manufactured and cured strictly in accordance with these requirements or which are in any other way considered unsatisfactory by the Engineer, will be rejected and shall be removed from the Site.

PSG 3.3 Holes, Chases and Fixing Blocks (Concrete Boxouts) (Sub-clause 5.3)

Where pipes are to be cast into concrete, the Contractor shall provide a box-out in the wall and grout the unit in at a later stage. When constructing such a box-outs, reinforcement shall not be cut, but shall run through the opening. Reinforcement shall be cut and/or bent out at a later stage to suit the item being cast in. After installation of the item the remaining reinforcement shall be bent back in position.

Where box-outs for pipes/specials have been provided in the walls, the Contractor shall be responsible for the grouting in of such pipes/specials regardless of whether or not these have been supplied by himself.


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2



An approved non-shrink grout shall be used for the grouting in of pipes and specials after they have been positioned. The details and method statement are to be submitted to the Engineer for approval prior to the commencement of any grouting. The approval by the Engineer shall not relieve the Contractor from his obligation to provide a watertight joint between the concrete and grout used.

PSG 3.4 Strength concrete (Sub-clause 5.5.1.7)

Add the following sub-clause:

The grade of strength concrete for each portion of the works will be indicated on the drawings and/or specified in the Schedule of Quantities. The grade of concrete will be designated as "Class S/A", where "S" is the characteristic strength in Mpa and "A" is the maximum nominal size of coarse aggregate in mm.

With the exception of mixes weaker than 15 Mpa, all concrete for the Works shall be considered to be strength concrete in terms of Sub-clause 5.5.1.7.

No concrete shall be cast until the mix designs have been approved by the Engineer. The Engineer may call for revised mix designs at any stage during the contract.

Contractor to supply and test 6 No. cube test results for approval prior to commencement of the works.

Unless otherwise specified on the drawings or in the Schedule all structural concrete shall have a strength of 35/19 Mpa.

The concrete to be used on this contract shall be as follows:

- (a) For all water retaining structures (including reservoir roofs), 35/19 MPa. The slump limits shall be 75 mm. The water/cement ratio shall not be greater than 0,5. A waterproofing agent (Crystalline Admix) shall be added as per supplier's specification to a minimum of 1% by weight of cement.
- (b) For all other structures not in contact with water 25/19 MPa concrete.
- (c) For anchor blocks, benching and mass concrete, 20/19 MPa concrete.
- (d) For no-fines concrete 15/19 Mpa concrete
- (e) All sizes of aggregate used shall be 19 mm granite.

These mixes shall be designed for vibration. All data reports prepared by the Institute shall be submitted to the Engineer for information and approval.

DESIGN OF CONCRETE MIX:

The concrete mix design shall be prepared by an approved independent laboratory and submitted to the Engineer for approval. Historical data shall be provided for a similar mix design to the same strength.


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2



The successful Tenderer will be required to submit samples of the fine and coarse aggregate which he proposes using, to an approved laboratory for tests regarding the suitability of such aggregates. The laboratory shall prepare trial mixes of the two stronger grades of concrete required for the contract to establish acceptable design mixes.

PSG 3.5 Formwork and finishes (Sub-clause 5.2)

Add the following to the sub-clause:

FORMWORK TIES

The use of sleeves through the concrete for formwork ties will not be permitted. Ties, when cast in, shall have some form of positive shear key to prevent any rotation when loosening formwork.

The formwork ties and bolt holes shall be placed with regularity and precision.

The finish of exposed concrete surfaces of concrete structures shall be “smooth” as detailed in (b) of sub-clause 5.2.1.

Tenderer

Witness 1

Witness 2

Employer

Witness 1

Witness 2

**FILLETS AND CHAMFERS**

All internal and external angles in concrete works shall have 25 mm x 25 mm fillets and chamfers unless shown otherwise on the drawings.

The units rate tendered for formwork shall cover the cost of forming these chamfers and fillets.

PSG 3.6 Joints (Clause 5.5.7)

Add the following to the sub-clauses:

PSG 3.6.1 General

Notwithstanding Sub-clause 2.4.3 “designated joints” shall only be joints shown on the drawings and in the Schedule. Further joints required by the Contractor because of construction limitations or any other reason, shall be deemed to be “undesigned joints”.

The position and pattern of all joints (designated or undesigned) shall be to the Engineer’s approval.

All joints (designated or undesigned) except expansion and contraction joints shall be treated in accordance with Sub-clause 5.5.7.3.

Joints between tank bottoms, floors or wall bases and the walls and columns standing on them, shall not be made flush with the supporting surface, but shall be made in the wall or the column a distance of 140 mm above the base. The 140 mm high “riser” shall be cast as an integral part of the bottom, floor or base, i.e. the concrete in the riser shall be deposited at the same time as the concrete in the bottom, floor or base adjacent to it.

In cases where there is a fillet at the bottom of the wall or column, the construction joint shall be made 140 mm above the fillet.

The Contractor should note that the details of the undesigned joints shall be identical to the designated joints shown on the drawings where the joint is in a similar situation and performs the same duty.

The Contractor shall further note that the position and the type (where no identical designated joints exist) of undesigned joints shall be subject to the Engineer’s approval.

PSG 3.6.2 Construction joints (Sub-clause 2.4.3 and 5.5.7)

All joints other than expansion, contraction or other movement joints, shall be treated as follows:

As soon as practical, but not before 15 hours after placing, the joint surface shall be prepared to receive fresh concrete.


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2



This preparation, as specified in Sub-clause 5.5.7.3 (a) to (d) shall be such as to remove all laitance or inert and strengthless material which may have formed and the specified chipping and sand blasting shall be such as to produce a roughened surface all over.

Concrete surfaces, where concreting is interrupted, shall be protected from the sun as specified in Sub-clause 5.5.8 (d).

Floor slab concrete shall be cast in one continuous pour. Should the Contractor wish to deviate from this requirement for the larger pours, a water bar shall be placed in the centre of the joint. This deviation should first be discussed with the Engineer before construction commences.

A kicker joint shall be formed at all external floor/wall intersections. The kicker shall be formed with the floor pour and shall include a 200mm PVC water bar, of the dumbbell kind. The water bar shall be provided with eyelets so that the water bar can be held in its correct position. A rate item for construction joints is provided in the Bill of Quantities.

PSG 3.6.3 Construction joints (Sub-clause 5.5.7.3)

No vertical construction joints other than those shown on the Drawings may be formed without prior approval. Horizontal construction joints may be formed if the method of construction does not allow for one continuous pour. However, these construction joint will be indicated to and approved by the Engineer. It must be noted that should the Contractor wish to form a construction joint in water retaining concrete, the watertightness of this joint will remain the responsibility of the Contractor. In addition to the precautions to be taken as prescribed under clause 5.5.7.3, the Contractor may ensure watertightness by providing additional means (such as a bandage on the joints or wet to dry epoxy) to the approval of the Engineer. No additional payment will be made to the Contractor for ensuring that construction joints are watertight and the Contractor will have to include such costs in the rate for the concrete.

PSG 3.6.4 Expansion and construction joints

Expansion and contraction joints shall be made in the position and to the details shown on the drawings.

The specified filler strips shall be attached to the complete side of the straight or grooved concrete joint by means of an approved adhesive.

PSG 3.7 Items to be casted in or grouted into concrete (sub-clause 5.4)

Add the following to the sub-clauses:

PSG 3.7.1 Fixing for equipment and pipe specials supplied under this Contract

- a) The Contractor will be responsible for the forming of pockets and grouting in of pipe items and/or holding down bolts for equipment supplied under the contract.


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2



- b) Upon completion of the positioning and alignment of equipment, the Contractor shall, grout up pipe items, pockets and base plates (subject to (c) below) necessary for the permanent installation of the equipment.
- c) Only after the Engineer is satisfied with the alignment and the level of each item of plant shall the Contractor grout up the base plates/pipe specials with an approved non-shrink grout.

PSG 3.7.2 Fixing for equipment supplied under this contract

Holding down bolts or other fixings required for the installation of handstops, crane beams, ladders, handrails and other items supplied under the Contract, shall be provided by the Contractor. These fixings shall be cast in or grouted into pockets or installed by other means as approved by the Engineer.

Where anchor bolts are used which are installed into holes drilled into concrete or masonry, these shall be a type approved by the Engineer.

All anchor bolts shall be stainless steel grade 316.

PSG 3.7.3 Pipes and conduits embedded in concrete

Except with the written approval of the Engineer, no pipes other than those shown on the drawings shall be embedded in concrete and the approval of the Engineer for the position of all services to be embedded shall be obtained before concreting commences.

The clear space between pipes of any kind embedded in reinforcement concrete and the clear space between such pipes and reinforcement shall not at any point be less than:

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

PSG 3.8 Curing and protection (Sub-clause 5.5.8)

Add the following to the sub-clauses:

Level or gently sloping surfaces shall be cured by one of the methods described in Sub-clause 5.5.8 (a) or (b) and vertical surfaces by the methods described in Sub-clause 5.5.8 (e) for a period of five days after casting for an ambient temperature of 5°C or above and for eight days for an ambient temperature of below 5°C.

PSG 3.9 Concrete surfaces (Sub-clause 5.5.10)

Add the following to the sub-clauses:

PSG 3.9.1 Screed finish


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2



After placing and compacting, the concrete on a top (unformed) surface shall be struck off with a template to the designated grades and tamped with a tamping board to compact the surface thoroughly and to bring mortar to the surface, leaving the surface slightly ridged but generally at the required elevation. No mortar shall be added, and noticeable surface irregularities caused by the displacement of coarse aggregate shall be made good by re-screeding after the interfering aggregate has been removed or tamped.

PSG 3.9.2 Wood float finish

Where wood floating is ordered or scheduled, the surface shall first be given a finish as specified in PSG 3.6. and, after the concrete has hardened sufficiently, it shall be wood-floated, either by hand or machine, only sufficiently to produce a uniform surface free from screed marks.

PSG 3.9.3 Steel float finish

The surface of tank bottoms, floors and roof slabs, etc. shall be given a steel float finish in accordance with Sub-clause 5.5.10. To Degree 1 accuracy.

PSG 3.9.4 Power floated finish

Where power floating is required the surface shall be treated as specified in PSG 3.11.2 to a degree necessary.

PSG 3.10 Screeds (add the following sub-clause 5.5.16)**GRANOLITHIC SCREED**

Granolithic screed shall consist of: Cement - 1 part; Sand - 1.25 part; Coarse aggregate - 2 parts.

The coarse aggregate shall consist of granite or other approved chips which shall pass a 10 mm sieve and be retained on a 5mm sieve.

The cement/water ration of the mix shall be at least 2,0 mass.

PSG 3.11 Repairs and defects (add the following sub-clause 5.5.14)

All defects to the concrete shall be attended to, in full, as soon as possible after the formwork is removed. Further concreting of the element concerned may be prohibited by the engineer until he is satisfied that this remedial work has been satisfactorily attended to.

PSG 3.12 Porous Concrete

Porous concrete shall be laid under foundations and floor slabs, and behind walls, etc., where shown on the drawings and where directed by the Engineer.


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2



Porous concrete shall be placed behind shuttering to form a vertical layer against the external face of foundations, etc. where shown on drawings and where directed by the Engineer.

The thickness of the horizontal, sloping and vertical layers shall not be less than that shown on the drawings.

The exposed faces, both horizontal and vertical, of the porous concrete shall be finished with a cement mortar seal, as specified in Clause PSG2.11.3, where reinforced concrete is to be cast against it.

The schedule rates for porous concrete shall include the cost of the mortar seal and steel float finish.

Porous concrete shall comprise water, cement, coarse aggregate and not more than 5 % by mass of fine sand. Every size of aggregate shall be a single size aggregate, graded in accordance with SABS 1083.

The voids ratio of porous concrete shall not be less than 27,5 %.

No-fines concrete shall be classified by the prefix NF and the size of the aggregate to be used. Class NF19 means a no-fines concrete with a 19 mm nominal size. The volume of aggregate per 50 kg of cement is to be as follows:

Class	Aggregate Size	Aggregate per 50kg cement	Minimum Average Strength of a set of three test cubes after 28 days (MPa)
NF38	38	0.33 m ³	5.5
NF19	19	0.30 m ³	5.5
NF13	13	0.27 m ³	5.5

PSG 3.12.1 **Batching and Mixing**

The quantity of water to be added shall be just sufficient to form a smooth grout which will adhere to and coat completely each and every particle of aggregate, and which is just wet enough to ensure that at points of contact of aggregate the grout will run together to form a small fillet to bond the aggregate together. The mix shall contain no more than 20 liters of water per 50 kg of cement.

Mixing shall be carried out in an approved batch type mechanical mixer. The whole batch of aggregate together with half of the water shall be placed into the mixer and mixed together for at least half a minute. The cement, followed by the balance of water, shall subsequently be added and the mixing shall continue for at least 1,5 minutes or as much longer as is necessary to ensure that all aggregates are uniformly coated with cement grout.

Tenderer

Witness 1

Witness 2

Employer

Witness 1

Witness 2



Testing of porous concrete shall be carried out in accordance with test method 3 of BS 1881 Part 3 : 1970.

PSG 3.12.2 Placing

The Engineer shall be timeously advised to enable him to inspect the excavations or form work before no-fines concrete is placed.

After the placing of the concrete has commenced, it shall be continued uninterrupted and may only be halted at the construction joints approved by the Engineer. Control shall be exercised to ensure that no placed green concrete lies for longer than 30 minutes before being covered with fresh concrete and that the concrete is placed in its final position within 20 minutes after the cement has been loaded into the mixer.

The concrete shall be worked sufficiently to ensure that it completely fills the space to be concreted and that adjacent aggregate particles are in contact with one another. Excessive tamping or ramming shall be avoided and under no circumstances shall the concrete be vibrated.

PSG 3.12.3 Mortar seal over porous concrete

Where concrete is to be cast against previously cast porous concrete, the surface of the porous concrete shall be sealed with a 5 mm thick layer of mortar composed of one part normal Portland cement to two parts of fine aggregate by mass, trowelled on before screed to provide a dense, smooth, uniform plane surface without filling any of the internal voids of the porous concrete. The surface of the seal shall have a steel float finish.

PSG 3.12.4 Protection

All no-fines concrete shall be protected from the elements, particularly from strong wind, flowing water, damage to the surface and loss of moisture. Protection against loss of moisture shall be accomplished by one or more of the following methods :-

- (a) Keeping form work in place.
- (b) Covering exposed surfaces with sacking or other approved material that is kept continuously wet.
- (c) Covering exposed surfaces with plastic sheeting.

PSG 3.12.5 Sealing of surface of no-fines concrete

Where indicated on the drawings or instructed by the Engineer, the surface of the no-fines concrete shall be sealed with a layer of 1:8 cement mortar to prevent loss of moisture from the structural concrete.

This seal shall be placed after the no-fines concrete has hardened and must be leveled off to the same level as the top of the no-fines concrete.


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2

**PSG 3.13 Water tightness testing and cleaning (add the following sub-clause 5.5.11)**

On completion of concreting and when the concrete has attained its required strength, all structures shall be tested for water tightness. As a result, structures shall not be backfilled until the water test has been successfully completed. No water is available on site and the contractor must make his own arrangements for water for water tight testing of all the structures.

Each structure shall be filled with water and shall be allowed to stand for 48 hours. Thereafter the water level in the structure shall be monitored over a period of 10 days. The effects of evaporation shall be taken into account during this period. The structure will be deemed to have passed the test if it loses no more than 5mm of water after the drop due to evaporation is deducted.

Where there are visible signs of sweating, seepage or leakage, the affected areas shall be brought to standard. Where it is obvious that there is harmful leakage, the test shall be discontinued and the tank emptied without delay. The Contractor shall then, at his own expense, rectify the leak and re-test that tank. After the said tank has successfully passed the water tightness testing the tank shall be emptied again.

In order to conserve water, it shall be sequentially pumped from structure to structure as successful testing is completed. The rate tendered for testing shall include for the cost of testing as described above and the supply and operation of any pumping equipment required.

After the watertight test the water retaining structures shall be disinfected by applying water containing 20mg/liter free chlorine residual for a period of 24 hrs. The water retaining structures will not be accepted and cleaning of the water retaining structures have been passed by Engineer.


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2

**PSG 4 TOLERANCES (CLAUSE 6)****PSG 4.1 Permissible deviations (Sub-clause 6.2)**

Add the following to the sub-clause:

The degrees of accuracy of construction shall be as follows:

- (a) All structures (including water retaining structures) – Degree I accuracy.
- (b) All weirs (concrete) and weir plates shall have a tolerance of +1/-1 mm

PSG 5 TESTING (CLAUSE 7)**PSG 5.1 Grouting (add the following new sub-clause 7.4)**

The Contractor shall, where so ordered, carry out a site test for each grouting procedure and each grouting gang to be used. The tests shall be carried out on a dummy bedplate similar in configuration to that which is to be grouted, but not exceeding 1 m² in area unless otherwise ordered.

When the dummy bedplate is dismantled, the underside shall show a minimum grout contact area of 80 % with reasonably even distribution of the grout over the surface grouted except that, in the case of expanding grout, the minimum grout contact area shall be 95 %. The test shall show evidence of good workmanship and materials, and the results shall be to the satisfaction of the Engineer.

The Contractor shall, when so ordered, make standard test cubes from various grout mixtures and also subject them to compression tests to determine whether the specified strength has been achieved.

Test procedures shall comply with the relevant requirements of Sub-clause 7.2.1 to 7.2.3.

PSG 6 MEASUREMENT AND PAYMENT (CLAUSE 8)**PSG 6.1 Grouting / casting in of pipe specials (add the following sub-clause 8.10)**

Add the following pay item:

Item:

Grouting / casting in of pipe pieces in the following diameter
Unit: No

The rate shall include all labour, plant and material for the grouting/casting in of pipes of the above items as per PSG 2.6.4. The actual pipe/item to be cast in is measured elsewhere.


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2

**PSG 6.2 Step irons (add the following sub-clause 8.16)**

Add the following pay items:

Item:

Step irons (Calcamite or similar approved)
: No

Unit

The rate shall cover all costs to supply and install the step iron. The rate shall include for the drilling into the concrete, supplying and installing chemical anchors as well as the setting out of the step irons in the correct position.


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2

**PSHA SABS 1200 HA: STRUCTURAL STEELWORK (Sundry Items)****PSHA 1 MATERIALS (CLAUSE 3)****PSHA 1.1 Structural Steel (Clause 3.1)**

Add the following to this clause:

All structural steelwork, including pipe supports and ladders will be to SANS 1421 Grade 300 W. The Contractor must allow in his rates to provide for shop details. Corrosion protection to be hot dipped galvanising to the requirements of EN 10240:1997 and SANS ISO 1461:1999 unless indicated differently.

All handrails and flooring, including supports and fasteners shall be manufactured from hot dipped galvanised mild steel to the requirements of EN 10240:1997 and SANS ISO 1461:1999 unless indicated differently.

PSHA 1.2 Bolts, Nuts and Washers (Clause 3.3)

Add the following:

All bolts, nuts and washers shall be AISI 316 stainless steel.

All sleeve anchors shall be AISI 316 stainless steel.

All fixings shall be AISI 316 stainless steel and this will also apply to any bought out item. An approved molybdenum disulphide anti seize compound shall be applied on all bolts and nuts.

PSHA 2 CONSTRUCTION (Clause 5)

Add the following:

All surfaces shall be abrasive blast cleaned to Swedish standard SIS 05 59 00 of 1967 to SA 2½ finish. The blast profile shall be between 40 and 70 microns.

PSHA 2.1 Holes for Fasteners (Clause 5.2.3)

Add the following to this clause:

Holes for holding-down bolts shall not be flame-cut.

PSHA 2.2 Welding (Sub-clause 5.2.4) (site welding)

Add the following to this clause:

Manual flame-cutting is allowed only where authorised. Edges shall be grinded to be free of unevenness, defects and distortions.


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Witness 1


Witness 2


Employer


Witness 1


Witness 2



Welding shall comply with SABS 044 Part III, SABS 044 Part iv and SABS 0162.

Welding shall be minimum grade B welding.

The qualification of welders shall be in accordance with the relevant clauses of the above standards, and specifically SABS 044 Part III and shall be Grade 1 welders. Grade 2 welders will be permitted only with the Engineers written approval.

The Contractor shall provide evidence, acceptable to the Engineer, that welding procedures and welders have been tested in accordance with the requirements of AWS D1.1-81.

No welding shall be permitted on site without the express approval of the Engineer, with the exception of those details shown on the drawings as Site Welded.

PSHA 2.3 Handrails (Clause 5.2.6)

Handrails shall be of the two rail type, ball and stanchion, top mounted, type Mentis MT 90 or similar approved.

Add the following:

Handrails and stanchions shall be hot dipped galvanised and painted to the following specification:

- (a) Hot dip galvanise in accordance with Table 2 of SANS 763.
- (b) Clean with Galvkleen or similar approved to achieve a water break free surface and allow to dry.

STEP	PREPARATION/COATING METHOD	Minimum dft (µm)
1	After hot-dip galvanizing, do not passivate.	
2	Coat epoxy primer (two part for HDG surfaces)	75
3	Coat polyurethane enamel (two part)	50
		Total = 125 µm

Where handrails are specified as stainless steel, the handrails shall be AISI 316 stainless steel.

PSHA 2.4 Prefabricated open and chequer plate floors (clause 5.2.8 & 5.2.9)

Open grid steel covers and floor panels shall be pressure locked and welded as “Maclock” type “Eggcrate” or similar approved. All span bars shall have a depth of 40mm and be of such a width and at such a spacing that the maximum deflection of any bar under a 10 kN/m² uniformly distributed load shall not exceed 1/360 of the clear span. Under no circumstances will cutting and welding be permitted on site.


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Employer


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Witness 2



Framing to open grid “Maclock” or “Eggcrate” covers or panels shall be assembled and welded to the detail as shown on the drawings.

Chequer-plate flooring shall be of 6mm minimum thickness “treadplate” flooring or similar approved with raise 5-bar pattern and lifting key holes at each end of each plate.

Frames shall be angle and bar welded together and as detailed on the drawings.

PSHA 4.3 Open grid/ chequer plate flooring (clause 8.3.4)

Replace sub-clause 8.3.4 with the following:

Item:

Open grid flooring

Supply and install HDG floor grating, bearer bar=40mm Unit: m²

Supply and install cast-in HDG 45 x 45 x 5 mm angle support complete with fishtail lugs
Unit: m

Add the following to the clause:

The open grid or chequer plate flooring covers or panels will be measured by area, and the unit rates will be held to include for all cutting, welding, galvanising, etc. The cast-in angle support will be measured separately per linear meter. This rate will include for installation, galvanising, fixing complete with cement mortar and/or bolts/fishtail lugs which may be required to secure the frame. The rate shall include for supply and installation.


