CLUSTER

Trading Services

UNIT

Water and Sanitation

DEPARTMENT

Sanitation Operations

PROCUREMENT DOCUMENT

INFRASTRUCTURE

Documents are to be obtained, free of charge, in electronic format, from the National Treasury's eTenders website or the eThekwini Municipality's website.

Contract No: 30661-5W

Contract Title: Construction of the Southern Wastewater Treatment Works Low Level Effluent Pump Station Multidisciplinary upgrades

Est. CIDB Grade/ Class: 9 9EP and 9ME

CLARIFICATION MEETING AND QUERIES

Clarification Meeting: Compulsory Clarification Meeting

Meeting Location, Date, Time: Southern Wastewater Treatment Works (@ co-ordinates - 29.955135360820552, 30.97299685576011) on 13 June 2025 at 11h00

Queries can be addressed to:
The Employer's Agent's Representative:
Name: Shanir Ramjathan
Tel: +27 (0)31 254 5700
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TENDER SUBMISSION

Delivery Location: The Tender Box in the foyer of the Municipal Building 166 KE Masinga Road, Durban

Closing Date/ Time: Friday, 04 July 2025 at 11h00

FACSIMILE, eMAIL, or POSTED TENDERS WILL NOT BE ACCEPTED

Issued by:

ETHEKWINI MUNICIPALITY

Deputy Head: Water and Sanitation

Date of Issue: 24/02/2023

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VOLUME 5 OF 9

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Tenderer Name:			VAT Registered: Yes No
	Price (excl)	VAT	Price (incl)
Submitted:	R	R	R
Corrected:	R	R	R

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This Tender Document consists of 9 (Nine) Volumes as indicated in the table below.

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5 of 9	**Mechanical (This Document)**	**Standard Specifications Project Specifications - Mechanical Particular Specifications – Lifting Equipment Mechanical Data Sheets**
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Declaration by Tenderer

I, the undersigned, hereby declare and confirm that I have obtained all 9 (Nine) of the Tender Document Volumes as indicated in the table above.

NAME (Block Capitals): _____ **Date**

SIGNATURE: ---------- ----------

This Tender Document (Volume 5 of 9: Mechanical) consists of the following Documents.

STANDARD SPECIFICATIONS - MECHANICAL
PROJECT SPECIFICATIONS: MECHANICAL: LOW LEVEL PUMPSET INSTALLATION
PARTICULAR SPECIFICATION: MECHANICAL: LIFTING EQUIPMENT
MECHANICAL DATA SHEETS

STANDARD SPECIFICATIONS: MECHANICAL (GENERAL)

Contents

STANDARD SPECIFICATIONS: MECHANICAL (GENERAL)

1 INTRODUCTION

This specification covers the requirements all mechanical equipment and pipework installation for the works. This document should be read in conjunction with **eThekwini Municipality Standard Specifications for Mechanical works and Control Instrumentation (Included in Volume 8).**

1.1 Supporting Specifications

The following Standards shall apply to this contract unless indicated otherwise:

SANS 32	Internal and/or external protective coatings for steel tubes - Specification for hot dip galvanized coatings applied in automatic plants
SANS 62 -1	Pipes Suitable for threading and of nominal size not exceeding 150 mm
SANS 044	Welding consumables - Technical delivery conditions for welding filler materials - Type of product, dimensions, tolerances and markings
SANS 064	Preparation of steel surfaces for coating
SANS 0111	Engineering drawing
SANS 121	Hot dip galvanized coatings on fabricated iron and steel articles- Specifications and test methods
SANS 455	Covered electrodes for the manual arc welding of carbon and carbon manganese steels
SANS 664	Wedge gate and resilient seal valves for waterworks
SANS 719	Electric welded low carbon steel pipes for aqueous fluids (large bore)
SANS 10140	Identification Colour Marking
SANS 1200	Standardized Specification for Civil Engineering Construction
SANS 1123	Pipe flanges
SANS 1319	Zinc phosphate primer for steel
SANS 1476	Fabricated Flanged Steel Pipework
SANS 1700	Fasteners
SANS 1700-5-18:	Fasteners- non-electrolytically applied zinc flake coatings
SANS 1700:5	Fasteners, ISO metric precision hexagon head bolts (coarse thread medium fit series), screws and hexagon nuts
SANS 2808	Paints and varnishes - Determination of film thickness
SANS 51714	Non-destructive testing of welds - Ultrasonic testing of welded joints
ANSI AWS D01.6	Structural welding (stainless steel)
AP15L	Seamless Steel Tube Pipes for aqueous fluids, Chemical and Physical properties
JIS B2311	Steel Butt-welding pipe fittings for ordinary use
BS 4999	General requirements for rotating electrical machines
BS 5080 Part 1:	Methods of testing for structural fixings in concrete and masonry
ASTM A213	Standard Specification for Seamless Ferritic and Austenitic Alloy-Steel Boiler,

	Superheated and Heat Exchanger Tubes
ASTM A312	Standard materials specification for Seamless and welded Austenitic Stainless-Steel pipe
ASTM A333/A333M	Standard Specification for Seamless and Welded Steel Pipe for Low-Temperature Service
ASTM A370	Standard Test Methods and Definitions for Mechanical Testing of Steel Products
ASTM A403 WPW	Standard Specification for Wrought Austenitic Stainless Steel Piping Fittings
ASTM A488/ A488M	Standard Practice for Steel Castings, Welding, Qualifications of Procedures and Personnel
DIN 11850	Stainless steel tubes for the food and chemical industries - Dimensions, materials
DIN 11852	Fittings for the food and chemical industries - Fittings of stainless steel - Tees, bends and reducers for welding
ASME Section IX	Welding and Brazing Qualifications
SIS 05/59/00 – 1967	Pictorial Surface Preparation Standards for Painting Steel Surfaces.
ISO 898-1	Mechanical properties of fasteners made of carbon steel and alloy steel -- Part 1: Bolts, screws and studs
EN 1435	Non-destructive examination of weld – Radiographic examination of weld joints

Reference to the above Standards shall be deemed to be reference to the latest issue of the relevant Standard at the time of tender.

1.2 Shop Drawings

The Contractor shall prepare and submit to the Engineer for approval shop drawings for all equipment, fittings, and pipework.

The Contractor shall be responsible for verifying all dimensions on site including that of structures and existing mechanical items and pipework. It is noted that allowance for gaskets and setting gaps have not been shown in the general arrangement drawings. The Contractor shall make and show allowances for these in the shop drawings.

Before any materials for any pipe, valve, fitting and special is ordered, the Contractor shall prepare shop drawings for all the above ground pipes or pipes laid on or cast into structures, including those inside chambers. The shop drawings shall give the following details:

- All dimensions of the pipe or fitting/special and the line/structure wherein it is placed,
- The material, pressure class, relevant code/specification and wall thickness of pipe or special/fitting,
- The exact level/elevation, position and tolerance it is manufactured to, together with the integration of the shop drawings prepared for steel gantry structures,
- The jointing method on each side of the pipe or special, and in the case of flanges, the rating and specification of the flanges,
- The positioning and support of pipes, valves, meters, actuators, gearboxes, hand wheels, bypass pies and details of connections to instrumentation and sensors,
- Dimensions for all valves, pumps motors, etc.
- Corrosion protection

- The quality assurance plan for manufacturing, assembly, erection, testing and corrosion protection, clearly indicating hold and witnessing points,
- Details of pipe supports and spacing thereof,
- Details of instrument connections and assemblies,
- The joints/weld to be made in the shop versus those in the field,
- The inclusion of any crotch, collar and wye plates, designed by the Contractor,

Where required the Contractor will employ the necessary professionals to do the shop drawings. Submission of shop drawings for approval shall typically be electronic in PDF format.

Where design is required to ensure long term, durability related to stresses and deflection, the contractor will also employ qualified personnel to achieve this.

All equipment and pipework items shall be clearly marked in the workshop with markings corresponding with the shop drawings.

The Contractor shall also undertake the preparation and submission of final as-built drawings.

1.3 Essential Spares and Tools

The following shall apply for the entire Works:

- Contractor to supply a complete priced spare parts list.
- Contractor to supply a priced list of recommended spare parts to be kept on site, considering the Site's location, the time required for ordered parts to reach site and the criticality of the part to the operation of the Works.
- Contractor to supply commissioning spares as necessary and make them available on site to ensure a smooth uninterrupted commissioning of the plant. Unused commissioning spares shall remain the property of the Contractor.

One complete set of all specialised tools required for the operation and maintenance of the equipment to be supplied as part of this contract.

2 MATERIALS & PIPEWORK

2.1 General

Materials shall be suitable for the environment of the works.

Reference shall be made to the respective technical specifications (Project Specifications) for the various items of equipment for specific details on materials of construction.

Pipework that forms part of this contract will contain bends and specials etc. and shall be provided with sufficient flanged or flexible couplings to permit proper internal cleaning and treatment of all welds and heat affect zones. It shall also be provided with sufficient flanged or flexible couplings to permit ease of dismantling/ assembly.

2.2 Carbon Steel Pipework

2.2.1 Carbon Steel Pipes

Carbon Steel pipes, 150ND and smaller shall be seamless and be manufactured to conform to SANS 62-dimensional specification and conform with the SANS 62 Heavy Duty material specifications and shall bear the appropriate standards mark of approval.

Carbon Steel pipes, larger than 150ND shall be welded and be manufactured to conform to SANS 719-dimensional specification and conform with the SANS 719 Grade B material specifications and shall bear the appropriate standards mark of approval. However, all pipes will be tested in accordance with API 5L.

The minimum wall thickness shall be as follows:

Table 1: Minimum Wall Thickness

Nominal Diameter (mm)	Minimum Wall Thickness (mm)
200	4.5
250	5
300	5
350	6
400	6
500	6
600	6
700	8

The ends of the pipes shall not vary by more than 1.5 mm at any point from a true plane at right angles to the longitudinal axis. All weld beads, internally and externally, shall be level with the rest of the pipe. The ends shall be either flanged or bevelled accordingly or prepared for use with the type of flexible coupling required.

No pipes will have screwed joints and all specials, valves, instruments and meters shall be jointed with flanges. Off-line instruments such as pressure gauges may be connected by means of NPT threaded connections with the tapping's complying with the mechanical drawings.

The Contractor shall ensure that all welding is in accordance with ASME Section IX and ASTM A488/A488 while also complying with SANS 455. Radiographical testing of welds shall be evaluated in accordance with EN 1435 and will constitute at least 10% (ten percent) of the total quantity of weld manufactured pipes and fittings, which shall comply with ASTM A370 'Standard Test Methods and Definitions for Mechanical Testing of Steel Products'. In addition, non-destructive magnetic particle test of welds in accordance with SANS 51714 shall be required as instructed by the Engineer and shall constitute 90% of total quantity pipe and fittings installed. The contractor shall supply to the engineer a method statement for the welding carbon steel pipe for approval as part of the contract requirements, all cost that are associated with the compilation of the method statement, welding, testing of welds and test reports shall be included in the scheduled price for the pipework and fittings.

Manufacturing processes which require that the plate be hammered to obtain the requisite shape shall not be acceptable. The plate shall be free from pits and laminations after rolling.

Field welding will **NOT** be permitted for carbon steel pipes and fittings except if approved by the Engineer in writing.

2.2.2 Carbon Steel bends and specials

Bends and tees shall be to JIS B2311 for use with SANS 62 and SANS 719 piping.

The Contractor will be responsible that all pipes and fitting do not exceed safe maximum working pressure with a safety margin of at least 100% above the maximum working pressures. The margin will exclude for stress related to thrust and thermal forces.

Laterals will be made up from straight sections of schedule pipe.

Special bend such as 37˚ bends shall be made up of either 45˚ or 90˚ bend that would be cut and amended to achieve the required dimensions of the special bend.

Only long radius bends will be used unless physical constraints dictate otherwise. Mitred bends shall not be accepted.

2.3 Stainless Steel Pipes

2.3.1 General

In general, Stainless-Steel pipes shall be manufactured to conform to ANSI B36.19 or ANSI B36.10 dimensional specifications and ASTM A312, minimum **Schedule 10**, Grade 316L (to AISI) material specification for seamless and welded austenitic stainless-steel pipes which shall bear the appropriate standards mark of approval.

2.3.2 Handling of Stainless Steel

Great care shall be taken not to contaminate stainless steel items with iron or mild steel particles. Stainless steel parts shall be kept physically separated from any mild steel fabrication in the manufacturer's workshop such that grinding particles and the like cannot contaminate the stainless-steel items.

Tools and grinding wheels used shall be kept separate from those used for mild steel fabrications Brushing shall be with stainless steel brushes only. All tools used for cutting, grinding, brushing or machining of the stainless steel shall be dedicated to use on stainless steel only.

Before commencing welding of stainless-steel items, the Contractor shall notify the Engineer, in writing, of the type of welding process he proposes to use. The Engineer's written approval for the same shall be obtained before welding commences. Standard stainless steel welding practices, to ensure full penetration with a uniform crevice-free inner weld bead and good alignment, shall be employed.

2.3.3 Post Weld Cleaning and Passivation for Stainless Steel

All welds and heat affected zones shall be properly treated in accordance with ANSI AWS D18.1.

Any parts that have been machined shall be passivated.

Full details of the proposed methods of treatment, cleaning and sanitising are to be submitted before progressing with the works.

2.3.4 Additional Corrosion protection of Stainless Steel Pipes and Fittings

All stainless steel pipes and fittings used in systems that will pump effluent from the Low-Level Pump Station shall have additional corrosion protection as coating and lining as described below:

- 1st Coat : 125 µm Carboline 891 Biscuit
- 2nd Coat: 200 µm Carboline 891 Pipe Blue
- Note: Carboline coating and lining to be prepared with Thinners Type 2

2.4 Pipe Jointing

All joints shall be watertight.

2.4.1 Flanges

Flanges for pipes, valves, fittings, specials and equipment shall be to SANS 1123, Table 1000/3 except where specified differently on the drawings or particular specifications.

Flanges for pipes, valves and fittings shall be parallel faced, truly at right angles to the axis of the bore or branch and machined over the full width of the contact face. The flanges will have a gramophone finish. Where bolts could clash on bends and tees, long neck flanges will be used.

The dimensional tolerances for the fabrication of flanged steel pipework shall comply with SANS 1476.

Unless otherwise specified flanges shall be supplied complete with reinforced rubber insertion gaskets at least 3mm thick, cut to the full depth of the flange and with all bolts, nuts and washers.

Bolted joints shall be assembled in such a way that all bolts and nuts are evenly tightened, using a torque wrench. They shall be assembled, and initial slackness shall be taken up on all bolts, after which diametrically opposite nuts shall be tightened consecutively around the circumference not more than half a turn at a time each until the joint is tight.

The bolts and nuts shall not be subjected to a torque which is greater than their proof stress as defined in ISO 898.

Grade 8.8 stainless-steel Grade 316L bolts will be used for all steel pipework.

2.4.2 Flexible couplings and flange adaptors

Flexible couplings and flange adaptors shall be of the "Viking-Johnson" or equal approved type without central register unless otherwise specified and shall be supplied complete with bolts, nuts, washers, rubber rings, etc. They shall be designed to withstand the same test pressure as the pipes they are coupling.

Where restraining flanges and/or anchors are indicated, no notching of the coupling or adaptor will be permitted for passage of the restraining bolts. The Contractor shall be responsible for the design of suitable restraint where indicated.

2.5 Tie-Ins

2.5.1 General

The Contractor shall be responsible for tie-ins to pipework installed by others or existing pipework. The Contractor's responsibility shall include for dimensional verification, all flanges, couplings, adaptors, fasteners, fixings, gaskets (where applicable) and corrosion protection of the complete tie-in as required.

The Contractor shall be responsible for the complete tie-in.

2.5.5 Integration with Civil Contractor

The Electro-Mechanical Contractor shall review the position and alignment of cast-in items prior to grouting. Where the Civil Contractor is to grout in cast-in pipework items the Civil Contractor will give a minimum of 2 weeks' notice to the Electro-Mechanical Contractor before grouting into position to allow for the above checks to be carried out.

2.6 Corrosion Protection

The Contractor should take note of the effluent quality. The latest water sampling tests results are presented in Volume 1 – C4.3.

2.6.1 Hot-Dip Galvanized Coatings

All carbon steel pipes and specials as part of this contract shall be hot dip galvanized. Items to be hot-dip galvanized shall be hot-dip galvanized in accordance with the requirements of SANS 32:1997; the galvanizing shall be of the "heavy duty" class, with a minimum final film thickness of 150 microns. Where grit blasting is required to obtain this film thickness it shall be a done.

All welded articles shall be seal welded before galvanizing.

The Contractor shall handle, store and install all hot-dip galvanized items with great care to avoid

damage to their protective coatings. Should any damage be caused to the protective coatings the Contractor shall remedy such damage at his own expense. Such repairs shall comply with the requirements of SANS 121 and shall be by means of twin-pack zinc-rich epoxy repair coatings approved by the Hot Dip Galvanizers Association of South Africa unless otherwise approved by the Engineer.

If, in the opinion of the Engineer, any damage to the protective coatings cannot be remedied effectively by the above procedure than the item(s) will be re-hot dip galvanized at the Contractor's expense.

2.6.2 Protection of Other Surfaces

All machined and polished surfaces, including shafting, shall be given 1 coat of high-quality rust preventative compound before dispatch from the place of manufacture. Should any machined steel component, including bearing surfaces of shafting, show any signs of corrosion or of pitting, the same shall be rejected and shall be replaced by new components at the cost of the Contractor.

Prior to dispatch, the manufacturer shall paint bearing housings, gearbox casings, electric motor housings, etc., with heat resistant enamel (100°C). Upon completion of the installation, a finishing coat compatible with the heat resistant enamel shall be applied to a colour scheme to be approved by the Engineer or the Employer's colour coding system.

2.7 Equipment and Pipe Marking and colour coding

Colour coding shall comply with SANS 10140 Part 1, Part 2 and Part 3.

All exposed mild steel and PVC pipework above ground, in buildings and in chambers shall be colour coded with a suitable polyurethane paint along its full length.

Suitable compatible primers shall be used under the colour coding paint.

All stainless-steel pipework shall be marked with self-adhesive coloured bands of not less than 400mm width. Bands shall be placed at all junctions and on both sides of all valves. All straight pieces of pipe shall include at least one colour band. The space between colour bands shall not be more than 4 metres. Self-adhesive bands shall be made of fade proof plasticised PVC at least 100µm thick.

Colour coding of pipework and equipment shall be as per the Employer's colour coding schedule "Paint Colours and Codes for Wastewater Treatment Works.

All pipework shall be marked with flow direction arrows.

3 STRUCTURAL STEELWORKS

3.1 General

All structural steelwork, materials, welding and workmanship shall comply with the following:

- The contractor shall provide a quality assurance plan for approval by the Engineer before any manufacturing commences, indicating all hold points and inspections required by the Engineer, the Employer, as well as internal and external inspectors.
- Connections shall be designed to transmit the loadings specified, but where a connection is detailed on the drawing it shall be adhered to.
- All welded joints shall be fully continuous on all sides to prevent access of moisture. Welding shall be carried out in such a sequence as to minimize distortion.
- Splicing of the members will not be permitted without prior consent of the Engineer.
- Samples of welding may be required by the Engineer for testing purposes. The Contractor will allowance for the cost of providing such samples in the contracted rates.
- Material or workmanship rejected by the Engineer's appointed inspector will be remedied immediately or removed from site by the Contractor at his own cost.

All structural steelworks shall comply with the City of Durban Standard Engineering Specification Part L – Structural Steelwork.

3.2 Pipe Supports and Hangers

3.2.1 General

The materials to be used for the pipe supports and hangers shall be detailed and dimensioned on the drawings and shall consist of one or more of the materials listed below.

- 350MPa Mild steel manufactured to comply with SANS 920
- 350MPa, Grade 350W structural steel manufactured to comply with SANS 1431
- ANSI Type 304L Stainless Steel
- ANSI Type 316L Stainless Steel

Mild steel structural supports shall be hot dip galvanized with minimum final thickness of 150 microns.

All pipe supports, hanger, intermediate components and structural attachments must ONLY be used to support pipe, tubing or conduit and NEVER to be used for any other purpose. All pipe supports details supplied by the Engineer are designed for stationary piping unless otherwise noted. A 4mm thick neoprene lining shall be applied around the supported pipe over the entire contact surface between the pipe and the support bracket/strap/clamp.

All footings for supports (horizontally and vertically) shall be levelled using stainless steel shims, after which the holding down bolts will be installed. The cavity between the base plate/shims and surface bed, concrete surface or masonry surface shall be filled with an approved non-shrink grout. A typical detail of the required pipe support footing shall be provided by the Engineer on request.

3.2.2 Pipe Support and Hanger Spacing

The table below is based on using straight unclad nominal bore schedule pipe with the fluid on the inside having a specific gravity of 1,35. If the pipe is required to be insulated the span must be reduced by 30% to accommodate the additional load. No allowance has been made for concentrated loads such valves or instrumentation. These should be independently supported or the support spacing reduced to minimize stresses on the pipe.

Supports shall be positioned in such a manner to allow bends to move freely for the purpose of expansion and contraction caused by thermal expansion and contraction.

