NAIDU CONSULTING

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ETHEKWINI MUNICIPALITY

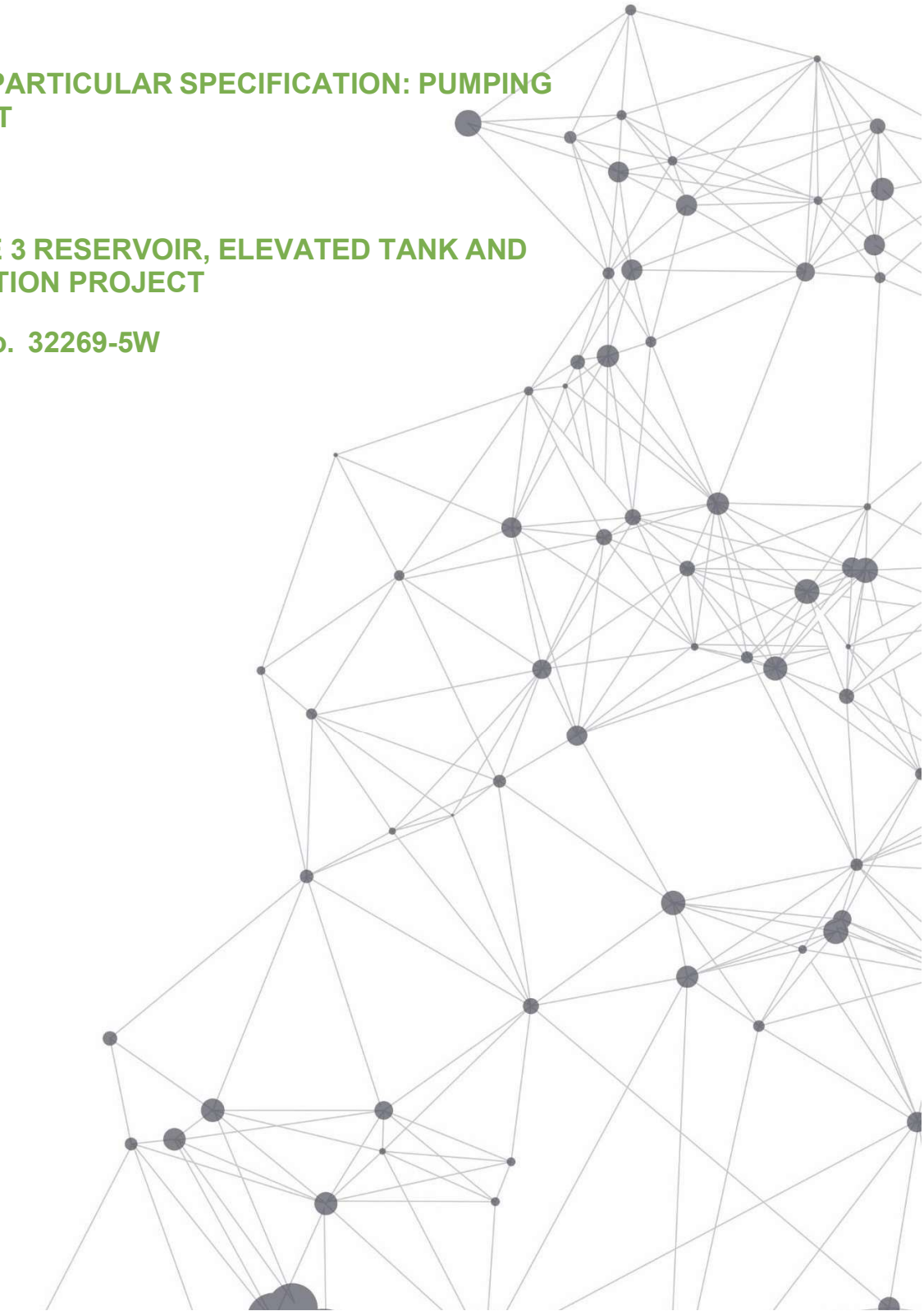
PROJECT PARTICULAR SPECIFICATION: PUMPING EQUIPMENT

PS WPE

TRENANCE 3 RESERVOIR, ELEVATED TANK AND PUMP STATION PROJECT

Contract No. 32269-5W

Rev 1



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PREAMBLE

This Project Specification forms an integral part of the contract. This specification shall be read in conjunction with the following specifications:

1) Project Particular Specification for Control Panel, Instrumentation and Electrical Installation
2) eThekwini Municipality PLC_Specification_Rev06
3) eThekwini Municipality Telemetry and Instrument Install Specification_Rev00
4) eThekwini Municipality Quality Control Specification_Rev02
5) EWS Standard Specifications, GS1 - Standard Specifications for DB's and Motor Control Centres
6) EWS Testing & Commissioning Sheets
7) EWS Standard Mechanical Specifications

PS WPE 1 SCOPE

This scope defined below is the applicable mechanical works information for all works associated with the assessments, repairs, supply, fabrication, construction, delivery, installation, testing and commissioning of the pumps, motors and associated equipment as specified hereunder.

PS WPE 1.1 PUMPS

a) Supply and install new pumps.

b) Install pumps, laser align with motor, fit coupling and coupling guards.

c) Testing and commissioning as per specifications.

PS WPE 1.2 MOTORS

a) Supply and install new 400V motors as specified.

b) Testing and commissioning of new motors.

PS WPE 2 GENERAL

PS WPE 2.1 STANDARDS

All plant and equipment shall be SABS approved (or other recognized international specification approved by the Engineer). In addition, the plant & equipment shall comply with the relevant portion of this project specification as well as the Electrical, Control & Instrumentation specifications included in this document as relevant. The terms particular and standard specifications are used interchangeably. In the event of conflict, this project specification shall take precedence over the standard or particular requirements.

PS WPE 2.2 PROPRIETARY MATERIALS

Where the term “or similar approved” is used in connection with proprietary materials or articles, it is to be understood that approval shall be at the discretion of the Employer.

Where brand or trade names are referred to in the Specification and Bills of Quantities, these shall indicate the quality and type of material or fitting required and substitution of materials so specified will only be permitted where the authority of the Employer has been obtained in writing before tender closes or with the submission of alternatives as part of the tender submission. No substitution will be allowed once the contract is awarded.

PS WPE 2.3 STANDARD TYPE AND MAKE OF EQUIPMENT

Once installation has commenced with the appropriate approvals for using any type and make of article or equipment, the same type and make of article or equipment shall be used throughout the project for that specific application unless otherwise specified.

PS WPE 2.4 STANDARD OF MATERIALS

All materials and equipment supplied and/or installed under this contract shall be new and the best of their respective kinds and shall comply with the requirements specified in the latest editions of the relevant SANS or BS standards and their amendments and with the requirements of this specification.

The Contractor shall be responsible for choosing materials for pump manufacture which are compatible with the pumped fluid and suitable for the intended duty under service conditions. The materials specified herein shall generally be acceptable for water, and prior approval will be required for the use of other materials.

PS WPE 3 DESIGN

PS WPE 3.1 OPERATIONAL HEALTH & SAFETY REQUIREMENTS

In addition to the safety requirements specified in the EWS OHS specifications & BRA (Basic Risk Assessment), the Contractor is responsible for ensuring that all equipment supplied and the complete installation complies with the Occupational health and Safety Act, Act 85 of 1993, and the regulations promulgated thereunder.

Installations which do not comply with the OHS Act shall be corrected by the Contractor at no cost to the Employer.

Equipment which are potentially dangerous shall be designed in accordance with an approved relevant South African or international Standard.

Hazards must be avoided or guarded to the satisfaction of the Engineer. Nip points shall be guarded. Sharp corners shall be rounded off. Items such as operating handles, supports and protrusions shall be kept clear of access ways or marked accordingly.

The Contractor shall cover all unsafe gaps and openings left in structures after installation.

Each motor driven device shall be provided with an emergency stop station in an appropriate position.

PS WPE 3.2 DESIGN PRINCIPLES

Mechanical engineering design shall ensure safety, robust construction, reliability, durability, prevention of avoidable corrosion, neatness as well as ease of maintenance and operation.

The design shall, where applicable, be based on the following:

a) The full range of duties which can be reasonably anticipated;

b) The maximum pressure or vacuum which can be produced by pumps, blowers and compressors under all conditions including blocked or closed inlet and outlet circuits;

c) Conservative service and safety factors based on approved standards;

d) Twenty-four hour per day operation (unless specified otherwise).

e) A minimum life of 24 months for large items of equipment before repair or major parts replacement

f) Prevention of serious damage from normal operational problems such as blockages, blinding, jamming, seizure, malfunction and, as far as is practical, maloperation (assuming that these occurrences cannot be avoided by good design).

g) The power and torque transmitted by the driver system under full load and stalled conditions;

h) Machines with non-overloading characteristics shall be selected wherever possible; eg: motors shall be sized so that they cannot be overloaded by the driven machine.