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Employer


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Witness 2

**PSL SABS 1200 L: MEDIUM PRESSURE PIPELINE****PSL 1 SCOPE**

All water pipelines in this contract shall be deemed to be medium pressure pipelines.

PSL 2 MATERIALS (CLAUSE 3)**PSL 2.1 General (Sub-clause 3.1)**

Add the following to the sub-clause:

Pipes

All pipes shall be of class as indicated on the drawings. The corrosion protection to the flanged steel pipe material shall be either Epoxy Coated or Hot dipped galvanized to SABS specifications

PSL 2.2 Steel Pipes, Fittings and Specials (Sub-clause 3.4)

Add the following to 3.4:

- a) Steel pipes with normal bore up to 150mm diameter shall be manufactured to conform to all the requirements of SANS 62 whereas steel piping of larger diameter shall be manufactured to conform to all the requirements of SANS 719.
- b) BUTT WELD FITTINGS: Steel butt welding pipe fittings shall be to ANSI B 16.9, BS 1965 or BS 1640 of the same schedule as the piping or heavier. Butt weld fittings in stainless steel shall be to ASA B 36.19 for schedule 5S and 10S and ASA B 16.9 for schedule 40S and 80S. Alternatively, fittings may be to BS 1640

PSL 2.3 Other types of pipes (Sub-clause 3.7)

Add the following to 2.3:

- a) PLASTIC PIPING: uPVC piping shall comply with the requirements of SANS 966 mark for pressure pipes and shall be fitted with spigot and socket joints with rubber sealing rings.
- b) GRP PIPING: GRP piping shall comply with the requirements of SANS 1748 mark for pressure pipes and shall be fitted with suitable couplings where the GRP piping connects to non-GRP piping or equipment. Joints between GRP pipes shall be GRP couplings (Flowtite double bell coupling or equal approved). Above ground GRP pipes shall be coated with 300 microns of UV resistant polyurethane or equal supplier-recommended coating. GRP pipes cast into concrete shall comply with manufacturer guidelines on floatation. The GRP piping installation of GRP pipes larger than dia. 800 mm shall be done by (or under the supervision of) a specialist

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field technician endorsed or provided by the GRP pipe manufacturer. The GRP pipe manufacturer shall be ISO 9001:2015 certified.

PSL 2.4 Isolating valves (Sub-clause 3.10)

Add the following to the sub-clause:

Except where otherwise specified, isolating valves shall be of the resilient seal gate type, with a non-rising spindle and shall be arranged for clockwise closing. All valves shall be standard coated and shall receive a final coat of light blue enamel paint after installation. All valves shall be flanged and drilled to the specification.

Materials shall comply to the following specifications:

Materials of Construction (minimum specifications)

<i>Component</i>	<i>Specification</i>
Body	Cast Iron to BS 1452 Gr 14
Bonnet	Cast Iron to BS 1452 Gr 14
Spindle seal housing	Cast Iron to BS 1452 Gr 14
Hand wheel	Cast Iron to BS 1452 Gr 14
Cap top	Cast Iron to BS 1452 Gr 14
Gate	Spheroidal Graphite Iron to BS 2789 Gr 17 covered with nit rile rubber
Spindle	EN57 Stainless Steel
Spindle seal "O" rings	Nit rile rubber
Seal housing "O" rings	Nit rile rubber
Seal bush "O" rings	Nit rile rubber
Wiper ring	Nit rile rubber
Seal housing	Nylon
Spindle nut	Bronze to SABS 200 Code 30

A copy of the relevant valve specification of the proposed valves shall be attached to this tender document.

PSL 2.4.1 Marking of valves

The design pressure in Megapascal (MPa) shall be engraved on the side of the valve where it is legible. Valves shall be marked with the item number of the schedules when delivered to site.

PSL 2.4.2 Handwheels and closure

Where handwheels are specified edges shall be machined to a smooth surface. Wording "OPEN" and "CLOSE" will be casted into handwheels. Valves will close clockwise except where it is otherwise specified. Spindles will be of the non-rising type.


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Witness 1


Witness 2

**PSL 2.4.4 Protection of valves**

Valves shall be painted externally with a zinc chromate primer according to SABS 679 Type 1. (Dry film thickness of 50 mnc) After installation damaged primer shall be made good with compatible primer in accordance with valve suppliers specifications.

Subsequently to making good of the primer the valve shall be painted with two layers of alkide based enamel according to SABS 630 Grade 1 (dry film thickness of 250 micro meter per layer) to match the colour of adjoining pipe work.

PSL 2.4.5 Handling, delivery and installation

All valves and related items shall be handled with the necessary care throughout all processes of manufacture, testing, delivery and installation. Valves furnished with lifting eyes shall be handled only by those eyes and other valves shall be handled solely with slings that will cause no damage.

In particular the inlet and escape orifices of air valves and special valves shall be effectively sealed after manufacture until completion of installation and this sealing shall be examined regularly to ensure that it is still effective.

Valves shall be effectively supported, packed or fastened down for transporting and care taken to avoid valves knocking together during transport.

Valves shall be stored in a safe place above ground and shall be protected against the ingress of foreign matter.

PSL 2.5 Fittings (Sub-clause 3.12)

Add the following sub-clause:

Generally all special fittings are to be manufactured in mild steel as applicable. No aluminum fitting shall be permitted. Fittings shall be compatible in respect of working and test pressure to those of the pipelines.

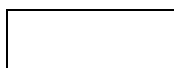
PSL 3 CONSTRUCTION**PSL 3.1 Laying Depths and Cover (Sub-clause 5.1.4)**

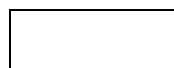
Add the following to sub-clause 5.1.4.1:

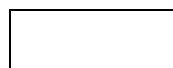
Water mains shall be laid to follow the grades of the existing adjoining roads, except where otherwise instructed by the Engineer. The depth from finished sidewalk level to the top of the pipe barrel shall be as follows, except where otherwise directed:

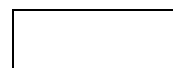
a) on sidewalks = 900 mm

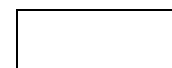
b) below carriageways = 1 000 mm

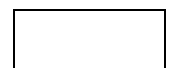

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Witness 1


Witness 2


Employer


Witness 1


Witness 2



c) outside road reserves = 900 mm

PSL 3.2 Joining Methods (Sub-clause 5.2)

Notwithstanding the provisions of sub-clause 5.2 of SANS 1200L, jointing of pipes and specials of all diameters shall be as follows:-

- i. uPVC pipes - by rubber ring spigot and socket.
- ii. Steel pipes - by welding except where pipes are connected to flanged fittings or elsewhere as shown on the drawings or as instructed by the Engineer.
- iii. GRP pipes – by coupling (Flowtite double bell coupling or equal approved) except where stainless steel and GRP pipes are connected using flanges or elsewhere as shown on the drawings or as instructed by the Engineer. Anchors for above ground pipe shall be designed as cradles with high friction cradle liners and a pretensioned steel clamp pressing the pipe against the cradle. The pretension of the clamp shall be sufficient to prevent the pipe from moving in the cradle. The clamp shall allow for thermal expansion of the GRP pipe.
- iv. Steel pipes shall connect to uPVC and GRP pipes using a steel flange adaptor or couplings. All pipes and fittings shall be suitable for a test pressure of 1200kPa.

PSL 3.3 Anchor / thrust blocks and pedestals (Sub-clause 5.5)

Add the following to the sub-clause:

Dimensions of all anchor / thrust blocks shall be supplied by the Engineer as and when required. The Contractor shall request such information not less than 14 seven calendar days in advance.

PSL 3.4 Crossing existing services (Sub-clause 5.1.4.3)

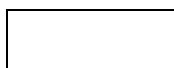
There will be existing services that will be crossed. Generally these areas can be identified and careful hand excavation will be required to expose these services.

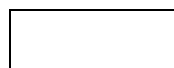
PSL 3.5 Pipe laying personnel (Sub-clause 5.1.1)

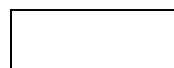
The laying of pipes and ancillary fittings shall be performed only by a qualified person who is registered as an artisan in the pipe fitting or drain laying trades, or is qualified by reason of having attended and passed the course on pipe laying of the Civil Engineering Industry Training Board.

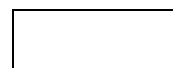
PSL 3.6 Steel pipes, specials and fittings scope

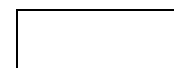
This specification covers the manufacture, corrosion protection, delivery, erection, installation, making good of corrosion protection as well as over-coating as may be

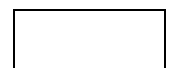

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Witness 1


Witness 2



required, site-testing and commissioning of steel pipes, specials and fittings mostly for the conveyance of water, but also for air, at normal ambient temperatures between 5°C and +70°C.

PSL 3.6.1 Manufacture of steel pipes

Steel pipes with normal bore up to 150mm diameter shall be manufactured to conform to all the requirements of SABS 62 whereas steel piping of larger diameter shall be manufactured to conform to all the requirements of SABS 719, all as may be amplified or amended below.

The requirements regarding pipe sizes and grades, wall thicknesses, pipe lengths and pipe and requirements are specified in the Pipe Schedule and / or stated in the Schedule of Quantities.

The following minimum wall thicknesses shall apply:

External Diameter (mm)	Minimum wall thickness (mm)
168 – 406	4,5mm
419 – 508	5,9mm
570 – 864	6,0mm

With regard to Sub-clause 4.2.2.1 in SABS 719 the Contractor shall, before commencing with pipe manufacture, satisfy the Engineer that the welding methods to be used in the pipe manufacture are adequate by:

- The preparation of a weld sample employing precisely the same welding process, equipment and artisans by which the pipe shall be manufactured.
- The preparation and destructive testing of the sample in (a) above, as laid down in Clause 7.2 of SABS 719.

The results of the tests on the test pieces shall comply with the requirements of Clause 7.2 of SABS 719 in all aspects.

Such destructive testing shall be carried out for each grade of steel and for each thickness of steel in that grade.

With regard to sub-clause 4.2.2.2 and 4.2.2.3 in SABS 719 the height of the inner weld reinforcement shall not exceed 1mm.

PSL 3.6.2 Manufacture of pipe specials

Only pipe conforming to the requirements of Clause PSL 3.5.1 above, may be used for the manufacture of pipe specials.


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Witness 1


Witness 2


Employer


Witness 1


Witness 2



For pipes of nominal bore, up to 150mm diameter T-pieces shall be heavy class pipe only, with the same wall thickness for both main and branch pipes. The manufacturing process and quality requirements are as specified in the relevant section of BS 806 (Section 3).

Dimensions and joint types for pipes specials are specified in the Pipe Schedule and / or stated in the Schedule of Quantities.

Welding shall be done by a welder holding a valid competence certificate (Grade 1) in terms of SABS 044 – Part V. Butt-welded joints shall conform to the requirements for welding for pipes, and the Contractor shall prove all butt and fillet welded joints to be crack-free by carrying out dye penetrant tests, following the procedure laid down in BS 4416.

If at all practicable, pipe specials shall be subjected to hydraulic pressure tests as specified. Where this is not feasible, butt-welds must be subjected to radiographic inspection over their full length, with inspection procedure and acceptability limits for defects as specified in API 1104, keeping a record of all weld inspection and repair.

Where working pressures allow the use of malleable cast iron fittings for nominal bore up to 150mm diameter, these shall conform to the requirements of SABS 509.

PSL 3.6.3 Pipe flanges, bolts and jointing

PSL 3.6.3.1 Material and dimensions for flanges

The requirements for the materials and dimensions for flanges are in all respects as specified in SABS 1123.

A raised joint face shall be provided on all flanges of pressure rating higher than 2,5 MPa unless otherwise agreed to by the Engineer or as stated in the Schedule of Quantities, and the backs of cast or forged flanges shall be machined.

The machined surfaces of flanges shall be covered immediately after machining by a temporary rust preventative film of a suitable type as specified in BS 1133 (Section 6).

All flanges shall be drilled to SABS 1123 (Table 1600/3) or otherwise to the class as stated in the Schedule of Quantities or on drawings.

PSL 3.6.3.2 Welding on of flanges

The procedure for the welding-on of flanges, shall comply with the requirements of BS 806 (Section 3).

The proficiency of the welder and the quality requirements for the weld are the same as those specified in Clause PSL 3.6.3 above.

As a rule, the bolt holes in flanges for pipe specials shall not be on the vertical centre line.


Tenderer


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Witness 2


Employer


Witness 1


Witness 2



When so specified in the Schedule of Quantities, flanged pipes shall be hydraulically tested after the welding-on of the flanges to a test pressure of 1,5 times the pressure rating of the respective flange.

PSL 3.6.4 Bolts

Materials and dimensional requirements of bolts and nuts are specified in SABS 135 or 136. These requirements shall correspondingly be prescribed by the Contractor when ordering.

The threaded length shall be adequate to allow two full threads to protrude beyond the nut after the latter is fully tightened.

Each bolt shall be fitted with a nut and steel washer and bolts, nuts and washers shall be cadmium plated in accordance with and to a thickness specified for Class A in BS 1706.

Unless otherwise indicated in the Pipe Schedule, the number of bolts to be supplied shall be determined on the basis that each flange is to be supplied with half the number of bolts required for that flange.

PSL 3.6.5 Jointing

Gaskets for flanges shall be recommended by the Contractor's supplier and shall be submitted to the Employer's Agent for approval.

PSL 3.6.6 Pipe joints and coupling other than flanges

Pipe ends shall be prepared for the type of jointing and coupling as specified in the pipe schedule and / or stated in the Schedule of Quantities with the requirements for and preparations as specified in SABS 62 and 719 as applicable.

Standard couplings and flange adapters shall be of the Viking Johnson type or equivalent and all loose bolts with nuts and washers shall be cadmium plated in accordance with and to a thickness specified for Class A in BS 1706 and shall be lined and coated as specified in Clause PSL 3.6.8 below.

PSL 3.6.7 Lining and coating of steel pipes, specials and fittings

All pipes, specials and fittings, including couplings and flange adapters, shall be fully lined and coated by fusion bonded epoxy on the outside and liquid epoxy on the inside with a minimum of three coats to a minimum total dry film thickness of 400 micrometres on a steel surface that has been prepared by sandblasting to Grade SA 2.5 as specified in SIS 055900, with a delay of not more than four hours between sandblasting and the application of the first paint coat.

Successive paint coats shall be of different colours, and the colour of the final coat shall be approved by the Engineer prior to painting. Over-coating time between the applications of successive coats shall not exceed 24 hours.


Tenderer


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Witness 2



The epoxy product and process shall be presented to the engineer prior to the ordering of any pipe fittings applicable.

The coating and lining applied shall be as per the Standard Specification DWS 9900 Section C1 unless specified otherwise in the text above. The Specification is attached under C5 Annexures.

Tape wrapping

All underground steel pipes joints (flanged, flexible coupling, etc.) shall be tape wrapped in accordance with this specification. No additional payment shall be made as the rate for the coupling shall include for the tape wrapping.

External steel pipe coating and wrapping specification:

A Denso Corroklad 750 tape or equivalent should be applied to the external surface of the steel pipeline.

The tape consists essentially of a specially formulated polyethylene film laminated to a pressure sensitive, non-hardening thermoplastic adhesive. The adhesive layer is generally one and a half times thicker than the polyethylene film.

The composite wrapping system provides a durable impact and cut resistant rockshiled for normal and rugged service conditions.

Technical Data

The following information pertains to the Corroklad 750 tape:

- The base layer is made of polyethylene and is 0,3mm thick.
- The adhesive layer consists of rubber modified bitumen and is 0,45mm thick.
- The product thickness is 0,75mm.
- The tape has a minimum tensile strength of 15 MPa.
- The minimum elongation at failure is 300%.
- The adhesive and peel strength of the tape at 25°C is 2,2N/mm and 1,65N/mm respectively.
- The minimum dielectric strength of the tape is 25 KV.
- Cathodic disbondment by ASTM G8 Method B is 425mm².
- The service temperature of the tape is -10°C to 65°C.

Application Procedure

Corroklad tape can be successfully wrapped by hand (maximum tape width 100mm) and by machine. The general application is detailed below.

Surface Preparation

- All dirt, loose rust/mill scale and grease must be removed from the pipe surface.
- The minimum surface preparation acceptable for tape wrapping with Corroklad is ST2 (Swedish Standard SIS 055900-1967, Mechanical wire brushing).


Tenderer


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Witness 2

Priming the Pipe Surface

- The primer to be used is Denso Primer D or equivalent Polymer Bitumen Solution, and is to be applied by means of a medium pressure cop gun.
- The primer may be thinned for application with white spirits or toluene.
- The primer should nominally cover 9m² liter.
- The minimum drying period at 20°C is 20 minutes.
- The flash point occurs above 23°C.
- If the pipes are prepared and primed off site, it may be necessary to apply a second coat of primer on site in order to rejuvenate the first application. This is only required if the pipe is being wrapped on site.
- The primer should be dust free prior to the application of the tape wrap system. Should the primer be contaminated, the surface must be reprimed.
- The primer should be allowed to dry for approximately 30 minutes at 20°C to 25°C prior to the application of the tape system.

Tape Application

- The Corroklad tape or equivalent should be spirally wrapped onto the primed pipe, utilising a 55% overlap.
55% Overlap will ensure a minimum of two layers of tape at any point.
- Ensure that a constant web tension of 10 to 15kg/100mm is maintained during wrapping.
- At no time is the shrinkage of the total width of tape to exceed 2%.

Pipe Handling

- Non-metallic slings are to be utilised when handling the wrapped pipe sections or pipe, in order to ensure that no mechanical damage occurs to the tape.

PSL 3.6.8 Making good and over-coating of steel pipes, specials and fittings**PSL 3.6.8.1 Steel pipes, specials and fittings**

After erection, all damage to the Epoxy coatings or Linings, shall be made good strictly in accordance with The DWS 9900 Specification which is attached under C5 Annexures.

PSL 3.6.8.2 Handling, delivery and installation

All pipes, pipe specials and fittings shall be handled throughout the processes of manufacturing, corrosion protection, delivery and installation with all care necessary to prevent any damage.

After the corrosion protection of the outside of pipes and specials has been carried out, these items must be handled only by means of straps that will in no way damage the protection.


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After completion of corrosion protection at the place of manufacture, all pipe ends shall be effectively closed off by at least a sheet of plastic held fast to the pipe and by binding wire.

This seal shall be checked specifically during delivery and after off-loading on site to confirm that it is still fully effective and shall immediately be repaired or replaced if damaged. Should there be the slightest danger of the ingress of foreign matter into the pipework during installation, the ends shall be kept sealed off all the time.

Pipes shall be supported during travelling on shaped and padded cradles while pipe specials shall be adequately supported and separated from each other to prevent any damage.

Steel pipes will only be offloaded with the aid of a spreader boom of 6m length to spread the point load and minimize the deflection in the pipe.

At the delivery points on site, pipes, pipe specials and fittings shall be supported by plastic sandbags of sufficient strength, such that the under sides of the pipes and pipe specials are at least 200mm off the ground. The number and positioning of supports under the pipes, shall be such as to prevent any undue pipe deflection.

Bolts, nuts, washers and jointing, shall be packed in strong metal or wooden containers with effective lids, with each different sizes of bolts grouped separately in hessian bags all clearly labelled as to their contents.

Pipe work shall be securely clamped in its final position by means of galvanised fittings.

PSL 3.7 Flexible couplings at structures

Flexible couplings shall be provided at the point where pipelines enter all structures.

PSL 3.8 Valves (Sub-clause 3.10)

PSL 3.8.1 Scope

This specification covers the requirements for material, manufacture, delivery, installation, over-coating as may be required, site-testing and commissioning for gate valves for use in pipe work, mainly for the delivery of raw and purified water, but also for air supply, at ambient temperatures up to 70°C.

PSL 3.9 Testing of pipelines (Sub-clause 7.3)

PSL 3.9.1 Test pressure (Sub-clause 7.3.1(a))

Replace the Sub-clause 7.3.1 with the following:

All pipes shall be tested at 1.25 the working pressure at the specific point where the pressure test be executed. The Contractor shall identify the points on the pipeline where the hydrostatic pressure test be executed and shall notify the Engineer in advance in order


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for the Engineer to be able to furnish the Contractor with the required test pressure at the specific test point.

PSL 3.9.2 Method of testing (Sub-clause 7.3.1(b))

Add the following new clauses:

- a) The Contractor shall provide an approved test pump, an accurate water meter, sealed pressure gauge, tested and certified by an independent testing organisation, and all other equipment, materials and labour required for the test.
- b) The section of pipeline to be tested shall be clean and closed off at the ends by isolating valves, end caps or approved end-closure pieces
- c) During the initial filling stage, the pipe section joints and all specials, fittings and valves shall be visually inspected for visible leaks and same rectified before proceeding with the test.
- d) The pressure shall be maintained for one hour and if a pressure drop occurs, more water shall be added to reinstate the test pressure and the valve closed again. The quantity of water added shall be measured by recording the readings before and after pumping. This procedure shall be repeated for a period of 24 hours, with water added at hourly intervals where necessary to reinstate pressure and water meter reading recorded. At the end of the 24 hour period, the aggregate quantity of water required to reinstate pressure over 24 hours shall be determined.
- e) The Contractor shall give the Engineer 48 hours written notice of his intention to commence pressure testing and the Engineer may attend and supervise all or any part of tests. All records and recording charts shall be handed to the Engineer as soon as tests over any section have been completed.
- f) All valves, specials, fittings and exposed joints, shall be inspected visually during the 24 hours pipeline test and all visible signs of leaks, sweating and distress shall be reported and attended to without delay.
- g) Immediately after completion of the prescribed 24 hours hydrostatic test, all air valves shall be tested in turn before test pressure in the pipeline is released. Each air valve shall be isolated and the drain plug removed. The air valve shall work freely without restraint. The isolating valve shall be checked for leakage before replacing the plug. Finally, the automatic resealing of the air valves shall be checked by re-opening the isolating valve.
- h) After completion of tests on air valves, the section of pipeline under test shall be completely refilled with water, if necessary, and pressured to the static head shown on the drawings or indicated by the Engineer. Each scour valve shall be checked by opening isolating valves where applicable for a duration sufficient to check the complete opening and closing cycles. If necessary, the pipeline shall be refilled after

Tenderer

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each individual test and re-pressurised to the prescribed static pipeline head in order to test all scours within the section under test.