Table 2: Support Spacing

Nominal Bore (mm)	Support Spacing Schedule 10 Pipe (m)	Support Spacing Schedule 40 and Schedule 80 Pipe (m)
15	1,4	1,5
20	1,6	1,8
25	2,0	2,1
40	2,4	2,7
50	2,7	3,0
80	3,2	3,6
100	3,7	4,2
150	4,7	5,2

200	5,2	5,8
250	6,1	6,7
300	6,4	7,0
>300	6.5	7.5

3.3 Pipework for Pump Suction

3.3.1 General

Pump suction pipework shall be designed in accordance with good engineering practice. The following shall be complied with:

(a) **Suction pipework shall be sized, where practical, to ensure that the flow speed is no higher than 1,5 m/s.**

(b) High points shall be avoided, and it is preferred that the pipework slopes up toward the pump.

(c) Air leaks shall be avoided / prevented.

(d) Reducers shall be of the unequal type.

(e) Reducers shall have a diametral reduction of no more than 50 mm per 300 mm length and shall have a parallel-sided length between the tapered portion and each flange.

(f) “Lobster-back bends” shall have a minimum of five segments. The segments welded to the pipe flanges shall be perpendicular those flanges.

(g) Flow straighteners shall be provided where specified in the Detailed Mechanical Specification.

(h) Strainers shall be provided where specified in the Detailed Mechanical Specification.

3.3.2 Bell-Mouths

All pump suction piping which draws the pumped liquid from open sumps shall be provided with bell-mouth inlets. The bell-mouth shall have an integral flange and shall be bolted to a flange on the suction pipework. The preferred material for the bell-mouth is glass-fiber or stainless steel 316L, however cast iron suitably coated, may be acceptable.

4 VALVES, SLUICE GATES AND PENSTOCKS

4.1 General

All valves shall be rated to 10 bar unless otherwise specified.

The Contractor should take note of the effluent quality. The latest water sampling tests results are presented in Volume 1 – C4.3.

All valves, meters, strainers and flexible couplings of mild steel, cast iron or SG iron, shall be lined with Pipe Tank 8800 (or equal approved) and coated externally with Sigmaguard 720 and Sigmadur 550 (or equal approved coating system).

Surface preparation and application of lining and coating to be done to manufacturers’ specifications.

Any site repairs to damaged coatings and linings shall be done with a compatible repair epoxy approved by the manufacturer and shall have a thickness equal to or greater than the original coating or lining.

The Engineer reserves the right to test the dry film thickness of the coatings using a Magnet Flux type

gauge. For this purpose, an appropriate size piece of metal of composition and thickness the same as that of any component of the supplied plant is to be supplied, for the calibration of the gauge, and the test will be conducted in accordance with SANS 2808: Paints and varnishes - Determination of film thickness.

Mild steel (in any form) studs, nuts, bolts, washers and other parts shall not be permitted.

Handwheels shall be ductile iron SG42 hand wheels, coated with primer, and painted with two coats of re-coatable polyurethane paint (matt finish) with a final film thickness of 150 microns. Colour of paint to be as per colour coding table.

4.2 Valve Specifications

The Contractor should take note of the effluent quality. The latest water sampling tests results are presented in Volume 1 – C4.3.

4.2.1 Gate Valves

Gate (or sluice) valves shall comply with the requirements of SANS 664, except where the requirements of this specification differ, and then the requirements of this specification shall rule. Gate valves shall be:

(i) Class 10 unless otherwise specified.
(ii) double-flanged.
(iii) have rising forged bronze spindles (extended to suit application),
(iv) of the outside screw type,
(v) fitted with cast iron hand wheels (if not actuated),
(vi) arranged to close clockwise,
(vii) suitable for use in sewage in a corrosive tropical climate

Gate valves shall generally be fixed with spindles vertical. If, however, the Contractor proposes to install the gate valve in other than an erect position, he shall obtain the Engineer's approval before proceeding with the installation.

4.2.2 Knife Gate Valves

Knife gate valves shall comply with the following:

(i) be of the light duty type,
(ii) have body of ductile iron SG42,
(iii) have blade of Grade 316L stainless steel,
(iv) have pillars and bridge pieces of Grade 316L stainless steel,
(v) be of the wafer type,
(vi) have body and transverse seal of nitrile rubber,
(vii) have impregnated PTFE gland packing; be clockwise closing with rising stainless-steel spindle and fitted with sliding indicators,
(viii) have a vee-notch opening for fine and accurate flow regulation where specified.

4.2.3 Diaphragm Valves

Diaphragm valves shall be of the "full bore" type and of suitable pressure rating and comply with the following:

(i) body to be high-grade cast-iron grade 220 to BS 1452,
(ii) bonnet, compressor and hand wheel to be of high-grade cast iron grade 220 to BS 1452,
(iii) diaphragm shall be of a suitable rubber,
(iv) be clockwise closing with rising brass spindle and spindle nut,
(v) be double-flanged

4.2.4 Ball Valves

Ball valves shall be of the "full bore" type and of suitable pressure rating and comply with the following:

(i) Valve body - hot pressed brass OT 58.
(ii) Ball - hard chrome-plated hot pressed brass OT 58.
(iii) Seal - Teflon (P.T.F.E.).
(iv) Stem - hot pressed brass OT 58.
(v) Stem seal - hot pressed brass OT 58.
(vi) "O" ring - Teflon (P.T.F.E.).
(vii) Handle - aluminium.
(viii) Temperature range - 0 to 100°C.
(ix) Threaded connections - but making allowance for ease of removal from pipework.

4.2.5 Butterfly Valves

Butterfly valves shall comply with the following:

(i) Have a wafer type body with flat faces.
(ii) Body to be of cast iron or ductile iron.
(iii) Shafts to be of stainless steel.
(iv) Disc to be of ductile iron or stainless steel.
(v) Have liners, O-rings, seat rings and other materials that are suitable for use in temperatures up to 130°C (continuous).

4.2.5 Reflux valves

Reflux valves shall comply with the following:

(i) Be suitable for use in sewage in a corrosive tropical climate.
(ii) Be of Class 10 and comply with SANS 144.
(iii) Be of the single tongue type and so designed as to allow full flow area during normal working.
(iv) The design shall allow easy access to the floor and insides for cleaning and maintenance without the removal or disturbance of any piping.
(v) Have extended hinge pins fitted with an outside lever and weight so as to close the valve immediately the flow ceases, thereby eliminating slamming.
(vi) Body, cover, door and hinge shall be of cast iron to SANS 1034, Grade 250.
(vii) Valve trim shall be either type B (gun metal) or type C (stainless steel).
(viii) Hinge pin shall be of grade 304 stainless steel.
(ix) Pins, nuts, bolts, washers, screws, etc. shall be manufactured from non-corrodible materials.

4.3 Mechanical Sluice/Channel Gates, Adjustable Weirs, Hand Stops and Stop Logs

4.3.1 General

This specification covers the requirements for all sluice gates (also referred to as penstocks), hand stops and channel gates.

The design shall comply with the requirements of DIN 19704 and/or AWWA C561.

The Contractor shall submit samples of sluice gates and/or penstocks if required by the Engineer for approval.

4.3.2 Sluice Gates, Handstops and Channel Gates

4.3.2.1 General

All gates shall be of the type, size and specification as set out below and as indicated in the drawings and schedule of quantities.

They shall be of robust construction, of a reputable make, suitable for use in sewage of domestic and

industrial origin in a humid, corrosive atmosphere and designed for seating and/or unseating pressures as specified.

No mild steel components will be permitted.

The Contractor shall submit fully detailed and dimensioned shop drawings of each gate for the approval of the Engineer, prior to commencement of fabrication.

All parts shall be designed for the duty required, but the minimum factor of safety against structural failure shall not be less than 3, based on the working stress of the material. In the design, due consideration shall be given to the thickness of materials regarding corrosion and operating conditions. The force required at a hand wheel or crank to raise a gate or open a valve shall be in the order of 100 Newton, and the design parameters must be submitted in the Technical Schedule.

Sluice/channel gates, adjustable weirs, hand stops and stop logs shall be so transported, stored and handled as to prevent damage. Equipment damaged in any way shall be removed from the site repaired or replaced to the satisfaction of the engineer.

The Contractor shall satisfy the Engineer as to the sufficiency of the place of manufacture regarding manufacturing, testing and inspection equipment to ensure that the production of equipment is strictly in accordance with the specification.

4.3.2.2 Sluice and channel gates gate Frames and Wedges

The gates and frames shall be of 316L stainless steel. Frames shall either be surface mounted, or slot mounted as indicated on the drawings.

Joint faces shall be watertight and formed by neoprene seals with HDPE faces. Individual adjustment of all wedges will be required.

Alternative materials for gates and seals will be considered but full details, drawings and costs must be submitted with the completed tender.

The sliding frames, floor seats and gates of wall mounted as well as channel type gates with head frame shall be made of grade 316L stainless steel or as specified. All gates shall be well guided with no possibility of jamming. The gates shall be held uniformly against the side facings of the frames by the action of adjustable wedges and shall provide drop-tight closure under the operating conditions. Sluice gates shall be of the standard or flush invert type fitted with renewable seals of a non-biodegradable material on the invert.

Channel gates shall be dimensioned such that their installation in the channels and openings shown on the drawings is facilitated. The channel gates shall be standard items and shall be installed so that head frames shall be flush with vertical channel walls and do not project horizontally into the channel. Vertical sliding frames and floor seat to be cast into concrete so as to leave an unobstructed waterway to dimensions indicated in the schedule. Pre-formed recess details for casting in of frames to be submitted by the supplier. Head frame bridge for a channel gate to allow indicated water level to pass under the gate when in UP-position.

Gates shall be robustly designed and constructed, having vertical and horizontal ribs to withstand pressures from both directions. The matching head frame for channel gates shall be adequately designed to resist distortion, and both the gate and the frame shall have machined seating faces to ensure perfect sealing. The head frame shall extend above the concrete channel, to support the gate in the fully open position.

4.3.2.3 Head Stocks & Handwheels

Penstocks and sluice gates shall be either actuated or manually operated as specified on the drawings. Actuators shall be measured separately. Where actuators are to be used the mounting requirements of the actuator shall be considered in the design of the frame or pedestal.

Handwheels shall be mounted in an accessible position either directly on the headframe or on a tubular pedestal. Bevel gearboxes shall be included where required.

The headstocks and pedestal shall be of the pillar tubular type, suitable for motorised operation where applicable. The pillar, footplate and all brackets shall be manufactured from 316L stainless steel.

Hand wheels shall be of SG cast iron or fabricated stainless steel. Handwheels and gearboxes shall be sized so that the maximum torque applied to operate the gate shall not exceed 130Nm. Handwheel diameter shall not exceed 400mm unless approved by the Engineer.

Twin lifting spindles with interconnected gearboxes will be provided if necessary for wide gates.

Where headframes are required, these shall preferably be separate bolt-on frames rather than integral to the frame design.

4.3.2.4 Spindles

The spindles shall be manufactured from stainless steel and the spindle nuts and guides are to be made from LG2 Bronze. The spindles shall be fitted with a bronze threaded stop collar to limit stroke.

Spindles shall be of the rising spindle type and, unless otherwise specified, shall be arranged to open with clockwise rotation of the hand-wheel. The spindles shall be machined from solid bar, 316L stainless-steel, and are to be twin start, with sufficient bronze spindle guide brackets evenly placed along the spindle length. The spindle shall be made of a suitable diameter to resist buckling or bending under operating conditions.

Rising spindles shall be provided with clear uPVC cover tubes unless otherwise indicated on the drawings.

Spindles to be extended as required and secured to structure to Engineer's approval.

Arrows shall be cast on all hand wheels together with the wording "OPEN" or "CLOSE". The closing direction shall be clockwise unless otherwise specified.

Gates shall be fitted with position indicators. Fully closed, fully open and intermediate positions shall be indicated in corrosive proof and robust design indicators.

On rectangular penstocks with openings in excess of 0,84m², a ball thrust bearing shall be fitted beneath the spindle collar to ensure easy rotation of the hand-wheel.

4.3.2.5 Bolts and Brackets

Penstocks and sluice gates shall be supplied complete with all necessary fixing and jacking bolts and brackets. All fasteners, anchors and accessories shall be stainless steel.

4.3.2.6 Handstops

Hand stops and frames shall be fabricated from stainless steel 304L.

Hand stops shall be either surface mounted or slot mounted as indicated on the drawings.

All hand stops shall be of the sealing type with neoprene angle-type seals fitted.

4.3.2.7 Installation

All gates and stops shall be installed strictly in accordance with the manufacturer's specifications and every precaution taken against any twisting or distorting of the frames during installation.

The maximum gate deflection shall not be greater than 1 mm under full unbalanced pressure.

Non-shrink grout shall be used to seal the frame of surface-mounted gates and channel mounted gates.

4.3.2.8 Leakage

The design pressure for the sluice/channel gates, adjustable weirs, hand stops and stop logs is to

ensure no leaking, or a maximum leakage of 1.24 L/min/m (according to AWWA C501), under the operational conditions.

Leakage testing shall be done on the maximum unbalanced pressures on either face. No leakage between the frame and the structure shall be permitted

4.3.2.9 Guarantee

All sluice/channel gates, adjustable weirs, hand stops and stop logs shall be guaranteed against faulty design, materials, and workmanship until the end of the maintenance period on the Main Contract. During this period the Contractor shall be required to attend to and rectify any defects, which occur due to faulty design, materials, or workmanship at his own cost.

4.3.2.10 Operating and Maintenance Manuals

A copy of the Operating and Maintenance Manuals for each equipment type shall be bound in with the Operating and Maintenance Manual for the project. The manual shall be A4 size and properly bound. Drawings larger than A3 size shall be contained in separate plastic pockets. The entire as-built pack should be as follows:

There should be Five hard cover books with glossy pages with the following information:

1) Final design report (civil, mechanical and electrical)
2) Control Narrative of Electrical and Mechanical
3) All electrical, instrumentation schematics and mechanical drawings
4) All certifications test reports , calibration certs etc
5) Pictures of the newly installed equipment

4.3.2.11 Factory Test Certificate

A copy of the signed factory test certificate shall be bound in with the manual, while the original shall be handed to the Engineer. It shall include the following:

(i) Operating instructions.
(ii) Maintenance instructions.
(iii) Lubrication instructions.
(iv) Spare parts list.
(v) Drawings.
(vi) Brochures.

4.3.2.12 Jointing Material

Jointing material shall comply with SANS 1700. Sluice/channel gates, adjustable weirs, hand stops and stop logs shall be supplied complete with bolts, nuts, washers (2 per bolt) and gaskets for joining up to adjacent mating flanges and or concrete mounting.

Bolts shall be of stainless steel and shall be long enough to allow at least two screw threads to protrude from the nut when the assembly is fully tightened. A washer must be provided both under the bolt head and the nut.

4.3.2.13 Contact Between Dissimilar Metals

When flanges of dissimilar metals are bolted together, the internal epoxy coating shall cover the contact area of the flange without any break.

Suitable insulation material shall be used between the contact faces of dissimilar metals of which the potential difference exceeds 0,3 V. Where corrodible metal is welded to a corrosion resistant metal, the protection coating specified shall overlap onto the latter by at least 5 mm.

Table 3: Sluice gate Details

Sluice Gate no.	Location	Type	Opening/ Gate size (w x h) mm	Invert to platform/ top	Max head when closed	Seating	Handwheel above platform/ wall	Operation
1	Inlet to Sump No.1	Penstock (Wall Mounted)	1 100 x 1 100	7 000	7 000	Off	900	Electrical Actuated
2	Inlet to Sump No.2	Penstock (Wall Mounted)	1 100 x 1 100	7 000	7 000	Off	900	Electrical Actuated
3	Connection between Sump No.1 and 2	Penstock (Wall Mounted)	1 100 x 1 100	7 000	7 000	Off	900	Electrical Actuated

5. ELECTRICAL ACTUATORS

Electric actuators shall be specifically matched to the design duty. Actuators providing modulating duties shall be specifically designed for continuous modulation.

The actuator motor and gearbox shall form one integrated unit. Motors shall be for three phases, 400 Volt, 50 Hz supply, shall be no less than Class H and shall have an embedded thermostat for overload protection. The complete unit, including installation work, glands and controls shall be ingress protected to IP 68 unless otherwise specified.

If the opening or closing period is specified in the detailed Particular Specification (e.g., to avoid water hammer) this period shall be achieved, without pulsing, by incorporating a suitable gear ratio to allow the motor to operate from fully open to fully closed without stop/starts.

For open/shut duties, the continuous actuator torque rating shall be at least 200 % of the start-opening or shut-off torque, whichever is higher, specified by the valve manufacturer for this application (after the gearbox mechanical advantage has been considered). For modulation duties, the continuous actuator torque rating shall be at least 400 %.

All components of the drive shall be designed to prevent backlash.

Electric actuators shall incorporate the following features:

(a) hand operated gearwheel override operation incorporating open/close direction indication.
(b) visual valve position indication at the unit.
(c) the terminal compartment shall be separately sealed from the internal electronics and mechanisms.
(d) the actuator shall initiate a trip if: 1) it does not succeed in moving the valve within a suitable period, 2) the motor windings overheat.

Where specified in the Detailed Mechanical Specification, the following shall be provided:

(e) the actuator shall provide an impact effect to overcome: 1) tightly seated valves,2) an unintended loss of movement.

(f) the following information shall be fed back to the control panel or, if applicable, the SCADA system: 1) valve position, 2) torque on output shaft.

(g) it shall be possible to configure the control instructions and interrogate the actuator status without removing covers.

6 MECHANICAL – REFURBISHEMENT OF VALVES, PIPEWORK AND PENSTOCKS

6.1 Scope

6.1.1 Application

This specification covers the refurbishment of valves, penstocks, and short lengths of pipe, complete with ancillary works for the transport of water and wastewater under working pressures up to 2.5Mpa.

6.2 References

The interpretation clause of SANS 1200L: Medium Pressure Pipelines and the interpretation clauses in the applicable standards listed below, shall apply:

SANS 664	Cast iron gate valves for water works
SANS 1123	Steel pipe flanges
API 621	Reconditioning of Metallic Gate, Globe and Check Valves
SANS 10257	Reconditioning of valves for use with pipelines

When reference is made to a code, specification or standard, the reference shall be taken to mean the latest edition of the code, specification or standard.

6.3 Plant

The Contractor shall supply all equipment needed for handling, removal, and loading of all valves, pipework and penstocks. Because shutdown periods result in supply downtime and are critical for the client, backup equipment such as generators, cutting torches, welding equipment and any other tools or plant critical to the operation shall be on site prior to commencing with the work and this is to be included / stated as a hold point in the quality management plan by the Contractor. All dimensions will be verified as part of a pre-shutdown procedure unless this is not possible before shutdown.

6.4 Inspections

6.4.1 General

All refurbishments and repairs shall commence with a visual inspection of the equipment. The Contractor shall thereafter follow the procedure outlined in this specification to identify and execute the most appropriate method of refurbishment. The Contractor shall also adhere to the following points:

- The Contractor shall supply all equipment needed for off-loading, handling, and removal and installing of valves, pipes, penstocks, and all other equipment covered by this specification.
- Valves, pipes, penstocks shall be removed, dismantled, inspected, refurbished, tested, and installed by experienced and competent coded pipe fitters and coded welders.
- Any equipment showing cracks, blowholes, broken flanges, or other defects shall be set aside and the Engineer called upon to determine whether it must be repaired or replaced, all at the Contractor's expense and this is to be taken into consideration in the costing by the Contractor.
- All material shall, before installation, be checked to ensure that it is in good order and condition and each item must be thoroughly cleaned inside and outside
- On completion the site shall be cleaned of all surplus materials and debris and left in a clean and tidy condition.
- The contractor shall maintain a detailed photo collection of all aspects of the works. The photo collection shall be submitted at progress meetings in an electronic format. No additional

payment shall be made for this instruction, it is accepted that the Contractor has made provision for it in the Preliminary and General items in the document.

6.4.2 Removal of Valves, Pipes and Penstocks,

6.4.2.1 General

The contractor shall make necessary arrangements for a shutdown in accordance with the approved Method Statement and Request for Shut Down as set up in conjunction with the client as detailed in the Project Specifications.

The Contractor shall supply all equipment needed for handling, removal, loading, installing, and testing the valves, pipes, fittings or specials. As shutdown periods result in supply downtime and are critical for the client, backup equipment such as generators, cutting torches, welding equipment and any other tools or plant deemed critical to the operation shall be on site prior to commencing with the work and this must be included as an inspection hold point in the quality management system. All dimensions will be verified as part of a pre-shutdown procedure, unless otherwise agreed in writing.

The Contractor shall, once the items are removed, make all necessary measurements as required for in the event of a new item (valve, pipe, penstock) being ordered. When ordering new equipment, the Contractor shall ensure that the correct sizes and flange details are given to the selected supplier.

Prior to removing any valves, pipes, or penstocks; the contractor shall ensure that he has sufficient blank flanges, gaskets, seals, and all necessary items in hand available to temporally blank off the pipework in such a manner to allow the normal operation of the works. This shall also be applicable as a backup in the event of the removed valve been replaced by a new valve.

6.4.2.2 Cataloguing of Equipment

All valves, pipes and penstocks that are removed shall be catalogued in detail prior to leaving the site. The catalogue shall include detailed photos of the valve from all sides. This catalogue shall be submitted to the Engineer within one week after removal of the valve.

6.4.2.3 Access in Low Level Effluent Pump Station

The contractor is to note that certain valves, pipes, and specials located in the low-level pump station are difficult to access and remove. The removal of such items will generally require the removal of adjacent items. All items will either require replacement or refurbishment. The contractor is to consider and allow for this in his approach and planning of refurbishment of specific items.