PS WPE 3.3 MOUNTING AND ARRANGEMENT

The arrangement and general design shall take the following requirements into consideration:

a) Lifting eyes, lugs, hooks, etc., shall be provided on heavy or large items to facilitate handling.

b) Castings or fabrications shall have machined pads for seating and be mounted

on either soleplates or baseplates as appropriate.

c) Where accurate alignment is required, positioning pins and/or jacking screws shall be provided.

d) The needs of operation and maintenance including neatness, access, working space, safety, cleaning, adjustment, handling, assembly, alignment, disassembly, removal, etc.

e) With plant and equipment to be mounted on or against concrete or brick structures built by others, provision shall be made for adjustment in the mechanical design. Any special accuracy requirements must be specified on the Contractor's Documents.

f) Guide rails for submersible pump applications.

PS WPE 4 WELDING

PS WPE 4.1 STANDARDS

Standards complying with good modern practice, and acceptable to the Engineer, shall be adopted. These include the following:

BS EN 1011	Arc welding carbon and carbon manganese steelwork.
BS 4677	Arc welding austenitic stainless steel pipework.
BS 2633	Class 1 Arc welding of steel pipework.
BS 2971	Class II Arc welding of steel pipework.

Welders shall be experienced artisans approved in accordance with BS 4872 or equivalent.

PS WPE 4.2 CONTINUOUS WELDING AND ELIMINATION OF CREVICES

Welding shall be continuous on all sides of any joint.

Crevices, including those arising from welding on one side only, shall be eliminated. This requirement applies to the welding of all metals and welding procedure shall be designed to prevent unacceptable deformation.

Welds which are only accessible from one side shall be prepared so that the root run provides an acceptable profile and prevents the formation of crevices. Pipework shall be designed so that such welds can be inspected and, where applicable, pickled and passivated.

In special cases only, non-continuous welding might be approved in writing by the Engineer. The resulting crevices shall be sealed with a two part solvent free epoxy which can be applied at thicknesses of up to 600 µm and above such as Sigmaline 523 or Corrocoat Zip E or Sigmacover 1000 or equivalent.

PS WPE 4.3 WELD APPEARANCE

Welding shall be free of blowholes, projections, pinholes, splatter and undercuts and all welding flux, weld spatter and other sharp imperfections shall be removed. Weld beads with a surface irregularity exceeding 3 mm or with sharp crests having a radius under 2 mm shall be ground.

PS WPE 4.4 SITE WELDING

Site welding shall be kept to a minimum and shall only be undertaken with the approval of the Engineer.

PS WPE 4.5 WELDING OF STAINLESS STEEL AND 3CR12 – ADDITIONAL REQUIREMENTS

Fabrication of austenitic stainless steels and 3CR12 shall comply with the

recommendations in "The Stainless Steel User Manual", "The 3CR12 Fabrication Guide" and the general welding requirements in “Pocket Guide – Stainless Steels” issued by Columbus Stainless. Compliance with publications from equivalent authorities will be acceptable.

Stainless steels to be welded shall be of the low carbon grade; e.g. 1.4306 rather than 1.4301 and 1.4404 rather than 1.4401.

The welding rods used shall be the most suitable for the metal and purpose. Only welders qualified and experienced with welding stainless materials shall be used. Welds which are accessible from only one side shall be executed in a manner to prevent heat tint or shall be post-weld treated in order to remove all traces of heat tint.

Type 316 stainless steel welding rods shall be used for welding 3CR12 unless otherwise approved in writing. 3CR12 shall be welded as recommended in "The 3CR12 Fabrication Guide" issued by Columbus Stainless.

All possible steps shall be taken to ensure maximum corrosion resistance and strength of the welds and welded material. Special care shall be taken to avoid prolonged heating. Welds shall be passivated. Discolouration and steel contamination must be removed by pickling or electro cleaning as approved by the Engineer but should rather be avoided by taking the appropriate measures.