PSL 3.9.3 Remedial measures (Sub-clause 7.3.1 (c))

Add the following new clauses:

- a) Should the maximum leakage limits as specified be exceeded, the Contractor shall determine the position and cause of the leaks and shall take remedial measures at his own expense and to the satisfaction of the Engineer to stop such leaks and ensure the specified degree of water tightness.
- b) If during the contract period of maintenance, the number of leaks and other defects is considered by the Engineer to be more than could reasonably be expected from a well laid pipeline operating under normal conditions, he may order the Contractor to re-test parts or the whole of the pipeline at the Contractor's own expense and no claims for escalation in costs or for whatever other reasons the Contractor might consider to submit claims shall be considered, except where such re-tests are the result from damages caused to the pipeline by the Employer."

PSL 3.10 Concrete work (Sub-clause 5.13)

Add sub-clause 5.13 as follows:

PSL 3.10.1 Encased pipe work

- a) Where pipes and / or specials are permanently encased in concrete, e.g. in thrust blocks, walls of concrete valve chambers, stream crossings, etc., the coating over the portion to be so encased shall be to the same standard as the rest of the pipeline, except where indicated to the contrary in the Schedule of Quantities or on the drawings.
- b) Whenever it is necessary to encase pipes in concrete, the flexible joints shall not be encased and the concrete shall terminate 300 mm from the flexible joint.
- c) All specials encased in concrete shall be painted with one coat of bitumen primer and two coats of bit mastic paint to a dry film thickness of 180 micrometers.

PSL 3.10.2 Brickwork (Sub-clause 5.14)

Add sub-clause 5.14 as follows:

- a) Brickwork is to be built to the dimensions, thicknesses and heights as shown on the drawings.
- b) All exposed brickwork shall be plastered and shall have joints raked out to a depth of 12 mm to ensure good plaster bond.


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2



- c) Mortar shall consist of one part cement to four parts approved sand by volume and shall be used within one hour of mixing.
- d) Brickwork shall be built in stretcher bond and all common bricks shall be well wetted before being laid.

PSL 4 MEASUREMENT AND PAYMENT**PSL 4.1 Steel specials and fittings (sub-clause 8.2.1)**

Add the following clause to the payment item:

The rate shall also cover the cost of the coating and lining as specified in this contract as well as repairing or making good, damaged coatings and linings on site.

PSL 4.2 Steel specials and fittings (sub-clause 8.2.2)

Add the following payment item:

Item:

Fabrication, supply, transport and install and test the following pipe fittings. All items to be approved by Engineer prior to ordering. Unit: number (no)

The unit of measurement for payment for the manufacture, corrosion protection and final over-coating as may be required, delivery, installation of pipes, site-testing and commissioning of pipes, pipe specials and fittings conforming with this Specification shall be measured by number for each type, class and size as stated in the Schedule of Quantities.

The rates tendered and paid for valves and fittings must include the cost of the provision of an approved coating and the cost of any additional couplings other than those listed in the Schedule of Quantities to connect to the water mains.

All adapters and distance pieces required for the extension to the specified level and length as shown on the drawings for air and scour valves must be included in the rates for the units. All underground pipe fittings shall be wrapped in an approved isolating material as specified in PSL 3.5.7

The cost of providing couplings, cutting pieces, etc. shall be allowed for in the rate tendered for pipe work.

PSL 4.3 Reinstate Road Surface

Add the following payment item:

Item:

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Witness 1

Witness 2

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Witness 1

Witness 2



Reinstate road surface as per detail drawings:

- a) Cut and remove existing gravel layer in windrow and stockpile Unit: m³
- b) Reinstate existing gravel layers to original state (98% MAMDD) Unit: m³

The above item covers the complete repair of the road surface where the pipeline trench exaction is required over an existing gravel or surfaced road. The rate shall cover all materials, plant, watering, stabilizing, labour and tests to repair the road surface and related layer works back to its original state.


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Witness 2


Employer


Witness 1


Witness 2

**PSLB SABS 1200 LB: BEDDING (PIPES)****PSLB 1 MATERIALS****PSLB 1.1 Selected granular material (Sub clause 3.1)**

Add the following to this sub-clause:

Granular materials shall be selected from trench excavations. If the contractor elects not to apply selection of material from excavations, he shall provide suitable material from any other approved source at his own expense.

Bedding material shall be either of the following type:

a) Type A : Finally graded, composed of material with the following properties:

i) Percentage by mass passing:

4,75 mm screen - 100 %
0,425 mm screen - 80 to 100 %
0,002 mm screen - 0 to 45 %

ii) Liquid limit (LL) as determined in accordance with SABS Method 852 shall not be more than 15, when performed on all the material passing the 0,425 mm sieve.

iii) Plasticity index (PI) as determined in accordance with SABS Method 852 shall not be more than 15, when performed on all the material passing the 0,425 mm sieve.

iv) Linear shrinkage (LS) as determined in accordance with SABS Method 853 shall not exceed 5 %, when performed on all the material passing the 0,425 mm sieve.

b) Type B : Medium graded, composed of material with the following properties:

i) Percentage by mass passing:

4,75 mm screen - 80 to 100 %
0,425 mm screen - 60 to 80 %
0,002 mm screen - 0 to 40 %

ii) Liquid limit (LL) as determined in accordance with SABS Method 852 shall not be more than 35 %, when performed on all the material passing the 0,425 mm sieve.


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Witness 1


Witness 2



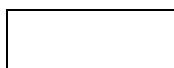
- iii) Plasticity index (PI) as determined in accordance with SABS Method 852 shall not be more than 18, when performed on all the material passing the 0,425 mm sieve.
- iv) Linear shrinkage (LS) as determined in accordance with SABS Method 853 shall not exceed 7 %, when performed on all the material passing the 0,425 mm sieve.
- c) Type C : Granular, composed of material with the following properties:
- i) Percentage by mass passing:
- 9,5 mm screen - 100 %
4,75 mm screen - 70 to 100 %
0,425 mm screen - 30 to 60 %
0,002 mm screen - 0 to 45 %
- ii) Liquid limit (LL) as determined in accordance with SABS Method 852 shall not be more than 40 %, when performed on all the material passing the 0,425 mm sieve.
- iii) Plasticity index (PI) as determined in accordance with SABS Method 852 shall not be more than 20, when performed on all the material passing the 0,425 mm sieve.
- iv) Linear shrinkage (LS) as determined in accordance with SABS Method 853 shall not exceed 10 %, when performed on all the material passing the 0,425 mm sieve.

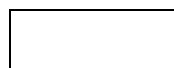
Items a), b) and c) are conveniently summarised in the following table:

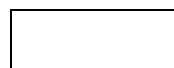
Material	PERCENTAGE BY MASS PASSING SCREENS				ATTERBERG LIMITS SHALL NOT EXCEED		
	9,5 mm	4,75 mm	0,425 mm	0,002 mm	Liquid Limit (LL) %	Plasticit y Index (PI)	Linear Shrinkag e (LS) %
Finely graded / A	100	100	80 -	0 - 45	30	15	5
Medium graded /	100	80 -	100	0 - 40	35	18	7,5
B	100	100	60 - 80	0 - 35	40	20	10
Granular / C		70 - 100	30 - 60				

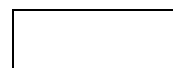
PSLB 1.2 Bedding (Sub-clause 3.3)

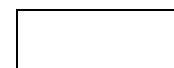
Add the following to this sub-clause:

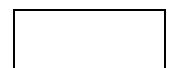

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Witness 1


Witness 2


Employer


Witness 1


Witness 2



All steel pipes in the works shall be classed as “rigid” with flanged joints and shall be bedded on Class C bedding as described in sub-clause 5.2 of SABS 1200 LB, unless otherwise specified or instructed by the Engineer.

PSLB 1.3 Backfilling of pipe trenches (Sub-clause 3.5)

Add sub-clause 3.5 as follows:

No backfilling of pipe trenches on top of the selected fill layer may commence without the written consent of the Engineer or his Representative.

PSLB 2 CONSTRUCTION

PSLB 2.1 Waterlogged trench bottoms (Sub-clause 5.5)

Add sub-clause 5.5 as follows:

- a) Where trench bottoms are too soft and waterlogged to permit placement and compaction of bedding material in the normal manner, such trench bottoms shall be excavated to a depth of at least 300 mm below the underside of pipes and specials for the full width and length of the trench affected.
- b) The full width and length of the trench bottom and at least 500 mm height of both sides of trench walls shall be covered by an unwoven approved geotextile, similar to Kaymat U24.

The full width and length of the trench shall thereupon be covered by a 300 mm thick layer of coarse gravel, coarse sand or 19 mm nominal size crushed stone, fully compacted within the confines of the geotextile to take the mass of the pipe filled with water and all loads on the pipe without settlement.

The free drainage layer shall be covered over the full width of the trench by a single layer of geotextile with the cloth on trench walls folded over and overlapping to completely seal off the free drainage layer against ingress of sand or fine soil particle.

Pipes shall be laid directly on the bed prepared as above and pipe bedding and selected backfill completed as specified.


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2

**DESIGN OF THE WORKS****1. GENERAL**

THE GENERAL PROVISIONS OF PARTICULAR SPECIFICATIONS SPEC GM, SPEC GP, SPEC CP AND SPEC LK PERTAINING TO THE DESIGN OF THE WORKS SHALL APPLY UNLESS STATED OTHERWISE BELOW.

The Contractor is responsible for the detailed design of all mechanical and electrical systems, in accordance with the performance and detailed specifications.

The Employer is responsible for concept, feasibility, basic engineering and layout for the mechanical and electrical works to tender stage of the project.

The Contractor is also responsible for the design for any temporary works, anchor blocks, and pipework support structures.

The Contractor's design shall adequately cater for all unbalanced forces acting against the pump station structure.

Design Services and Activity Matrix

The design responsibility for the Works is as per Clause 4.2 of SANS 1921-1 and Clause 5 of the General Conditions of Contract. Where conflict arises, the Project Specifications take precedence. All the Contractor's design work and selection of equipment shall be subject to the Engineer's written approval before final orders are placed for procuring the equipment and materials.

The Design responsibilities are as follows:

Design Process	Responsibility
Concept design & control philosophy	Engineer on behalf of Employer
Basic engineering and layout to tender stage	Engineer
Detailed design of civil site works	Engineer
Detailed design of buildings civil works	Engineer
M&E Final design for construction stage (including Pumpstation pipework and fittings)	Contractor
Detailed M&E equipment design	Contractor
Control /functional design	Contractor
Temporary works	Contractor
Supports for pipes and fittings	Contractor
GMS walkways (layout & structural)	Engineer
Mark-up of as-built drawings	Contractor
Compilation and Preparation of Operation and Maintenance Manuals	Contractor

The Contractor shall design the stipulated components of the Works in accordance with the Employer's Requirements as specified in Part C3: Scope of Work and as shown on the drawings provided by the Employer in Volume 3.


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2



1. DRAWINGS, SAMPLES AND INSPECTIONS

Tender Drawings

The drawings issued to Tenderers as part of the Tender Document shall NOT be used for construction.

The drawings issued separately for tender purposes are listed in Part C3.5: Annexures.

Design Drawings

Where requested the design of temporary works must be submitted to the Engineer for approval.

Manufacturing drawings

The Contractor shall timeously provide workshop drawings for the following for the Engineer's review and approval:

- a) All pipework and associated supports (including general arrangement plans and sections)
- b) Motor Control Centre panel construction

Manufacture and delivery of these items shall not proceed without the Engineer's written instruction to proceed.

The Contractor shall timeously advise the Engineer of inspections at the manufacturer's premises to enable the Engineer to perform said inspections.

Record (as-built) drawings

The Contractor shall provide 'To-Scale' record (as-built) general arrangement drawings of all the relevant equipment. Such drawings shall be made available in an approved electronic format such as AutoCAD and shall be submitted to the Employer's Agent prior to issue of the Taking Over Certificate.

2. EMPLOYER'S DESIGN

The drawings prepared by the Employer and provided in Volume 2 and Volume 3 form part of the Employer's Requirements; the Contractor shall design and execute the Works in accordance with these.

The Contractor shall confirm that structures constructed by others are represented correctly on the drawings.

Where drawings for the structures have been prepared by the Engineer, the Contractor shall base his drawings on the Engineer's drawings and shall check that his equipment fits into and can operate satisfactorily within the structures shown on the Engineer's drawings.

Drawings, dimensions and details of mechanical and electrical equipment are supplied to the Contractor in good faith, however, the Contractor shall base the design of his


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2



infrastructure and equipment on the dimensions of the pump station superstructure as constructed and measured on site and obtain approval from the Engineer.

3. CONTRACTOR'S DESIGN

Duties

The Contract includes the following duties in respect of the Works:

- Design
- Manufacture
- Supply
- Delivery
- Installation and construction
- Preparation of as-built drawings
- Compilation and preparation of Operations and Maintenance Manual
- Testing
- Commissioning
- Training
- Quarterly inspection and service visits & upholding during the defects notification period.

Design brief

The equipment shall comply with the design requirements of the particular specifications and as amended by the Project Specifications.

The proposed equipment shall be designed to fit into the proposed structure, unless notification of required alterations were given with the tender and such alterations have been approved by the Engineer.

Design procedures

The Contractor shall interface the proposed equipment with the proposed structure.

Any modification to the structure or temporary measures required shall be detailed on drawings and sent to the Engineer for approval.

Modification of the structure and the provision of temporary measures shall only commence once the Contractor has received written approval from the Engineer.

Contractors Documents

Drawings forming part of the Contractor's Documents to be provided in accordance with the requirements of Clause 5 of the General Conditions of Contract shall comply with the following:

One hard copy set and an electronic copy of all drawings shall be provided.
A register of all the Contractor's documents shall be provided with each submission.
Drawings shall be prepared in accordance with the latest issue of SANS 10111

Item lists shall be provided on the drawing or on a separate parts list. Item descriptions shall include the material of construction, quantity and full identification information, including, as applicable, brand name, manufacturers.


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2



4. CONTROL SPECIFICATION

Basic Control Philosophy

The pumpstation is to be 'demand driven'; in other words, to keep the receiving reservoir full or nearly-full at all times. Detailed requirements are given in the following sections.

The pumpstation shall be controlled using a PLC.

The pumpstation shall be fitted with soft starters for the motors.

Control Requirements

Safety Devices

The following safety loops or devices are to be provided per pump:

- **Low level in supply reservoir:** When low level is detected (float switch installed inside the supply reservoirs), the pumps shall be shut-down and not restarted until either or both reservoir levels have recovered above the low level limit. This protection must be effective when the system is in auto and manual mode.
- **Low pump flow:** This function must be implemented using an insertion type no-flow sensor (on suction branch of each pump) which has no moving parts. The tripping must be disabled during starting via an adjustable timer. An output from the no-flow sensor must be wired back to the PLC for control requirements and alarm indication on the PANEL INDICATOR and SCADA. This protection must be effective even when the system is in auto and manual.
- **Motor overload/ high pump delivery:** This function is to be embedded in the Soft starter. When a motor overload occurs the Soft starter must stop the motor (preferably via a ramp down if possible to reduce water hammer). The pump must not be able to be started until the Soft starter has been reset and all alarms cleared. An output from the Soft starter must be wired back to the PLC for control requirements and alarm indication on the PANEL INDICATOR & SCADA. Modbus and Ethernet TCP/IP is essential for the Soft Starter.
- **Motor fault protection:** This function is to be implemented in the Soft starter. When a motor fault is detected (earth fault, locked rotor) the motor must be de-energised. The pump must not be able to be started until the Soft starter has been reset. An output from the Soft starter must be wired back to the PLC for control requirements and alarm indication on the PANEL INDICATOR & SCADA.
- **Pump and motor vibration:** All pumpsets shall be fitted with two vibration sensors on the pump and two vibration sensors on the motor. These vibration sensors are to be wired back to controllers located on the respective Soft starter cubicle. The controllers must be fitted with 4-20mA retransmission outputs which will be connected to the PLC for indication on the PANEL INDICATOR and SCADA system. When any of the vibration sensors first register an out-of-normal-range level of vibration, a warning indicator light must light-up on the MCC and a warning signal sent to the central SCADA system. The pumps will continue to run. When


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2



an out-of-acceptable-range vibration is detected on either the pump or motor, the motor must stop via a controlled stop. This protection must be effective even when the system is in auto and manual. Pushing the 'Reset' button should not bypass the warning or pump shutdown if the cause of the vibration has not been attended to.

- **Motor temperature (Thermistors):** The motor is to be supplied with thermistors. The Soft starter should preferably make provision for these thermistors to be connected directly to it. When a high motor temperature is detected, the motors should be stopped via a controlled stop. This protection must be effective when the system is in auto and manual.
- **High discharge pressure:** The pressure in the pipe on the delivery side of each pump (between the pump and the isolating valve) is monitored by a pressure transmitter. The pressure transmitter is wired to the PLC in the local control panel. If a high pressure is recorded for longer than a preset time limit (typically 10 seconds), the motor must be stopped via a controlled stop. The pump can be restarted manually or automatically without resetting the soft starter. This protection will not be effective in manual operation mode.
- **Emergency stops:** An emergency stop will be located at each pump set with an additional emergency stop on the main pump control panel. Additional emergency stops must also be provided for each of the pumps, in the event of any emergency stop being is pressed, all pump sets in the pump room must stop. The emergency stop must be hard wired into the soft starter control circuit. A contact will be wired into the PLC for alarm indication.
- **Pump low suction pressure:** The pressure in the pipe between the suction side of each pump and its respective isolating valve is monitored by a pressure transmitter. The pressure transmitter is wired to the PLC in the local control panel. If a low pressure is recorded, the motor must be stopped via a controlled stop. The pump can be restarted manually or automatically without resetting the Soft starter. This protection will not be effective in manual operation mode.

The definition of a controlled stop is one in which the Soft starter ramps the motor to a stop (special feature of the soft starter know as Soft Stops). An uncontrolled stop is one in which the Soft starter turns off and the motor freewheels to a stop.

The PLC and Soft starter must support Modbus and Ethernet TCP/IP with expandability for remote control functionality.

Automatic Control

The Automatic controls are to be implemented in a PLC. The annunciation of faults and the display of operating conditions will be displayed via panel indicator lamps. The PLC and panel indicator are to be located in the local control panel. The mode of operation will be selected via a rotary control switch on the local control panel. When auto is selected the pumps will start and stop automatically as controlled by the PLC.

The pumps will be controlled in such a manner as to keep the respective receiving pipeline at the set pressure at possible at all times (except when the level in the supply line pressure falls too low). In all cases, this requires the pumps to deliver water until the receiving line inlet control valve starts closing down as the receiving reservoir approaches full level, a high pressure setpoint will be detected on the pump discharge


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2



pipeline and all pumps will stop. An adjustable timer will then activate when the pump/s stop and cause the Duty Pump/s to re-start after a set period (typically 30 minutes). In auto mode, an audible buzzer shall sound for 10 second inside the pumpstation as a warning to any operator present that the Duty Pumps are about to start.

The controlling signal to the PLC will be from the pumpstation delivery manifold pressure transmitter and the electromagnetic flow meter and float switches in the nearby supply reservoirs (float switches to be hard-wired to PLC). A PID control loop embedded in the PLC will constantly monitor the three input signals and switch-off the Duty Pump/s should **any one** of the following be detected:

- Float switch in supply reservoir indicates that water level has fallen below operating limit;
- The flow meter registers a declining flow (eg falls below, say, 80% of normal steady-state flow).
- The pressure sensor registers an increasing pressure (eg rises, say, 50 kPa above the normal steady-state pressure).

Should **either** the flow meter or pressure sensor be faulty (out-of-range detected), its signal shall be ignored for pump control purposes. If **both** flow meter and pressure sensor are found to be faulty, it shall be possible to pump in manual mode until one of the motor protection systems kicks-in (low flow / low motor current).

The program will allow for a monitoring cycle period of 5 minutes or more prior to restarting the PID loop. The control system must ensure that the running hours on the pumps are balanced. To ensure this when a pump needs to be stopped the pump with the highest running hours must be stopped first. When starting a pump the pump with the lowest running hours must be started first.

If a pump is out of service the control system must continue to operate as normal.

Manual Control

Manual control should only be used when testing pumps or in the event of a PLC failure. When in manual (determined by the position of the auto manual switch on the local control panel), the pumps are started and stopped by the operator via the start stop buttons on the local control panel.

Local Control Panel

A local control and indication panel must be located in the Pumpstation. The location should be easily accessible and located away from the pumps but preferably at a point which affords visual contact with the pumps. The local control panel will house the local PLC as well as the Manual controls and a 5 inch HMI which are installed on the main MCC panel. The HMI must display a history of all errors and trips recorded by the PLC.

The following indication must be available on the main screen of the HMI:

For each pump:

- a) Pump running indication (green)
- b) Pump tripped indication (red)
- c) Pump alarm indication (orange)
- d) Pump suction pressure


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Witness 1


Witness 2


Employer


Witness 1


Witness 2



- e) Pump discharge pressure
- f) Pump and motor vibration alarms
- g) Motor winding temperature

For system:

- h) Local supply reservoir low water level indication (red) for both reservoirs
- i) Rising main pressure in kPa
- j) System in automatic or manual mode
- k) Audible alarm mute

The following controls will be on the control panel:

- a) Lockable Automatic/ Manual switch
- b) Pump start button (green) one per pump
- c) Pump stop button (red) one per pump

The manual controls must be laid out in a logical order such that no confusion can occur.

The local control panel will also control an audible alarm. The audible alarm must be sounded for the following conditions:

- a) Local supply reservoir low water level for reservoir currently in service
- b) Pump tripped (any trip)
- c) Discharge pressure high

The audible alarm will sound until the mute button is pressed. The alarm must be re-triggered again if another alarm becomes active. The alarm must activate even if there are other active alarms still present.

The PLC shall not be used in the manual control mode and essential protection shall be hardwired into the soft starter control circuit. The essential protection shall include the following:

- a) Motor protection (internal to soft starter)
- b) Pump and motor vibration
- c) Motor winding temperature (thermistors via soft starter)
- d) Emergency stop
- e) Suction Manifold Low pressure trip
- f) Delivery Manifold High and Low pressure trip

The HMI will have an engineering screen. This screen will be password protected and will enable maintenance and senior operating staff to change operating and alarm set point values. This information shall also be made available to the telemetry system installed by others. The telemetry communication is Modbus based.

5. PUMP START & STOP SEQUENCE

General

The start-up sequence can be initiated from any of the above mentioned modes. At start up, it is assumed that the manually operated suction and delivery valves are fully open (they are normally left fully open and are only closed if a pump has to be removed


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2



for repairs). Should the valves not be fully or almost fully open, one of the alarm signals should cause the pumps to shut down.

On start-up, the Soft Starter shall slowly ramp the pump set up to normal speed.