6.4.3 Dismantling of Valves, Pipes, Penstocks, Fittings and Specials

On instruction from the Engineer, identified valves, pipes, fittings, specials shall be dismantled and inspected by the Contractor in the company of the Engineer or his Representative to determine the following:

- The cause of any mal operation of the valve or penstock.
- Whether any parts are missing or whether any parts need repair or replacement.
- Whether on-site refurbishment will be adequate to reinstate the valve to a fully operational condition.
- A record of inspection of valve shall be kept by the Contractor. The condition of all parts that may have to be replaced or reconditioned shall also be recorded.
- All parts of the dismantled valve or penstock shall be marked to facilitate identification and proper storage.

- After assessment of the repairs necessary and the costs, the Engineer shall decide whether the valve, pipe or penstock shall be reconditioned on-site, or shall require re-fitting and/or machining and testing in a workshop or should be scrapped.
- Should the valve or special require refitting/machining in a workshop, or if it has to be scrapped, the Contractor shall obtain authorization from the Employer prior to taking the valve or special off-site. This may be facilitated though the authority vested in the Engineer's representative on site.
- Where a decision is taken to recondition a valve, the reconditioning shall be undertaken by the Contractor off site, unless specified otherwise or agreed to by the Engineer.
- The Contractors Quality Management System will be set up as to account for the options above (repair, refurbish, replace).

6.4.5 Transportation of Valves, Pipes, and Penstocks

- The Contractor shall transport the valves and ancillaries to a pre-approved workshop for further dismantling, inspection, and possible refurbishment. Every valve shall have its components labelled/marked to prevent delays in refurbishment activities. The valve workshop shall keep adequately detailed internal records for each valve which shall be the basis for payment. Once refurbished, the Contractor shall transport the valve back to the site. Included as transportation, the contractor shall make provision for all loading operations, fuel, wear on the vehicle and all related labour costs.
- The condition of all valves shall be documented prior to and after transportation. The contractor shall provide safe and secure transportation of all valves; in the event of any damages, the Contractor shall be liable for the costs. He is further required to provide sufficient insurance to cover the costs replacing the valves in the event of damage, theft or any other potential losses.
- The Contractor shall determine whether any parts are missing or whether any parts need repair or replacement.
- A record of inspection of unit shall be kept by the Contractor. The condition of all parts that may have to be replaced or reconditioned shall also be recorded.
- After assessment of the repairs necessary and the costs, the Engineer shall decide whether the unit shall be reconditioned on-site or shall require re-fitting and/or machining in a workshop or should be scrapped. All valves will be tested.
- Should the unit require refitting/machining in a workshop, or if it has to be scrapped, the Contractor shall obtain authorization from the Employer's Representative prior to taking any equipment off-site.
- Satisfactory temporary end covers shall be provided to protect threads, flanges and prepared ends of all fittings from damage during transportation and handling on site.
- All fittings shall be so transported, stored and handled as to prevent damage. Fittings damaged in any way shall be removed from the Site and replaced by the Contractor at his own expense.

6.4.5 Inspection of Valves, Pipes, and Penstocks

The inspection and cleaning shall cover the following points:

- The Engineer shall be given at least two working days' notice for the inspection. The Contractor shall accompany the Engineer during the inspection.
- During the inspection the unit shall be opened and closed to test for functionality
- (Valves) Inspect the wall of the bonnet and body for any reduction of thickness. Obvious reduction of the wall thickness (in excess of 10%) shall be cause for rejection of the valve body or bonnet.
- (Applicable to wedge gate valves). Inspect the wedge gate seating. Seats and guides in good condition shall be cleaned and re-finished by hand sanding only.

- The Contractor is to arrange for access to the penstocks and sluice gates for inspection and refurbishment.
- The Contractor shall, in the company of the Engineer, determine the cause of any mal operation of the sluice gate, penstock or valve.
- The Contractor shall assess the repairs necessary and the determine the associated costs, this shall be compiled in a report which shall be reviewed by the Engineer and form the basis of the Engineers decision on whether to refurbish or scrap the valve.
- Should the valve, penstock, pipe or special require refitting/machining in a workshop, or if it has to be scrapped, the Contractor shall obtain authorization from the Employer prior to taking the valve or special off-site. This may be facilitated though the authority vested in the Engineer's representative on site.

6.4.6 Salvaging of Valves, Pipes, Fittings, Penstocks and Specials

- All valves, pipes, fittings, specials removed from within the Southern Wastewater Treatment works site shall remain the property of eThekwini Water and Sanitation unit.
- Should a decision be made that the items be scrapped, the valve shall be returned the eThekwini Water and Sanitation unit to a premises within a 30km distance from the Southern Works. This location shall be confirmed by the Employer.

6.4.7 Reporting

The Contractor shall compile a report on the condition of the valve, pipe or penstock which has been assessed for refurbishment. The report shall summarize the results of all tests and inspections carried out. The report shall be submitted to the Engineer within 5 working days of the assessment. The Engineer shall use the report as the basis for deciding of whether to refurbish the valve, pipe, fitting, special, penstock or whether to scrap it and replace with a new valve, pipe, penstock, fitting or special.

A separate report shall be compiled for each item assessed for refurbishment.

Each report shall comprise of the following:

- Type of valve / pipe / fitting / penstock / special
- Manufacturer Name, Model Name, Model Number, Date of Manufacture
- Body material, grade, pressure rating (if applicable).
- Dimensions of valve / pipe / fitting / penstock presented in a neat sketch, accompanied by photographs.
- Details of flange sizes, drilling patterns, flange types.
- Detailed description and photographs of any defects in the coating and lining.
- Detailed description of any structural defects to the valve / pipe / penstock
- List of all damaged and missing parts.
- Itemized description of all actions required for the complete refurbishment of the valve, including a list of all new parts required.
- Name of Third-party inspector (where applicable)
- Cost of full refurbishment with an itemized breakdown of the costs.
- Estimate of lead time required for refurbishment.
- Cost of replacement.
- Estimate of lead time required for replacement.
- Availability of replacement valve / pipe / fitting / penstock / special.

Based on the effort, cost and time required for complete refurbishment, the Engineer shall decide on where to refurbish the valve / pipe / penstock / fitting or special or replace.

6.5 Refurbishments

All renovations or repairs to valves shall be done according to the requirements of ISO 9002 and SANS 10257.

6.5.1 General

- Valves, Pipes, Fittings and Specials shall be refurbished to meet with the relevant technical specification and an approved Quality Control Plan (QCP) with 3rd party independent intervention points.
- The Contractor, as part of his methodology statement, shall provide full details of the proposed team who will be responsible for the refurbishment.

6.5.2 Valve Reconditioning:

- The Contractor shall open up, expose, dismantle, and abrasive blast the valve in preparation for the inspection of the valve.
- Areas to be repaired by welding shall first be ground and / or machined to sound metal.
- Check the spindle for straightness and cracks using dye penetrant. Spindles showing cracks or marks of overstressing or otherwise deemed unsuitable and not complying with the valve manufacturer's standards shall be replaced.
- Reconditioned valves shall be tested to open and close freely when operated by a single operator. Wedge gate seating must be checked for standard or fit by using marking chalk.
- Hand sanding shall only be used to improve the seating of a wedge gate. Within a prescribed limit.
- Any damaged or missing parts shall be replaced.

6.5.2 Corrosion Protection

- Valves shall be repainted externally and internally, taking care not to impair the valves' functionality.
- Valves, Pipes, Penstocks, fittings, and specials shall be cleaned internally and externally by power-assisted hand tools to remove loose rust, scale and paint, and using solvents to remove grease.
- Valve bodies shall be painted internally with one coat of Copon JH21 high coat epoxy coating or similar approved, taking care not to coat wedge gate seats and guides. Externally valves shall be coated with a coat of calcium plumbate primer and one coat of grey or blue high build, chlorinated rubber paint.
- All other pipes, fittings and specials shall, unless otherwise specified, be coated with a suitable two-pack epoxy coating to 300µm DFT.
- Corrosion protection is to be include inspection testing (SA2.5 blasting, DFT testing).

6.5.3 Final Inspection

The Contractor shall make necessary arrangements for the Engineer to inspect the valves, pipes, fittings, or specials upon arrival on site, and prior to installation.

All material shall, before installation, be checked to ensure that it is in good order and condition and each item must be thoroughly cleaned inside and outside. Any equipment showing cracks, blowholes, broken flanges or other defects shall be set aside and the Engineer called upon to determine whether it is to be repaired or replaced, all at the Contractor's expense.

6.5.5 Metal Seated Gate Valves

Refurbishment of gate valves shall cover the following:

- The preparation of a detailed QCP, and submission to the Engineer for approval and including all hold points prior to commencement of work.
- The gaining of access to valves in dry well of low-level pump station.
- The verification of all the existing pipework and components of the installation, including verification of the components' dimensions, pressure ratings, fittings, and valve's details. This shall be discussed and confirmed with the Engineer prior to any refurbishments take place.
- The proving and fixing a temporary blind flange with gasket bolts, nuts and washers were necessary.
- The removal of the gate valve, site storage, handling and transport to a pre-approved workshop.
- In the event of a new valve being ordered while the old valve is removed, make all necessary measurements for the new installation.
- The cataloguing of the valve in detail, including photographs of the valve from all sides.
- The dismantling of the valve.
- The removal and disposal of old packing, gaskets and bonnet bolting.
- Immediately after disassembly, the valves identification number shall be stamped onto the valve's closure element, stem/shaft, seat rings if removed, and any other major part as per *API RP621*.
- The cleaning of the valve (abrasive shot blasting (if necessary), chipping with hammer to remove rust, thorough hand wire-brushing to remove loose scale and old coatings). Finished surfaces that may be damaged during the cleaning process shall be protected. The cleaning process shall remove all, or nearly all paint, grease, rust and product from both internal and external surfaces.
- The inspection and repair or replacement (if necessary) of the following items (where applicable): valve stem, valve bonnet, wedge or disc, valve seat rings, stem nut retainer, stem nut, stem nut housing, back seat bushing, bonnet stuffing box, yoke and all threaded parts in accordance with *API RP621*.
- The replacement of seals, gaskets, gland packing and all fasteners. Sources of the replacement parts preferably purchased from the original equipment manufacturer.
- The inspection and repair or replacement (if necessary) of hand-wheel nut in accordance with *API RP621 Clause 6.3*.
- The inspection and repair or replacement (if necessary) of hand-wheel in accordance with *API RP621 Clause 6.4*.
- The repairs to coating and lining – recoat inner and outer surfaces with suitable rapid curing two-pack epoxy to 300µm DFT.
- The oiling and greasing of moving parts.
- The pressure testing of valves to 1.25x working pressure. The Engineer is to be present for the pressure testing and shall inspect the valve prior to re-installation on site. Given the age of the valves, the leak tolerance shall be 150ml per 60 minutes at test pressure.
- Re-installation.
- The tightening up of glands.
- Commissioning and.
- Everything necessary to complete installation and make valve functional as per drawings and specification.

6.5.6 Butterfly Valves

Refurbishment of gate valves shall cover the following:

- The preparation of a detailed QCP, and submission to the Engineer for approval and insertion of all intervention points prior to commencement of work.
- Gaining access to the valve.
- verification of all the existing pipework and components of the installation, including verification of the components' dimensions, pressure ratings, fittings, and valve's details. To be discussed and confirmed with the Engineer prior to any refurbishments take place.
- The proving and fixing a temporary blind flange with gasket bolts, nuts and washers, unless deemed unnecessary.
- The removal of the butterfly valve, site storage, handling and transport. If possible, the refurbishment of the valve is to be conducted on site.
- In the event of a new valve being ordered while the old valve is removed, make all necessary measurements for the new installation.
- All jointing materials.
- The cataloguing of the valve in detail, including photographs of the valve from all sides.
- The dismantling of the valve.
- The removal and disposal of old packing and gaskets.
- Immediately after disassembly, the valves identification number shall be stamped onto the valve's closure element, stem/shaft, seat rings if removed, and any other major part as per *API RP621*.
- The cleaning of the valve (abrasive shot blasting, chipping with hammer to remove rust, thorough hand wire-brushing to remove loose scale and old coatings). Finished surfaces that may be damaged during the cleaning process shall be protected. The cleaning process shall remove all, or nearly all paint, grease, rust and product from both internal and external surfaces.
- The inspection and repair or replacement (if necessary) of the following items (where applicable): valve stem, valve disk, valve seats, stem nut retainer, stem nut, stem nut housing, back seat bushing, gearbox and all threaded parts in accordance with *API Std 609 (1997)*.
- The replacement of seals, gaskets, gland packing and all fasteners. Sources of the replacement parts preferably purchased from the original equipment manufacturer.
- For inspection and repair or replacement (if necessary) of hand-wheel nut in accordance with *API RP621 Clause 6.3*.
- The inspection and repair or replacement (if necessary) of hand-wheel in accordance with *API RP621 Clause 6.4*.
- The repairs to coating and lining – recoat inner and outer surfaces with suitable rapid curing two-pack epoxy to 300µm DFT.
- The coating of exposed flanges and fasteners with *DENSO profiling mastic* and wrapping with *DENSO Petrolatum Tape* (only where necessary and agreed by Engineer and where not included in any other payment item)
- The oiling and greasing of moving parts.
- The pressure testing of valves to 1.5x working pressure and leak tests (at 1.1x WP) to be performed on the valve seat for 3 minutes. The Engineer is to be present for the pressure testing and shall inspect the valve prior to re-installation on site. For re-installation. Leakage tolerance shall be 150ml per 60 minutes at test pressure
- Re-installation.
- The tightening up of glands.
- The commissioning and.
- Everything necessary to complete installation and make valve functional as per drawings and specification.

6.5.7 Resilient Seal Gate Valves

Refurbishment of gate valves shall cover the following:

- The gaining access to manholes at where refurbishments to such RSV's are required.
- The verification of all the existing pipework and components of the installation, including verification of the components' dimensions, pressure ratings, fittings, and valve's details. To be discussed and confirmed with the engineer prior to any refurbishments take place.
- The proving and fixing a temporary blind flange with gasket bolts, nuts and washers, unless deemed unnecessary. Note that the RSV's are not anticipated to exceed 150mm in nominal bore diameter. All flanges and drillings to SANS1123 table 16 unless otherwise specified in drawings.
- The removal of the RSV, site storage, handling and transport. If possible, the refurbishment of the valve is to be conducted on site.
- While the valve is removed, make all necessary measurements required for in the event of a new valve being ordered.
- All jointing materials.
- The cataloguing of the valve in detail, including photographs of the valve from all sides.
- The dismantling of the valve.
- The removal and disposal of old packing and gaskets.
- The cleaning of the valve as the condition dictates (hand wire-brushing to remove loose scale and old coatings). Finished surfaces that may be damaged during the cleaning process shall be protected. The cleaning process shall remove all, or nearly all paint, grease, rust and product from both internal and external surfaces.
- The replacement of seals, gaskets, gland packing and all fasteners. Sources of the replacement parts preferably purchased from the original equipment manufacturer.
- The repairs to coating and lining – recoat inner and outer surfaces with rapid curing two-pack epoxy to 300µm DFT.
- The coating of exposed flanges and fasteners with *DENSO profiling mastic* and wrapping with *DENSO Petrolatum Tape* (only where necessary and agreed by Engineer and where not included in any other payment item)
- The oiling and greasing of moving parts.
- The pressure testing of valves to 1.5x working pressure and leak tests (at 1.1x WP) to be performed on the valve seat for 3 minutes. The Engineer is to be present for the pressure testing and shall inspect the valve prior to re-installation on site. For re-installation.
- Re-installation.
- Tightening up of glands.
- Commissioning and.
- Everything necessary to complete installation and make valve functional as per drawings and specification.

6.5.8 Swing-Type Wafer Check Valves

Refurbishment of swing-type wafer check valves shall cover the following:

- The preparation of a detailed QCP, and submission to the Engineer for approval and including all hold points prior to commencement of work.
- The gaining access to valves in dry well of low-level pump station.
- The verification of all the existing pipework and components of the installation, including verification of the components' dimensions, pressure ratings, fittings, and valve's details. To be discussed and confirmed with the engineer prior to any refurbishments take place.

- The removal of the check valve, site storage, handling and transport to a pre-approved workshop.
- In the event of a new valve being ordered while the old valve is removed, make all necessary measurements for the new installation.
- The cataloguing of the valve in detail, including photographs of the valve from all sides.
- The dismantling of the valve.
- The removal and disposal of old packing, gaskets, and springs.
- Immediately after disassembly, the valves identification number shall be stamped onto the valve's closure element, stem/shaft, seat rings if removed, and any other major part as per *API RP621*.
- The cleaning of the valve (abrasive shot blasting (if necessary), chipping with hammer to remove rust, thorough hand wire-brushing to remove loose scale and old coatings). Finished surfaces that may be damaged during the cleaning process shall be protected. The cleaning process shall remove all, or nearly all paint, grease, rust and product from both internal and external surfaces.
- The inspection and repair or replacement (if necessary) of the following items (where applicable): valve stem, disc, valve seat rings, stem nut retainer, stem nut, stem nut housing, back seat bushing, stuffing box, yoke and all threaded parts in accordance with *API RP621*.
- The replacement of seals, gaskets, springs, gland packing and all fasteners. Sources of the replacement parts preferably purchased from the original equipment manufacturer.
- The inspection and repair or replacement (if necessary) of for repairs to coating and lining – recoat inner and outer surfaces with suitable rapid curing two-pack epoxy to 300µm DFT.
- The oiling and greasing of moving parts.
- The pressure testing of valves to 1.25x working pressure. The Engineer is to be present for the pressure testing and shall inspect the valve prior to re-installation on site. Leakage tolerance to 150ml per 60 minutes at test pressure.
- Re-installation.
- Tightening up of glands.
- Commissioning and.
- Everything necessary to complete installation and make valve functional as per drawings and specification.

6.5.9 Refurbishment of Pipes, Fittings and Specials (Short Pipe Runs)

Short Pipe Runs shall be measured per unit of installation refurbished (i.e. per item). This shall be the sum of the costs of each item refurbished in the chamber. Such items shall include (but are not limited to): refurbishments to spool pieces, exposed flanges, bends, laterals, tees, and (where necessary) the replacement of items where refurbishment is unfeasible.

The refurbishments of pipes, fittings, specials and short runs shall be held to include for the following:

- The preparation of a detailed QCP, and submission to the Engineer for approval and insertion of all intervention points prior to commencement of work.
- The gaining of access to location where refurbishments to pipes, fittings and specials are required.
- The removal of the pipe, fitting or special; site storage, handling and transport to a pre-approved workshop (whichever applicable).
- The verification of all the existing pipework and components of the installation, including verification of the components' dimensions, pressure ratings, fittings, and items details. To be discussed and confirmed with the Engineer prior to any refurbishments taking place.
- In the event of a new item being ordered while the old item is removed, make all necessary measurements for the new installation.

- For proving and fixing a temporary blind flange with gasket bolts, nuts and washers, unless deemed unnecessary. All flanges and drillings to SANS1123 table 16 unless otherwise specified in drawings or schedule of quantities All fasteners to be Stainless Steel 316.
- For disassembly of all the installation (including removal of all valves, flanges, gaskets, fasteners, gearboxes, and all other pieces) fastened to the pipe, special or fitting. Pieces are to be temporarily stored in a secure manner while refurbishments are performed.
- For cleaning of pipe, fitting or special, including abrasive shot blasting, chipping with hammer to remove rust, removal of internal linings (if present), thorough wire-brushing to remove loose scale and old coatings). The cleaning process shall remove all paint, grease, rust and products from both internal and external surfaces.
- Repairs to coating of pipe, fitting or specials – recoat inner and outer surfaces with suitable two-pack epoxy coating to 300µm DFT (or otherwise as directed in the drawings and schedule of quantities).
- For installation of pipe, fitting or special.

6.5.10 Refurbishment of Sluice Gates and Penstocks

The cleaning and refurbishment shall cover the following points:

- Penstocks and Sluice gates shall be refurbished to meet with the relevant technical specification and an approved Quality Control Plan (QCP) with third party independent or Engineers intervention points.
- The Contractor, as part of his method statement, shall provide full details of the proposed team who will be responsible for the refurbishment.

Sluice gate and penstock reconditioning:

- The Contractor shall open up, expose and dismantle the unit.
- The frame of the sluice gate shall be inspected for damage, corrosion and distortion.
- Stainless steel members shall be hand sanded with a fine sandpaper to remove surface corrosion if present.
- The condition of the following components shall be inspected: spindle, shaft, spindle nut, gearbox, hand wheel, bearings and the gate. Where necessary components shall be reconditioned or replaced.
- All replacement parts shall be either Grade 304L stainless steel (or higher quality) or closely grained cast iron to BS grade 14 (min).
- No mild steel parts shall be accepted.
- The seals of the sluice gate shall be replaced with neoprene seals and or riveted brass strips cushioned on cork. No leakage through seals of the refurbished unit shall be permitted.
- Check the spindle for straightness and cracks using dye penetrant. Spindles showing cracks or marks of overstressing or otherwise deemed unsuitable and shall be replaced.
- Reconditioned sluice gates and penstocks shall be tested to open and close freely when operated by a single operator.
- All replacement fixing and jacking bolts, nuts and washers shall be grade 304 stainless steel.
- All grouted areas shall be inspected for leakage and or deterioration. Where necessary the Contractor shall be repair / re-grout.