PS WPE 4.6 INSPECTIONS

The Contractor shall arrange for all fabrications to be inspected by the Engineer prior to transport from the fabrication workshop

PS WPE 5 MECHANICAL PUMP EQUIPMENT

PS WPE 5.1 SCOPE

This is the mechanical and works information for the supply, fabrication, construction, servicing, delivery, installation, testing and commissioning of the pumps and associated equipment as specified hereunder.

In particular this specification includes for the following pumps:

Pump Description	No.
Trenance 3 Elevated Tank Pumps for High Level Supply Zone	2 off - Duty and Stand-By

PS WPE 5.2 PUMP DESIGN, MATERIALS AND MANUFACTURE

PS WPE 5.2.1 Pump Casings

The pump casings shall be manufactured in normal SG Iron or cast Iron to grade GGG or stronger non- corrodible approved material.

No welding, burning, filling or plugging of defective castings shall be permitted without the Engineer's permission in writing, following an inspection of the defects.

The inspection and testing of castings and test bars shall be in accordance with the Engineers instructions.

All pump casings shall be hydrostatically tested at the Manufacturer's workshop and in the presence of the Engineer or his Representative.

Particular care must be exercised in designing a pump casing which will resist the tendency to crack through the cutwater or guide passage walls during the pressure tests and the Contractor is to indicate clearly in his tender the design features incorporated in his pump to ensure that this requirement is satisfied.

PS WPE 5.2.2 Impellers

All impellers shall be stainless steel with a stainless steel shaft as indicated by the Engineer. Alternative materials may be considered subject to the approval by the Engineer.

The castings shall be free of blow-holes and other defects. No welding, burning, filling or plugging of defective castings shall be permitted without prior approval being obtained from the Engineer in writing, following an inspection of the defects.

Impeller shrouds and blades shall be of adequate thickness after they have been dressed, the minimum thickness being equal to : 7,00 (mm) for impeller diameters less than 350 mm and 0,00625 x diameter of impeller (mm) + 5 mm for impeller diameters equal to or greater than 350 mm.

All water passages are to be finished smooth to a template or NC machine finished.

All impellers shall be fitted with replaceable wearing rings of stainless steel or bronze. These rings, which shall be "L" cross-section, shall be secured to the impeller with non-corroding screws and mechanically locked.

Each impeller shall, after final machining and dressing, be independently statically balanced and the completely assembled rotating element with coupling half shall be dynamically balanced.

The critical speed of the rotating element shall be considerably higher (25%) than the running speed.

PS WPE 5.2.3 Pump Shaft, Sleeves and Diffusers

Pump shafts shall be of an approved material, to EN26 or equivalent and of sufficient dimensions to transmit the power to which they will be subjected without undue torsional or bending stresses and deflection.

The shafts shall be stress-relieved after initial machining, and ground to final size. The manufacturer shall take special care to avoid sharp radii. Shaft failures due to corrosion are common and the manufacturer shall indicate which steps he has taken to prevent the occurrence of pitting corrosion in pump shafts.

The shafts shall be suitably designed for the reception of the impeller which shall be adequately secured to the shaft in such a manner as to be readily removable without damage to either the shaft or the impeller.

The Contractor shall ensure that both the critical speed and torsional oscillation characteristics of the combined pump and motor rotating elements are satisfactory for all possible conditions of operation.

The shafts shall be adequately protected with replaceable sleeves of an approved stainless steel or other similar approved non-corrodible material at all areas where wear and/or corrosion could possibly be expected. These sleeves shall be readily removable without causing damage to either the shaft or the sleeves.

If separate diffusers are used, they shall be cast in an approved zinc-stainless steel and finished smooth all over.

PS WPE 5.2.4 Bearings

The bearings shall be either grease or oil-bath lubricated, or water lubricated for submersible pumps. Where grease is used, a high-quality bearing grease of lithium-soap base, free of resins and acids with an anti-corrosive effect, shall be used. The grease shall have a penetration figure of between 2 and 3, and a drip point of not below 175ºC.

A thrust bearing shall be provided to accommodate the end thrust of the impellers. The

bearing numbers shall be given for all bearings in the pumps to facilitate replacement. The lubrication points of the bearings shall be situated in a safe accessible position, so that lubrication can be done without taking the pump out of operation. Thrust bearings for vertical pumps may be located in the drivers.