During running mode, the PLC shall continually monitor:

- Individual pump delivery pressures
- Motor winding temperatures
- Pump and motor vibration

Each of the above shall be displayed real time on the panel indicator. The alarm and trip set points shall be settable on the panel door.

In addition, pumps will trip as a result of out-of-range signals activating due to:

- Low pressure at suction
- Low pressure at delivery

The shutdown sequence shall be the reverse of the start-up operation

Pump Sequence for Pumpstation with one duty and one standby pump (Masobe Pumpstation).

The duty pump will start and run until a high pressure set point is detected at the discharge pipeline transducer, at this point the duty pump will soft stop to prevent any damage. An adjustable timer will begin timing out once the duty pump has stopped. Once the timer has timed out, provided the standby pump does not have a trip alarm, the standby pump will start and run until the nominal pressure set point is reached. If the standby pump has a trip alarm, the duty pump will restart to achieve the nominal pressure set point. The adjustable timer will be controlled by the time of day to allow for longer delays between pump stops at night, which shall adjust as the demand on the Masobe Command reservoir increases, the delays between stops and starts can be reduced.

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Witness 1

Witness 2

Employer

Witness 1

Witness 2



6. EXISTING WORKS

CONTROL SPECIFICATION

Basic Control Philosophy

The pumpstation is to be 'demand driven'; in other words, to keep the receiving reservoir full or nearly-full at all times. Detailed requirements are given in the following sections.

The pumpstation shall be controlled using a PLC.

The pumpstation shall be fitted with soft starters for the motors.

8. CONTROL REQUIREMENTS

Safety Devices

The following safety loops or devices are to be provided per pump:

- **Low level in supply reservoir:** When low level is detected (float switch installed inside the supply reservoirs), the pumps shall be shut-down and not restarted until either or both reservoir levels have recovered above the low level limit. This protection must be effective when the system is in auto and manual mode.
- **Low pump flow:** This function must be implemented using an insertion type no-flow sensor (on suction branch of each pump) which has no moving parts. The tripping must be disabled during starting via an adjustable timer. An output from the no-flow sensor must be wired back to the PLC for control requirements and alarm indication on the PANEL INDICATOR and SCADA. This protection must be effective even when the system is in auto and manual.
- **Motor overload/ high pump delivery:** This function is to be embedded in the Soft starter. When a motor overload occurs the Soft starter must stop the motor (preferably via a ramp down if possible to reduce water hammer). The pump must not be able to be started until the Soft starter has been reset and all alarms cleared. An output from the Soft starter must be wired back to the PLC for control requirements and alarm indication on the PANEL INDICATOR & SCADA. Modbus and Ethernet TCP/IP is essential for the Soft Starter.
- **Motor fault protection:** This function is to be implemented in the Soft starter. When a motor fault is detected (earth fault, locked rotor) the motor must be de-energised. The pump must not be able to be started until the Soft starter has been reset. An output from the Soft starter must be wired back to the PLC for control requirements and alarm indication on the PANEL INDICATOR & SCADA.
- **Pump and motor vibration:** All pumpsets shall be fitted with two vibration sensors on the pump and two vibration sensors on the motor. These vibration sensors are to be wired back to controllers located on the respective Soft starter cubicle. The controllers must be fitted with 4-20mA retransmission outputs which will be connected to the PLC for indication on the PANEL INDICATOR and SCADA system. When any of the vibration sensors first register an out-of-normal-range level of vibration, a warning indicator light must light-up on the MCC and a warning


Tenderer


Witness 1


Witness 2


Employer


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Witness 2



signal sent to the central SCADA system. The pumps will continue to run. When an out-of-acceptable-range vibration is detected on either the pump or motor, the motor must stop via a controlled stop. This protection must be effective even when the system is in auto and manual. Pushing the 'Reset' button should not bypass the warning or pump shutdown if the cause of the vibration has not been attended to.

- **Motor temperature (Thermistors):** The motor is to be supplied with thermistors. The Soft starter should preferably make provision for these thermistors to be connected directly to it. When a high motor temperature is detected, the motors should be stopped via a controlled stop. This protection must be effective when the system is in auto and manual.
- **High discharge pressure:** The pressure in the pipe on the delivery side of each pump (between the pump and the isolating valve) is monitored by a pressure transmitter. The pressure transmitter is wired to the PLC in the local control panel. If a high pressure is recorded for longer than a preset time limit (typically 10 seconds), the motor must be stopped via a controlled stop. The pump can be restarted manually or automatically without resetting the soft starter. This protection will not be effective in manual operation mode.
- **Emergency stops:** An emergency stop will be located at each pump set with an additional emergency stop on the main pump control panel. Additional emergency stops must also be provided for each of the pumps, in the event of any emergency stop being pressed, all pump sets in the pump room must stop. The emergency stop must be hard wired into the soft starter control circuit. A contact will be wired into the PLC for alarm indication.
- **Pump low suction pressure:** The pressure in the pipe between the suction side of each pump and its respective isolating valve is monitored by a pressure transmitter. The pressure transmitter is wired to the PLC in the local control panel. If a low pressure is recorded, the motor must be stopped via a controlled stop. The pump can be restarted manually or automatically without resetting the Soft starter. This protection will not be effective in manual operation mode.

The definition of a controlled stop is one in which the Soft starter ramps the motor to a stop (special feature of the soft starter known as Soft Stops). An uncontrolled stop is one in which the Soft starter turns off and the motor freewheels to a stop.

The PLC and Soft starter must support Modbus and Ethernet TCP/IP with expandability for remote control functionality.

Automatic Control

The Automatic controls are to be implemented in a PLC. The annunciation of faults and the display of operating conditions will be displayed via panel indicator lamps. The PLC and panel indicator are to be located in the local control panel. The mode of operation will be selected via a rotary control switch on the local control panel. When auto is selected the pumps will start and stop automatically as controlled by the PLC.

The pumps will be controlled in such a manner as to keep the respective receiving pipeline at the set pressure at possible at all times (except when the level in the supply line pressure falls too low). In all cases, this requires the pumps to deliver water until the receiving line inlet control valve starts closing down as the receiving reservoir


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Witness 1


Witness 2


Employer


Witness 1


Witness 2



approaches full level, a high pressure setpoint will be detected on the pump discharge pipeline and all pumps will stop. An adjustable timer will then activate when the pump/s stop and cause the Duty Pump/s to re-start after a set period (typically 30 minutes). In auto mode, an audible buzzer shall sound for 10 second inside the pumpstation as a warning to any operator present that the Duty Pumps are about to start.

The controlling signal to the PLC will be from the pumpstation delivery manifold pressure transmitter and the electromagnetic flow meter and float switches in the nearby supply reservoirs (float switches to be hard-wired to PLC). A PID control loop embedded in the PLC will constantly monitor the three input signals and switch-off the Duty Pump/s should **any one** of the following be detected:

- Float switch in supply reservoir indicates that water level has fallen below operating limit;
- The flow meter registers a declining flow (eg falls below, say, 80% of normal steady-state flow).
- The pressure sensor registers an increasing pressure (eg rises, say, 50 kPa above the normal steady-state pressure).

Should **either** the flow meter or pressure sensor be faulty (out-of-range detected), its signal shall be ignored for pump control purposes. If **both** flow meter and pressure sensor are found to be faulty, it shall be possible to pump in manual mode until one of the motor protection systems kicks-in (low flow / low motor current).

The program will allow for a monitoring cycle period of 5 minutes or more prior to restarting the PID loop. The control system must ensure that the running hours on the pumps are balanced. To ensure this when a pump needs to be stopped the pump with the highest running hours must be stopped first. When starting a pump the pump with the lowest running hours must be started first.

If a pump is out of service the control system must continue to operate as normal.

Manual Control

Manual control should only be used when testing pumps or in the event of a PLC failure. When in manual (determined by the position of the auto manual switch on the local control panel), the pumps are started and stopped by the operator via the start stop buttons on the local control panel.

Local Control Panel

A local control and indication panel must be located in the Pumpstation. The location should be easily accessible and located away from the pumps but preferably at a point which affords visual contact with the pumps. The local control panel will house the local PLC as well as the Manual controls and a 5 inch HMI which are installed on the main MCC panel. The HMI must display a history of all errors and trips recorded by the PLC.

The following indication must be available on the main screen of the HMI:

For each pump:

- l) Pump running indication (green)
- m) Pump tripped indication (red)
- n) Pump alarm indication (orange)



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Witness 1



Witness 2



- o) Pump suction pressure
- p) Pump discharge pressure
- q) Pump and motor vibration alarms
- r) Motor winding temperature

For system:

- s) Local supply reservoir low water level indication (red) for both reservoirs
- t) Rising main pressure in kPa
- u) System in automatic or manual mode
- v) Audible alarm mute

The following controls will be on the control panel:

- d) Lockable Automatic/ Manual switch
- e) Pump start button (green) one per pump
- f) Pump stop button (red) one per pump

The manual controls must be laid out in a logical order such that no confusion can occur.

The local control panel will also control an audible alarm. The audible alarm must be sounded for the following conditions:

- d) Local supply reservoir low water level for reservoir currently in service
- e) Pump tripped (any trip)
- f) Discharge pressure high

The audible alarm will sound until the mute button is pressed. The alarm must be re-triggered again if another alarm becomes active. The alarm must activate even if there are other active alarms still present.

The PLC shall not be used in the manual control mode and essential protection shall be hardwired into the soft starter control circuit. The essential protection shall include the following:

- g) Motor protection (internal to soft starter)
- h) Pump and motor vibration
- i) Motor winding temperature (thermistors via soft starter)
- j) Emergency stop
- k) Suction Manifold Low pressure trip
- l) Delivery Manifold High and Low pressure trip

The HMI will have an engineering screen. This screen will be password protected and will enable maintenance and senior operating staff to change operating and alarm set point values. This information shall also be made available to the telemetry system installed by others. The telemetry communication is Modbus based.

9. PUMP START & STOP SEQUENCE

10. GENERAL

The start-up sequence can be initiated from any of the above mentioned modes. At start up, it is assumed that the manually operated suction and delivery valves are fully open (they are normally left fully open and are only closed if a pump has to be removed


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Witness 2


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Witness 1


Witness 2



for repairs). Should the valves not be fully or almost fully open, one of the alarm signals should cause the pumps to shut down.

On start-up, the Soft Starter shall slowly ramp the pump set up to normal speed.

During running mode, the PLC shall continually monitor:

- Individual pump delivery pressures
- Motor winding temperatures
- Pump and motor vibration

Each of the above shall be displayed real time on the panel indicator. The alarm and trip set points shall be settable on the panel door.

In addition, pumps will trip as a result of out-of-range signals activating due to:

- Low pressure at suction
- Low pressure at delivery

The shutdown sequence shall be the reverse of the start-up operation

Pump Sequence for Pumpstation with one duty and one standby pump (Masobe Pumpstation).

The duty pump will start and run until a high pressure set point is detected at the discharge pipeline transducer, at this point the duty pump will soft stop to prevent any damage. An adjustable timer will begin timing out once the duty pump has stopped. Once the timer has timed out, provided the standby pump does not have a trip alarm, the standby pump will start and run until the nominal pressure set point is reached. If the standby pump has a trip alarm, the duty pump will restart to achieve the nominal pressure set point. The adjustable timer will be controlled by the time of day to allow for longer delays between pump stops at night, which shall adjust as the demand on the Masobe Command reservoir increases, the delays between stops and starts can be reduced.

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Witness 1

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Witness 1

Witness 2



11. EXISTING WORKS

Corrosion Protection

Specification

Corrosion protection of equipment shall generally comply with Specification CP – Corrosion Protection for Water Works.

12. CORROSION PROTECTION SYSTEMS

The following table lists the materials and corrosion protection system to be applied to various components of the works:

Item	Material	Corrosion Protection System
Pumps: Internally/Externally	Cast iron	Manufacturers Standard
Motors	Manufacturers standard	Manufacturers standard
Piping: Inside and above ground	Low Carbon steel	Hot dipped galvanised
Piping: buried	Low Carbon steel	Hot dipped galvanised and Denso-tape wrapped (2 layers; 50% overlap)
Pipe supports	Low Carbon steel	Hot dipped galvanised
Valves	Manufacturers standard	FBE
Restrained Flange Adaptors	Low Carbon steel	FBE
Check valves & valves	Manufacturers standard	FBE
Nuts, bolts & washers on suction and delivery manifolds and pipe supports	Grade 8.8 Steel	galvanised
MCC panels	Low Carbon Steel	FBE

13. PUMPS & MOTORS

GENERAL

PARTICULAR SPECIFICATIONS

The pumps shall generally comply with the Specification MG: General Mechanical and WP: Pumping Equipment.


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Witness 1


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Witness 1


Witness 2



14. NPSH AND SUCTION CONDITIONS

NPSH_R curves for both 0% and 3% cavitation shall be included with the submitted pump characteristic curves.

Should the pump manufacturer not have made such tests, the Engineer will make the following assumptions to obtain an approximate 0% head drop curve to ensure that cavitation does not occur because of insufficient suction pressure when the NPSHA calculations are made:

a) On the left hand side of the 3% curve, 150% will be added to the value shown;

At the BEP of the 3% curve, 40% will be added to the value shown;

On the right hand side of the 3% curve, 50% will be added to the value shown.

15. MATERIALS

All impellers shall be bronze.

16. SHAFT SEALS

Mechanical cartridge type seals shall be provided. Face materials shall be to the approval of the Engineer.

17. PUMP CASING PRESSURE RATING

Casings and seals shall be able to accommodate a total pressure that is 50% higher than the normal operating pressure or the shut-off head of the pump, whichever is the higher.

18. MOTOR RATED CAPACITY

The Contractor shall check the motor absorbed power under all possible operating scenarios and identify the scenario which draws the highest power. The motor rating shall exceed this by at least 10%. The Contractor shall be responsible for selecting a motor with adequate 'pull-out' torque during start-up of pump set. The motor shall furthermore be suitable for a minimum of six starts per hour.

19. PERFORMANCE TESTING

Each pump shall be subjected to a witnessed factory test to ISO 9906:2012 Grade 1E. Only after demonstrating compliance with project requirements, will the pump be released for delivery.

An on-site test of the operational conditions and delivery is required to verify performance, each pump individually, and in selected groups up to a maximum of two pumps running together, according to ISO 9906: 2012, Grade 2B. Failure to meet with project requirements will require the cause to be identified and rectified.

20. MASOBE PUMPS

PUMP TYPE AND CONFIGURATION

Two centrifugal horizontal multistage pumps shall be provided (1 Duty + 1 Standby).



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Witness 1



Witness 2



Employer



Witness 1



Witness 2



A preliminary layout for the 2 pumpsets has been provided to assist the Contractor in providing a suitable design (See Drawing J26137C/C1.1-103). For this configuration, a GMS 'rectagrid' type walkway over the suction manifold (leading from and level with the loading platform and with steps dropping down in-between each pump set) shall be provided.

21. PERFORMANCE SPECIFICATIONS

The pump and associated equipment shall be designed to operate under the configuration shown on the drawings and on the characteristic curves shown on Drawings J26137C/C1.1-301 & J26137C/C1.1-302.

The pumps shall be capable of performing the following duties:-

	Scenario	Head (m)	Flow (m ³ /hr)	Comment
a)	One duty pump operating	65	84.62	Design Duty Point (one pump delivering 84.62m ³ /hr @ 65m).

Pumps shall be coupled to a 4 pole electric motor (ie operating speed to shall be 1490 rpm).

22. NPSH AND SUCTION CONDITIONS

There is a clear water reservoir that will supply water to the suction main of the new pump station: from the proposed 11,5ML reservoir.

The full depth (9 m) of the supply reservoir is to be available to the Pumpstation. The maximum and minimum water levels in the supply reservoirs are RL 1110.m respectively. The pump elevation is approximately RL 1102.5m. The static head available at the pump inlet therefore varies between 7.5m and 3.5m (i.e. the pumps will experience a flooded suction under all conditions).

There are two suction mains (one from each clear water reservoir) that combine to form the main suction manifold. The length of the 300mm diameter suction main from the 11,5ML Command clear water reservoir to the manifold junction is 5m in length with 250mm diameter.

The Tenderer shall consider whether the specified pump performance parameters are technically acceptable for the pumps offered with respect to the suction conditions (flow velocity in suction pipework, NPSH_{available} and NPSH_{required} etc.).

23. PIPEWORK

General

All pipework and specials shall be manufactured from mild steel and hot dipped galvanised after fabrication and testing of welds. The Contractor is responsible for ensuring that the structural design of the bends and tees does not exceed 55% of the steel's minimum yield stress under 50% above normal operating conditions. Where necessary, stiffening webs, crotch plates, wrappers or collars shall be added. Such reinforcement shall be made from the same material. The above stress limit

Tenderer

Witness 1

Witness 2

Employer

Witness 1

Witness 2



notwithstanding, no steel pipe shall have a wall thickness of less than 5mm (up to DN250) or 6mm (up to DN600).

All tees off the main manifolds shall be either gusseted or swept.

The angle of taper on reducers on the suction and delivery side of the pumps shall not exceed 15°.

24. MANUFACTURE

The steel specials shall be manufactured exclusively at the works of such manufacturers as may be approved by the Engineer and at only one works unless otherwise agreed by the Engineer in writing. All specials shall be fabricated and galvanised under an approved Quality Management Plan and all welders shall be in possession of the relevant competency certification. All welds shall be at least dye penetrant tested.

All specials to be installed at the delivery sides of the pumps shall be suitable for the maximum expected surge pressures. All specials to be installed at the suction side of the pumpsets shall be suitable for a working pressure of up to PN 10. The maximum expected pressure, without mitigation, is 400 m.

The Contractor shall be fully responsible for determining the actual dimensions of these specials. No extra payment will be made should the Contractor find it necessary to adjust or alter pipework on Site.

The Contractor shall provide lifting lugs on the specials to assist him in his installation and to avoid damaging the paintwork.

No site welding will be allowed.

Where different metals are to be joined by means of flanges, etc., and the possibility of bi-metallic action exists, the Contractor shall suitably insulate the metal contact area to the approval of the Engineer.

25. FLANGES

Flanges shall comply with the following:

- i) Flanges shall conform to the requirements of SANS 1123.
- ii) All flange gaskets shall be of the appropriate pressure rating. Reinforced gaskets shall be used for PN16 flange joints.
- iii) All flange joints onto catholically-protected steel rising mains shall be joined using an insulation gasket kit.
- iv) Flanges each side of electromagnetic flow meters shall be fitted with stainless steel grounding rings which shall be connected to the pumpstation earthing to ground.

26. BOLTS AND NUTS

Bolts, nuts and washers shall be hot dipped galvanised Grade 8.8 carbon steel.


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Witness 1


Witness 2


Employer


Witness 1


Witness 2



27. GATE VALVES

Specification

The isolating gate valves shall have a local content of at least 70% in terms of DTI directives and comply with specification LK.

Isolating valves on the suction side shall be PN10 resilient seal gate valves with non-rising spindles and fitted with handwheels.

Isolating valves on the delivery side shall be PN16 gunmetal lined wedge gate valves with non-rising spindles and fitted with handwheels (with the necessary gearing to allow operation at normal operating pressures).

Isolating valves on air valves shall be wedge gate type and PN16.

28. CHECK VALVES

specification

The check valves shall have a local content of at least 70% in terms of DTI directives and comply with specification LK.

Nozzle-type check valves shall be used.

Detailed Requirements

Scope

Check valves shall be installed on the delivery side of the all pumps. All check valves at Pumpstations shall be nozzle check valves ('Vent-O-Mat' or equal approved), with the exception of Viedgesville Pumpstation where a wafer check valve may be used (type).

Performance Requirements

All check valves shall have a pressure rating suitable to the expected maximum surge pressure and shall be of the flanged type, drilled in accordance with the relevant tables of SANS 1123.

The operating conditions of the check valves on the delivery pipeline is as follows:

Maximum Static Pressure (m)	Maximum Working Pressure (m)	Maximum Surge Pressure (m)	Maximum Flow through Valves (m3/hr)
65	87.5	120	84.6

29. FLANGE ADAPTORS AND FLEXIBLE COUPLINGS

Restrained flange adaptors or dismantling joints shall be used where appropriate. It is important that the design of these connections is such that no significant unbalanced forces are transferred onto the pump casing. All pipe forces shall be transferred to the pump room floor or to independent anchor blocks by means of suitable pipe supports.


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2



All steel "slip-on" couplings and flange adaptors for jointing specials shall be "Klamflex", "Viking Johnson" or equivalent, conforming to Clause 15 of BS 534. The inside face of the outer ring (in contact with the machined spigot) shall be machined to ensure that a tight tolerance between the coupling and the spigot is obtained so that the rubber seal does not extrude. Allowance for paint thickness shall be made when the outer ring face is machined. The flange faces on the slip on "Klamflex" or "Viking Johnson" flange adaptors shall be machined in according with SANS 1123.

30. PRESSURE GAUGES

Detailed Requirements

A pressure transducer and dial gauge shall be fitted upstream of the check valve on the delivery side for each pumpset and a single one on the main manifold. A BSP connection of at least DN 25 shall be provided in the pipework for the installation of these gauges.

Positive and negative surges up to 50% of the maximum operating pressures can be expected to be experienced during the starting and stopping of the pumps.

Another pressure gauge and transducer shall be fitted on the suction pipework of each pump.

The pressure gauges and transducers shall be capable of registering pressures from 0 to 100 kPa on the suction side, and from 0 up to the maximum surge pressures or twice the normal operating pressure, whichever is the higher, on the delivery side.

The pressure gauges shall be highly robust, glycerine-filled, large face and of superior quality in order to give long service and shall be fitted with isolating / venting cocks.

The data from the pressure transducer shall be displayed on the HMI at the control panel. The instrument shall be capable of transmitting a 4-20 mA signal proportional to pressure.

31. PIPE SUPPORTS

Scope

Where applicable, supports for pipework and specials in the pumping station shall be supplied under this Contract to adequately secure the pipework to the walls and floors (not necessarily shown on the tender drawings). The Contractor shall design the supports and shall take account all the forces involved such that no forces are transferred to the pumps.

Design and Construction

Pipework supports shall be designed so that no forces are transferred to the pump. Pipes that are installed in an upright position shall be supported by means of reinforced footplates.

The supports shall be manufactured from low carbon steel with systems corrosion protection as per the pipe specials, or be suitably insulated.

The grouting-in of bolts into pockets, etc. shall be undertaken by the Contractor.