Refurbishment of sluice gates and penstocks shall cover the following:

- The preparation of a detailed QCP, and submission to the Engineer for approval and including all hold points prior to commencement of work.
- The gaining of access to the unit.
- The verification of all details of the installation, including verification of the components' dimensions.

- The removal of any components, site storage, handling and transport to a pre-approved workshop.
- In the event of a unit being ordered while the old valve is removed, make all necessary measurements for the new installation.
- The dismantling of any components
- The removal and disposal of old seals, bolting and any other component requiring removal and disposal.
- The cleaning and refurbishment of all components as detailed in the specification above.
- The inspection and repair or replacement (if necessary) of the following items (where applicable): spindle, stem, gate, bearings, spindle nut retainer, gear box, hand wheel, and all parts as described in the specification above.
- The replacement of seals, gaskets, and all fasteners.
- The repairs to coating and linings.
- The oiling and greasing of moving parts.
- The leak testing of the unit.
- The re-installation.
- The re-grouting where necessary.
- The commissioning and.
- Everything necessary to complete installation and make the unit functional as per the specification.

6.6 Replacements of Valves, Pipes, Penstocks, Fittings and Specials

6.6.1 Supply of New Valves, Pipes, Fittings, Sluice Gates Pen Stocks and Specials

If during the inspection it is decided by the Engineer that a valve requires replacement, the Contractor shall do the following:

- The Contractor shall make immediate arrangements to order the new item and to manufacture any fittings that may be required.
- The Contractor shall supply all equipment needed for off-loading, handling, removal and installation.
- All valves to be replaced shall be purchased by an approved valves' supplier. The contractor shall enter into his own contract with the supplier. The basis of this contract shall be provided to the contractor prior to commencement of the works but will be based on the General Conditions of Contract relevant to this project.
- Valves, pipes, fittings and specials purchased shall meet with the relevant technical specifications in Section 4 of this specifications, and an approved QCP with intervention points of the Engineer and independent 3rd party inspector. It can be expected that the Engineer will do random quality inspections on an ad-hoc basis during the fabrication process. The contractor shall ensure that the Engineer has unrestricted access to during normal working hours for this purpose. The contractor shall make necessary arrangements for the Engineer to inspect the items.
- All new items shall be inspected upon arrival on site, and prior to installation. Should there be any defects in the new valve; the elected Supplier will be responsible for the replacement of that item at his own costs. The supplier shall be responsible for all transportation costs including sufficient insurance to cover the costs replacing the items in the event of damage, theft or any other potential losses.

6.6.2 Cast Iron Pipes, Fittings and Specials

Shall be replaced with equivalent steel pipes, fittings and specials where cast iron items cannot be sourced. The steel item shall be fabricated such that it is compatible with all adjacent cast

iron items. Flanges (where applicable) shall be drilled to match adjacent flanges.

6.7 Installation

6.7.1 General

The Contractor shall adhere to the following:

- When installed, all items shall be placed accurately to line and level and neatly finished off in a workmanlike manner. Spanners used to loosen and tighten bolts shall only be set spanners of the correct sizes.
- Drift pins, jacking equipment and the like shall not be used to bring improperly fabricated members into place. A moderate degree of cutting and reaming may be employed to correct minor misfits only if, in the opinion of the Engineer, this will not be detrimental to the appearance or strength of the equipment
- All made-up steel sections and items to be installed in lines shall have an approved corrosion protection system applied. Where welding has been done on existing steel pipes, epoxy repair coatings shall be done using a suitable fast-curing (2 hours or less) two-pack epoxy (or similar approved) of minimum thickness 300 microns in accordance with the manufacturer's specification, before re-commissioning of the line/s, and taking adequate curing time into account, including curing times between application of consecutive paint layers.
- On re-assembly, the following items shall be replaced with new materials complying with the specification of the original manufacturer:
    (i) All bolts and nuts, which shall be stainless steel 304
    (ii) Spindle nut and gate nuts. (valves)
    (iii) Removable spindle thrust collars. (valves)
    (iv) Gland packing. (valves)
    (v) Resilient seals. (valves)
    (vi) Gaskets.
- On completion the site shall be cleaned of all surplus materials and debris and left in a clean and tidy condition.

6.8 Testing

6.8.1 General

Valves, pipes, penstocks, fittings and specials shall be tested both in the workshop and in situ following refurbishment. All testing shall be performed in using equipment supplied by the Contractor.

6.8.2 Hydrostatic Testing

All valves, pipes, fittings and specials shall be hydrostatic tested following refurbishment and prior to despatch back to site. The test shall be witnessed by the Engineer.

6.8.3 Site Testing

On completion of the installation of all refurbished valves and pipework, the Contractor will be required to make appropriate arrangements, and supply any necessary instruments or apparatus, etc., for the testing of all valves, pipework, fittings and specials, in the presence of the Engineer's representative in order to demonstrate compliance with the requirements of the specification. The Engineer may require valid calibration certificates to be submitted to cover any meters, gauges, or other instruments used in the test and may, if considered necessary, arrange for the use of additional meters or other instruments in order to establish the degree of accuracy of the tests.

6.9 Guarantee

Notwithstanding the requirements of the Conditions of Contract, the Contractor shall guarantee all valves, pipes and penstocks supplied by him and installed under this contract for a period of 5 years.

The guarantee shall include any latent defects in the plant, equipment, fittings and installation thereof and any labour or other costs inherent in repairing any defect and ensuring that the plant, equipment and fittings remain free of defects and in good working order to the satisfaction of the Engineer.

Fair wear and tear shall not be considered as requiring any action by the Contractor under the requirements of the contractual guarantee. It shall be clearly stated in written format by the Contractor which portion of work is constituted to fear wear and tear.

Inspection of the plant shall be made by the Contractor in the presence of the Council's Staff, at suitable intervals, to confirm that the plant is operating in a satisfactory manner. The Contractor shall make sufficient allowance for these visits in the tender and shall nominate the suitably qualified person in the tender document. After each visit a written report must be submitted within 7 working days of the last day of the site visit.

Provision, as required, shall be made in the contract rates, or elsewhere, for any additional cost incurred in providing this contractual guarantee.

7 BOLTS, NUTS, WASHERS AND ISOLATION KITS

Class 8.8 Bolts and nuts in their respective sizes shall comply in all respects with SANS 1700 for ISO metric precision hexagon head bolts, screws and nuts. Allen head screws of any type shall not be used without the Engineer’s written consent.

Fasteners shall be the sizes shown on the drawings, or as approved.

Washers of similar material to the bolts shall be provided under each nut and setscrew head. Multiple washers or shims shall not be used. Spring washers or other approved lock arrangement shall be used on all fasteners subject to vibration and approval by the Engineer. It is good practice to use “through hardened” washers.

The bolts and nuts shall be fitted with a flat washer under the bolt head and a further flat washer under the nut. Bolt lengths shall be such that when in position and fitted with one washer under both nut and head, not less than 3mm or more than 6mm of thread protrudes from the nuts.

Bolts, nuts and washers for structural mild steel/mild steel shall be of mild steel and shall be hot dip galvanised to SANS 1700-5-18 with reference to SANS 121.

Under no circumstance shall zinc or cadmium electroplated fasteners be acceptable on any equipment, structures or pipework.

Bolts, nuts and washers for use with stainless steel shall be of Grade 316L stainless steel.

For stainless steel connections to mild steel, grade 316L stainless steel nuts, bolts and washers shall be used with an isolation kit that is to be approved by the engineer. Preference will be given to Tufnol washers with fibreglass sleeves. Gaskets shall be reinforced rubber inserts 3mm thick cut to full depth of the flange.

The threads of all Stainless-Steel bolts shall be coated with Nickel Anti-Seize compound or a similar approved release paste prior to fastening. The release paste shall be water resistant with no more than 40% petroleum oil and meet Mil Spec. A.907D.

The Contractor shall note:

Copper-based compounds are not acceptable and, if used, shall be cleaned off before correct compound is applied.

If it is found during inspection that compound has not been applied, the Contractor shall disassemble all fasteners and comply with this requirement.

A small amount of compound shall be applied along the full length of the thread before the nut is applied. Excessive compound visible on the thread after the nut has been applied shall be cleaned off.

After installation, the exposed surfaces of bolts not made of grade 304 stainless steel shall be coated as for the items being fastened. If the use of Allen head or similar fasteners has been approved by the Engineer, the recessed heads shall be filled with a suitable non-hardening sealing compound.

Anchor bolts shall be installed in accordance with BS 5080: Part 1: 1974 and the type of fixing bolt the Contractor proposes to use shall be submitted to the Engineer for approval. All anchor fasteners shall be of grade 304 stainless steel. Anchor fasteners for water retaining structures and for brickwork shall be of the chemical anchor fastening type. Anchor fasteners for other applications may be of the expanding type or chemical anchor type. Anchors shall be so located away from the edge of concrete to minimize the risk of cracking. The minimum edge distance for anchors in concrete shall be 70mm.

Where machinery is anchored by studs or bolts which extend through the supporting structure and is therefore fastened down with the use of nuts from both sides, these, together with associated washers and brackets, shall also be of grade 316 stainless steel.

8 REDUNDANT EQUIPMENT

Existing redundant mechanical and electrical equipment for removal shall be indicated by the Engineer on site, in specifications or on drawings.

Potentially energised equipment to be removed shall first be made safe and confirmed as isolated/locked-out if required.

Equipment shall be cleaned before transport. Cleaning shall typically be by pressure cleaning.

Equipment shall be disposed of as described in the Project Specification.

PROJECT SPECIFICATIONS: MECHANICAL: LOW LEVEL PUMPSET INSTALLATION

Contents

PROJECT SPECIFICATIONS: MECHANICAL: LOW LEVEL PUMPSET INSTALLATION

1 SCOPE

This specification covers aspects of mechanical works pertaining to the design, supply and installation of upgrades to the low-level pumps and pipework in the Low-Level Effluent Pump Station. The following aspects of these works are covered in the sections which follow:

i) Scope of Works for Low Level Pump Station

ii) Final Effluent Discharge System Description

iii) Current and Proposed System Operation

v) Designs by Contractor

vi) Low Level Pumps

vii) Bypass and Tie-ins

viii) Timelines and Milestones

ix) Ancillaries

x) Commissioning and Testing

1.1 Scope of Works for Low Level Pump set Installation:

The Electro-Mechanical Contractor shall be responsible for the following activities pertaining to the Low-Level Effluent Pump Station:

1.1.1 Primary Activities

- Contractor's Mechanical Design Report and Presentation
- Design, submission of shop drawings, fabrication, and delivery to site of 2 No. new vertically mounted, direct coupled end suction centrifugal, solids handling pumps, with Cardan (extended) shafts, 3.3 kV motors and ancillary equipment
- Design, submission of shop drawings, fabrication, and delivery to site of 2 No. new immersible type pumps, installed in a dry-well, with free-flow channel type impellers, with 3.3 kV motors and ancillary equipment
- Design, submission of shop drawings, fabrication and delivery to site of complete pipework, specials, valves, bends, couplings, pipe supports, plinths and thrust blocks for all 4 No. pumps
- The refurbishment of, penstocks, valves, specials and pipe support by the Contractor.
- Design, submission of shop drawings, fabrication, and delivery to site of 4 No. new immersible sewage type, solids handling centrifugal pumps and associated electrics for drainage of the sumps.
- Design, submission of shop drawings, fabrication, and delivery to site of 1 No. new immersible sewage type, solids handling centrifugal pumps and associated electrics for drainage of the sumps.
- The execution of tie-ins
- Decommissioning and Removal of redundant pumps, valves, pipework, couplings and ancillary items.

1.1.2 Supporting Activities Covered in this Specification

- Refurbishment of Penstocks (3 No.) for sumps No.1 and No.2.

1.1.3 Supporting Activities Covered Elsewhere

- Design, Supply, Installation and Commissioning of new MV switchgear.
- Design and construction of new Transformer yard.
- Design, Supply, Installation and Commissioning of new Transformers.
- Design, Supply, Installation and Commissioning of new LV switchgear.
- Design, Supply, Installation and Commissioning of new Control Systems and instrumentation
- Decommissioning and Removal of Existing Transformers.
- Decommissioning and Removal of Existing MV switchgear
- Decommissioning and Removal of Existing LV switchgear
- Decommissioning and Removal of Existing Control Systems (PLC).
- Design, Supply, Installation and Commissioning of new Overhead Travelling Crane and Ancillaries
- Supply, Routing, and Installation of all MV, LV, Instrument Cabling and Terminations, including special racking arrangements to supply low level pump sets.
- Supply, Installation and Commissioning of Cable Trays
- Earthing
- Design, Supply, installation and commissioning of forced ventilation system for low level effluent pump station.
- Upgrading of auxiliary power systems and lighting for low level pump station.
- Removal of redundant equipment.
- Diversion of existing services where necessary.
- Protection of existing services where necessary.

1.2 Final Effluent Discharge System Description

The Low-Level Effluent Pump Station is located at the southern boundary of the works near the entrance on Travancore Road. The purpose of the pump station is to empty the low-level storage tanks which are used to attenuate peak flows. The pump station discharges effluent into the two landlines of the Southern Outfall.

Effluent is discharged from the Works via an elevated concrete channel which runs along the western boundary of the site. The channel discharges effluent into a buried pipe in the vicinity of the pump station. The buried pipe bifurcates into two pipelines which run parallel to the Stanvac canal and converge on the beach to form the Southern Outfall pipeline. The Southern Outfall discharges effluent approximately 4,000m out at sea via 33 diffusers. The system works by gravity. During peak flows the capacity of the outfall is exceeded and excess effluent is diverted into the low-level storage tanks. These are low level storage tanks No.1, No.2 and No.3.

The low-level pumps draw effluent from the storage tanks via two sumps, Sump No. 1 and Sump No. 2. The operation of the pumps is currently controlled by the level of low-level storage tank 1. There are two delivery pipelines from the pump station. These pipes discharge into the two pipelines running parallel to the Stanvac Canal. The tie-in points are two elevated inverted siphons. A non-return valve upstream of the two pipelines prevents the pumps from discharging back up the channel and into the low-level system.

1.3 Battery Limits “Pump Set”

1.3.1 General

The low-level pumps shall be replaced under this Contract. The size and model of replacement pump is not yet certain and shall be proposed by the Tenderer. The design and supply pipework, valves, and ancillaries between the battery limits have been made the responsibility of the Electro-Mechanical Contractor.

1.3.2 Definition of Battery Limits

Reference is made to the “Battery Limits” between which the Contractor is responsible for the design and construction of pumps, pipework, valves, and ancillaries.

The battery limits are defined from the flange of the suction bend to the flange of the gate valve on the delivery side. The battery limits furthermore include the suction bends and bell-mouths in Sumps No. 1 and 2.

1.3.3 Scope of Contractor’s Design Responsibility within Battery Limit

The scope of the Contractor’s design responsibility for items within the defined battery limits are as follows:

- Design and Selection of vertically mounted, direct coupled end suction centrifugal, solids handling pumps driven by direct coupled 3.3 kV MV electrical motors (2 No) and Accessories
- Design and Selection of immersible type pumps, installed in a dry well, capable of handling solids driven by direct coupled 3.3 kV MV electrical motors (2 No) and Accessories
- Design, submission of shop drawings, fabrication, and delivery to site of complete pipework, specials, valves, bends, couplings, pipe supports, plinths and thrust blocks for all 4 No. pumps. All piping shall be 314L Stainless Steel.
- Design, selection, supply, installation of new swing arm with weight non-return valves (4 No).
- Design, selection, supply, installation of new Rising spindle wedge/knife gate valves (12 No)
- Design of reinforced concrete plinths to support pumps and all unbalanced hydraulic loads for all pump sets
- Design of mounting / alignment special to align the new pipework with the intake nozzle for all pump sets.
- Design of all couplings necessary.
- Design of all necessary pipe supports and restraints for delivery pipework.
- The design of re-alignments to the discharge pipework for the pump sets.

The Electro-Mechanical contractor’s designs shall be subject to the approval of the Engineer.

All Contractor designs shall include quality control plans and shop drawings. These shall be subject to the approval of the Engineer.

All Contractor designs above shall be performed and approved by competent registered professionals accredited by the Engineering Council of South Africa.

1.4 Low-Level Pump Station Operation

1.4 1 Current Operating Cycles

The Low-Level Effluent Pump Station is currently operated to empty the low-level storage tanks of attenuated effluent from daily peak flows and wet weather peak flows. The current triggers for the operation are:

- Level of Low-Level Storage Tank No. 1 exceeds 75%
- Manually triggered by Operators to empty low level tanks at night. This is to limit the generation of unpleasant odours.

The Low-Level Effluent Pump Station generally starts up once a day and operates for a few hours to empty low level tank No. 1. During wet weather peaks the pump station will start up multiple times and operate over longer periods to empty both low level storage tank (No. 1 and 3).

Ordinarily the low-level effluent discharge system operates by gravity.

1.4.2 Shutdowns

The system configuration allows flexibility to shut down components without compromising effluent discharge. The Contractor will be required to shut down the low-level pump station, sump 1, sump 2, and low-level tank 1 at specific stages of the contract. The table below details the actions required for the isolation of specific components of the low-level discharge system:

Table 4 : Low-Level Pump Station Operation

Component Shutdown	Methodology to maintain effluent discharge		Time (average flow conditions)	Approvals Required
Low Level Pump Station	Discharge effluent by gravity	while attenuating excess effluent in low level tanks	<18-24 hours (dependant on catchment. Less in wet weather, more in dry weather)	Engineer & Works Superintendent
	Discharge effluent by gravity	while overflowing excess effluent onto beach	>18-24 hours	Not Permitted
Sea Outfall Pipeline	Attenuate effluent in low level tanks		Limited, uncertain.	Engineer & Works Superintendent
	Attenuate effluent in Low level tanks	and overflowing excess effluent onto beach	Unlimited	Not Permitted
Low Level Sump 1	Low level pump station / gravity	isolate Sump 1 and low-level pumps 1 & 2. Attenuate in low level tanks 1 & 3	Unlimited	Engineer & Works Superintendent
Low Level Sump 2	Low level pump station / gravity	isolate Sump 1 and low-level pumps 1 & 2. Attenuate in low level tanks 1 & 3	Unlimited	Engineer & Works Superintendent
Low Level Tank 1	Low level pump station / gravity	while using the penstock to tank No.3 and the interconnector pipe. Isolate tank 1 connection to sumps 1 & 2	Unlimited	Engineer & Works Superintendent
Low Level Tank 3	Low level pump station / gravity	while avoiding wet weather peak flows	Unlimited except for Wet Weather Peaks	Engineer & Works Superintendent

1.4 3 Proposed Operating Cycles

The low-level effluent pump station shall continue to operate in the manner which it currently operates. It shall be used to empty the low-level tanks of attenuated effluent from daily peak flows and wet weather flows. The primary method of effluent disposal shall be by gravity flow through the sea outfall.

The frequency of use of the pump station is not anticipated to change.

The start-up triggers shall be amended to the following:

- Level of Low-Level Storage Tank No. 1 exceeds 75%
- At 19h00 every day
- Manually triggered by Operators to empty low level tanks when required.

2 DESIGN OF SYSTEM COMPONENTS

2.1 Requirements of System

There are currently 4 pumps operating in the low-level pump station. Three of the pumps are the original Allen Gwynnes model 24“VS vertical turbine pumps installed in the dry well in the 1970‘s. The pumps are driven by line shafts from 6.6kV 10-pole motors mounted on the ground floor level. There were 3 pumps installed in a 2 duty: 1 standby configuration. The pumps ordinally pumped to the nearby high level storage tank from where effluent was discharged through the sea outfall by gravity. This scheme was abandoned, and the pump station was connected directly to the sea outfall.

A fourth pump was installed in the wet well in the 1990’s. This is the existing Wilo EMU pump model FA 60.83-605 V.

The 4 pumps currently operate on a 2 duty: 2 standby configuration. Operation is restricted to 2 duty pumps. A single duty pump is incompatible with system hydraulic curves.

The new configuration shall match the existing configuration. All new pumps will be installed in the dry-well in the positions currently occupied by the Allen Gwynnes pumps and the delivery pipework of the EMU pump.

The new pumps shall be vertically mounted, direct coupled end suction centrifugal, solids handling pumps driven by direct coupled 3.3 kV MV electrical motors (2 No) and 2 No. new immersible type pumps, installed in a dry-well, with free-flow channel type impellers, with 3.3 kV motors and ancillary equipment.

The ideal pump requirements are summarized in the table below:

Table 5 : Pump Requirements

Description	Design Values
Min. Target Flow Range	1.5 to 1.8 m^3/s
Max. Target Flow Range	2.5 to 3.0 m^3/s
Min. Pump Flow Range (per pump)	0.75 to 0.9 m^3/s
Max. Pump Flow Range (per pump)	1.25 to 1.5 m^3/s
No. of duty pumps	2 or possibly 3 & 4
Pumping Hours	As required depending on inflow

***** The Contractor should take note of the effluent quality. The latest water sampling tests results are presented in Volume 1 – C4.3.

3. DESIGN INFORMATION

A system hydraulic model was based on the sea outfall system curve provided by EWS at inception of the project, anticipated system conditions and practical design properties of the system.

There is currently uncertainty about the system curves. This contract has been approached with the view to validate the system curves by installing a temporary flow meter on the beach pipeline. Until a validation is done, the accuracy of the system curves will remain uncertain.

The hydraulic characteristics of the system are highly dependent on the condition of the diffusers of the Southern Outfall. Diffusers periodically become blocked due to the presence of solids in the effluent. The system is restricted when the diffusers block. The hydraulic system curves become steeper as more energy (head) is required to maintain a certain flow rate.