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2



Proposed designs of pipe supports shall be submitted to the Engineer for acceptance prior to manufacture. Specific requirements are:

- a) Pipe supports shall be so located that when an item of mechanical equipment is removed, the associated valves and pipework are still adequately supported. Supports shall be provided close to heavy items such as valves. No external loads shall be placed on items of mechanical equipment such as pumps.
- b) Adequate provision shall be made for expansion and contraction due to variations in temperature or pressure.
- c) Steel supports shall be fabricated from heavy duty hot-rolled steel sections. The complete assembly shall be hot-dip galvanised after all fabrication is completed.
- d) Welds shall be "all-round".
- e) Each pipe support foot shall feature at least four anchor fasteners.
- f) For cantilevered pipe supports, the spacing between anchor fasteners shall be not less than one quarter of the cantilevered length.

32. SPARES

Pump

The Contractor shall supply and deliver the following spares for one pump:

- a) Shaft assembly
- b) Full set of impellers
- c) Full set of bearings (including gaskets for bearing housing)
- d) Full set of mechanical seals
- e) Coupling

Packaging is to be sealed and clearly marked. These shall be delivered to the relevant pumpstation at the end of the contract.

Payment items for these have been included in the BoQ.

Power Supply

ESKOM is the Electrical Supply Authority for all sites under this contract. The electrical power supply to the associated sites shall be as follows;

- Abstraction Pump Station: Pole mount transformer rated at 50kVA, 22/0.42kV.
- Water Treatment Works: Pole mount transformer rated at 150kVA, 22/0.42kV.
- Booster Pump Station 2: Pole mount transformer rated at 50kVA, 22/0.42kV.
- KAT 01 Borehole Pump Station: Pole mount transformer rated at 25kVA, 22/0.42kV
- KAT 03 Borehole Pump Station: Pole mount transformer rated at 25kVA, 22/0.42kV
- MAS 04 Borehole Pump Station: Pole mount transformer rated at 25kVA, 22/0.42kV
- SE 03 Borehole Pump Station: Pole mount transformer rated at 25kVA, 22/0.42kV
- SE 04 Borehole Pump Station: Pole mount transformer rated at 25kVA, 22/0.42kV


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2



- PRD 04 Borehole Pump Station: Pole mount transformer rated at 25kVA, 22/0.42kV
- ZP 01 Borehole Pump Station: Pole mount transformer rated at 25kVA, 22/0.42kV
- Public Works Borehole Pump Station: Pole mount transformer rated at 25kVA, 22/0.42kV
- NK NEW Borehole Pump Station: Pole mount transformer rated at 25kVA, 22/0.42kV
- PRD 01 Borehole Pump Station: Pole mount transformer rated at 25kVA, 22/0.42kV

The borehole pump stations require resuscitation. The Contractor shall execute this as per ESKOM standards and specifications.

The Eskom cost required for the upgrade shall be processed for payment by the municipality directly with no allowance for mark-up.

Motor Control Centres

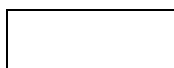
The Motor Control Centres (MCC) shall cater for the following:

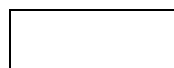
Control Location	Absorbed Pump Size (kW)	Proposed Pump Size (kW)	Type of Control	Number of Pumps
APS	28.6	30	VSD	2
BPS2	19.6	22	VSD	2
BPS3	19.6	22	VSD	2
KAT 01	-	3 & 3	DOL	2
KAT 03	-	2.2 & 1.1	DOL	2
MAS 04	-	15 & 5.5	DOL	2
SE 03	-	2.2 & 1.5	DOL	2
SE 04	-	3 & 4	DOL	2
PRD 04	-	3 & 4	DOL	2
ZP 01	-	3 & 4	DOL	2
PW	-	4 & 0.75	DOL	2
NK NEW	-	1.5	DOL	1
PRD	-	5.5	DOL	1

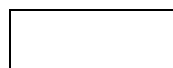
Variable Speed Drives

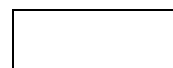
The VSDs shall provide the following as a minimum requirement:

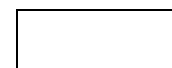
- All VSDs shall be used to control and regulate the speed of pump-motor sets. They must be capable of providing smooth linear acceleration during starting and stopping by means of increasing the motor supply frequency from zero to the desired operational speed on an adjustable time ramp during run-up and the reverse on deceleration to standstill.
- All VSDs shall have serial communication capability to communicate on an Ethernet communication bus to the controlling PLC.
- The panel doors for VSDs shall be interlocked that it is not possible to open any panel door without switching off the main circuit breaker for that drive.

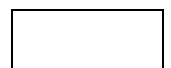

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Witness 1


Witness 2


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Witness 1


Witness 2



- The VSDs shall be equipped with the door mount display which will allow the operator to monitor the VSDs and make changes without opening the panel door making for a safer installation.

The VSDs must be of a well-known brand with local support.

MCC Signals

Motor control signals shall be linked to PLC inputs which will provide status feedback to the remote viewing SCADA systems/HMI. The following MCC signals must be linked:

- Pump set feeder breaker status Open
- Pump set feeder breaker status Closed
- Pump set feeder breaker status Tripped
-
- VSD feedback as per requirement
- All other transducers and motor sensors

Soft Starters

The soft starters will provide the following as a minimum requirement:

- a) Will be of the inline type
- b) Rated higher than the full load motor current to avoid overcurrent starts.
- c) Will have a bypass contactor (internal or external) and when the bypass contactor is on the protection functions will still be active
- d) Will have torque control or similar function for reducing water hammer during starting and stopping
- e) Will provide Class 10 motor over load protection
- f) Will provide locked rotor protection
- g) PTC inputs for motor thermal protection
- h) Field communications for connection to PLC for warning and load current display on the panel.
- i) The keypad and display will be mounted on the front of the motor starter cubicle so the cubicle door does not need to be opened to interrogate the soft starter
- j) Will have coated circuit boards for operation in harsh environments
- k) Current limit control with adjustable set point
- l) Motor underload protection (may be used for pump running dry protection)
- m) Will have an event log with time stamp
- n) Serial and ProfiNet compatible communication

The soft starter must be of a well-known brand with local support.

Power Factor Correction

Power factor correction is required for the Masobe Pump Station.

The Power Factor Correction shall be installed once all commissioning has been completed onsite and a full power quality recording analysis has been undertaken. The power factor correction system shall be sized in accordance to the lowest power factor recorded during operation with consideration to voltage and current harmonic effects. A report documenting the power quality analysis must be sent to the engineer for review and consideration prior to the manufacturing of the power factor correction unit.


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2



Power factor correction capacitors shall be of the inert gas filled metal body capacitors and should have no risk of ignition. A power factor controller with constant monitoring of the electrical network characteristics shall be used to control the power factor steps and protect the capacitors from abnormal electrical characteristics. The power factor steps shall be protected by HRC fuses and controlled using special capacitive contactors. The overall panel shall be protected by a suitably specified electronic MCCB with a shunt trip release connected to the temperature alarm module in the panel.

If a generator is connected on the same electrical LV network as the power factor correction unit, measure must be taken to ensure the power factor unit is disabled during the use of the generator. All power factor equipment must be labelled with the electric shock warning for users regarding the discharge of capacitors.

Variable Speed Drives

The VSDs shall provide the following as a minimum requirement:

- All VSDs shall be used to control and regulate the speed of pump-motor sets. They must be capable of providing smooth linear acceleration during starting and stopping by means of increasing the motor supply frequency from zero to the desired operational speed on an adjustable time ramp during run-up and the reverse on deceleration to standstill.
- All VSDs shall have serial communication capability to communicate on an Ethernet communication bus to the controlling PLC.
- The panel doors for VSDs shall be interlocked that it is not possible to open any panel door without switching off the main circuit breaker for that drive.
- The VSDs shall be equipped with the door mount display which will allow the operator to monitor the VSDs and make changes without opening the panel door making for a safer installation.

The VSDs must be of a well-known brand with local support

33. MCC SIGNALS

Motor control signals shall be linked to PLC inputs which will provide status feedback to the remote viewing SCADA systems/HMI. The following MCC signals must be linked:

- Pump set feeder breaker status Open
- Pump set feeder breaker status Closed
- Pump set feeder breaker status Tripped
-
- VSD feedback as per requirement
- All other transducers and motor sensors

34. ELECTRICAL LOW VOLTAGE INTERCONNECTIONS

The method for electrical connection of the low voltage supply from the transformers to the MCC panels is to be via LV cables as specified in drawing numbers for each Pumpstation.


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2



The cable for the installation shall be suitably sized and specified in accordance to the MCC requirements. The installation of the cables shall be in accordance to the SANS 10142-1.

35. SUPERVISORY CONTROL AND DATA ACQUISITION

The operations within the WTW is to be automated using a Supervisory Control and Data Acquisition (SCADA) system. The Pumpstation is to be incorporated into existing SCADA systems via the network connection to the Pumpstation PLC.

Remote access control for the each Pumpstation via the PLC is possible when linked to the TWTW SCADA. Provision is to be made to allow for manual operations to be carried out in the simplest manner in the event of the SCADA system failing.

Interfaces

The following communications protocols must be provided:

Modbus over Ethernet (TCP/IP): All new equipment being installed at the Pumpstation is to be specified with Modbus communications over Ethernet.

- **Modbus RTU:** This will allow for legacy telemetry equipment to be incorporated in the SCADA system.

PLC Hardware

The Pumpstation PLC hardware required shall be a modern compact design PLC. The minimum specifications are detailed below;

Program Capacity:	128,000 Steps
Data Registers:	60,000 Words
Max I/O Points:	1024 – via Expandable modules
Communication:	RS485/Ethernet/IP (must accept expandable modules)
Storage:	Internal and Micro SD card

The DC power supply unit for the PLC hardware and all other instrumentation shall have a reserve expandable battery functionality to provide backup power during loss of supply.

SCADA Requirements

The PLC hardware and telemetry interface shall be compatible with the selected all SCADA software package. Information for this specification can be provided.

Operator login and security

All PLC hardware shall be “administrator password” protected to prevent unauthorised changes to the software. All control functions available on the PLC shall only be accessible via a “user password” input.

HMI Graphical representation

All HMI devices shall have detail graphical representation of the pump sets and all transducers for the pipe system. The information must be represented using a tag


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2



number and tag location. All information must be visually displayed in live feed; the PLC hardware shall store historical data which can be accessed by the system administrator.

Alarming and event management

All alarms in the system (low level, high level, pump trips) must be alarmed and stored in a PLC memory. The alarm must be displayed in an alarm list on the SCADA and will need to be accepted by the operator locally or remotely before it is cleared. An alarm management system must also be provided which should generate the following reports:

- Most occurring alarms from start to end date entered
 - Date and time of specified alarm from start to end date entered

Reliability

The PLC CPU selected shall have a redundant backup of the software program store on a spare PLC CPU for the Pumpstation. A backup of the PLC configuration for the Pumpstation shall be provided to the operators. All PLC shall share the common firmware version to ensure optimal operations.

Data Transfer

The PLC CPU must have the ability to export historical data to spreadsheets and SQL databases. All exported data if required, should be importable into the SCADA system by the operators.

Remote access/ Web enabled interface

Remote access to the PLC is required. This can be via a remote client viewer login or preferably via a web enabled interface with fixed network IP address.

Email FTP function

The PLC built in function or its external FTP gateway device shall be configured to provide push notification to any user email. Additional function for SMS notification is optional added benefit.

Scripting

It is not envisaged that scripting will be required during the implementation of the PLC CPU. It is however a very powerful tool and could be required in future and is thus requested.

Data Logging

All analogue data must be logged to a SQL database (levels, flow and pressure) on board the PLC CPU memory. Alarms must be visible on a specific page of the HMI graphical representation. All alarms must also be logged to a SQL database. Historic information must be easily accessible from the database and displayed on a graph. This information must also be easily exported to a CSV or similar file that a spreadsheet program can open. Dead bands must be used to limit the amount of data to be logged. The logging interval of analogue signals should be 30 seconds for fast moving signals (generator loads) and 5 minutes for slow moving signals (reservoir levels).


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2



PLC Input List

The PLC hardware shall be selected to accommodate for the below table of inputs for the Pumpstation. Consideration must be given for spare capacity.

Table 1: Data points to be linked to a hardware device

Data point	Type	Logged	Alarmed	Hardware connection
Pumpstation water flow	Analogue	Yes	No	LOCAL PLC
Pumpstation water totalizer	Analogue	Yes	No	Flow meter
Pumpstation discharge Pressure	Analogue	Yes	High	LOCAL PLC
For each supply reservoir:				
• Reservoir level	Analogue	Yes	No	LOCAL PLC
• Reservoir low level alarm	Digital	No	Yes	LOCAL PLC
• Reservoir high level alarm	Digital	No	Yes	LOCAL PLC
Pump 1 breaker Open/Closed	Digital	No	No	LOCAL PLC
Pump 1 breaker tripped	Digital	No	Yes	LOCAL PLC
Pump 1 Estop active	Digital	No	Yes	LOCAL PLC
Pump 1 Running Status	Analogue	No	High	Soft Starter
Pump 2 breaker Open/Closed	Digital	No	No	LOCAL PLC
Pump 2 breaker tripped	Digital	No	Yes	LOCAL PLC
Pump 2 Estop active	Digital	No	Yes	LOCAL PLC
Pump 2 Running Status	Analogue	No	High	Soft starter
Pump control system in manual	Digital	No	Yes	LOCAL PLC
Main breaker tripped	Digital	No	Yes	LOCAL PLC
Main breaker open	Digital	No	No	LOCAL PLC
Main breaker closed	Digital	No	No	LOCAL PLC
PFC output alarm signal	Digital	No	Yes	LOCAL PLC
Room Occupancy Sensor	Digital	No	Yes	LOCAL PLC
Spare Card (10 DI and 5 AI)	Both	No	No	LOCAL PLC

Licensing

All software licensing cost must be provided; this includes total initiation fees of system, license fee product on initiation, all annual fees for products for a period of 24 months and any future recurring fees relating to the system.

Mimic pages

This is a guide on the anticipated mimic displays and navigation between them. The contractor is responsible for ensuring the SCADA displays are easy to read and navigate.

There should be a number of tabs on the displays that will allow navigation between the various mimics. The following should be considered the minimum number of mimics for the Pumpstation:



Tenderer



Witness 1



Witness 2



Employer



Witness 1



Witness 2



- a) Status of the pumps and various sensors and alarms
- b) Motor control panel and power factor system status (where applicable).

36. EARTHING AND LIGHTNING PROTECTION

The Electrical Contractor shall provide a main earth/s in accordance with the local supply authority requirements. The LV earth system shall be independent from the 11 kV earth system.

Earthing shall generally be provided in accordance with SANS 10142 and SANS 10292. The earthing installation shall include an accessible common consumer earth terminal, to which all incoming services using metallic conduits, pipes etc. shall be bonded, including water and Telkom.

Earthing of dedicated or "clean" circuits shall also be ultimately bonded to the consumer earth. Dedicated or "clean" earth conductors shall be insulated.

All steel building structures and roofs to be bonded to ground via earth rods at building corners and at intervals not exceeding 10m along the length of the building. The installation of an air termination lighting rod at least 1.5 times the measure height of the Pumpstation building is required. This shall provide a minimum of class level 2 lighting protection and must comply with SANS 10313 – The protection of structures against lightning.

The Contractor shall earth all satellite dishes and antennas in accordance with SANS 10142-1.

37. INSTALLATION OF UNDERGROUND CABLES (LV)

Laying Cables in Prepared Trenches

Before the cables are laid, the bottom of the trench shall be covered with a 75 mm layer of earth which shall have been passed through a sieve with a maximum mesh of 12 mm. The Electrical Contractor shall lay the cables on the prepared bed carefully to avoid cuts and damage. Cable rollers shall be used.

The trench shall be back-filled with clean builder's sand to provide 150 mm of cover as soon as possible after the cable has been laid. To prevent theft and possible damage, long lengths of cable shall not be left exposed in an open trench overnight. The trench shall be back-filled and compacted in layers to achieve 100% compaction.

Water shall not be allowed to accumulate at any part of the works. The Electrical Contractor will therefore ensure that no cable laying is carried out until the trenches are free from water.

The minimum cover over the cables shall be 600 mm for LV cables and 800 mm for MV cables.

All side channels, sumps or temporary excavations for dewatering purposes shall be filled in after use.

Plastic Cable Warning Sheeting


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2



All cables shall be covered with a light yellow plastic warning sheet 450 mm in width of approved design with the skull and cross bones insignia together with the words "DANGER, GEVAAR, INGOZI" printed in black at regular intervals. The warning shall be placed 300 mm above the top of the cables.

Markers

The routes of all underground cables and duct ends shall be marked by means of approved concrete markers having cast insert the words "Electric Cables". They shall be positioned at every change of direction, and every point of crossing another cable, or service, and not less than one per 30 meters of straight run.

Distribution Cabling

Cables have been sized on the basis of copper conductors but cables with aluminium conductors may be used, with the Engineer's written approval, provided they have an equivalent current carrying capacity and comply with all regulations regarding volt drop. In addition the Electrical Contractor must provide satisfactory evidence that he is well experienced in the handling of aluminium conductor cables and must take adequate precautions against corrosion and creep.

The cables shall be spaced on cable ladders that there is a gap between adjacent cables of at least 2.5 times the diameter of the larger cable of the two (if different sizes).

No cables shall be strapped or fixed to AC ducting, roof structure or sprinkler pipes or other services and their hangers.

All internal cables shall be installed through sleeves, on cable ladders or wire cable baskets, unless otherwise specified.

38. CONDUIT AND CONDUIT FITTINGS

Conduits

Conduits cast into concrete shall be SABS approved PVC conduits.

Bosal/heavy duty steel galvanised shall be used for any conduit work surface mounted.

Where PVC and uPVC conduits are cast into concrete, the Electrical Contractor shall be present during the pouring of concrete to ensure that the conduits are not damaged or blocked. All joints shall be taped to prevent the ingress of wet fines during wet concrete vibration.

The Electrical Contractor shall check conduits for continuity/blockages as soon as possible after pouring of the slab.

All AC detection and evacuation alarm conduits shall be Bosal/heavy duty steel galvanised, unless cast or built in.

Under no circumstances shall structural concrete be chased without the Structural Engineer's written permission.


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2



39. CABLE TRAYS

Cable Tray/Ladder and Wiremesh Basket Support

The Electrical Contractor shall obtain the Engineer's approval of the method by which cable trays are to be supported.

Cable trays baskets shall be heavy duty and hot dip galvanised.

40. CABLE TRUNKING

Trunking

The Electrical Contractor shall obtain the Engineers approval of the method by which cable trunking are to be supported.

Trunking for telephone and electrical installations shall have plastic/steel covers.

All trunking bends and Tee's shall be fitted with mitered inside corners.

Communications Wireways and Distribution Boards

The Electrical Contractor is responsible for supplying and installing telecommunications conduits, ducts, sleeves, draw boxes and distribution boards.

Galvanized draw wires shall be installed in all telecommunications conduits and sleeves.

The Electrical Contractor shall provide a separate insulated telecommunications earth (minimum 16 mm² copper) for Telkom, bonded to the consumer earth terminal.

The occupier of the premises shall apply for telecommunications services.

41. INTERIOR LUMINAIRES

Luminaire Installation

The Electrical Contractor shall comply with the installation requirements of the luminaire manufacturer when installing light fittings. The Engineer's approval of the method by which luminaires are to be supported is to be obtained.

For fluorescent luminaires, excluding HO luminaires, fixed in continuous rows wiring may be carried from one outlet and then wired through the channels of the fittings, provided the channels form a separate compartment. The internal wiring shall be clipped to the sides of the channels.

Wiring through bulkhead type luminaires will not be permitted. The conduit installation shall be arranged in such a manner that the cables loop in and out of the bulkheads adjacent to the lamp holders.

Under no circumstances shall more than one circuit be permitted to be wired through any luminaire.


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2



In areas where transformer equipment is located, an explosion proof fitting must be installed by the contractor. All explosion proof fittings must be approved by the engineer prior to procurement.

Lamps

All discharge, fluorescent and light emitting diode (LED) lamps shall be supplied by the Luminaire Supply Subcontractor for installation by the Electrical Contractor.

All lamps shall be SABS approved with certification to confirm type tests on hand. The room must meet a minimum of 300 Lux in lighting level.

External Lighting Installation

The external lighting shall be in the form of round head bulk heads fitted to the buildings controlled by a photocell on a separate circuit to the internal and emergency lighting circuits.

42. INSTALLATION OF INTERIOR LUMINAIRES

Emergency Lighting Installation

All emergency lighting shall have a built in battery power supply which can be recharged automatically by the mains supply after use. Emergency lighting will continue to provide a minimum of 100 lux lighting level in the interior area and exterior area of the Pumpstation for a period of 3 hours.

43. LOW VOLTAGE SWITCHBOARDS

General Power Installation

The general power installation shall be in accordance with the Engineers drawings.

Labels

All labels shall be English. All labels shall be of ivory or plastic and securely fixed by screws or rivets. Lettering shall be block capitals, minimum size 4 mm.

All feeder and control cables shall be identified with approved marked brass or fibre identifying discs at terminations, every 10 m (if practical) horizontally and at every floor level vertically. The Contractor shall provide diagrammatic charts showing the identity, type and size of each cable.

Where distribution board labelling is by means of legend cards, the permanent legend cards shall be clearly typed, laminated in clear plastic and secured to the distribution board in a permanent legend cardholder.

Uninterruptable Power Supply (UPS)

The Electrical Contractor shall provide a UPS. The UPS shall be capable of supporting a 10kVA single phase load for not less than 15 minutes. The UPS will have its batteries installed in a suitable self-contained enclosure if the batteries are not mounted internal to the UPS. The UPS will be of the dual conversion type and comply with SANS 10142-1 requirements.


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2



Power Factor Correction Equipment

Although the Power Factor equipment cannot be completed until after the plant has been commissioned (to ensure a power factor of unity), the cost of providing and accommodating such equipment shall be included in the MCC cost. Harmonics must be considered in this installation.

Final Connections

The Electrical Contractor will be responsible for the final connection to the following equipment:

- a) Ventilation, Control Boards/Isolators, motors and all other electrical connections required for the operations.

Where the item of equipment being connected is fixed, then the final connection shall be via an isolator.

44. DISTRIBUTION BOARDS

All electrical panels and motor control centres must be manufactured by a reputable specialist nominated subcontractor.

Where distribution boards are recessed into walls the Electrical Contractor shall provide a 50 mm x 50 mm trunking from the top of the distribution board to the ceiling space for future use.

45. SUPPLIES TO MOTORS

The Electrical Contractor will be responsible for the provision of supplies to motors and heaters. The electrical isolator devices required at the motor as per the SANS regulation. All motor and cable earth and bonding connections as per the SANS regulation.

The supply of all variable speed drives, soft starters, motor starters, overload protection etc. is to be completed by the Electrical Contractor, unless otherwise specified.

46. LIGHTNING AND SURGE PROTECTION FOR BUILDINGS

Over-Voltage Surge Protection

Surge arrestors shall be fitted in all the following distribution boards:

Arrestors in Main Distribution Boards shall be Overvoltage Category IV, and in all other distribution boards Overvoltage Category III, in terms of IEC60664-1. The devices shall be rated appropriate to the fault current rating at the board.

Arrestors in PLC cabinets shall have a minimum class 1 SPD device to ensure protection of the DC output from the power supply.

Visual status indication including end-of-life indicators for surge arrestors shall be provided.


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2



Metal oxide elements shall include thermal disconnection facilities. All necessary suitable pre-fusing techniques as per the IEC60664-1.

Also see distribution board schematics which may have surge protection device specification.

47. WALL SWITCHES AND SOCKET OUTLETS

Fireman's Switch

The Electrical Contractor shall install a fireman's switch/es complying with the local Authority's requirements.

Fire Protection of Cables

The Electrical Contractor shall paint cables passing through openings in firewalls (viz around fire escapes, plantrooms and vertically through slabs) with intumescent paint for a minimum of one meter on either side of the wall or slab. Penetrations will be sealed by the builder. The Contractor is required to certify to the Engineer that all penetrations have been sealed.

In instances where 120 minute fire rating is required (as indicated by the Engineer), the cables shall be wrapped in high density mineral rockwool (minimum 25 mm thick) and coated with Flamsayf mastic, or approved equivalent fireproofing treatment.

Screws

Cover plate securing screws for all electrical or telecommunications boxes shall be chromium plated.

Danger Notices

The Electrical Contractor shall supply and install all danger and substation notices in terms of the relevant regulations.

Corrosion

The Electrical Contractor shall take adequate measures to protect the installations against corrosion, according to the site conditions.

Lighting Control System/s

All internal lights are to be switched by means of conventional lever type switches. All external security lights are to be switched by means of photocell. Emergency lighting will be activated by the loss of supply.

Twin and Earth

The Electrical Contractor shall not install twin and earth cable except as permitted by the Engineer and relevant standards.

48. STANDBY POWER GENERATOR


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2



Generator Specifications

The contract includes the manufacture, testing, delivery, rigging, commissioning and hand-over of the generating set (diesel engine coupled to an alternator mounted on a base mounted fuel tank), this shall include for the FAT prior to delivery for the client and engineers.

The pump station shall have a standby power generator set; this will be adequately sized to support the pumping system in the event of loss of Eskom supply. The generator shall be housed in a newly constructed bund base within the existing generator room located on the site and shall supply the new motor control panel via an ATS switch built into the generator room.

The generator shall meet the following specifications outlined as follows;

Engine

- a) Heavy-duty diesel engine Six cylinder equipped with piston cooling
- b) Electronic governor control system
- c) Replaceable wet type cylinder liners
- d) 24v DC starter and charge alternator
- e) Replaceable fuel filter, oil filter and dry element air filter
- f) Cooling radiator and fan Fuel connection hoses and manual sump oil drain valve
- g) Exhaust silencer
- h) Maintenance free battery including racks and cables
- i) Jacket water heater

Alternator

- a) Brushless, single bearing system, four poles
- b) Insulation class H with circuit breaker protection
- c) Standard degree of protection IP21
- d) Self-exciting and self-regulating
- e) Half-wave phase-controlled thyristor type Automatic Voltage Regulator (AVR)
- f) Screen protected and drip proof
- g) Stator winding with 2/3 pitch for improved harmonics
- h) Close voltage regulation

Chassis

- a) Steel chassis and anti-vibration pads
- b) Base frame design incorporates an integral fuel tank of 700 litres
- c) The generator can be lifted or carefully pushed/pulled by the base frame
- d) Includes diesel level sensor information to the controller

Canopy

- a) Ventilation parts are designed with modular principles
- b) Weather resistant and lined with sound reducing foam
- c) All metal canopy parts are painted by powder paint
- d) Panel window Lockable doors on each side
- e) Easy maintenance and operation
- f) Easy lifting and moving
- g) Insulated engine exhaust system
- h) Exterior emergency stop push button


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2

**Auto Mains Failure Control Panel**

- a) Intelligent European specification automatic transfer switch module
- b) Electronic controller unit with mains quality sensing, event logging and alarms
- c) Emergency stop push button with remote signalling
- d) Static battery charger
- e) Four-pole electrically and mechanically interlocked automatic transfer switch

Metering Via LCD Display

- a) Generator volts (L-L/L-N); mains volts (L-L/L-N)
- b) Generator amps (L1, L2, L3); generator (kVA and kW)
- c) Generator frequency; generator (cos)
- d) Engine hours run; plant battery (volts)
- e) Engine oil pressure (psi and bar)
- f) Engine speed (rpm)
- g) GSM SMS signal
- h) Engine temperature (°C)

Automatic Shutdown And Fault Conditions

- a) Under/over speed; fail to start
- b) High engine temperature; fail to stop
- c) Low oil pressure; charge fail
- d) Under/over generator volts; over current
- e) Under/over generator frequency; emergency stop
- f) Under/over mains frequency
- g) Under/over mains voltage
- h) Low/high battery volts

Dimensions

- a) Length x Width x Height 3900mm x 1400mm x 1850mm
- b) Dry weight 4000kg
- c) Generator bund is required.

Spare Parts

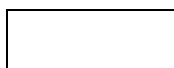
Tenderers must give with their tender an assurance that spare parts for the plant offered by them as a whole are readily available within the Republic of South Africa and to state where these are available.

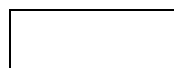
A spare parts list must form part of the hand-over documentation.

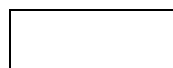
Guarantees

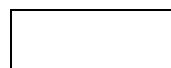
The tenderer shall guarantee the generating set for a period of twelve months after first delivery of the plant. During the guarantee period the tenderer shall repair any defective material, equipment or workmanship (excepting proven, wilful or accidental damage, or fair wear and tear). These shall be made good with all possible speed at the tenderer's expense and to the satisfaction of the client.

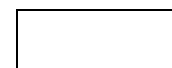
When called upon by the client the tenderer shall make good on site and shall bear all expense incidental thereto including making good of work by others, arising out of

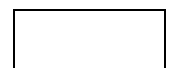

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Witness 1


Witness 2


Employer


Witness 1


Witness 2



removal or reinstallation of equipment. All work arising from the implementation of the guarantee of equipment shall be carried out at times which will not result in any undue inconvenience to users of the equipment or occupants of premises.

If any defects are not remedied within a reasonable time the client may proceed to do the work at the tenderer's risk and expense, but without prejudice to any other rights which the client may have against the tenderer.

The Employer reserves the right to demand the replacement or making good by the tenderer at his own expense of any part of the tender which is shown to have any latent defects or not to have complied with the specification, notwithstanding that such work has been taken over or that the guarantee period has expired.

Should any specified materials or equipment in the tenderer's opinion be of inferior quality, or be unsuitably employed, rated or loaded, the tenderer shall prior to the submission of his tender advise the engineer accordingly. His failure to do so shall mean that he guarantees the work including all materials or equipment as specified.

49. MANAGEMENT OF THE WORKS

Right of Access to Site

The Contractor will be given uninterrupted access to the site for the duration of the Contract.

Other Contractors on Site

There will be no other Contractors on site, except, perhaps, where others will be completing the rising main up to the pump station building.

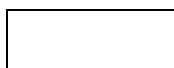
meetings

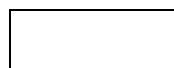
The Contractor shall attend the following meetings during the Contract:

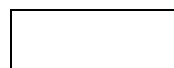
- a) An inaugural site meeting at the GIBB offices or as called by the Employer's Agent
- b) Monthly site meetings, at GIBB's Mthatha offices and on Site or as called by the Employer's Agent, from the commencement of the Works until the issue of the Practical Completion Certificate (or where necessary as determined by the Employer's Agent).

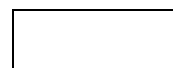
Monthly technical meetings called by the Employer's Agent (or where necessary as determined by the Employer's Agent).

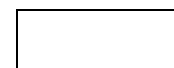
- c) Meetings during the Defects Notification Period called by the Employer's Agent (only if warranted)
- d) The following reports shall be submitted by the Contractor before the monthly Site Meetings:
 - Progress Report
 - Plant & Labour returns
 - Updated Programme vs Baseline Programme
 - Updated cashflow projection.

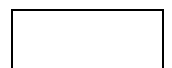

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Witness 1


Witness 2


Employer


Witness 1


Witness 2

**Monthly Reporting to accompany payment claims**

It is a specific requirement of this Contract that the Contractor shall collect and record all relevant information for the completion of end-of-month documentation to be submitted with each payment claim. The Payment Certificate (prepared by the Employer's Agent) will not be accepted by the Employer unless accompanied by the following:

- Local Labour Schedule (in EPWP format; ie giving employee names, IDs, gender, age group and disability status if applicable)
- Contract Participation Goal expenditure to date vs target (details of labour wages and salaries paid and payments to Targeted Enterprises vs value of work certified to date)
- Monthly Progress Report (from Site Meeting).

Work outside normal working hours

Should the Contractor wish to work outside normal working hours (as defined in the Contract Data) for any reason, he shall first seek permission to do so from the Employer's Agent. Attending to emergency situations or making-safe the Works are exempt from requiring prior approval, but notification shall still be sent to the Employer's Agent.

50. PLANNING, PROGRAMMING AND REPORTING**Progress Reporting**

The Contractor shall review his progress each month and should progress lag behind the latest accepted programme, by more than 2 weeks, he shall submit a revised programme and method statement of how he proposes to make up the lost time. If, in the opinion of the Employer's Agent, such revised programme will not make up the lost time, the Employer's Agent shall have the right to request the Contractor to reorganize his work in a manner which will ensure an acceptable programme. Claims for additional payment to meet any costs incurred due to such reorganisation will not be accepted.

Programming Restrictions**General**

The Contractor shall take cognisance of the following when programming his activities:

- a) Site handover and commencement of execution of the Contract will only take place once all the necessary documentation (details given in Contract Data) has been submitted and approved. Before any site work is undertaken, an introductory meeting with the local community has to be held. The latter is arranged by the Employer's Agents.
- b) As specified in the Contract Data, the Time for Completion is limited to a maximum of 12 months (notwithstanding extensions of time granted for whatever reason). However this does not mean that it is guaranteed that the rising main to be


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2



constructed by others will be completed in time to allow testing and commissioning to take place within 12 months of the commencement of the Contract.

Masobe Pump Station

The Masobe Pumpstation will have access to water produced by the WTW for the purpose of testing and commissioning.

The rising main (to be completed by Others) is planned to be due for completion prior to the time of testing and commissioning.

Should completion of the rising main cause delay to testing and commissioning, allowance has been made in the BoQ for re-establishment teiat such time when commissioning can take place and de-establishment thereafter.

There is currently an existing electricity supply to the WTW site. The power supply to the site will have to be upgraded to accommodate the power requirements of the new pumping equipment. It is anticipated that this will have been completed at the time of testing and commissioning.

Should the upgraded power supply not be complete by the time the works is ready for testing and commissioning, an allowance has been made in the Bill of Quantities for the hire of temporary generators to provide the electricity supply required for testing and commissioning.

Programme Format

Programmes shall be submitted in Microsoft Project format in hardcopy and softcopy.

Programme Content

The Contractor's programme shall show:

- a) The various activities, related to a time scale, for each element of the Works, including those of Subcontractors, in sufficient detail to be able to assess construction progress.
- b) Time for procurement of all material and equipment ready to deliver to Site and install
- c) Milestone dates when factory pre-commissioning tests are required on the MCCs
- d) The installation period
- e) The milestone point where no further work can take place until the rising main is complete
- f) The testing and commissioning period from where the rising main is complete
- g) Critical path activities and their dependencies,
- h) Key dates in respect of information to be provided by the Employer's Agent and/or others.


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2

**Revised Programme**

If during the course of the contract, the execution of the work deviates in any manner from the programme, the Contractor shall, on instruction by the Employer's Agent, within one week of such instruction submit a revised programme.

Should such a revision be as a result of the Contractor falling behind with his work, the programme shall clearly show the steps to be taken in order to rectify the situation so as to enable the contract to be completed within the accepted contract period. Such a programme shall be accompanied by positive steps to increase production through increased resources, or the more efficient usage of existing resources.

51. DAILY RECORDS

For all on-site activities, the Contractor shall keep daily records of activities in progress, any delays, requests for information, day works, plant breakdowns, etc. These daily records shall be signed by the Contractor and Employer's Agent Representatives.

52. EXTENSION OF TIME RESULTING FROM ABNORMAL WEATHER

No extension of time will be considered for adverse weather conditions.

53. CONSTRUCTION OF THE WORKS**General**

The general provisions of Particular Specifications Spec GM, Spec GP, Spec CP, Spec LK, and Spec QB pertaining to the construction of the Works shall apply unless stated otherwise below.

54. METHODS AND PROCEDURES**Method Statements**

Where requested in writing by the Employer's Agent, the Contractor shall submit Method Statements for constructing specific aspects of the Works. Such work shall not be started until the Contractor receives approval of the Method Statement in writing from the Employer's Agent.

Quality Assurance System: Quality Management Plan and Quality Control Plan

The Contractor is required to have in place, and follow, an approved Quality Assurance System for the execution of this Contract. To this end, the Contractor shall submit his proposed Quality Management Plan (QMP) to the Employer's Agent for approval along with his up-front documentation required before the commencement of the Works. The QMP shall include the Contractor's proposed Quality Control Plan (QCP) which shows how conformance to the QMP is to be documented.

In addition to this, the Contractor is required to follow the Employer's Agent's Site Quality Control procedures which entails the following:

- Contractor's submission of Request for Inspection of Work;


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2



- Employer's Agent's signing-off of 'hold points' at each stage of the work (thereby authorising the Contractor to proceed with the next stage of the work). This may take several iterations should the Employer's Agent require further work before signing-off. Work may not proceed on the next stage until the previous stage has been signed-off.

Claims for particular items of completed work for each interim Payment Certificate will not be certified for payment where the required sign-offs have not been obtained.

No claims for extension of time, nor any other form of compensation, will be entertained for delays in receiving the Employer's Agent sign-offs on 'hold points' where, in the opinion of the Employer's Agent, insufficient notice has been given to inspect and approve the Works. The default notice required is 48 hours.

The Contractor shall submit copies of all his conformance documentation to the Employer's Agent on a monthly basis and proof of recent calibration of all measuring devices that are to be used.

55. FINISHING AND TIDYING

The Contractor is required to progressively and systematically finish and tidy the work as it proceeds. This will be monitored against the latest approved programme. The Employer's Agent shall have the right to not certify full payment of particular scheduled items where such items are largely complete, but finishing and tidying is deemed still outstanding.

Under no circumstances shall spoil, rubble, materials or equipment be allowed to unnecessarily accumulate on Site. If, in the opinion of the Employer's Agent, this is occurring, the Employer's Agent shall have the right to make an allowance for the estimated cost of rectifying the above by reducing particular measured quantities from claims being processed for payment.

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Employer

Witness 1

Witness 2

**56. PREFERENTIAL PROCUREMENT PROCEDURES****RESOURCE STANDARD PERTAINING TO TARGETED PROCUREMENT**

- SANS 1914-1:2002 Targeted Construction Procurement Part 1 – Participation of Targeted Enterprises
- SANS 1914-2:2002 Targeted Construction Procurement Part 1 – Participation of Targeted Partners in Joint Ventures
- SANS 1914-3:2002 Targeted Construction Procurement Part 1 – Participation of Targeted Enterprises and Targeted Partners in Joint Ventures
- SANS 1914-4:2002 Targeted Construction Procurement Part 1 – Participation of Targeted Enterprises and Targeted Labour (local resources)
- SANS 1914-5:2002 Targeted Construction Procurement Part 1 – Participation of Targeted Labour
- SANS 1914-6:2002 Targeted Construction Procurement Part 1 – Participation of Targeted Enterprises in Concession Contracts

57. SAFETY ON SITE**OCCUPATIONAL, HEALTH AND SAFETY ACT 85 OF 1993 AS AMENDED BY THE OCCUPATIONAL HEALTH AND SAFETY AMENDMENT ACT OF 2014.**

Contractors shall comply in all respects with the provisions the Occupational Health and Safety Act and the latest Construction Regulations promulgated thereunder and the Employer's Occupational Health and Safety Act Particular Specification given in Part C3.4.

It is specifically noted that the person officially appointed as the Contractor's Health and Safety Officer shall be properly qualified and experienced and be based full-time between the five Sites while activities at the sites are taking place.

58. SPECIFIC RISKS AND HAZARDS

Please refer to the Baseline Risk Assessment given in the Employer's OH&S Particular Specification. This highlights in particular the hazards associated with working on electrical installations and lifting and working with heavy items of equipment. The Baseline Risk Assessment provided is not necessarily fully comprehensive and the Contractor is responsible for carrying out his own Baseline Risk Assessment.

59. CONTRACTOR'S HEALTH AND SAFETY PLAN

The Contractor's Health and Safety Plan, prepared in accordance with the Employer's Occupational Health and Safety Particular Specification, shall be submitted to the Employer for approval.

The Contractor shall not commence work before the Employer has approved the Health and Safety Plan in writing.

Time lost due to delayed commencement or suspension of the work as a result of the Contractor's failure to submit the safety plan timeously, shall not be used as a reason to claim for extension of time or standing time and related costs.


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Employer


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60. ENVIRONMENTAL MANAGEMENT

The Contractor shall comply with the requirements of the Environmental Management Plan (given in Part C3.4: Particular Specifications) and the Environmental Authorisation (given in Part C3.5: Annexures).

61. ACCEPTANCE TESTING AND COMMISSIONING GENERAL

The general provisions of Particular Specifications Spec GM, Spec GP, Spec CP and Spec LK pertaining to the acceptance testing and commissioning the Works shall apply unless stated otherwise below.

Once the mechanical and electrical installation work is completely ready to proceed with live pre-commissioning tests, acceptance tests and commissioning, there are four scenarios applicable; namely:

- Adequate main power supply is available and the rising main is ready to deliver water to the receiving reservoir (i.e. NO DELAY IN PROCEEDING WITH ACCEPTANCE TESTING AND COMMISSIONING AND COMPLETING THE WORKS);
- Adequate main power supply is unavailable although the rising main is ready to deliver water to the receiving reservoir (i.e. NO DELAY IN PROCEEDING WITH ACCEPTANCE TESTING AND COMMISSIONING AND COMPLETING THE WORKS) – in this case the standby generator will be used;
- Adequate main power supply is available but the rising main is not ready to deliver water to the receiving reservoir and the Contractor cannot proceed with acceptance testing and commissioning (i.e. ACCEPTANCE TESTING AND COMMISSIONING IS DELAYED); and
- Adequate main power supply is unavailable nor is the rising main ready to deliver water to the receiving reservoir and the Contractor cannot proceed with acceptance testing and commissioning (i.e. ACCEPTANCE TESTING AND COMMISSIONING IS DELAYED).

In the case of the second scenario where the external power supply is unavailable but the rising main is ready to receive water, the standby generator is to be used to supply power for the purposes of live acceptance testing (but without putting the pumpstation into full operation delivering water to consumers). In this case the costs of operating the standby generator in order to carry out the testing and commissioning of the pumps will be measured for payment.

In the case of the third and fourth scenarios, payment items are provided for re-establishment and de-establishment costs for testing and commissioning. The amounts tendered for these items are to include for all associated costs arising from the delay in testing and commissioning and no further additional payment will be made for such costs.

62. ACCEPTANCE TESTING AND COMMISSIONING PROCEDURE

Preparation

Installation work shall be complete and approved by the Engineer prior to testing and commissioning.


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2



Before starting up any section of the Works, the Contractor shall make all necessary checks to ensure that the installation has been correctly carried out, that all ducts, pipework, tanks, etc., are clean, that all equipment is correctly aligned, lubricated and connected up, and is in all respects ready to start with safety.

The Contractor shall provide initial fill requirements, such as lubricating oil.

Starting Up

The Contractor shall arrange for the Engineer to be present at initial start-up and also for any electrical and control instrumentation sub-contractors to be present.

The Contractor shall start up and test each section of the Works. These tests shall be carried out to certify that the Works is operating in accordance with the requirements specified and must be witnessed by the Engineer. All necessary modifications and rectifications shall be carried out during this period.

Set points for equipment and process parameters which are required for the operation of control systems shall be confirmed and recorded.

Testing and Commissioning of Electrical Equipment

All motor control centres and distribution panels prior to delivery to site shall undergo a Factory Acceptance Test (FAT) by the engineer at the contractor's workshop.

All PLC related control systems will need to be bench tested at the Contractor's workshop to ensure the program is correctly written.

All motor control centres and distribution panels delivered to site will undergo an inspection by the engineer and related testing by the contractor prior to installation.

All motor control centre and distribution panels installed onsite shall undergo an inspection and related testing by the contractor prior to commissioning.

The contractor is required to document all tests and inspections in chronological order.

The contractor and related specialist subcontractors shall provide a commissioning report and conformance reports of all works undertaken.

Performance Acceptance

The Contractor shall demonstrate to the Engineer that the Works is fully functional over the full range of operating scenarios.

Commissioning

When all tests have been completed to the approval of the Engineer, the Works shall be commissioned.

Unless the Engineer states otherwise, all of the Works, including control functions and control systems shall be commissioned together and the process performance requirements shall be achieved during normal operation.


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2



Commissioning Report

A comprehensive commissioning test report, including the commissioning procedure and schedule of alarm messages, shall be submitted by the Contractor prior to issuing of the Taking-Over Certificate/s and shall be inserted in the Manual.

Operating and Maintenance Manuals

Except that three copies plus a CD of separate O&M Manuals for each pumpstation are required, the provisions of Section 21 of Spec GM shall apply regarding the content of the O&M Manuals.

Record ('As-built') Drawings

The Contractor shall provide 'To-Scale' record (as-built) detail drawings of all the relevant equipment. Such drawings shall be made available in an approved electronic format such as AutoCAD and pdf and shall be submitted to the Employer's Agent prior to issue of the Taking Over Certificate.

The contract will not be accepted as complete until these have been supplied, complete and to the satisfaction of the Engineer.

Training

The Contractor shall provide training in the operation and maintenance of each pumpstation to OR Tambo District Municipality's operations staff prior to the issuing of the taking over certificate/s.

A Provisional Sum has been included in the BoQ for selected OR Tambo District Municipality's operations staff to attend formal accredited training in operating and maintaining mechanical and electrical installations. Details are to be agreed with the Engineer before implementing such training.