The performance of the low-level pumps is influenced by several factors:

- Hydraulic roughness of Southern Outfall.
- Tide Levels.
- Sump Levels.
- Condition of Southern Outfall diffusers

The pump system is made up of the following pipe sections:

- The pump suction pipe work, 750mmϕ (steel), 3.0m long, two pump pipelines in parallel.
- The pump delivery pipe work, 600mmϕ (steel),10.m long, two pump pipelines in parallel.
- The delivery header pipe work, 1300mmϕ (steel), 40.3m long, two header pipelines in parallel.
- The delivery syphon and NRV pipe work, 900mmϕ (GRP), 11.23m long, two pipelines in parallel.
- The 1st rising main section pipe work, 900mmϕ (GRP), 409.04m long, two pipelines in parallel.
- The 2nd rising main section pipe work, 920mmϕ (HDPE), 310.68m long, two pipelines in parallel.
- The sea rising main section pipe work, 1300mmϕ (steel), 3877.94m long, single pipeline.
- The 1st diffuser section pipe work, 1300mmϕ (steel), 14.38m long, single pipeline with 7 diffusers.
- The 2nd diffuser section pipe work, 1100mmϕ (steel), 17.63m long, single pipeline with 9 diffusers.
- The 3rd diffuser section pipe work, 900mmϕ (steel), 27.64m long, single pipeline with 17 diffusers.

The following graph shows the system curves.

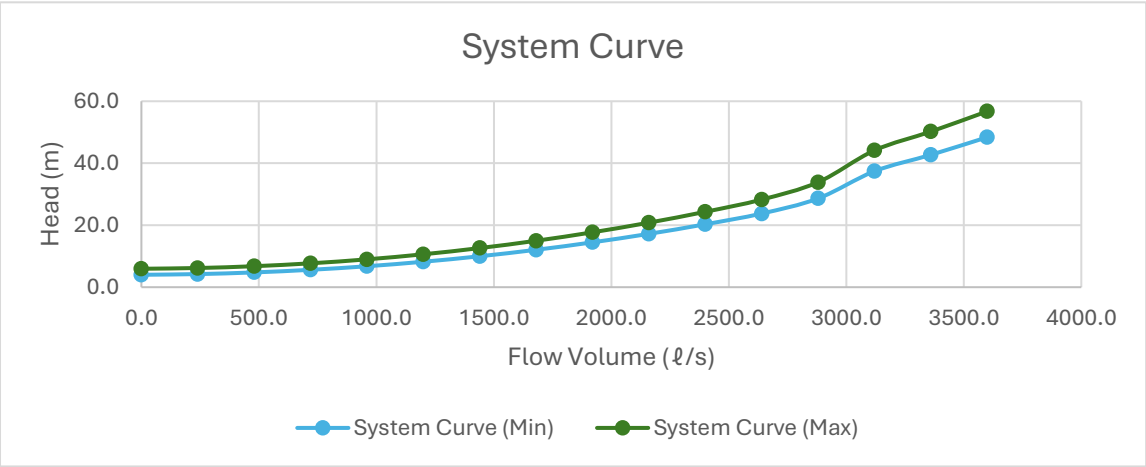

Figure 1: System Curve

Table 6 : System Curve data

Flow	0.0	240.0	480.0	720.0	960.0	1200.0	1440.0	1680.0	1920.0	2160.0	2400.0	2640.0	2880.0	3120.0	3360.0	3600.0
Head (Min)	4.0	4.2	4.8	5.6	6.8	8.2	10.0	12.1	14.5	17.2	20.3	23.8	28.6	37.4	42.7	48.4
Head (Max)	6.0	6.2	6.8	7.7	9.0	10.6	12.6	15.0	17.7	20.8	24.3	28.3	33.9	44.1	50.2	56.7

4. OPERATION & CONTROL PHILOSOPHY

The pump station will operate for short durations to empty low level storage tanks No. 1, 2 and 3. Two pumps shall be operated in parallel (one from each sump). Depending on the pump specification, wither a single or two pumps in parallel shall operate simultaneously. As main duty a single pump operating shall not be preferable, and 3 or more pumps in parallel will not be permitted.

The operation of the pumps shall be controlled by a PLC with the provision for manual operation.

The PLC shall favour the parallel operation of two pumps drawing from different sumps. Only when one of the sumps is isolated will the two pumps draw from the same sump.

The pumps shall start as a result of the following triggers:

i. Sump No. 1 and / or Sump No. 2 reaches 75% of its maximum level.

ii. Daily at 19:00.

iii. Manual start-up induced by operator.

iv. The total discharge from the pump station shall be limited to a flow of between 750-900 ℓ/s at a head of 10.5 m to 13 m.

The pumps shall stop as a result of the following triggers:

i. The level of Sump No. 1 and / or Sump No.2 is empty. (set point to be confirmed)

ii. Daily at 04:00, regardless of sump level

iii. Manual shut down induced by operator.

iv. As a result of a trip alarm.

All instrumentation on the pumps shall be trended for continuous condition monitoring.

The level-based trigger shall be controlled by the output of two ultrasonic level sensors, one installed in each sump. The output of both sensors shall be monitored by the PLC and averaged. Should a sump be isolated and drained, the PLC shall detect the difference in level between Sump No. 1 and Sump No. 2 and disallow the operation of pumps drawing from the empty sump. Alternatively, the pumps operating off the isolated sump shall be placed in emergency-stop mode to prevent PLC triggered start-up.

4.1 NPSH Design / Suction Design

The new low-level pumps selected by the Contractor shall be suited to the net positive suction head available and the suction regime of the intakes in sumps No. 1 and 2.

The Contractor shall confirm the lowest sump level at which his selected pump sets can safely operate.

Pump Suction Mounting Special

The Engineer recommends the use of a pump suction mounting special to align the horizontal suction pipework with the vertically mounted pump intake port. There are pump manufacturers which can provide such a mounting at a competitive price with the pump-set. Such a mounting should also minimize suction losses and improve flow distribution at the pump intake port.

The use of short radius bends at pump intakes is strongly advised against. The Contractor is referred to

ANSI/HI 9.8-2012 for supporting commentary.

5 DESIGN PRESENTATION

5.1 Contractor's Design Presentation

The Contractor shall present all design items listed in 1.4.3 Scope of Contractor's Design Responsibility within Battery Limit in a report prepared for the Engineer. The report shall be submitted to the Engineer for review. The Engineer shall review the report and provide feedback within 2 weeks of receipt of the Contractor's submission. The Engineer shall provide the Contractor opportunity to revise the design based on the Engineers review.

All designs produced by the Contractor shall be commented upon by EWS and approved by the appointed Pr Engineer prior to implementation.

A payment item is provided to produce the design report by the Contractor.

2.5.1 Contents of Design Presentation

The design presentation shall take the form of a written document produced by the Contractor. The design presentation shall include:

- Hydraulic system curve report as an appendix to the presentation.
- The proposed control philosophy for new low-level pumps
- Specifications of the proposed low-level pumps, motors and accessories, including all instruments and mountings.
- New pump curves superimposed on hydraulic system curves
- A section of report showing the new pumps are suited to the NPSH available and suction regime of the pump station.
- Shop drawings showing the new pumps and integrated with new and refurbished pipework. This shall include an itemized plan view, an itemized elevation through each pump-line, a pipe schedule for new and refurbished pipework and valves, pipe support drawings, concrete plinth drawings, drawings of the new pumps with suction mountings and all other drawings necessary to illustrate the Contractor's design. The shop drawings shall also take cognisance of the turning radii of cables feeding the pumps.
- A section of report on the new and refurbished pipework and valves between the battery limits defined in 1.4.3
- A detailed program for the procurement of the new low-level pumps, pipework, valves and the refurbishment.
- A section containing all method statements as defined in the Project Specification.
- Details of all sub-contractors and their involvement.
- Quality control plans for each aspect of the Contractor's Design.
- Testing and commissioning plans.

6 MAIN DUTY LOW-LEVEL PUMPS

6.1 General

The condition of the pump line (specifically the sea outfall portion) is unknown, and concerns about the integrity of the pipes necessitates that reduced flows be accommodated for the foreseeable future. Once the outfall pipeline has been assessed and / or replaced, the full flow required should be achieved by the pump station. The intent is therefore to supply pump sets that can accommodate pumps which can perform in the max. flow rage, but will be able to, by means of VSD and/or alternating impellors, deliver a flow in the min. flow range.

Preferably the two pumps must operate 2x in parallel. Any two pumps, two end-suction, two immersible or 1x end-suction with 1x immersible pump must be able to perform in the specified flow ranges.

This section of the specification covers the design, supply, delivery, storage, installation, testing, commissioning the low-level pumps, 2 off new vertically mounted, direct coupled end suction centrifugal, solids handling pumps driven by direct coupled 3.3 kV MV electrical motors, complete with Cardon shaft and Accessories, and 2 off new immersible type pumps, installed in a dry-well, with free-flow channel type impellers, with 3.3 kV motors and ancillary equipment, as well as their integration (including design of control philosophy) with other mechanical and electrical works for the Low-Level Effluent Pump Station.

Included in the offer (priced as a separate item in the Bill) the **OEM** must enter into an **SLA (Service Level Agreement**) with the Municipality for the maintenance of the Main Duty Pumps and Motor equipment. Refer to **SECTION 12: MAINTENANCE AND SLA** for details.

6.2 2 Off End Suction Pump Type

Furnish and install four off Vertically mounted, direct coupled end suction centrifugal, solids handling pumps driven by direct coupled 3.3 kV MV electrical motors (4 No) and Accessories. The pump casing shall be a modified concentric centerline discharge of back pull-out design. Single volute designs are acceptable if the radial loads do not exceed 3.025KN at any point on the pump curve, including shut off and they are of modified concentric design. The pumps shall be designed for continuous operating service at a minimum of 79% efficiency. The pump shall be constructed as follows to meet the intended service and shall be warranted for a period of two full years after date of shipment.

6.2.1 General.

The end suction centrifugal pump shall vertically frame style with ASTM A48 Class 30 fine Grey Iron bearing frame. The bearing frame shall be line bored for exact concentricity and be equipped with antifriction style bearings. The bearings shall be either ball or roller style properly sized to accommodate all thrusts both mechanical and hydraulic imposed upon them. The frame shall be designed for captured bearing positioning and shall not require any field axial adjustment. The bearings shall have a minimum calculated B-10 bearing life rating of hours at the stated design condition at 100,000 hours. A complete bearing life stress and loading calculation shall be provided by the pump manufacturer to illustrate compliance with this requirement. Bearing lubrication shall be grease, drains, vents or reliefs to facilitate easy relubrication in the field.

6.2.2 Casing

The pump casing shall be modified concentric centerline discharge of back pullout design. The casing shall be constructed of Ductile Iron of ASTM A536 Grade 65-45-12 with 1.5% Nicole. All casing sections shall have heavy wall thickness to provide long life under abrasive and corrosive operating conditions. All mating surfaces shall have register fits to ensure proper alignment. Piping connections shall be ANSI 125# flat face drilled flange. Flange face surface finish shall be a minimum of 250 micro-inch finish.

6.2.3 Wear ring

Impeller and Volute replaceable suction wear ring shall be provided. The ring shall be of the peripheral design requiring no axial adjustment. The ring shall be constructed of 420 Stainless Steel Heat Treated to 400-450BHN with a minimum of 50 BHN difference to prevent galling.

6.2.4 Impeller

The impeller shall be ASTM A487 / A743 Heat Treated CA6NM, 13% Chromium Stainless Steel with the three-port design, capable **of passing 114mm spherical solids**. Impellers shall have four back vanes to reduce axial thrust and lower the stuffing box pressure. The axial forces shall not exceed 5.173KN at any point on the pump curve, including shut off and they are of modified concentric design. Internal vane edges shall be well rounded to present smooth flow. Impeller shall have a straight non-tapered bore, by dynamically balanced, keyed to the shaft and further secured with a Stainless-Steel washer and a Stainless-Steel impeller lock screw. The impeller shall be fixed at location with no expected or required adjustment.

6.2.5 Mechanical Seal & stuffing box

The back plate and stuffing box shall be integrally cast from close- grained cast iron ASTM A48 Class 30 and bolted to the casing. The cavity in the cover shall be an open dished design with a minimum of six deflector vanes. The design shall allow for continuous operation without the need for external flush water or venting. Shaft sealing shall by means of a single mechanical John Crane Type 1 shaft seal with tungsten carbide seating and mating rings, 316 stainless steel construction. The design shall allow for continuous operation without the need for external flush water or venting. NB Pumps fitted with external balance lines will not be considered.

6.2.6 Shaft

The shaft shall be constructed of 17-4 PH Stainless Steel. The shaft shall be accurately machined and polished and of sufficient size to transmit full driver output without excessive flexure or stressing. Shaft deflections shall not exceed 0.1524 mm measured at end of shaft when operating at the specified design.

6.2.7 Shaft sleeve

Shaft shall be protected by a renewable shaft sleeve which extends through the stuffing box and under the gland. The sleeve shall be grooved on the inside for an O-ring to prevent leakage along the shaft and shall be positively locked to prevent rotation. The sleeve O.D. shall be a minimum of 9.525 mm over the shaft diameter and constructed of 416 Stainless Steel.

6.2.8 Gaskets

Pump gaskets shall be Teflon (PTFE). O-Rings. Pump O-rings shall be Buna- N.

A 400mm x 500” Long Radius reduction elbow ASTM A234 WPB with a minimum wall thickness of 10mm shall form part of the pump manufactures scope of supply. The pumps shall be suspended across two reinforced engineered concrete plinths by means of a sole plate. The sole plate shall be engineered and prior to commencement of the fabrication, the pump supplied shall demonstrate by means of calculations / finite element analyst suitability of the proposed sole plate. The sole plate shall form part of the pump manufactures scope of supply.

6.2.9 Testing

Each pump shall be fully tested on water before shipment. Tests shall consist of laboratory testing at shutoff and eight points over the operating range of the pump. One of the points shall be the specified primary design point. Certified test data shall include head, capacity, motor output KW, RPM, pump efficiency and be charted and graphed. All tests shall be under the direction of a registered engineer and shall be conducted in accordance with the applicable Hydraulic Institute Standards and Procedures according to Level “B.

Each pump shall be hydrostatically tested for casing integrity at 1.25 times the shut-off pressure of actual trim at operating speed before shipment. Tests shall be conducted as directed by a registered Engineer.

Each pump shall be tested for its NPSHR, when operating and in conjunction with the H/Q performance test before shipment. The test shall include ten (10) points on the test performance curve using water at ambient temperature.

6.2.10 Corrosion Protection

Although corrosion protection is not specifically detailed, all pumps shall be corrosion protected and a detailed written report on the corrosion protection offered on the pumps shall be included in any submitted tender. The Contractor should take note of the effluent quality. The latest water sampling tests results are presented in Volume 1 – C4.3.

Only high-quality centrifugal pumps and motors will be accepted. The pumps shall have a soundtrack record of performance in South Africa and is to be of a well-known and reputable make.

6.3 2 Off End Suction Pump Motors

The motors shall be of the conventional dry-wound, squirrel-cage, induction type, suitable for Direct-On-Line, starting. Insulation shall be to BS4999, **Class H**, and the electrical supply shall be 3300-volt 3 phase 50 Hertz. ***Additionally, two motors will be immersible type motors.*** Thermistors embedded in each phase of the motor windings shall detect a temperature rise above normal enabling protection against thermal overload to be affected. The motor shall be a premium efficiency motor (IE3) or higher.

The pump motor manufacturer will be supplied to the Engineer for approval. Allowance will be made for at least 12 starts and stops per hour.

The minimum design temperature of all components of the pump is 60˚C.

The motor's continuously rated power shall exceed the greater of the following:

(a) 10 % above the maximum power demand under any condition of operation for the pump, including open discharge.

(b) 20 % above the pump's maximum power demand over the full range of flow and pressure conditions anticipated in the pump installation.

Thermistors shall be embedded in each phase of the motor windings to protect against damage due to over-temperature. These should be both hard-wired to the MCC and linked to the PLC. The pump shall be tripped on detection of motor winding over-temperature.

6.3.1 Bearing Temperature Detection

The pump shall be fitted with thrust and journal bearing RTD sensors. These shall be connected to a PLC for condition monitoring. The pump shall be tripped on detection of bearing over-temperature.

6.3.2 Technical Data:

Number Of	:	2
Suction Branch Dia	:	Design by Contractor
Discharge Branch Dia	:	Design by Contractor
Pumped Fluid	:	Sea Outfall Effluent
Specific Gravity	:	1.0
Design Flow Rate	:	750-900 to 1 250-1 500 ℓ/s per pump
Total Design Head	:	Approx. 13.8 to 33.03 m
Total Design Head Range	:	To be confirmed by Contractor’s validation of VFD control.
Min Pump Efficiency	:	79%
Min Motor Efficiency	:	95%
Min Overall Pump set Efficiency	:	80%
Speed	:	4 pole or higher
Solid’s handling	:	175mm Sphere

6.3.3 Plinths and Holding down bolts

The Contractor shall confirm all plinth and holding down bolt requirements for the permanent and temporary installations.

6.3.4 Performance Curve/Data:

Two duty pumps will operate in parallel to achieve the design flow. The pumps proposed by the Contractor shall cover the full envelope of hydraulic system curves possible.

Note that the final pump curve shall be subject to the validation of the hydraulic system curve for the low-level pump station.

6.3.5 Accessories

Each pump will be provided with the following accessories:

- Pump Suction Mounting Special

Each pump shall be removable with the aid of a hoist. The hoist could be a fixed permanent hoist or a mobile hoist.

Pumps shall be supplied complete with delivery pressure gauges mounted on a tee complete with -bleed and isolating cocks.

6.3.6 Pressure Tapping Points and Gauges:

Pressure tapping points shall be provided near the suction and discharge connections of each pump. These points shall be located, where feasible, on a straight length of pipework where readings will be steady and accurate. Pressure (or suction, as applicable) gauges shall be fitted at these tapping points. Gauges shall measure gauge pressure (i.e. not absolute pressure).

Each pump shall be provided with a chromium-plated information plate securely fastened to the pump casing, clearly and indelibly marked with the following details:

a) maker's name, pump type and serial number

b) year of manufacture

c) rated duty of pump in litres per second

d) head in metres at rated duty

e) pump speed in rpm

f) mass of completely assembled pump in kg

In addition, each pump set shall be provided with a chromium-plated number plate not less than 200 mm x 200 mm square indicating "No 1", "No 2", etc, mounted in a readily visible position.

Two pump sets, pumps no. 2 and 4, shall have extended CARDAN shafts to allow the installation of the TEFC electrical motors to be mounted on the upper level of the pump station.

6.3.7 Control

Permanent Dry-well Installation:

Pump control shall be based on the level in Sumps No.1 and No.2 of the low-level pump station, as measured by ultrasonic level sensors. A low-level switch is to be installed for protection in case of ultrasonic failure.

6.4 2 Off Immersable Suction Pump Type

6.4.1 General

Immersible (Submersible) Wastewater Pump in vertical dry installation Single-stage close-coupled submersible centrifugal pump with of semi open multi vane impeller designed to transport wastewater with fibrous materials and sludge. The impeller blades shall be self-cleaning upon each rotation as they pass across a sharp relief groove in the Insert ring and shall keep the impeller blades clear of debris.

Discharge **DN 500** and inlet flange DN 600 drilled acc. EN 1092-2 tab. 8 (PN 10)

6.4.2 Duty parameters:

Liquid	:	Storm or Waste water fibrous materials and sand
Max temperature of pumped liquid	:	40 ° C

Design Flow Rate	:	750-900 to 1 250-1 500 ℓ/s per pump
Total Design Head	:	Approx. 13.8 to 33.03 m
NPSHre at duty point	:	< TBC
Max. rated speed	:	TBC rpm
Max. required power P2 at duty point	:	500 kW
Rated power P2	:	>.= 500 kW
Operating voltage	:	3.3 V 50 Hz
Starting method	:	VFD

Minimum overall efficiency at the operating point: TBC

6.5 2 Off Immersable Suction Pump Motor

The motor shall be submersible according IEC 60034 protection class IP 68, suitable for continuous operation (S1), equipped with a cooling jacket and cooled by the pumped liquid which provides sufficient cooling in an ambient temperature of 60°C (140 ° F) even if the pumped liquid reaches a temperature of 40°C (104 °F). The velocity inside the cooling jacket shall be designed to at least 0.5 m/s at all point to avoid sedimentation of particles.

Restrictions limiting the liquid temperature below 40°C (104 °F) or the use of fans or blowers are not acceptable. Motor and pump shall be designed and produced by the same manufacturer.

The pump motor shall be induction type with a squirrel cage rotor, housed in an air filled watertight chamber. The stator windings and stator leads shall be insulated with moisture resistant Class H insulation rated for 180 °C (355 degree °F). The stator shall be heat-shrink fitted into the stator housing.

The motor shall be equipped with 10 m submersible and screened cable.

The motor shall be protected by following sensors:

- 3 bi-metal Thermal switches for thermal control of the stator
- 1 PT 100 thermal sensor (RTD) to monitor the stator temperature of 1 Winding
- 1 PT 100 thermal sensor (RTD) to monitor the temperature of the main bearing
- 1 Vibration sensor to monitor vibration on 3 axes 10 – 600 Hz.
- 1 float switch in leakage chamber to monitor leakage
- 1 float switch in the terminal connection housing to monitor any leakage thru the cables and the cable entries.

The pump shall be supplied with a Pump electronic module (PEM) mounted inside the motor. The PEM shall collect, store and digitize all measurement from all sensors and shall communicate the data in a digital format via 2 control leads integral to the pump power cable to a Base unit mounted in a pump control cabinet to the Central control unit.

The signals from the sensors shall be digital and transferred by just 2 leads within the motor cable. An additional pilot cable shall not be allowed.

The PEM shall have information about the pump as well as features for startup and service support, such as:

- Pump serial number and other data plate information.
- Specific configuration of monitoring functions for the actual pump such as alarm limits, delays, reset types, etc.

- Counters by which the system can generate service reminders in accordance with the service policy specified in the pump manual.
- Operating data and alarm history to analyze the condition of the pump and enable troubleshooting and reporting.
- Accumulated running time and number of starts.
- Pump duty rate (percentage of operation).

6.5.1 Motor sealing

The cable entry shall consist of dual cylindrical elastomer sleeves, flanked by washers, all having a close tolerance fit against the cable and the cable entry. Epoxies, silicones, or other secondary sealing systems shall not be considered acceptable.

The shaft seal shall be a positively driven dual, tandem mechanical shaft seal system consisting of two seals, each having an independent spring system. The seal is in a separate lubricant chamber and is lubricated and cooled by an environmental friendly medical white oil. The lubricant chamber shall be designed to prevent overfilling and shall provide capacity for lubricant expansion. It shall have one drain and one inspection plug that are accessible from the exterior of the motor unit. The seal system shall not rely upon the pumped media for lubrication.

The seals shall require neither maintenance nor adjustment and shall be capable of operating in either clockwise or counter clockwise direction of rotation without damage or loss of seal function. The rotating inner seal ring shall have small back-swept grooves laser inscribed upon its face to act as a micro pump as it rotates, returning any fluid that should enter the dry motor chamber back into the lubricant chamber. Shaft seals without positively driven tandem mechanical seal or conventional double mechanical seals that are carried out with a common single or double spring are not accepted.

Any leakage passing the sealing shall not pass the bearings. Before it reaches the bearings, the liquid shall create an alarm via the floating leakage sensor.

Motor shall be equipped with isolated bearings for VFD operation.

Material of construction

Pump housing : EN-GJL 250

Impeller and insert ring : ASTM A487 / A743 Heat Treated CA6NM, 13% Chromium Stainless Steel

Stator housing : EN-GJL 250

Shaft : 17-4 PH Stainless Steel

Shaft seal:

- Pump side: - Corrosion resistant Tungsten carbide WCCR
- Motor side: - Corrosion resistant Tungsten carbide WCCR

All castings must be blasted before coating. All wet surfaces are to be coated with two-pack oxyrane ester Duasolid 50. The total layer thickness should be at least 120 microns. Zink dust primer shall not be used.

Performance test of 2 pump(s) shall be witnessed

Duty points shall be guaranteed either by ISO 9906 grade 1B or Hydraulic institute 11.6 grade 1B and test reports shall be delivered with the pump. The efficiency has to be reported as the total (wire-to-water) efficiency including motor losses.

6.6 Monitoring and Data logger unit

The pump manufacturer shall supply a Control system deigned to monitor and control his pumps. The

Monitoring system shall be mounted in the cabinet and contain per pump 1 Base unit acting as a gateway between the Pump and the Central Monitoring and a Central Control Unit (CU). The CU shall be able to control up to 10 Pumps.

Just 2 controls leads to the base unit (BU) shall connect each pump. The control leads shall be part of the Motor cable. An additional Pilot cable shall not be allowed.

The Base Unit (BU) shall be able to stop the pump if required via an interlocking relay and it shall provide connections for optional measuring modules such as a power meter and other I/O modules.

The central unit (CU) shall be provided for external access and information exchange with the monitoring system via one single point. The user should be able to connect to the CU via an RJ45 jack to Local PC point to point and Local area network.

A local operator panel shall be possible to connect to the CU via a separate RJ45 socket.

The CU shall have a functionality based on embedded web pages that can be used through a PC or operator panel that allows:

- Pump status overview
- Alarm management
- Analysis through trend graphs and histograms.
- External communication with any SCADA via Modbus RTU or Modbus TCP

The CU shall contain the same pump data and logged data stored in each pump electronic module for quick access and redundancy.

The system shall support the service and maintenance policy that applies to the pump by generating service reminders and graphically providing users with an overview of service status that facilitates planning of upcoming service

The Cabinet shall be equipped with HMI Touch panel for access and interaction with the Monitoring and Control system.

When a pump related alarm is generated, the system shall support the user in the form of:

- Measurement data linked to the specific alarm item for analysis.
- Text information about possible root cause errors.
- Remedial actions.

6.7 Power Analyzer

Power analyzer to monitor electrical supply quantities and transfer following data via RS-485/Modbus:

- System pump/motor current
- Individual phase pump/motor current (each of 3-phases)
- Current and Voltage imbalance
- System voltage
- Individual line voltage (each of 3-lines)
- System power and Power factor
- Energy consumption

6.8 Base Plate for vertical dry installation

Base plate for vertical dry installation on concrete base.

Drawing by the contractor Material: Mild Steel, Hot Dipped Galvanized.

6.9 Concrete Pedestals

Erection of concrete pedestal according to suppliers installation guidelines. Minimum required concrete quality: C 35/45 (DIN EN 206-1)

6.10 Inlet Elbow

Inlet elbow 90° DN 600 PN 10 with cleaning opening. Material: Stainless steel AISI 304 drilled acc. EN 1092-2 tab. 8 / ANSI B16.1-89; tab.5 *)

6.11 Suction Pipe

Suction pipe DN 600 PN 10

Material: Stainless steel AISI 304 drilled acc. EN 1092-2 tab. 8 / ANSI B16.1-89; tab.5 *)

6.12 Discharge Pipe

Discharge pipe DN 500 PN 10

Material: Stainless steel AISI 304 drilled acc. EN 1092-2 tab. 8 / ANSI B16.1-89; tab.5 *)

6.13 Submersible Cable

Submersible Cable connection box acc. IP 68

4 Cable Entry: 30 – 50 mm Material : Stainless Steel AISI 316

Model INTEX, Kohlstaedt , Richard Wöhr or equivalent

6.14 Pump Protection Instrumentation

Each of the supplied pumps must be equipped and fitted with the following protection instrumentation.

6.4.1 Temperature

a) Pump Cold Air Temperature (TT-01)

b) Pump Drive End (DE) Bearing Temperature (TT-02)

c) Pump Drive End (DE) Gland Temperature (TT-03)

d) Motor Bearing Temperature (TT-04)

e) Motor Bearing Temperature (TT-05)

f) Motor Casing Temperature (TT-06)

g) Motor Cold Air Temperature (TT-07)

h) Motor Hot Air Temperature (TT-08)

The instrument to be a compact limit switch for pump protection, active build-up compensation and flush mounted. CIP suitable, ambient temperature; -20°C to 60°C, process temperature; -20°C to 100°C, process pressure / Max. over pressure limit; Vacuum to 10 Bar, Min. conductivity of medium; 10µS/cm, Main wetted parts; 1.4571, PTFE, Process Connection; G3/4 and Communication; relay.

6.4.2 Vibration

a) Pump Drive End (DE) Vertical Vibration (VT-001)

b) Pump Drive End (DE) Horizontal Vibration (VT-002)

c) Pump Drive End (DE) Axial Vibration (VT-003)

d) Motor Drive End (DE) Vertical Vibration (VT-004)

e) Motor Drive End (DE) Horizontal Vibration (VT-005)

f) Motor Non-Drive End (NDE) Vertical Vibration (VT-006)

g) Motor Non-Drive End (NDE) Horizontal Vibration (VT-007)

Instrument to be a vibration and inclination sensor, shock and vibration sensor, with MEMS 3-axis accelerometer to monitor all accelerations and vibrations. M18 housing, Analog and Digital NO/NC output, AISI316L stainless steel housing, fully programmable in all its functions, thresholds, alarms and node addresses.

SUPPLY PROTECTION	:	Polarity reversal, transient
INDEX PROTECTION IP	:	IP67
HOUSING MATERIAL	:	AISI316L stainless steel housing
PROGRAMMABLE OPERATING RANGE	:	2g, ±4g, ±8g, ±16g
REFERENCE AXIS	:	3 (X,Y,Z)
FREQUENCY RANGE	:	0 to 400Hz
DIGITAL OUTPUT	:	1 x RS485 (addressable with max 128 nodes)
ANALOGUE OUTPUT	:	1 x analogue output (programmable voltage or current)
SUPPLY VOLTAGE		24 VDC
OPERATING RANGE		2g...16g 0...10V 4...20mA

6.4.3 Flow Switch

a) Delivery Flow Switch (FS-001)

Instrument to be a Flow / pump in-line flow switch.

DESCRIPTION	:	In-line flow switch 1 inch pipe thread
SUPPLY	:	250 VAC
MAX PRESSURE	:	8 BAR
MINIMUM FLOW	:	3 litres/ minute (maximum 90 litres / minute)
MAXIMUM TEMPERATURE	:	40°C
RELAY	:	10A 250 VAC

6.4.4 Pressure

a) Delivery Pressure (PIT-001)

Instrument capable of variety of aseptic process connections, Process temperatures up to 150 °C [302 °F], Diaphragm seal parts all welded, Suitable for SIP and CIP and Ingress protection up to IP68.

The instrument suitable for the special conditions of CIP/SIP cleaning processes, such as chemical stability

towards cleaning liquids and high temperatures.

The flush diaphragm to be directly welded to the process connection, for a crevice-free joint between the process connection and the measuring cell.

Dead-space free instrumentation, aseptic process connections; clamp, threaded, VARIINLINE® and NEUMO®.

To conform to the 3-A Sanitary Standard and must be EHEDG-certified.

Diaphragm; 1.4435 stainless steel, with flush separation of the process medium from the pressure transmitter.

Process pressure to be transmitted hydrostatically from the diaphragm, via an FDA-approved system fill fluid, to a piezoresistive sensor.

The measuring range	:	0 to 250 mbar, up to 0 to 25 bar.
Power Supply; DC voltage	:	10 (14) to 30 V.
Output signals	:	4 to 20 mA, 0 to 20 mA or 0 to 10 V.
Process temperatures	:	up to 150 °C.
Case	:	Stainless Steel, with ingress protection of up to IP68.

7 TESTING

The pumps must undergo the following Tests:

- Tightness test
- Dielectric test

The test shall be witnessed by the Engineer if the test is conducted in South Africa. Should the test not be conducted in South Africa, an internationally accredited third-party inspectorate shall witness this test.

Performance testing is required, and a Site Acceptance Test shall be conducted.

Corrosion protection shall be the responsibility of the Contractor and certification of the preparation, the painting and the finishing shall be provided to the Engineer before the pumps will be released to come to site.

In addition, the Contractor is to ensure that he plans and includes for performance testing in his costing – noting that at least one representative of the Engineer and one from the Client will attend and witness the performance testing.

8 IMMERSIBLE DRAINAGE PUMPS

8.1 Scope

This section of the Contract covers the design, supply, delivery, transport, handling, storage, erection, installation, commissioning, testing, adjustment, handing over in complete working order and upholding during the Defects Liability period of the following equipment:

- Drainage pumps for Sump (MLSS) No.1 and 2, comprising of four (4) submersible, solids handling type, centrifugal pumps, 1x duty/1x standby for Sump No.1 and 1x duty/1x standby for Sump No.2 of the low-lift pump station, hereinafter called the sump drainage pumps, complete with 316L duct foot bend, guide rails, pipework, non-return valves, isolation valves, flanged adaptors, pipe supports and ancillary equipment.
- Drainage pump for the Dy-Well (RAS), comprising of one (1) submersible, solids handling type, centrifugal pumps, 1x duty for the Dry-Well of the low-lift pump station, hereinafter called the dry-

well drainage pump complete with 316L, pipework, non-return valve, isolation valve, flanged adaptors, pipe supports and ancillary equipment.

8.2 Immersible Pumps

The pumps shall be of the submersible type with VORTEX impellers, preferably recessed, and shall be so designed as to allow the passage of solids, the size of which shall be 50 mm. Pumps with screw/centrifugal impellers and pumps fitted with cutters shall not be accepted.

Pump casings and guides, shall be made of high-grade cast iron. The impeller shall be ASTM A487 / A743 Heat Treated CA6NM, 13% Chromium Stainless Steel with the shaft from 17-4 Stainless Steel with suitable protecting sleeves. Bearings shall be waterproof and with suitable provision for proper lubrication. The rotating assembly shall be properly balanced so as not to give rise to end thrust or alternatively, suitable thrust bearings shall be provided. All parts shall be of ample dimensions and strength, properly machined and assembled to ensure perfect free running.

The pumps shall be capable of doing the required duty at a speed not exceeding 1 450 r.p.m. and shall be of the self-regulation type, the power curve being such that with an increase in rate of delivery beyond a certain figure, the power demand shall decrease, thereby protecting the electrical motor from overloading in the event of a burst occurring in the rising main, etc. The electric motors shall be sized to cope with the maximum power requirement of the associated pumps.

Performance particulars and characteristic curves shall be submitted at the time of tendering. Pumps shall be selected such that the closed valve pressure is at least 25% higher than the maximum head in the pump's operating range and the rated duty point shall preferably be to the left of the peak efficiency point on the characteristic head-capacity curve for the impeller diameter proposed.

The motors shall be sized to cope with maximum power requirements of the pumps plus an additional 15% allowance.

8.2.1 Corrosion Protection

Although corrosion protection is not specifically detailed, all pumps shall be corrosion protected and a detailed written report on the corrosion protection offered on the pumps shall be included in any submitted tender. The Contractor should take note of the effluent quality. The latest water sampling tests results are presented in Volume 1 – C4.3.

Only high-quality centrifugal pumps and motors will be accepted. The pumps shall have a soundtrack record of performance in South Africa and is to be of a well-known and reputable make.

8.2.2 Lubrication

Efficient means of lubrication shall be provided for all bearings; full details of which shall be submitted at the time of tendering.

8.2.3 Air Release

All pipework with local high points where air can be trapped shall be equipped with the necessary drains and air cocks or automatic air release equipment with pipe connections for discharging from the drains to the drainage channels or wet sumps as applicable.

8.2.4 Ancillary pump equipment and pipework for submersible pumps

The pumps shall be provided with underwater quick-release pressure couplings, suitable stainless steel (316L) vertical guide rails, block-and-tackle, and suitable A-frame gantry for lowering and raising the pumps from the back of a LDV directly into the pump sump. Flexible hoses with above-water couplings shall not be accepted.

In addition, all the necessary equipment for manual removal of and replacement of pumps for maintenance purposes, shall be supplied and installed under this section of the contract. All guide rails, duck foot bends, lifting eyes, chains, block-and-tackle etc. required for the operation of the pumps offered, are to be included in

the Contractor's supply. Gantries will be erected by the contractor under this contract.

Each pump set shall be fitted with the necessary approved pipework, calibrated glycerine filled pressure gauges suitably dampened against vibration, flexible couplings, pipe supports, bends, resilient seal gate valves and non-return valves (ball check, suitable for 10 bar pressure rating), and with suitable connections and stopcocks for fitting the necessary pressure gauges. Pressure gauges shall be supplied on the delivery side of each pump. Gauges shall be fitted with clog free in-line pressure sensors with flexible rubber sleeves of the membrane type.

Each discharge pressure gauge shall have a maximum reading of not more than twice the closed valve pressure of the pump.

Fully detailed drawings showing the proposed layout of pumps and pipework shall be submitted with the tender. The suction and delivery pipework shall terminate in a flanged pipe at a distance as shown on the drawings.

The pipework shall be of 316L stainless-steel with corrosion protection as specified and shall be flanged and drilled to SABS 1123 for a working pressure of 1 000 kPa (10 bar). Bends and branches shall provide non-turbulent flow conditions and the layout of the pipework shall be such as to facilitate dismantling and inspection. The pipes are to be properly supported and so arranged that all stresses created in the pipeline by static and dynamic forces including recoil shock, will be taken up by suitable anchors. Unless a specific size is specified, pipework shall be sized so as to limit maximum flow velocities to 1.6 metres per second, but no pipes shall have a diameter of less than 150 mm.

All suction and delivery pipework shall be provided with a flexible coupling in a convenient position to facilitate removal and reinstallation of a pump. Check valves on delivery mains shall only be used in a horizontal position.

All brackets and supports in dry well of pump stations shall be of grade 316L stainless-steel and shall be of grade 316L stainless steel in wet wells of pump stations.

8.2.5 Pressure Switches

Where pressure switches are used to protect pumps against closed or blocked lines by interrupting the supply to the motor, a pressure switch shall be mounted on the pump outlet and a vacuum switch shall be mounted on the pump inlet.

8.2.6 Pressure Gauges

A suitably rated pressure or combination pressure/suction gauge shall be installed on the suction and discharge of each pump.

8.2.7 General

The following shall be provided for each pump:

1. A suitable check valve on the discharge pipework.
2. protection against running against a closed discharge, i.e. discharge pressure switch or pressure relief valve.
3. Protection against running dry, i.e. suction pressure switch, pump stator temperature switch or low flow signal from related flow meter or no-flow switch.

8.3 Pump Duties

Table 7 : Submersible Pump Duties

Description	MLSS Transfer	RAS Pumps No.1
Pump type	Submersible, solids handling, centrifugal.	Submersible, solids handling, centrifugal.
Duty/standby arrangement	2 off 1x duty/1x standby, a total of four (4)	1x duty, a total of one (1)

Description	MLSS Transfer	RAS Pumps No.1
Delivery rate and duty point per pump	12.0 ℓ/s @ 10.0 m	5.0 ℓ/s @ 8.0 m
Type of fluid/medium to be pumped	Final Effluent Discharge	Final Effluent Discharge
Static head minimum	Approx. 5.0 m	Approx. 5.0 m
Static head operating condition	Approx. 5.0 m to 6.0m	Approx. 5.0 m
Static head maximum	Approx. 6.0 m	Approx. 5.0 m
Self-priming height	N/A	N/A
Suction pipe length	N/A	N/A
Delivery pipe length	Approx. 45.0 m, 150 mm Φ	Approx. 20.0 m, 80 mm Φ
Orifice plate as per supplier recommendation	N/A	N/A
Total head (operating)	10.0 m	8.0 m

8.4 Site Testing of Pumping Plant

On completion of erection of the pumps and of rendering them operational, the Contractor shall make suitable arrangements to test them in the presence of the Engineer.

Each pump shall be tested over its whole range of delivery. Where pumps are to operate in parallel, tests shall also be carried out to check these operating conditions.

The rate of delivery during testing shall be determined by cutting off the inflow to the sump and timing the drop in water level therein. Where this is not possible, other appropriate measurements shall be taken.

During the tests, the average values of voltage and current drawn by the motor shall be noted and recorded. Motor efficiencies and power factors shall be used as supplied by the manufacturer.

The test results shall be compared with the tendered pump characteristics and the following tolerances will be allowed:

Delivery rate : - 0 to + 10%

Overall efficiency : - 5%

In the event of the pumps failing to achieve the tendered performance in regard to discharge or efficiency within the tolerance allowed, then the Employer shall have the right to reject the pumps, to recover all monies paid to the Contractor under the Contract for such pumps and to confiscate the surety by way of agreed and liquidated damages; whereupon the Contractor at his own expense shall remove all rejected plant where ordered to do so by the Engineer. Alternatively, the Engineer shall have the right to negotiate with the Contractor a reduction in the price of the pumping plant based on the increased power consumption over an 8 year life.

Each pump shall be operated, and a check made that no undesirable effects occur when it is tripped.

8.5 Characteristic Curves for Pumps

The Tenderer shall submit the following characteristic curves of performance of the pumps offered.

Pump (1) head - quantity curve

(2) efficiency curve

(3) NPSH curve

Motor (1) efficiency curve

(2) power factor curve

8.6 Operation

The pump sets will be manually and automatically operated.

In manual mode, the pumps will be started with start buttons and stopped with stop buttons. Each pump will have a field emergency stop station.

In automatic mode, the pumps will be started and stop by ultrasonic level meters. The ultrasonic level meter will start a pump on a high level and will stop the pump on a low level for pump sets with 1x duty / 1x standby pump configuration.

For pump sets with 2x duty/ 1x standby configuration, a 1st high level will start the 1st pump, a 2nd high level will start the 2nd pump, and the low level will stop both pumps.

The pumps will alternate after each pump cycle. The ultrasonic will additionally sound an alarm on an emergency low and emergency high level detected in the sump.

The pumps will be protected with a current sensing overload device with a built-in intelligent control facility and shall be incorporated within the pump's starter compartment in the motor control centre.

8.7 Electrical Installation

Provision has been made for the required electrical installation under a separate section of the contract.

8.8 Corrosion Protection

All steel pipes and equipment manufactured in 316L stainless-steel shall be thoroughly cleaned in accordance with the Particular Specification of this document and coated within four (4) hours after cleaning with a polyamide-cured epoxy system similar and equal to Copon EP2300 or Amercoat 385. The coating shall be built up to dry film thickness of 350 microns minimum, or higher as prescribed by the manufacturer. The manufacturer shall be acquainted with the circumstances under which the product is to be used. Pipes and equipment shall be coated externally and internally.

Surfaces exposed to UV shall be coated with one coat of polyurethane enamel (two part) with a minimum thickness of 40 microns.