Trial Operational Period

There will be no trial operating period.

Inspection

At the end of the commissioning, an inspection shall be done by the Contractor and the Engineer for the purpose of taking over the Works in terms of Clause 10 of the General Conditions of Contract.

As per the Contract Data, the taking over will be done in the defined Sections.

Defects Liability

Refer to Clause 11 of the General Conditions of Contract for the Contractor's responsibility during the 365 day Defects Notification Period.

As per the General Conditions of Contract, the Defects Liability Period will only commence once the final Taking Over Certificate has been issued to the Contractor.


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Witness 2


Employer


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**BOREHOLE DRILLING AND TESTING****PC1.1 General**

The specifications are for the drilling (or rehabilitation), development and testing of ground-water boreholes for rural water supply.

The Contractor shall provide all labour, transport, plant, tools, and appurtenances (unless otherwise specified by the Employer in the work order). The Contractor shall perform all work necessary to satisfactorily construct and complete the boreholes in accordance with this Specification and to any further details as may be ordered by the Employer's Representative. The borehole depths will be dependent on drilling results and the strata intersected.

PC1.2 Equipment

The equipment to be used must be of such standard that the requirements as set out in the Project Specifications can be accomplished without any disruption of the works.

The Consultant shall specify in the type of geophysical equipment he intends to use. Its capacity shall be sufficient to cope with the work as specified for each particular Work Order. It shall be kept at all times in full working order and in good repair. The Employer's Representative will reserve the right to inspect the equipment to be used for the completion of the Works prior to the commencement of the Works.

If the Employer's Representative considers that the equipment in use on the site of the Works is in any way inefficient or inadequate in capacity, the Employer's Representative shall have the right to call upon the Contractor to put such equipment in order within seven (7) days. Alternatively, the Contractor will remove such equipment and replace it with additional equipment the Employer's Representative considers necessary to meet the requirements of the Contract. In the event that this requirement is not satisfied, the Employer's Representative reserves the right to advise the Employer to terminate the Work Order immediately.

It will be the responsibility of the Contractor to arrive on site with all equipment required to complete the work specified in the work order without interruption.

PC1.3 Materials

All materials to be used shall be new and undamaged and shall be supplied and delivered as such on site.

All materials as are required in the drilling, development, testing, equipping and maintenance of ground-boreholes shall be assembled in an approved manner and in accordance with normal ground-water engineering practice.

PC1.4 Drilling**(i) Drilling Techniques****a) Rotary Air Percussion Drilling**

Where the geological formation comprises consolidated rock with limited overburden the standard drilling technique shall be rotary air percussion drilling unless otherwise ordered by the Employer's Representative. Under this technique provision must be made for drilling through boulders and the provision of Odex Air Percussion drilling for advancement through collapsible



Tenderer



Witness 1



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layers.

b) Rotary Mud Flush Drilling

Where the geological formation comprises predominantly un-consolidated soils and subordinate weakly to well cemented sediments the standard drilling technique shall be rotary mud flush drilling unless otherwise ordered by the Employer's Representative. Under this technique provision must be made for drilling through boulders.

Both drilling techniques shall further include the necessary facilities with adequate capacity to consistently introduce lubrication water and / or foam as required.

(ii) Design and Depth

Various borehole design options will be employed. Typical Borehole Design Options include:

PC1.5 Geological Formation

a) Boreholes in Consolidated Rock Formations

- Stable rock formation (with outer casing only)
- Un-stable rock formation and Production Type Borehole (with inner casings, perforated casings and/or screens)

b) Boreholes in Un-consolidated Soil Formations

- All types of boreholes

The decision as to which design to use will be made by the Employer's Representative. The Employer's Representative will base his decision(s) on geological conditions encountered as well as the final diameter to which the borehole must be completed.

It is anticipated that borehole depths will vary typically between 50 and 120m. It should however be noted that provision has been made in the Schedule of Rates for drilling to depths greater than 250m. Final depth of the borehole will be determined by the Employer's Representative. Boreholes not reaching the requested depth will not be acceptable and will not be paid for, unless it can be satisfactorily proved that the borehole cannot be drilled to the required depth.

A minimum 10m sump will be drilled below the level at which the major water strike is intersected or to a level as specified by the Employer's Representative.

(iii) Drilling Diameter

Drilling diameters will be 140 mm (5 ½ "), 165 mm (6 ½ "), 203 mm (8"), 216 mm (8 ½ "), 254 mm (10") and 305 mm (12"). Diameter/s for each borehole to be drilled will be specified by the Employer's Representative.

(iv) Drilling Media

The Contractor may not use drilling media which may cause hole erosion or involve the use of native clay, oil, salt or any lost circulation agent, sawdust, cement, or any form of plugging that could affect the production capacity of the water bearing strata intersected, unless specified in writing by the Employer's Representative.


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2

(v) Drilling Foam

In the event of circulation losses, commercially available foam can be introduced during drilling operations at the Contractors own discretion and cost.

(vi) Straightness and Verticalitya) Straightness

Boreholes shall be sufficiently straight to permit a steel tube 6 m in length and with outer diameter no more than 15 mm smaller than the inner diameter of the cased borehole, to be lowered without hindrance to the full depth of the particular borehole. Deviation preventing the lowering of such plumb to the bottom of the borehole will not be accepted, and the hole declared a lost borehole. The Contractor shall, in such case, re-drill the hole at his own cost to specification.

The Contractor shall ensure that the above piping, complete with the necessary attachments and equipment required for testing straightness, is available at the drilling machine and such piping shall form part of his standard equipment.

b) Verticality

The centre of the borehole at any depth shall not deviate from the vertical through the centre of the borehole at the top by more than one-third (1/3) of the borehole diameter per 30 m of depth. The diameter of the deviation of a borehole from the vertical shall be carried out in accordance with the latest issue of SABS 045. The apparatus referred to in SABS 045 shall be supplied by the Contractor and shall form part of his standard equipment under this Contract.

In the event that these requirements for verticality are not met, the borehole will be declared a lost borehole. The Contractor shall thereupon re-drill the hole at his own cost, to specification.

(vii) Sampling

Representative drilled cutting samples of the materials intersected shall be collected every metre and the Borehole Information recorded on the Borehole Drilling Report as outlined in Clause 2.12.

Where specifically instructed by the Employer's Representative, the Contractor shall bag and label the samples with the depth increment and store in a position where they will not be contaminated by site conditions or drilling operations for detailed logging by the Employer's Representative.

(viii) Reaming

Where a borehole has previously been drilled to a smaller diameter than required, the original borehole shall be reamed to the required diameter as specified by the Employer's Representative. Reaming shall comprise the widening of the existing borehole using rotary air percussion methods for varying borehole diameters advanced through all types of consolidated rock formations encountered. Reaming shall be to one of the following diameters: 203 mm (8"), 216mm (8 ½ ") 254 mm (10") and 305 mm (12").

(ix) Borehole Rehabilitation

Where an existing borehole is not serviceable the Contractor shall at the instruction


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2



of the Employer's Representative rehabilitate the borehole. Rehabilitation shall comprise one or more of the following activities:

- removal of existing pump equipment
- drilling and cleaning of existing borehole
- insertion of casing (where deemed necessary)
- development of borehole
- re-installation of existing serviceable pumping equipment

This Clause does not cover the return of the Contractor to a borehole previously drilled by the Contractor.

PC1.6 Development and Capping

(i) Development of Borehole

On completion of construction the borehole shall be developed to attain the maximum possible yield of ground-water, free of suspended materials. Where the required development time exceeds 30 minutes duration approval from the Employer's Representative must be obtained. Development by means of flushing and blowing large volumes of water shall be carried out using air surging, jetting, or such other standard techniques as may be directed by the Employer's Representative.

Where there is insufficient natural water in the borehole to develop adequately, then sanitised water shall be imported to site by the Contractor to augment the low yielding borehole.

(ii) Blow Yield Measurement

Blow yield measurement shall be undertaken and recorded during drilling operations in order to establish the blow yields for different water strikes occurring in each borehole. Additionally, a blow yield test shall be carried out by the Contractor after completion of drilling of the borehole as specified by the Employer's Representative. The blow yield test comprises the constant displacement of ground-water at optimum yield using air flush methods with the yield measured by draw-off pipe and bucket method or a v-notch flow meter.

(iii) Jetting of Borehole

High pressure water jetting to effectively develop a sand filter and / or aquifer shall be carried out on a screened borehole at the instruction and supervision of the Employer's Representative.

(iv) Backfilling

Where there is a need to provide a base for a sanitary seal or support for the sidewalls of the borehole and the solid casing, back-fill comprising drill cuttings removed from the borehole while drilling, may be used. Annular back-filling is not suitable where the casing extends to substantial depths and comprises open casing (perforated, slotted or screens) or where the water-bearing zone is shallow and open to the borehole via open casing. Back-fill of drill chips or as otherwise stipulated is to be inserted in the annular space of the borehole and solid casing at depths specified by the Employer's Representative.

(v) Filter Pack/Gravel Pack


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2



A filter pack installed between the annular space of the borehole and perforated casing and / or screens may be specified by the Employer's Representative where specific geological conditions are encountered. The filter material shall comprise clean, graded gravel (as specified) and shall be placed by means of a "tremie pipe" to the levels as specified by the Employer's Representative. Sanitised water shall be used for this process.

(vi) Grout Backfill / Bentonite Seal

Where specific levels in a borehole require to be sealed off, a grout back-fill or bentonite seal shall be specified by the Employer's Representative. The grout shall comprise a mixture of bentonite, sand and cement as specified by the Employer's Representative.

(vii) Capping of Borehole

During the Time for Completion when work is not in progress, the boreholes shall be kept capped in such a manner as to prevent the ingress of foreign material. The Contractor shall remove any foreign matter at his own expense. Unsuccessful boreholes shall also be capped in the same manner unless otherwise instructed by the Employer's Representative to stone plug the unsuccessful borehole as given in Clause PSL1.6 (viii).

On completion of the borehole and / or prior to installation of a pump the Contractor shall cap the borehole by completely welding a 3mm thick steel cover onto the protruding steel casing or by permanently affixing a PVC cap onto the protruding PVC casing. It is the responsibility of the contractor to ensure that the capping is not broken off and the borehole not damaged. A borehole number identification is to be inscribed onto the capping as given in Clause PSL1.9.

(viii) Plugging of Unsuccessful Borehole

Where an unsuccessful borehole is drilled or a borehole abandoned or lost the outer casing may be removed at the direction of the Employer's Representative and the borehole stone plugged

A borehole identification number is to be inscribed onto the concrete cover as given in Clause PSL1.9.

(ix) Water Quality Testing (Field Test)

Field pH and Electrical Conductivity (EC) readings are to be recorded on a fresh sample of groundwater taken on final completion of drilling operations at the end of developing of borehole as given in Clause PSL1.6 (i). In addition, the Employers' Representative may instruct that samples be taken for and delivered to the laboratory for more detailed testing.

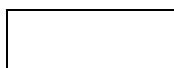
(x) Disinfection

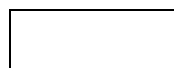
On completion of developing of borehole as detailed in PSL1.6 (i) and water quality testing as detailed in PSL1.6 (ix), the borehole shall be disinfected with a solution of 0,5kg of HTH mixed in 250 litres of water.

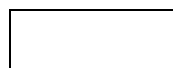
PC1.7 Casing, Perforated Casing and Screens

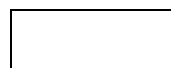
(i) General

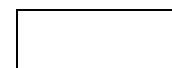
Casings, perforated casings and screens shall be supplied by the Contractor as

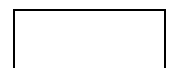

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specified in the Schedule of Rates or as specified otherwise by the Employer's Representative. Mild steel casing will be used predominantly for consolidated type rock formation boreholes and PVC casing will be used predominantly for un-consolidated type formations.

All materials to be used shall be new and undamaged and shall be supplied and delivered as such on site.

(ii) Plain Casing

Plain casing shall be used as an outer and / or inner lining to a borehole and shall be made of either mild or stainless steel, or PVC depending on the nature of the formation and as determined by the Employer's Representative.

The outer casing shall be inserted through the overburden and any zones of non-potable / undesirable seepage water and driven into the consolidated rock formation below. The inner casing shall be installed in conjunction with perforated casing and / or screens according to the specification issued by the Employer's Representative.

All steel casing shall have a minimum wall thickness (as specified by the Employer's Representative), shall be bevel edged and weld jointed. All PVC casing shall be a minimum CLASS (as specified by the Employers Representative) and shall be threaded both ends with which they shall be joined unless otherwise specified by the Employer's Representative.

Casing shall be installed to depths as specified by the Employer's Representative. After completion of the work, the casing shall protrude a minimum of 500mm above natural ground level.

The casing shall be of the diameter specified, self-aligning and from approved suppliers. It must be possible to uplift, disconnect and re-use the casing.

(iii) Perforated Casing

Perforated casing shall be used as an inner lining to a borehole where collapsing conditions occur at water bearing horizons and for production boreholes. The perforated casing shall be made of either mild or stainless steel, or PVC as determined by the Employer's Representative and shall comply with the requirements of Clause PSL1.7 (ii) for Plain Casing. The perforated casing shall be installed under supervision to levels as given by the Employer's Representative. There may be a requirement to perforate steel casing on-site otherwise all casing must be factory perforated as specified by the Employer's Representative.

a) Perforation of Steel Casing (on-site)

Perforation on-site may only be performed on steel casing. The width of the perforations shall be as specified by the Employer's Representative within the range of 1mm minimum and 4mm maximum. The perforations shall be of uniform width with no resultant protrusions and shall be clear of debris.

b) Factory Perforated Casing

PVC and steel factory slotted casing is normally plasma or machine cut casing. The diameter, slot size and percentage open area of the slotted casing shall be determined by the Employer's Representative.


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2

(iv) Screens

Where production boreholes are constructed the Employer's Representative may request that stainless steel, wedge-wire "Johnson" type screens (or equivalent) be installed at the water bearing horizons. The diameter, slot size and percentage open area of the screens shall be determined by the Employer's Representative. Minimum 0,25mm slot size and minimum 20% open area is allowed for in this contract.

The screens shall be installed under supervision to levels as given by the Employer's Representative.

(v) Temporary Casing

Where difficult drilling conditions occur, the insertion of temporary casing during drilling and borehole construction will be necessary. This casing must also comply with the requirements of Clause PSL1.7 (ii).

(vi) Casing Centralizers

Casing shall be guided and supported by casing centralisers where requested by the Employer's Representative.

PC1.8 Test Pumping(i) General

The test pumping of boreholes will be conducted according to the SABS 0299-4:1998 Code of Practice.

Borehole yields shall be tested to determine the safe yield and demand period for which they can be pumped on a continuous basis, as specified by the Employer's Representative. Water levels shall be measured during pumping and recovery at specified time intervals using an electrical dip Meter sleeved within a suitable conduit. Water level monitoring equipment shall be approved by the Employer's Representative. All yield test results must be quantified i.e. accurate measurements of drawdown, flow rate, time and recovery are to be recorded on the applicable Test Pumping Report as supplied to the Contractor and as outlined in Clause PSL2.13. The depth of the borehole shall be ascertained and recorded prior to commencement of the test.

(ii) Calibration, Variable & Constant Discharge Test

A variable discharge or constant discharge test (using either an approved line-shaft or submersible pump) shall be carried out to determine the optimum yield. The pump must be typically capable of pumping at variable rates between 500 litres/hr and 12 000 litres/hr.

Only positive displacement type pumps are acceptable for yields greater than 12 000 litres/hour if and when required by the Employers Representative. Pumping heads are typically in the order of but not limited to 100m.

Typically tests will comprise 4 x 60minute step tests, and associated recovery. The Employer's Representative will make a decision whether to perform a constant discharge test of 24 or 48 hours (maximum of 72 hours) and associated recovery. In the event that no information is available on the estimated yield of the borehole, a calibration test may be initially performed under the direction of the Employer's Representative.


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2

(iii) Recovery

The rate of recovery comprising the monitoring of recovery of water level at specific time intervals shall be measured for a minimum period of 1 hour or as specified by the Employer's Representative. Typically, recovery will be to 95% of original static water level or equal to pumping time (whichever occurs first). The Employer's Representative may change the recovery period at their discretion.

(iv) Laying of Discharge Hose

The laying of discharge hose is particularly important to minimize recharge of the aquifer from the discharge component of the test. Depending on the hydro-geological conditions, the Employer's Representative will instruct the direction and the distance away from the borehole in 50m increments the discharge hose is to be laid to a maximum anticipated length of 500m.

(v) Water Samples

A two litre water sample is to be taken by the Contractor for testing to an approved laboratory for every pump test performed. Typically, samples should be taken 10 minutes before the end of the final step of a step test, or alternatively 2 hours before the end of a constant discharge test, depending on the type of test being performed.

Tests will typically be:

- Step tests and associated recovery,
- Step test, 24 hour constant discharge and associated recovery,
- Step test, 48 hour constant discharge and associated recovery,
- Step test, 72 hour constant discharge and associated recovery,
- Calibration test, Step tests and associated recovery,
- Calibration test, Step test, 48 hour constant discharge and associated recovery
- Calibration test, Step test, 24 hour constant discharge and associated recovery
- Calibration test, 72 hour constant discharge and associated recovery.

At the Employer's Representatives discretion, the time of sampling may be altered to incorporate effective delivery to the laboratory. The Contractor is to ensure that the water sample is suitably cooled (cooler box with ice packs) and delivered, where possible, within 24 hours of the sample being taken. It is the Contractor's responsibility to properly mark and deliver the samples to an approved laboratory.

PC1.9 Borehole Number Identification

Each new borehole drilled shall be allocated a Borehole Number by the Employer and issued to the Contractor by the Employer's Representative. It is the responsibility of the Contractor to clearly inscribe the Borehole Number for each new borehole as follows:

Position	Type	Method of Inscription	Details Inscribed
Borehole Capping (for capped successful and unsuccessful Boreholes)	Steel cover PVC cap	Welding Indelible Marker Pen	Borehole No. Wet or Dry
Stone Plugged Concrete Cover (where unsuccessful, Abandoned or	Galvanised Iron Name	Stamping	Borehole No. Dry,
abandoned or lost Borehole has been stone plugged)	Plate		Lost Date Drilled


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2

**PC1.10 Cessation of Drilling Activities**

The termination, at any stage, of drilling operations on a particular borehole shall rest with the Employer's Representative.

PC1.11 Abandonment

The Employer's Representative shall have the right at any time during the progress of the work to order the abandonment of the borehole. The Contractor shall thereupon remove the plant and where required withdraw the casing as the Employer's Representative shall direct and / or, up until the Employer's Representative revokes such direction, and shall leave the borehole to the satisfaction of the Employer's Representative. No payment will be approved for any casing remaining in the borehole which has been abandoned unless the Employer's Representative has satisfied himself that the casing cannot be withdrawn and has certified this in writing. An abandoned borehole shall be stone plugged as given in Clause PSL1.6 (viii).

Should the abandoned borehole be considered a potential pollution point source, the Employer's Representative may issue further instructions to effectively seal the borehole.

PC1.12 Lost Borehole

Should accident to the plant, behaviour of the ground, jamming of the tools or casing, non-compliance of the straightness or verticality test (as specified in Clauses PSL1.5 (vi)) or any other cause, prevent the satisfactory completion of the works, the borehole shall be deemed to be lost and no payment shall be made for the drilling or borehole construction costs nor for any materials, nor for any time. The cost of materials which have been recovered but are in a damaged state are borne by the Contractor. Should the materials recovered be in good order, then the Contractor shall have no claim for such materials and will have the option to re-use such materials within the scope of the project. A lost borehole shall be stone plugged as given in Clause PSL1.6 (viii).

Should the lost borehole be considered a potential pollution point source, the Employer's Representative may issue further instructions to effectively seal the borehole.

In the event of a lost borehole, the Contractor shall construct a new borehole adjacent to the lost borehole, on a site indicated by the Employer's Representative. The option of declaring any borehole lost shall rest with the Contractor, subject to directions from the Employer's Representative.

No payment whatsoever will be made for the lost borehole. Measurement and payment for the construction of a borehole adjacent to the lost borehole shall be in accordance with the specifications of any other borehole included in this document, provided that the specifications therefore are met.

PC1.13 Reports

The Contractor shall accurately record the following reports:

Name	Description	Supplied
Construction Report	An accurate record of all Contractors activities including time, personnel, plant, equipment, quantities of materials used, borehole depths, etc.	Daily record kept by Contractor and available for inspection by the Drilling Inspector or

Engineer

Tenderer

Witness 1

Witness 2

Employer

Witness 1

Witness 2



Borehole Drilling Report	An accurate record for each borehole of borehole No., locality, drilling techniques used and stratigraphic data including depths, strata type, water strike levels, blow yields, casing diameter, lengths, etc.	On completion of each borehole drilled
Borehole Rehabilitation Report	An accurate record for each borehole of borehole no., locality, drilling techniques used and stratigraphic data including depths, strata type, water strike levels, blow yields, casing diameter, lengths, etc.	On completion of each borehole rehabilitated
Test Pumping Report	An accurate record of yield test information including borehole no., locality, borehole depth, datum point, water levels, time intervals, flow rates, recovery and any special observations. Refer to SABS 0299-4:1998.	On completion of each yield test
Borehole Maintenance Report	An accurate report of the pump maintained including maintenance number, locality, pump type, repairs effected, spares used un-servicable. items removed.	On completion of each borehole drilled

The Contractor shall not be paid for any work invoiced unless the above mentioned reports pertaining to the work invoiced have been satisfactorily submitted.

The Contractor shall submit each report to the Employer's Representative within 3 days of completion of the work as detailed in the Report. Failure to do so shall be regarded as non-performance in terms of the contract and will be subject to the conditions of contract.

PC1.14 Supervision

The Contractor is to provide a suitably experienced foreman who is required to supervise and direct the work at all times, and who will be responsible for:

- confirmation of borehole positions (with allocated Borehole Numbers) as set out by the Employer's Representative;
- introduction and acquaintance with the Employer's Area Representative, the community leader and / or water committee representative if so directed by the Employer's Representative;
- supervision of operations;
- Preparation of all field reports.


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2

**PC2 REMUNERATION AND PAYMENT****PC2.1 GENERAL**

The Contractor under this Contract is considered to be an expert in groundwater borehole construction and is expected to organise and carry out the work specified hereunder in a competent manner. Drilling problems encountered will be overcome entirely within the framework of this Specification and Schedule of Rates, and no claims for extra payments will be entertained for problems foreshadowed in the Specification or due to limitations placed by this Specification.