The tendered price for equipment shall include the cost of providing instruments for testing the thickness of the coating and for testing for pin holes.

Fabrication stainless steel components shall be carried out in a clean workplace, free from contamination with mild steel and care shall be taken in handling to avoid scratching of finished surfaces. Dedicated grinding and polishing elements shall be used and shall not be contaminated with mild steel.

Cut edges, welds and heat affected surfaces shall be pickled and passivated to remove discoloration by means of proprietary pickling and passivating pastes in accordance with the manufacturer's specifications.

After passivation, surfaces shall be thoroughly washed and rinsed with clean potable water to remove any traces of acid. Surfaces shall be allowed to dry, and polished where necessary by means of suitable polishing compounds.

9 ANCILLARIES

9.1 Pipe Supports, Plinths and Thrust Blocks

9.1.1 General

The Contractor shall be responsible for the design and construction of pipe supports, thrust blocks and reinforced concrete plinths in the low-level effluent pump station.

The Contractor is referred to the standard detail drawings which shall be the basis for the design and construction of pipe supports and supporting plinths.

Pipe supports shall be designed to suit the Contractors chosen pump and his design for the pipework and valves within the battery limits defined on the drawings and in this specification.

Pipe supports and plinths shall accommodate all unbalanced forces imposed by the pumps and pipework. Unbalanced forces shall be transmitted via pipe supports and plinths into the reinforced concrete floor and foundations. The Contractor shall be responsible for all necessary pipe stress analyses.

9.1.2 References

The Contractor is referred to the following general and particular specifications for the design and construction of pipe supports, thrust blocks and plinths:

Standard specifications:

SANS 1200 G – Concrete (Structural)

SANS 1200 H – Structural Steelwork

SANS 1200 HA – Structural Steelwork (sundry items)

SANS 1200 L – Medium Pressure Pipelines

The Contractor is referred to the mechanical specification for materials for fasteners and steel pipe supports.

9.1.3 Construction

The Contractor shall provide the Engineer with shop drawings for the proposed pipe supports and construction drawings for all concrete items. These shall be reviewed by the Engineer prior to construction.

Concrete plinths shall be constructed as per details provided by the Contractor.

9.2 Essential Spares

Tenderers shall detail those spare parts required and recommended for at least two years continuous operation of all plant supplied under this Contract.

All spare parts shall be interchangeable with the corresponding parts of the plant, and each shall bear a corrosion proof metallic label giving adequate description for its rapid identification.

The minimum spares required for the pumps shall include the following:

(a) Spare rotating element

(b) Spare pump bearing set

(c) Spare pump primary and secondary mechanical seals

(d) Casing wearing ring

(e) Impeller wearing ring

10 COMMISSIONING AND TESTING

10.1 Low Level pumps

The Contractor is referred to Volume 8 – Annexures continuing the requirements for Quality Assurance, Transportation, Testing and Commissioning.

11 ACTUATORS

11.1 Electric Actuators

Actuators shall be fitted with a 3 phase 400 squirrel-cage motor. If two speeds are required a pole-changeable motor may be used. Output force of the motor shall be transmitted through a stage of spur gears, a spring-balanced worm with axial bearings, a worm wheel, and a clutch stage to the output shaft. All actuators shall be fitted with a double torque-dependent switch. For remote position indication of actuators fitted to modulating

valves, provision for an analogue 4-20 mA attachment shall be provided. For isolation valves two limit switches shall be provided. Provision for manual operation shall be made by means of a hand wheel – the mechanically independent hand-wheel shall be engaged by means of a clutch, which also de-clutches the motor drive from the output shaft.

Actuators shall be fitted with a mechanical position indicator.

Technical specifications:

Torque and travel dependent switches:	
No, NC or change-over:	10A at 30V AC, 5A at 250V AC
	5A at 30V DC, 0,4V at 250V DC
Mechanical lifetime:	± 106 cycles
Suitable for ambient temperature	-20 to +80°C
Electronic position indicator:	
Supply voltage:	15 to 30V smoothed
Output:	4-20 mA load R: 500 ohm at 15V, 1250 Ohm max. at 30V
Current consumption:	Max. 40 mA at 20 mA output signal
Linearity deviation:	±1% from 5 to 95% of measuring range
Suitable for ambient temperature	-25 to +90°C
Adjustment:	Independent for span or better
Linearity:	0,1% of span
Hysteresis:	0,2% of span
Accuracy:	0,5% of span or better
Case:	Dust-tight for general application

12 MAINTENANCE AND SLA

The contractor shall be responsible for the initial routine maintenance, until such time as the plant and equipment has been accepted and handed over to EWS and is capable of fulfilling its' specified operational duties. Once the plant and equipment has been successfully commissioned and accepted, the council's site staff will undertake the operations of the plant and equipment. The normal operational maintenance of the 4 main duty pumps and motors, in accordance with the manufacturer's recommendations, will be undertaken by the OEM under a Service Level Agreement, paid for by the Contractor as per the Bill of Quantities items allowed. The Service Level Agreement (SLA) between the OEM and Municipality will then come into effect for the routine maintenance in accordance with the submitted schedule and operating instructions and routine maintenance requirements set by the manufacturers. This SLA should be valid for a 5 year period (commencing at practical completion of the project) and cover the following aspects:

1. Specify equipment covered under the SLA agreement (four (4) Main Duty Pumps)

The pump sets will include the pump, coupling, cardan shafts, electrical motors, base frame, instruments and all ancillary equipment originally forming part of the main pump sets.
The pricing shall show price per pump and the total amount for all four pump sets.
The SLA proposal will comprehensively show the proposed scheduled inspections and maintenance work priced. The inspection and maintenance schedule will show the frequency (running hour or elapsed time), between previous and next inspection and maintenance work.
Scheduled inspections and maintenance work must be listed in terms of daily, weekly, monthly and quarterly actions.

2. Routine periodic physical inspection of the equipment
   The SLA proposal shall clearly list the specific monitoring (visual, audible, instruments) observations and measurements made during the inspections rounds as well as physical maintenance work.

3. Prices must include, if applicable, for all scheduled inspections and maintenance work the following and broken down fer each sperate inspection and maintenance tasks.
   a. Traveling (km, rate & amount).
   b. Delivery (km, rate & amount).
   c. Specialized labour (hour, rate & amount).
   d. General labour (hour, rate & amount)
   e. Special parts, components, fluids and consumables for the equipment (each, rate & amount)
   f. Special tools & instrumentations (each, rate & amount).
   g. Any other provision that may be necessary to execute the scheduled inspections and maintenance work (each, rate & amount).

4. Unforseen breakdowns cannot be predicted or feasibly priced, but the OEM must submit as part of the SLA propose a comprehensive spare part list to establish a benchmark for any unforeseen breakdown repairs.

5. As part of the spare part list the OEM must provide in the SLA proposal their rates for special and general man-hours, traveling rates etc.

6. Forming part of the SLA proposal, the OEM shall indicate response times for addressing unforeseen breakdowns, maximum supply times on special ordered parts and equipment components.

7. The OEM must include in the pricing, as part of the SLA proposal for the following compliances.
   a. Compliance with OHS Act No. 85 of 1993.
   b. Compliance with EMPLOYERS Requirements, access to site and other special requirements.

8. The OEM must submit with the SLA proposal an organogram showing the allocated personnel for the scheduled inspections and maintenance work. All the allocated personnel's qualification and experience should be included with the SLA proposal.

The Contractor will be instructed to attend to maintenance of a non-routine nature for the duration of the Defects Liability period. If the contractor fails to respond to such an instruction within period of twenty-four (24) hours, then such maintenance may be carried out by the council at the risk of the contractor. All costs incurred by the council under these circumstances will be deducted from the contract sum.

13 COMPULSORY DATA PACK

A detailed design pack will be submitted, including, but not limited to a Detailed Design Report, CAD drawing

of the travelling crane, pumps, motors valves , piping, supports, as built drawing indicating the layout of the equipment, a design report with all table's, guidelines, standards etc all as per the IEC codes is to be provided on three hard copy format and on soft copy format (native file and PDF) on a suitably sized hard drive with 10% spare capacity. Any other reports, calculations (showing formulas used) and narrative to comply with the scope of work and the discussions held on site.

PARTICULAR SPECIFICATION: MECHANICAL : LIFTING EQUIPMENT

Contents

PARTICULAR SPECIFICATION: MECHANICAL: PC LIFTING EQUIPMENT

1. SCOPE

This Specification covers the supply, delivery, installation, testing and upholding during the Defects Liability Period of Lifting Equipment comprising of winches, davits, crawl beams, steel gantries, hoists and overhead travelling cranes.

2. GENERAL

All lifting equipment shall comply with the following:

(i) The design, fabrication and installation of lifting equipment shall be fully in accordance with the relevant aspects of the Occupational Health and Safety Act and Regulations.

(ii) Test certificates shall be provided for all items of lifting equipment.

(iii) Lifting equipment shall be designed, constructed and installed in accordance with an internationally accepted technical standard. The guidelines given in the Southern African Steel Construction Handbook may be used where applicable where these do not conflict with the standard.

(iv) The safe working load (SWL) shall be marked clearly and permanently on all items of lifting equipment.

(v) Lifting installations shall be inspected and shall be tested over the complete lifting range using a test load. Unless otherwise specified in the lifting equipment design standard, the test load shall be:

(vi) at least 125% of the SWL for equipment with a SWL of up to 10 tonne;

(vii) at least 100% of the SWL for equipment with a SWL of 10 tonne and above.

(viii) High-tensile and alloy steel chains shall have a factor of safety of at least four. Other chains shall have a factor of safety of at least five.

(ix) Steel-wire ropes shall have a factor of safety of at least six. Man-made fibre ropes or woven webbing shall have a factor of safety of at least six. Natural fibre ropes shall have a factor of safety of at least ten.

(x) Anchor fasteners for securing steel structures to concrete shall have a diameter of not less than M16.

(xi) Foot-plates for columns which form part of lifting gantries shall be secured with a minimum of four anchor bolts.

(xii) Tenderers shall note that many aspects, such as fabrication, welding, corrosion protection and fasteners, shall be in accordance with the requirements of other clauses in this Standard Mechanical Specification.

(xiii) Tenderers shall allow for confirmation of the design loads once all equipment to be lifted has been selected and approved.

3. SHOP DRAWINGS

Shop drawings of the lifting equipment shall be submitted to the Engineer for approval prior to fabrication. Shop drawings shall include details of the loads imposed on structures and any relevant tolerances to be maintained.

The Contractor may use the lifting equipment during the installation of other equipment on condition that all testing and certification for the complete lifting installation, including supporting structure, has been

successfully completed. Any damage or excessive wear on the equipment shall be repaired before handover to the client.

4. CRAWL BEAMS

In addition to the general requirements for all lifting equipment, crawl beams shall comply with the following:

(i) Crawl beams shall be fabricated from standard I-Sections or standard H-Sections.

(ii) Crawl beams shall be hot-dip galvanised after all fabrication is complete. If the zinc coating is removed or damaged by drilling or welding or by any other fabrication technique, the complete beam shall have the zinc removed by abrasive blasting and it shall be returned to the galvanisers for hot-dip galvanising. Repair using cold-applied zinc products is not acceptable.

(iii) Crawl beams anchored to concrete shall be secured using grade 316 anchor bolts. The anchor bolts shall be through-bolted or U-type cast into concrete.

(iv) Crawl beams fastened to steel support structures shall be secured using hot-dip galvanised fasteners, including high tensile fasteners.

5. A-FRAME STEEL GANTRIES

In addition to the general requirements for all lifting equipment, steel gantries shall comply with the following:

(i) The same design Code or Standard used for the design of the crane or lifting beam shall be used for designing the gantry, which supports the crane or lifting beam.

(ii) Columns shall be cross-braced and/or “triangulated” in more than one direction, i.e. columns shall not be vertical cantilevers.

(iii) Gantry steelwork shall be hot dip galvanised.

(iv) Mobile gantries shall have lockable heavy duty durable caster wheels

6. HOISTS AND CHAIN BLOCKS

In addition to the general requirements for all lifting equipment, hoists shall comply with the following:

(i) Hoists shall be provided with an overload prevention device such as a clutch, which slips upon overloading.

(ii) Powered hoists shall hold the load upon power failure.

(iii) The bottom hook shall swivel on a ball or roller bearing through 360° and the bearing shall have a protective skirt. The hook shall be fitted with a safety latch.

(iv) Lifting chain is preferred, but corrosion-protected steel wire rope is acceptable.

(v) Chain boxes shall be provided for holding unloaded lengths of lifting chain.

(vi) Wire rope hoists shall comply with the following:

a. Drum diameter shall be at least 25 times the wire rope diameter.

b. Drums shall have no more than three layers of wire rope when fully wound up.

c. Drums shall have no fewer than three full turns of wire rope when fully wound out.

7. OVERHEAD TRAVELLING CRANES

In addition to the general requirements for all lifting equipment, overhead travelling cranes shall comply with the following:

(i) Construction of the crane shall be in accordance with BS 466 and BS 2573, as applicable. All welding of steelwork shall be carried out in accordance with BS EN 1011-1 by competent artisans meeting the requirements of BS EN 287-1. Suitable equivalent standards are acceptable.

(ii) Design requirements for the fixing and installation of the crane rails shall be provided by the Contractor to the Engineer for acceptance. The Tenderer shall inspect the drawings to determine what steps need to be taken for installation of the crane and shall plan work on site accordingly.

(iii) The hoist shall be supported on and travel along a steel crane beam structure. The crane beam shall be supported on end carriages which travel along crane rails. The crane rails shall be supported along their full length, either on a concrete beam or on a hot-dip galvanised steel beam structure.

(iv) The crane long travel, cross travel and hoist shall be electrically powered or manually operated as stated in the Project Specification or on the Drawings.

(v) Unless otherwise stated, the lowest hook level shall be room floor level and all operating chains and pendants shall fall to one metre above this level.

(vi) All materials shall be new and unused and suited to the application. Structural steelwork shall comply with the requirements of SANS 1431 and the grade used for structural members shall be 300 WC.

(vii) Fabrication shall comply with the following:

a. Site welding will not be acceptable.

b. Welding shall be continuous.

c. Crevices will not be permitted.

d. Welding slag and weld spatter shall be removed, and welds shall be ground smooth prior to coating.

e. Welds shall be fee of blowholes.

f. Sharp edges resulting from cutting operations shall be rounded to a radius of at least 3 mm.

g. Open pockets which are inaccessible for preparation and coating will not be permitted.

(viii) The crane beam and end carriages shall be designed with suitable dimensions, wheel spacing and gusset plates or diagonal bracing to prevent cross-whipping.

(ix) End stops with rubber buffers shall be fitted to prevent the hoist from moving off the travelling beam. Stops and buffers are also required to limit the long travel on the rails.

(x) Lubrication systems shall be designed to exclude dirt and moisture and all gear wheels shall be fully enclosed.

(xi) Bearings shall be mounted in sealed, cast-iron bearing housings or in totally enclosed and sealed housings, grease-lubricated and provided with grease nipples in both cases. The open type bearing units with exposed “lubricated for life” bearings will not be acceptable.

(xii) The crane and rails, when erected and installed, shall be of neat and workmanlike appearance, solidly and evenly supported, true to line, level, plumb and in proper working order. The crane rails shall be straight to within the permissible deviations given in BS 466 over their entire length.

(xiii) In the alignment of equipment or structures, the use of multiple shims will not be permitted.

(xiv) The crane rails shall be made from standard rail sections. Rails manufactured from square section steel bar will not be acceptable. Rail lengths shall be joined using fishplates, with at least four fasteners, to provide a continuous path for the travel of the crane wheels. The rails shall be hot dip galvanised after all fabrication work.

(xv) The distance between rail supports shall not exceed 1000 mm. Every rail length shall be supported at both ends.

(xvi) Crane rail anchor fasteners shall be M16 or larger and shall be of grade 316 stainless steel.

(xvii) The crane beam and end carriages shall be zinc-sprayed and sealed in accordance with the clause "Corrosion Protection: Metal Coatings". Smaller items, such as cable brackets and protective covers, shall be hot dip galvanised.

(xviii) The Contractor shall arrange for the crane to be inspected by the Engineer at the fabricator's premises prior to preparation for corrosion protection.

(xix) The full length of the rails shall be grouted in cases in which the rails rest on a concrete beam. A suitable gap between the rails and the beam shall be provided for application of the grout. The grout shall be applied strictly in accordance with the manufacturer's instructions. The grout shall be neatly finished with a 45° chamfer. The Engineer shall be notified prior to application of the grout. All shims shall be stainless steel 316. Grouting shall be by using a non-shrink cementitious grout, ABE Duragrout 1000 or other equally approved by the Engineer and to be applied in accordance with the manufacturer's instructions.

(xx) The Contractor shall supply to the Engineer a certificate from the manufacturer which:

(xxi) Certifies that the crane has been manufactured in accordance with the requirements of the local Occupational Health and Safety legislation.

(xxii) Specifies the design standards used, and States the SWL and the test load.

(xxiii) This certificate shall be provided to the Engineer prior to delivery of the crane to site.

(xxiv) The Contractor may use the crane during the installation of other equipment on condition that all testing and certification for the complete lifting installation, including supporting structure, has been successfully completed.

(xxv) Overhead cranes shall be supplied with pendant type controls unless otherwise stated on the drawings.

8. MAINTENANCE

8.1 The contractor shall be responsible for the initial routine maintenance, until such time as the plant and equipment has been accepted and handed over to ews and is capable of fulfilling its' specified operational duties. Once the plant and equipment has been successfully commissioned and accepted, the council's site staff will undertake the operations of the plant and equipment and its routine maintenance in accordance with operating instructions and routine maintenance requirements.

8.2 The normal operational maintenance, in accordance with the manufacturer's recommendations, will be undertaken by council staff at no charge to the contract. The contractor will be instructed to attend to maintenance of a non-routine nature. If the contractor fails to respond to such an instruction within period of twenty-four (24) hours, then such maintenance may be carried out by the council at the risk of the contractor. All costs incurred by the council under these circumstances will be deducted from the contract sum.

8.3 The maintenance period in terms of clause 11,1 (FIDIC DNP) shall commence concurrent with the guarantee period as defined in clause ps.10 (guarantee).

8.4 Details of tests and work to be performed at the end of the maintenance period are given in the

specification.

8.5 The contractor shall maintain all mechanical equipment installed as per the OEM recommendations on a QUARTERLY BASES DURING THE 2-YEAR DNP.

9. COMPULSORY DATA PACK

A detailed design pack will be submitted, including, but not limited to a Detailed Design Report, CAD drawing of the travelling crane, pumps, motors valves , piping, supports, as built drawing indicating the layout of the equipment, a design report with all table's, guidelines, standards etc all as per the IEC codes is to be provided on three hard copy format and on soft copy format (native file and PDF) on a suitably sized hard drive with 10% spare capacity. Any other reports, calculations (showing formulas used) and narrative to comply with the scope of work and the discussions held on site.

10. SCHEDULED ITEMS

MS 1 Overhead Travelling Crane – Low Level Pump Station

Design, submission of shop drawings, fabrication, and delivery to site of complete overhead travelling crane 10,000kg S.W.L, span 6,690mm, travel length 22,500mm.

The overhead travelling crane shall complete with all the details required by the specification, including all shop drawings, fabrication, transportation, handling and installation, testing and commissioning. The tendered sum shall also include compensation for the gantry, rails, end stops, travel beam, bogey (crab), electric hoist, electric motor, pendant, control and hoist panels, limit switches, slack rope switches, fasteners, anchors, and corrosion protection. Payment shall be made as a single sum on successful delivery of the equipment to site.

MS 2 Mobile A-Frame Gantry

Design, submission of shop drawings, fabrication, and delivery to site of complete of a mobile A-frame gantry with 500 kg S.W.L.

The gantry shall be complete with all the details required by the specification. The tendered sum shall also include all shop drawings, fabrication, transportation, handling and installation as directed by the engineer on site. Payment shall be made as a single sum on successful delivery of the equipment to site.

MS 3 Chain Block with Trolly

The rate shall include supply, delivery and installation of a chain block and cross traveling trolly complete as per the specification. Payment shall be made as a single sum on successful delivery of the equipment to site.

MS 4 Evaluate and Remove (if required) existing crane rails

The contractor shall arrange for the overhead crane supplier to inspect and evaluate the current installed rail system. If it is found to be adequate for the new overhead crane the rails may be used. If the rails are not suitable for use, the contractor is to remove the rails, clips and all sundry items, and transport to EWS store or dispose of as instructed by the Engineer.

MS 5 Dismantling, removing and

The contractor shall dismantle and remove the existing manual overhead crane, and transport to EWS store or dispose of as instructed by the Engineer.

MECHANICAL DATA SHEETS

Contents

MAIN DUTY LOW-LEVEL PUMP SETS – END SUCTION

General Data

Number of pumps required	4
Manufacturer	.....
Place of manufacture	.....
Type	.....
Model	.....
Speed	.....
Type of impeller	.....
Type of coupling	.....
Speed of rotation (rpm)	.....
Duct foot bend size (mm)	.....
Number & Size of guide rails	.....
Type of bearings	.....
Materials of wear rings	.....
Method of lubrication	.....
Method of gland sealing	.....
Overall mass of pump set (kg)	.....
Type of overheat protection:	.....

Overall dimensions:

Length (mm)	.....
Width (mm)	.....
Height (mm)	.....

Pump Dimensions:

Pump casing (mm)	.....
Shaft at drive end (mm)	.....
Delivery diameter (mm)	.....
Suction diameter (mm)	.....