The rates as given are to include full compensation for the supply of all materials, labour, equipment, utilisation, transport and all work necessary for, or incidental to, the items scheduled.

PC2.2 TRANSPORT (DRILL RIG)**PC2.2.1 Establishment**

The rate is inclusive of provision of all equipment, plant, personnel and facilities that is necessary to perform the work as required per rig with establishment thereof at the first borehole site and de-establishment on completion of the work order.

Payment shall be made per borehole to relocate the rig to the first borehole site..... Unit: No

PC2.2.2 Inter-Borehole Move**(a) Set-up**

The rate is inclusive of all transport and personnel required for relocation of the drilling rig and all plant and equipment from one borehole site to another and the set-up thereof. The provision of sumps is included in the Rotary Mud set-up.

Payment shall be made at a unit rate per borehole and include travel costs for a move up to but not exceeding 10km).....Unit: No

(b) Travel

Moves involving travel over and above the first 10km travel.....Unit: km

PC2.2.3 Water Haulage

Where additional water is required to be hauled (GPS co-ordinate of source to be included in borehole summary report 1.) to site in order to satisfactorily carry out Rotary Mud Drilling, Development of Borehole and Jetting of Borehole.

The rate is inclusive of all water supply equipment and personnel required to draw, contain and the haul water from water source to site.

Payment shall be made per cubic metre (m3) of water hauled per kilometre.....Unit: m3/km

PC2.2.4 Transport of Special Items

The rates are to include for the provision of suitable vehicular transport and personnel, for additional transport of Odex Casing Shoes, Special Casings and / or Screens or Additional Items as directed by the Engineer. The rate will be from the Contractors operational base within the Umzinyathi District Municipality (LDV rate according to the rates published by the National Department of Public Works and as stipulated in the

Tenderer

Witness 1

Witness 2

Employer

Witness 1

Witness 2



work order) to site as agreed with the
Engineer.....Unit: km

PC2.3 DRILLING**PC2.3.1 Air Percussion Drilling**

The rates for Air Percussion Drilling are based on diameter and cover all costs for labour, plant, materials and fuel required for advancement of borehole to specified depths, and which are not covered under other payment items. Payment shall be per linear metre advanced.....
Unit: m

The drilling depth rates for depths greater than the base rate of 0 - 150m range are determined as a set percentage (30%) over and above the base rate.

Payment shall be per linear meter..... Unit: m

PC2.3.2 Odex or Symetrix**(a) Odex or Symetrix Air Percussion Drilling**

The rates for Odex or Symetrix Air Percussion Drilling are based on diameter and cover all costs for labour, plant, material and fuel required for the successful advancement of the borehole through collapsible layers of any thickness occurring within the consolidated rock formation where standard air percussion drilling methods are proved to be ineffective, and which are not covered under other payment items.

Payment shall be per linear metre advanced.....Unit: m

(b) Odex or symetrix Air Percussion Casing Shoe

Where Odex or Symetrix Air Percussion drilling is required an odex or symetrix casing shoe shall be supplied and used. Payment for the cost of supply, transport, delivery and safe keeping on site of the casing shoe as specified by the Engineer.

Payment shall be per casing shoe used.....Unit: No

Where the requirement for Odex or Symetrix drilling has not been specified in the work order and if special transport of the casing shoe is required the transport cost thereof shall be covered under Payment Item PSL2.2.4.

PC2.3.3 Reaming

The rate provides for all additional labour, plant, material and fuel required for reaming a smaller diameter borehole to a larger diameter as specified by the Engineer. The Contractor shall be paid at a rate per linear metre advanced. The reaming depth rates for depths greater than the base rate of 0m - 150m range are determined as a set percentage over and above the base rate.....Unit: m

PC2.3.4 Borehole Rehabilitation

The rate provides for the appropriate air percussion drilling operations required to clean the existing borehole to the satisfaction of the Engineer. The rate includes all risks attached to the rehabilitation of boreholes and is a fixed rate of 60% of the air percussion drilling rate per meter.

Payment shall be per linear meter advanced.....Unit: m

Payment for the removal of existing equipment at the borehole as well as the re-installation thereof after the successful rehabilitation of the borehole is measured in



Tenderer



Witness 1



Witness 2



Employer



Witness 1



Witness 2



Payment Item PSL2.6.12.

Note: Where existing pump-housing requires to be removed and subsequently re-erected, the Contractor may be requested by the Engineer to obtain three competitive quotes from reputable dealers to undertake such work.

PC2.3.5 Rotary Mud Flush Drilling

(a) Un-consolidated and cemented Sediments

The rates for Rotary Mud Drilling are based on diameter and cover all costs for labour, plant, material and fuel required from advancement of borehole to specified depths and which are not covered under the other payment items.

Payment shall be rate per linear metre advanced.....Unit:
m

(b) Boulders

The rate provides for all additional labour, plant, material and fuel required for the successful advancement of the borehole through boulder layer of any thickness occurring within the unconsolidated soil formation where standard Rotary Mud Drilling methods are proved to be ineffective. The rates are determined as a set percentage (75%) over and above the drilling rate per borehole diameter for the drilling depth range 0m - 100m as provided in Payment Item 2.19 and 2.20 above.

Payment shall be per linear meter advanced..... Unit: m

PC2.4 DEVELOPMENT AND CAPPING OF BOREHOLE

PC2.4.1 Development and Blow Yield Testing

The borehole development and blow yield testing rate is to cover all the time effectively spent on borehole development and the blowing time required for carrying out blow yield testing as instructed by the Engineer and where drilling operations are not being performed concurrently. The Contractor is deemed to have all the necessary equipment on site for development and blow yield testing.

On completion of drilling a borehole, the first 30 minutes of development is deemed to be the necessary cleaning out of the borehole and as such the cost thereof is included in all of the aforementioned Drilling & Reaming rates.

Blow yield testing undertaken by the Contractor during drilling operations is deemed to be a part of the drilling operations and the cost thereof is deemed to be included in the rates provided therefore.

Payment for all other blow yield testing shall be at an hourly rate for any further development for blow yield testing thereafter and as instructed by the Engineer.....Unit: hr

If additional water is required for development the water haulage cost thereof shall be covered under Payment Item 2.21.

PC2.4.2 Jetting of Borehole

The rate is to cover all the special equipment used and time effectively spent on jetting the borehole as instructed by the Engineer. The Contractor is deemed to have all the necessary equipment on site for jetting.

Payment shall be made per hour the borehole is jetted.....Unit: hr

Tenderer

Witness 1

Witness 2

Employer

Witness 1

Witness 2



If additional water is required for jetting the water haulage cost thereof shall be covered under Payment Item 2.22.

PC2.4.3 Backfill

Where instructed by the Engineer backfill shall be inserted and will be measured at a rate per cubic metre (m³) of material inserted.

Payment shall be per cubic meter inserted.....Unit: m³

PC2.4.4 Gravel / Filter Pack

Payment for the cost of supply, transport, delivery and safekeeping on site and inserting of filter pack / gravel pack as specified by the Engineer shall be on the basis of three competitive quotes from reputable dealers and as approved by the Employer, with a percentage mark up of 15% on the nett price (excluding VAT). Payment shall be made only for materials used and shall be calculated for each completed borehole. No claims for extra payment will be entertained by reason of remoteness, wharfage, insurance, etc. The Contractor shall purchase the specified material on the basis of competitive quotes from reputable dealers as approved by the Engineer.

Payment shall be per cubic metre (m³) of gravel / filter pack supplied and inserted.....Unit: m³

Where the requirement for gravel / filter pack has not been specified in the work order and if special transport (as approved by the Engineer) is required to deliver these items to site, the cost thereof shall be made in accordance with Payment Item 2.24. To take into account the higher cost of a special supply of filter material payment shall be made for the supply and insertion of a minimum 0,5 m³ of filter pack at a time.

There shall be no payment for material declared lost or made unusable due to damage thereof.

PC2.4.5 Grout Back-fill / Bentonite Seal

Payment for the cost of supply, transport, delivery and safekeeping on site of cement and bentonite used for the grout back-fill / bentonite seal as specified by the Engineer shall be on the basis of three competitive quotes from reputable dealers and as approved by the Employer, with a percentage mark up of 15% on the Nett price (excluding VAT). Payment shall be made only for materials used and shall be calculated for each completed borehole. No claims for extra payment will be entertained by reason of remoteness, wharfage, insurance, etc. The Contractor shall purchase the specified material on the basis of competitive quotes from reputable dealers as approved by the Employer's Representative.

Payment shall be per linear metre of grout back-fill / bentonite seal supplied and inserted.....Unit: m

There shall be no payment for material declared lost or made unusable due to damage thereof.

PC2.4.6 Sanitary Seal

Payment for the cost of supply, transport, delivery and safekeeping on site of cement and bentonite used for the effective sanitary seal as per Department of Water Affairs and Forestry Standards.

Payment shall be made per sanitary seal installed.....Unit: No


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2

**PC2.4.7 Capping of Borehole**

The rate for capping of a borehole of varying diameter includes the provision and affixing of the steel or PVC cover to the steel or PVC casing respectively and the inscription of the borehole number identification thereof.

Payment shall be per borehole capped..... Unit: No

PC2.4.8 Plugging of Unsuccessful Borehole

The rate for the plugging of an unsuccessful borehole includes the provision of a suitable stone plug, concrete collar and the inscription of the borehole identification number.

Payment shall be per borehole plugged..... Unit: No

PC2.4.9 Disinfection of Borehole

The rate for the disinfection of a borehole includes payment for the cost of supply, transport, delivery and safekeeping on site of disinfectant (HTH) as specified by the Engineer. The rate shall be on the basis of three competitive quotes from reputable dealers and as approved by the Employer, with a percentage mark up of 15% on the Nett price (excluding VAT). Payment shall be made only for materials used and shall be calculated for each completed borehole. No claims for extra payment will be entertained by reason of remoteness, wharfage, insurance, etc. The Contractor shall purchase the specified material on the basis of competitive quotes from reputable dealers as approved by the Engineer.

Payment shall be per kilogram of material supplied and inserted.....Unit: kg

There shall be no payment for material declared lost or made unusable due to damage thereof.

PC2.5 CASING**PC2.5.1 Supply of Mild Steel Casing****(a) Plain and Factory Perforated Mild Steel Casing**

Payment for the cost of supply, transport, delivery and safekeeping on site of Plain and Factory Perforated Mild Steel Casing of varying diameter and wall thickness as given in the Schedule of Rates and as specified by the Employer's Representative shall be on the basis of three competitive quotes from reputable dealers and as approved by the Employer, with a percentage mark up of 15% on the Nett price (excluding VAT). Payment shall be made only for materials used per linear meter and shall be calculated for each completed borehole. No claims for extra payment will be entertained by reason of remoteness, wharfage, insurance, etc. The Contractor shall purchase the specified casings on the basis of competitive quotes from reputable dealers as approved by the Engineer.

Payment shall be measured at a rate per linear metre of casing.....Unit: m

(b) Perforation of Steel Casing (on-site)

The rate provides for the on-site perforation of plain casing as supplied under 2.32 above and is inclusive of all equipment and labour required for perforation. The Contractor is deemed to have all the necessary equipment on site for perforation.

Payment shall be measured at a rate per linear metre of casing perforated.....Unit: m

Tenderer

Witness 1

Witness 2

Employer

Witness 1

Witness 2



There shall be no payment for casings and screens declared lost or made unusable due to damage thereof.

PC2.5.2 Supply of PVC Casing

Payment for the cost of supply, transport, delivery and safekeeping on site of threaded Plain and Factory Perforated PVC Casing (inclusive of end caps) of varying diameter and class (wall thickness) as given in the Schedule of Rates and as specified by the Engineer shall be on the basis of three competitive quotes from reputable dealers and as approved by the Employer, with a percentage mark up of 15% on the Nett price (excluding VAT). Payment shall be made only for materials used per linear meter and per end cap used, and shall be calculated for each completed borehole. No claims for extra payment will be entertained by reason of remoteness, wharfage, insurance, etc. The Contractor shall purchase the specified casings on the basis of competitive quotes from reputable dealers as approved by the Engineer.

(a) Payment shall be measured at a rate per linear metre of casing.....Unit: m

(b) Payment shall be measured per PVC end cap used.....Unit: No

Only factory perforated PVC casing will acceptable (ie. not to be perforated on site). There shall be no payment for material declared lost or made unusable due to damage thereof.

PC2.5.3 Supply of Stainless-Steel Wedge-wire Screens

Payment for the cost of supply, transport, delivery and safekeeping on site of Stainless steel wedge-wire screens of varying diameter, open area and slot size as given in the Schedule of Rates and as specified by the Employer's Representative shall be on the basis of three competitive quotes from reputable dealers and as approved by the Employer, with a percentage mark up of 15% on the Nett price (excluding VAT). Payment shall be made only for materials used per 3m screen and shall be calculated for each completed borehole. No claims for extra payment will be entertained by reason of remoteness, wharfage, insurance, etc. The Contractor shall purchase the specified screens on the basis of competitive quotes from reputable dealers as approved by the Engineer.

Payment shall be per 3m screen.....Unit: No

There shall be no payment for material declared lost or made unusable due to damage thereof.

Where the requirement for stainless steel screens have not been specified in the work order and if special transport as approved by the Engineer is required to deliver these items to site the cost thereof shall be made in accordance with Transport of Special Items.

PC2.5.4 Supply of Screen to Casing Adaptors

Payment for the cost of supply, transport, delivery and safekeeping on site of screen to casing adaptors of varying diameter as given in the Schedule of Rates and as specified by the Engineer shall be on the basis of three competitive quotes from reputable dealers and as approved by the Employer, with a percentage mark up of 15% on the Nett price (excluding VAT). Payment shall be made only for materials used per adaptor and shall be calculated for each completed borehole. No claims for extra payment will be entertained by reason of remoteness, wharfage, insurance, etc. The Contractor shall purchase the specified screens on the basis of competitive quotes from reputable dealers as approved by the Engineer.

Payment shall be measured at a rate per adaptor..... Unit: No

Tenderer

Witness 1

Witness 2

Employer

Witness 1

Witness 2



There shall be no payment for material declared lost or made unusable due to damage thereof.

Where the requirement for adaptors have not been specified in the work order and if special transport as approved by the Engineer is required to deliver these items to site the cost thereof shall be made in accordance with Transport of Special Items.

PC2.5.5 Centralisers

Payment for the cost of supply, transport, delivery and safekeeping on site of casing centralisers of varying diameter as given in the Schedule of Rates and as specified by the Engineer shall be on the basis of three competitive quotes from reputable dealers and as approved by the Employer, with a percentage mark up of 15% on the Nett price (excluding VAT). Payment shall be made per casing centraliser used and shall be calculated for each completed borehole. No claims for extra payment will be entertained by reason of remoteness, wharfage, insurance, etc. The Contractor shall purchase the specified casing centralisers on the basis of competitive quotes from reputable dealers as approved by the Engineer.

Payment shall be per casing centraliser..... Unit: No

There shall be no payment for material declared lost or made unusable due to damage thereof.

Where the requirement for casing centralisers have not been specified in the work order and if special transport as approved by the Engineer is required to deliver these items to site the cost thereof shall be made in accordance with Transport of Special Items.

PC2.5.6 Insertion or removal of Casing

The rate provides for the insertion of permanent casing in boreholes as instructed by the Engineer. The same rate provides for the removal of casing where instructed by the Engineer. There shall be no payment for removal of casing in boreholes declared lost or dry or in which the casing cannot be set in position due to misalignment or other operational problems.

Payment shall be per linear meter of casing inserted or removed.....Unit: m

PC2.6 TEST PUMPING

PC2.6.1 Establishment

The rate is inclusive of provision of all equipment, plant, personnel and facilities that is necessary to perform the work as required per test pumping rig with establishment thereof at the first borehole site and de-establishment on completion of the work order.

Payment shall be made as per borehole to relocate the test pumping rig at the first borehole site..... Unit: No

PC2.6.2 Inter-borehole Moves

(a) Set-up

The rate is inclusive of all transport and personnel required for relocation of the test pumping rig and all plant and equipment from one borehole site to another and the set-up thereof.

Payment shall be made at a unit rate per borehole and include travel costs for a move up to but not exceeding 10km) Unit: No

(b) Travel

Moves involving travel over and above the first 10km travel noted in (a)



Tenderer



Witness 1



Witness 2



Employer



Witness 1



Witness 2



above..... Unit: km

PC2.6.3 Column and Shaft Installation and Removal

Pump installation depths vary from borehole to borehole thus a separate rate for the installation and removal of columns and shafts for positive displacement pumps has been introduced. The rate is to include the installation and removal of typically 3m (may vary for different pump types) columns and associated shafting with column stabilisers to the test depth specified by the Engineer.

Payment shall be per linear meter installed and removed.....Unit: m

PC2.6.4 Calibration Testing

The rate includes for the pumping time required to carry out test-pumping for the time period, pumped flow rate/s and time intervals as specified by the Engineer and the monitoring of water levels thereof.

Payment shall be made per hour (or part thereof) that calibration actually takes place..... Unit: hr

PC2.6.5 Variable Discharge Testing

The rate includes for the pumping time required to carry out test-pumping for the time period, pumped flow rate/s and time intervals as specified by the Engineer and the monitoring of water levels thereof.

Payment shall be made per hour (or part thereof) that variable discharge testing actually takes place.....Unit: hr

PC2.6.6 Constant Discharge Testing

The rate includes for the pumping time required to carry out test-pumping for the time period, pumped flow rate and time interval as specified by the Engineer and the monitoring of water levels thereof.

Payment shall be made per hour (or part thereof) that constant discharge testing actually takes place.....Unit: hr

Payment for a minimum of 6 hours pumping time shall be made for each constant discharge test in the event that the test needs to be abandoned.

C2.6.8 Recovery

Monitoring of water recovery levels shall be measured at an hourly rate for the time frame specified by the Engineer (typically to 95% of original static water level or equal to pumping period).

Payment shall be made per hour (or part thereof) that recovery actually takes place..... Unit: hr

PC2.6.9 Monitoring of Observation Boreholes

Monitoring of observation borehole water levels shall be measured per borehole as specified by the Engineer (typically only during constant discharge testing). This may not necessarily be a requirement of each test).

Payment shall be made per hour (or part thereof) that recovery actually takes place.....Unit: hr

Tenderer

Witness 1

Witness 2

Employer

Witness 1

Witness 2

**PC2.6.10 Laying of Discharge Hose**

The discharge hose should be capable of coping with flows as specified by the Employer's Representative (typically up to 5 l/s although higher yields may be required) and be of a minimum length of 50m with facility for extension to 500m in 50m lengths.

Payment shall be for 50m increments utilized..... Unit: No

PC2.6.11 Sampling and Delivery of Water Samples to approved laboratories

Water samples are to be taken at each borehole tested unless otherwise stated by the Engineer. Sample bottles are obtainable from laboratory. Samples are to be kept suitably cool and must be delivered to the laboratory within 24 hours of being taken.

(a) Payment shall be per sample delivered up to 100km (one way)Unit: No

(b) Per kilometer travelled as per the rates published by the National Department of Public Works and as specified in the work order, greater than 100km (one way) Unit: km

PC2.6.12 Removal and re-installation of existing equipment

Payment shall be made as detailed in payment item 3.12 to 3.17.

PC2.6.13 Capping

The rate for capping of a borehole of varying diameter includes re-affixing of the steel or PVC cover to the steel or PVC casing respectively and insuring the inscription of the borehole number identification thereof.

Payment shall be made per borehole that the casing is re-affixed.....Unit: No

PC2.6.14 Reporting

All test results must be quantified ie. Accurate measurements for drawdown, flow rate, time, recovery and test borehole details to be recorded on the applicable Test Pumping Report.

Payment shall be made per test result, inclusive of all observation boreholes.....Unit: No

Tenderer

Witness 1

Witness 2

Employer

Witness 1

Witness 2

**PC2.7 EXISTING BOREHOLES****PC2.7.1 Establishment**

The rate is inclusive of all equipment, plant, personnel, and facilities that is necessary to perform the work as required per maintenance team with establishment thereof at the borehole site and the de-establishment on completion of the installation.

Payment shall be made per borehole relocate the installation team at the borehole.
.....Unit: No

PC2.7.2 Removal and/or Re-installation of Existing Equipment

Due to the diverse nature of the type of installations, this payment item will be split into the following categories:

(a) Hand-pump Installation

The rate provides for the removal or re-installation of a hand-pump and its associated fittings. The Contractor is responsible for the on-site safe keeping there-of. The rate is to include the removal or re-installation of the complete hand-pump (excluding columns and shafting, where applicable, which will be charged as a separate item; see item 3.18 and 3.19), to the satisfaction of the Engineer.

Payment shall be per hand-pump removed or re-installed.....Unit:
No

(b) Submersible Pump Installation

The rate provides for the removal or re-installation of a submersible pump and associated fittings. The Contractor is responsible for the on-site safe keeping there-of. The rate is to include the removal or re-installation of the complete submersible pump (including piping and electrical connections), to the satisfaction of the Engineer.

Payment shall be per submersible pump removed or re-installed.....Unit: No

(c) Motorised Positive Displacement Installation (Electric)

The rate provides for the removal or re-installation of the positive displacement pump, electrical motor and associated fittings. The Contractor is responsible for the on-site safe keeping there-of. The rate is to include the removal or re-installation of the of the complete pump and the motor including discharge couplings and electrical connections (excluding columns and shafting which will be charged as a separate item; see item 3.18 and 3.19), to the satisfaction of the Engineer.

Payment shall be per positive displacement pump removed or re-installed.
..... Unit: No

(d) Motorised Positive Displacement Installation (Diesel)

The rate provides for the removal or re-installation of the positive displacement pump, diesel motor and associated fittings. The Contractor is responsible for the on-site safe keeping there-of. The rate is to include the removal or re-installation of the of the complete pump and the motor including discharge couplings and electrical connections (excluding columns and shafting which will be charged as a separate item; see item 3.18 and 3.19), to the satisfaction of the Engineer.

Payment shall be per diesel pump removed or re-installed..... Unit:
No

(e) Motorised Positive Displacement Installation (Solar)

The rate provides for the removal or re-installation of the pump, motor and associated fittings. The Contractor is responsible for the on-site safe keeping there-of. The rate is

Tenderer

Witness 1

Witness 2

Employer

Witness 1

Witness 2



to include the removal or re-installation of the complete pump and the motor including discharge couplings, electrical connections and solar panels (excluding columns and shafting which will be charged as a separate item; see item 3.18 and 3.19), to the satisfaction of the Engineer.

Payment shall be per solar pump removed or re-installed.....Unit:


Tenderer


Witness 1


Witness 2


Employer


Witness 1


Witness 2