Plinth dimensions required for pump plus motor:

Width (mm)	.....
Height (mm)	.....
Length (mm)	.....

Materials:

Casing	.....
Drive shaft	.....
Rotor	.....
Baseplate	.....
Impeller	.....

Bearing:

Type	.....
Size	.....

Duty point:

Delivery (m³/h)	.....
Head (m)	.....
Speed (rpm)	.....

Guaranteed performance at duty point:

Delivery (m³/h)	.....
Head (m)	.....
Speed (rpm)	.....
Power absorbed at coupling (kW)	.....
Efficiency of pump (%)	.....
Efficiency pump and motor (%)	.....

Performance Data

Minimum operating point:

Delivery (m³/h)	.....
Head (m)	.....
Speed (rpm)	.....
Efficiency (%)	.....

Maximum operating point:

Delivery (m³/h)	.....
Head (m)	.....
Speed (rpm)	.....
Efficiency (%)	.....

Piping and Valves

Pump suction:

Material	.....
Diameter (mm)	.....

Pump delivery:

Material	.....
Diameter (mm)	.....

Delivery manifold:

Material	.....
Diameter (mm)	.....

Valves:

Pressure gauges	.....
Gauge cocks	.....

Pressure Gauges

Name of manufacturer	.....
Place of manufacture	.....
Type	.....
Model	.....
Scale range and divisions for suctions gauge	.....
Scale range and divisions for delivery gauge	.....

Motor

Manufacturer .....
Country of manufacture .....
Type .....
Model .....
Rated voltage V .....
Starting Method .....
Starting Current (A) .....
Starting time with connected load (sec) .....
Number of consecutive starts per hour of the motor at its specific load.....
Class of insulation (IP): .....
Comply with SABS 948 (Yes/No) .....
Speed:
- Minimum (rpm) .....
- Maximum (rpm) .....

Power:
- At min speed (kW) .....
- At max speed (kW) .....

Power factor at:
- 100 % rated power: .....
- 75 % rated power: .....
- 50 % rated power: .....

Efficiency at:
- 100% load: .....
- 75 % load: .....
- 50 % load: .....

Line current at starting amps: .....
Line current at full load amps: .....
Type of overload protection: .....

Coupling

Manufacturer .....
Country of manufacture .....
Type .....
Model .....
Size .....

DELIVERY

Time required for delivery of complete plant from date of notification to commence fabrication	……weeks
Time required for erection and installation of plant from date of notification of availability of structures for erection and installation, or from time of completion of delivery, whichever is the later.	……weeks
Time required for testing, commissioning and putting into proper working order of complete plant from date of notification.	……weeks

Note: In addition, drawings showing details of equipment offered, its operation, control and other relevant details shall be submitted with the tender.

MAIN DUTY LOW-LEVEL PUMP SETS – IMMERSABLE

General Data

Number of pumps required	4
Manufacturer	.....
Place of manufacture	.....
Type	.....
Model	.....
Speed	.....
Type of impeller	.....
Type of coupling	.....
Speed of rotation (rpm)	.....
Duct foot bend size (mm)	.....
Number & Size of guide rails	.....
Type of bearings	.....
Materials of wear rings	.....
Method of lubrication	.....
Method of gland sealing	.....
Overall mass of pump set (kg)	.....
Type of overheat protection:	.....

Overall dimensions:

Length (mm)	.....
Width (mm)	.....
Height (mm)	.....

Pump Dimensions:

Pump casing (mm)	.....
Shaft at drive end (mm)	.....
Delivery diameter (mm)	.....
Suction diameter (mm)	.....

Plinth dimensions required for pump plus motor:

Width (mm)	.....
Height (mm)	.....
Length (mm)	.....

Materials:

Casing	.....
Drive shaft	.....
Rotor	.....
Baseplate	.....
Impeller	.....

Bearing:

Type	.....
Size	.....

Duty point:

Delivery (m^3/h) .....

Head (m) .....

Speed (rpm) .....

Guaranteed performance at duty point:

Delivery (m^3/h) .....

Head (m) .....

Speed (rpm) .....

Power absorbed at coupling (kW) .....

Efficiency of pump (%) .....

Efficiency pump and motor (%) .....

Performance Data

Minimum operating point:

Delivery (m^3/h) .....

Head (m) .....

Speed (rpm) .....

Efficiency (%) .....

Maximum operating point:

Delivery (m^3/h) .....

Head (m) .....

Speed (rpm) .....

Efficiency (%) .....

Piping and Valves

Pump suction:

Material .....

Diameter (mm) .....

Pump delivery:

Material .....

Diameter (mm) .....

Delivery manifold:

Material .....

Diameter (mm) .....

Valves:

Pressure gauges .....

Gauge cocks .....

Pressure Gauges

Name of manufacturer .....

Place of manufacture .....

Type .....

Model .....

Scale range and divisions for suctions gauge .....

Scale range and divisions for delivery gauge .....

Motor

Manufacturer .....
Country of manufacture .....
Type .....
Model .....
Rated voltage V .....
Starting Method .....
Starting Current (A) .....
Starting time with connected load (sec) .....
Number of consecutive starts per hour of the motor at its specific load.....
Class of insulation (IP): .....
Comply with SABS 948 (Yes/No) .....
Speed:
- Minimum (rpm) .....
- Maximum (rpm) .....

Power:
- At min speed (kW) .....
- At max speed (kW) .....

Power factor at:
- 100 % rated power: .....
- 75 % rated power: .....
- 50 % rated power: .....

Efficiency at:
- 100% load: .....
- 75 % load: .....
- 50 % load: .....

Line current at starting amps: .....
Line current at full load amps: .....
Type of overload protection: .....

Coupling

Manufacturer .....
Country of manufacture .....
Type .....
Model .....
Size .....

DELIVERY

Time required for delivery of complete plant from date of notification to commence fabrication	……weeks
Time required for erection and installation of plant from date of notification of availability of structures for erection and installation, or from time of completion of delivery, whichever is the later.	……weeks
Time required for testing, commissioning and putting into proper working order of complete plant from date of notification.	……weeks

Note: In addition, drawings showing details of equipment offered, its operation, control and other relevant details shall be submitted with the tender.

SUMP No. 1 & 2 DRAINAGE PUMP SETS

General Data

Number of pumps required	4
Manufacturer	.....
Place of manufacture	.....
Type	.....
Model	.....
Speed	.....
Type of impeller	.....
Type of coupling	.....
Speed of rotation (rpm)	.....
Duct foot bend size (mm)	.....
Number & Size of guide rails	.....
Type of bearings	.....
Materials of wear rings	.....
Method of lubrication	.....
Method of gland sealing	.....
Overall mass of pump set (kg)	.....
Type of overheat protection:	.....

Overall dimensions:

Length (mm)	.....
Width (mm)	.....
Height (mm)	.....

Pump Dimensions:

Pump casing (mm)	.....
Shaft at drive end (mm)	.....
Delivery diameter (mm)	.....
Suction diameter (mm)	.....

Plinth dimensions required for pump plus motor:

Width (mm)	.....
Height (mm)	.....
Length (mm)	.....

Materials:

Casing	.....
Drive shaft	.....
Rotor	.....
Baseplate	.....
Impeller	.....

Bearing:

Type	.....
Size	.....

Duty point:

Delivery (m³/h)	.....
Head (m)	.....
Speed (rpm)	.....

Guaranteed performance at duty point:

Delivery (m³/h)	.....
Head (m)	.....
Speed (rpm)	.....
Power absorbed at coupling (kW)	.....
Efficiency of pump (%)	.....
Efficiency pump and motor (%)	.....

Performance Data

Minimum operating point:

Delivery (m³/h)	.....
Head (m)	.....
Speed (rpm)	.....
Efficiency (%)	.....

Maximum operating point:

Delivery (m³/h)	.....
Head (m)	.....
Speed (rpm)	.....
Efficiency (%)	.....

Piping and Valves

Pump suction:

Material	.....
Diameter (mm)	.....

Pump delivery:

Material	.....
Diameter (mm)	.....

Delivery manifold:

Material	.....
Diameter (mm)	.....

Valves:

Make and class of gate valves	.....
Make and class of reflux valves	.....
Pressure gauges	.....
Gauge cocks	.....

Pressure Gauges

Name of manufacturer .....
Place of manufacture .....
Type .....
Model .....
Scale range and divisions for suctions gauge .....
Scale range and divisions for delivery gauge .....

Motor

Manufacturer .....
Country of manufacture .....
Type .....
Model .....
Rated voltage V .....
Starting Method .....
Starting Current (A) .....
Starting time with connected load (sec) .....
Number of consecutive starts per hour of the motor at its specific load.....
Class of insulation (IP): .....
Comply with SABS 948 (Yes/No) .....
Speed:
- Minimum (rpm) .....
- Maximum (rpm) .....

Power:
- At min speed (kW) .....
- At max speed (kW) .....

Power factor at:
- 100 % rated power: .....
- 75 % rated power: .....
- 50 % rated power: .....

Efficiency at:
- 100% load: .....
- 75 % load: .....
- 50 % load: .....

Line current at starting amps: .....
Line current at full load amps: .....
Type of overload protection: .....

Coupling

Manufacturer .....
Country of manufacture .....
Type .....
Model .....
Size .....

DELIVERY

Time required for delivery of complete plant from date of notification to commence fabrication	……weeks
Time required for erection and installation of plant from date of notification of availability of structures for erection and installation, or from time of completion of delivery, whichever is the later.	……weeks
Time required for testing, commissioning and putting into proper working order of complete plant from date of notification.	……weeks

Note: In addition, drawings showing details of equipment offered, its operation, control and other relevant details shall be submitted with the tender.

DRY-WELL DRAINAGE PUMP SET

General Data

Number of pumps required	1
Manufacturer	.....
Place of manufacture	.....
Type	.....
Model	.....
Speed	.....
Type of impeller	.....
Type of coupling	.....
Speed of rotation (rpm)	.....
Duct foot bend size (mm)	.....
Number & Size of guide rails	.....
Type of bearings	.....
Materials of wear rings	.....
Method of lubrication	.....
Method of gland sealing	.....
Overall mass of pump set (kg)	.....
Type of overheat protection:	.....

Overall dimensions:

Length (mm)	.....
Width (mm)	.....
Height (mm)	.....

Pump Dimensions:

Pump casing (mm)	.....
Shaft at drive end (mm)	.....
Delivery diameter (mm)	.....
Suction diameter (mm)	.....

Plinth dimensions required for pump plus motor:

Width (mm)	.....
Height (mm)	.....
Length (mm)	.....

Materials:

Casing	.....
Drive shaft	.....
Rotor	.....
Baseplate	.....
Impeller	.....

Bearing:

Type	.....
Size	.....

Duty point:

Delivery (m³/h)	.....
Head (m)	.....
Speed (rpm)	.....

Guaranteed performance at duty point:

Delivery (m³/h)	.....
Head (m)	.....
Speed (rpm)	.....
Power absorbed at coupling (kW)	.....
Efficiency of pump (%)	.....
Efficiency pump and motor (%)	.....

Performance Data

Minimum operating point:

Delivery (m³/h)	.....
Head (m)	.....
Speed (rpm)	.....
Efficiency (%)	.....

Maximum operating point:

Delivery (m³/h)	.....
Head (m)	.....
Speed (rpm)	.....
Efficiency (%)	.....

Piping and Valves

Pump suction:

Material	.....
Diameter (mm)	.....

Pump delivery:

Material	.....
Diameter (mm)	.....

Delivery manifold:

Material	.....
Diameter (mm)	.....

Valves:

Make and class of gate valves	.....
Make and class of reflux valves	.....
Pressure gauges	.....
Gauge cocks	.....

Pressure Gauges

Name of manufacturer .....

Place of manufacture .....

Type .....

Model .....

Scale range and divisions for suctions gauge .....

Scale range and divisions for delivery gauge .....

Motor

Manufacturer .....

Country of manufacture .....

Type .....

Model .....

Rated voltage V .....

Starting Method .....

Starting Current (A) .....

Starting time with connected load (sec) .....

Number of consecutive starts per hour of the motor at its specific load .....

Class of insulation (IP): .....

Comply with SABS 948 (Yes/No) .....

Speed:

- Minimum (rpm) .....
- Maximum (rpm) .....

Power:

- At min speed (kW) .....
- At max speed (kW) .....

Power factor at:

- 100 % rated power: .....
- 75 % rated power: .....
- 50 % rated power: .....

Efficiency at:

- 100% load: .....
- 75 % load: .....
- 50 % load: .....

Line current at starting amps: .....

Line current at full load amps: .....

Type of overload protection: .....

Coupling

Manufacturer .....

Country of manufacture .....

Type .....

Model .....

Size .....

DELIVERY

Time required for delivery of complete plant from date of notification to commence fabrication	……weeks
Time required for erection and installation of plant from date of notification of availability of structures for erection and installation, or from time of completion of delivery, whichever is the later.	……weeks
Time required for testing, commissioning and putting into proper working order of complete plant from date of notification.	……weeks

Note: In addition, drawings showing details of equipment offered, its operation, control and other relevant details shall be submitted with the tender.

SLUICE GATES

Sluice Gate No.	3
Name of manufacturer	
Place of manufacture	
Location	Sump No. 1 & 2
Type	Penstock
Number of items	3
General Arrangement	
Gate width (mm)	
Gate Height (mm)	
Invert to platform height (mm)	
Unbalanced operating head (mm)	
Seating type	
Spindle type	
Spindle diameter (mm)	
No. of spindle supports	
Operating gear	
Operating gear support	
Handwheel/crank diameter (mm)	
Handwheel height from platform (mm)	
Head gear bearing type	
Gate plate thickness (mm)	
Rib thickness (mm)	
Gate mass (kg)	
Total mass (kg)	
Materials of Construction	
Gate and frame	
Wedges	
Sealing faces	
Gate guides	
Spindle	
Spindle support brackets	
Spindle support bushes	
Pedestal	
Handwheel	
Assembly and foundation bolts	

DELIVERY

Time required for delivery of complete plant from date of notification to commence fabrication	……weeks
Time required for erection and installation of plant from date of notification of availability of structures for erection and installation, or from time of completion of delivery, whichever is the later.	……weeks
Time required for testing, commissioning and putting into proper working order of complete plant from date of notification.	……weeks

Note: In addition, drawings showing details of equipment offered, its operation, control and other relevant details shall be submitted with the tender.

NON RETUN VALVE / CHECK VALVE

TECHNICAL DATA SHEET NO …	CLIENT Nº.	PAGE
	Project Nº.	REV. 0

TI: TYPE OF ISSUE A - PRELIMINARY; B – FOR APPROVAL; C – FOR KNOWLEDGE; D – FOR QUOTATION; E – FOR CONSTRUCTION; F – AS PURCHASED; G – AS BUILT; H - CANCELLED

Rev.	TI	Description	By	Ckd	APP.	Aut.	Date
0	D	FOR TENDER					

Instructions on Filling Out This Form

I - Potential Suppliers should fill out the left column of the "Proposed" field with one of the following options: "MR" (Meets Requirements) or "D" (Deviation).

II - Suppliers must list any items marked "D" and any other clarifications in the "Deviations List", of the Technical Requisition. To include information in addition to the contents of this datasheet, suppliers should proceed in the same manner.

III - The explanatory notes at the end of the Data Sheet are to be filled out by the Issuer and not by Suppliers.

Supplier:	**Proposal:**			
Identification (TAG):	**Quantity:**	Refer to BOQ's		
Item	**Description**	**Unit**	**Specified**	**Proposed**
1	**MEDIUM DETAILS**			
1.1	Water quality (potable, raw, sewage, etc.)	-	As per project specification	
1.2	SG	-	As per project specification	
1.3	PH	pH	As per project specification	
1.4	Operating Temperature	°C	As per project specification	
2	**VALVE DETAILS**			
2.1	Manufacturer	-	-	
2.2	Model #	-	-	
2.3	Nominal Size DN	mm	-	
2.4	Door Type (single, double, nozzle, etc.)	-	-	
2.5	Method of closing (counter weight, spring, etc.)	-	-	
2.6	Inspection/Cleaning Cover	Yes/No	-	
2.7	Suitable for horizontal/vertical installation	Yes/No	-	
2.8	Operating Pressure	kPa	-	

2.9	Rated Pressure	kPa	-		
2.10	Body Test pressure	kPa	-		
2.11	Seat Test pressure	kPa	-		
2.12	Flanges (BS, SABS, ANSI, etc.)	-	-		
2.13	Raised Faced Flanges	Yes/No	-		
2.14	Face to Face distance	mm	-		
2.15	Actual inner bore	mm	-		
2.16	Loss coefficient K = (hm)/(v^2/(2g))	K	-		
3	**CONSTRUCTION MATERIALS**				
3.1	Body material (CI, DI, CS, etc.)	-	-		
3.2	Body Seat Trim (Stainless Steel, Copper Alloy, etc.)	-	-		
3.3	Door material (CS, etc.)	-	-		
3.4	Door Seat Trim (Stainless Steel, Copper Alloy, etc.)	-	-		
3.5	Shaft (Stainless Steel, Copper Alloy, etc.)	-	-		
3.6	Shaft Bearings/Bushes (PB, PTFE, etc.)	-	-		
3.7	Type of interior lining (2-pack Epoxy, FBE, etc.)	-	-		
3.8	Type of exterior coating (2-pack Epoxy, FBE, etc.)	-	-		
4	**GENERAL DETAILS**				
4.1	Total weight of valve (valve and actuator)	kg	-		
4.2	Main dimensions of valve (L x W x H)	mm	-		
4.3	Life expectancy (# open/close cycles)	No	-		
5	**FINANCIAL DETAILS**				
5.1	Cost per unit	ZAR	-		
5.2	Pressure testing cost per unit	ZAR	-		
5.3	Assembly delivery time	Weeks	-		

Explanatory Notes

01 - Supplier shall refer to reference documents listed on the requisition to complete equipment specification.

02 - Supplier shall confirm and/or provide all equipment data while filing the proposed column.

REFERENCE DOCUMENTS

ISOLATION VALVE

TECHNICAL DATA SHEET NO …	CLIENT Nº.	PAGE
	PROJECT Nº.	REV. 0

TI: TYPE OF ISSUE	A - PRELIMINARY	C – FOR KNOWLEDGE	E – FOR CONSTRUCTION	G – AS BUILT
	B – FOR APPROVAL	D – FOR QUOTATION	F – AS PURCHASED	H - CANCELLED

Rev.	TI	Description	By	Ckd	APP.	Aut.	Date
0	D	FOR TENDER					

Instructions on Filling Out This Form

I - Potential Suppliers should fill out the left column of the "Proposed" field with one of the following options: "MR" (Meets Requirements) or "D" (Deviation).

II - Suppliers must list any items marked "D" and any other clarifications in the "Deviations List", of the Technical Requisition. To include information in addition to the contents of this datasheet, suppliers should proceed in the same manner.

III - The explanatory notes at the end of the Data Sheet are to be filled out by the Issuer and not by Suppliers.

Supplier:	**Proposal:**
Identification (TAG):	**Quantity:**

Item	Description	Unit	Specified	Proposed	
1	**VALVE DETAILS**				
1.1	Manufacturer	-	-		
1.2	Model/ Series Clasification	-	-		
1.3	Nominal Size DN	mm	-		
1.4	Connection type	-	-		
1.5	Seat (soft/metal seated)	-	-		
1.6	Rated Pressure	kPa	-		
1.7	Body Test pressure	kPa	-		
1.8	Seat Test pressure	kPa	-		
1.9	Type of flanges (if applicable)	-	-		
1.10	Raised Faced Flanges	(Yes/No)	-		
1.11	Face to Face Distance	mm	-		
1.12	Hand wheel/Lever operated	(Yes/No)	-		
1.13	Gearbox	(Yes/No)	-		

1.14	Loss coefficient K = (hm)/(v^2/(2g))	K	-		
2	**VALVE CHARACTERISTICS AND PERFORMANCE**				
2.1	Rated flow rate	l/sec	-		
2.2	Reduced/ Full bore	-	-		
2.3	Actuation Torque	Nm	-		
3	**MATERIAL OF CONSTRUCTION**				
3.1	Body material (CI, DI, CS, etc.)	-	-		
3.2	Body Seat Trim (Stainless Steel, Copper Alloy, etc.)	-	-		
3.3	Door material (CS, etc.)	-	-		
3.4	Door Seat Trim (Stainless Steel, Copper Alloy, etc.)	-	-		
3.5	Shaft (Stainless Steel, Copper Alloy, etc.)	-	-		
3.6	Shaft Bearings/Bushes (PB, PTFE, etc.)	-	-		
3.7	Type of interior lining (2-pack Epoxy, FBE, etc.)	-	-		
3.8	Type of exterior coating (2-pack Epoxy, FBE, etc.)	-	-		
4	**GENERAL DETAILS**				
4.1	Total weight of valve (valve and actuator)	kg	-		
4.2	Main dimensions of valve (L x W x H)	mm	-		
4.3	Life expectancy (# open/close cycles)	No	-		
5	**FINANCIAL DETAILS**				
5.1	Cost per unit	ZAR	-		
5.2	Pressure testing cost per unit	ZAR	-		
5.3	Cost per actuator	ZAR	-		
5.4	Assembly delivery time	Weeks	-		

Explanatory Notes

01 - Supplier shall refer to reference documents listed on the requisition to complete equipment specification.

02 - Supplier shall confirm and/or provide all equipment data while filing the proposed column.

REFERENCE DOCUMENTS