Bearing housing closures of the labyrinth type slinger are required on horizontal pumps at each point where the shaft projects through a bearing housing, except that a mechanical oil seal is acceptable at the coupling end of the bearing housing. A non-labyrinth type slinger is acceptable on the stuffing box end of a bearing housing when it is combined with a mechanical oil seal. All bearings shall be suitable for shaft rotation in both directions. Bearing housings on vertical centrifugal pumps shall have equally adequate protection.

PS WPE 5.2.5 Stuffing Boxes

All pumps shall be equipped, unless otherwise specified, with soft-packed stuffing boxes of ample depth. Lantern rings shall be used in all pumps with a liquid or grease seal and these shall be provided with inlet and outlet connections.

Stuffing boxes shall have not less than four rings of packing plus the lantern ring and renewable-type non-ferrous throat bushings. Stuffing box glands shall be easily removable and must permit replacement of packing without removal or dis-assembly of any other part of the pump. Glands shall preferably be made with completely enclosed bolt holes. Slotted holes open at one side are acceptable only if studs are provided for securing glands. Gland leakage from the pumps shall be led through suitable tubing to a point immediately outside the pump house or to the nearest floor drain.

PS WPE 5.2.5.1 Mechanical Seals

Alternatively, to stuffing boxes or where ordered, mechanical seals complying with (a), (b) or (c) below, shall be used. The design shall be such that the static head on the pump discharge induces a closing action on the seal to ensure that no leakage occurs during pump shut-down.

a) Treated and Filtered Water

   A single self-aligning balanced mechanical seal manufactured in 316 stainless steel and fitted with ceramic on carbon seals.

b) Raw Water

   A single self-aligning balanced mechanical seal manufactured in 316 stainless steel and fitted with a least matched solid tungsten carbide (or other approved) rotating and stationary faces shall be supplied.

   An external flush shall be provided to ensure heat dissipation through circulation. Where raw water is being pumped, a cyclone separator (or external clear water source) shall be fitted.

c) Abrasive Liquids

   A double self-aligning mechanical seal manufactured in 316 stainless steel and fitted with at least either carbon or ceramic (for water lubrication) or carbon on Ni- iron (for oil lubrication) shall be supplied. Should the Contractor consider it necessary, more robust materials shall be fitted.

   An independent fresh water (or oil) flush shall be provided where required. Care shall be taken to ensure that the pressure of the flushing fluid is at least 100 kPa greater than the pressure of the liquid on the inboard side of the seal.

PS WPE 5.2.6 Base Plates

PS WPE 5.2.6.1 General

Equipment and drivers shall not be mounted directly onto a concrete base without the

use of either a baseplate or soleplate.

Driven equipment and their drivers shall be mounted on common hot dipped galvanised or fabricated steel baseplates of rigid construction. Common baseplates shall be provided for direct coupled and for belt driven machines.

In applications where baseplates are not practical, machined soleplates, suitably fixed and grouted into the concrete plinths, shall be provided.

The Contractor shall provide the baseplate, anchor fasteners and chemical anchor for securing the fasteners.

PS WPE 5.2.6.2 Design Requirements

Baseplates shall prevent pooling of water and shall be grout filled or shall be provided with drain holes in all side members.

The baseplate shall incorporate machined mounting pads at the support and fixing positions of each item of plant and equipment to be mounted on the baseplate. On fabricated baseplates this machining shall be done after fabrication, stress relieving (if applicable) and hot-dip galvanizing are complete. The thickness of the mounting pads shall be not less than 1,25 times the diameter of the holding down bolts. The pads shall not be provided with threaded holes for machine screws but shall be drilled for inserting through bolts and adequate provision shall made for reaching the nut with a suitable spanner. In the period between machining and installation of the equipment, the machined surface shall be protected against corrosion by a removable coating. After installation, a non-hardening compound, Tectyl or equivalent, shall be applied to exposed machined surfaces and to the crevice formed at the foot of the equipment. The above design may be suitably modified if the Contractor uses a pourable resin based chocking system. Such chocks shall be at least 15 mm thick.

At least two diagonally opposed jacking screws shall be provided for belt tensioning in the case of belt driven units. Direct coupled motors above 10 kW shall be provided with jacking screws for horizontal alignment and direct coupled motors above 150 kW shall be provided with jacking screws for vertical alignment as well. Jacking screws shall be galvanised mild steel or better. Drilled and tapped flat plate is not acceptable for jacking points. A jacking point shall consist of a suitable hot rolled steel section welded to the baseplate and with a captured machine nut to accept the jacking screw.

PS WPE 5.2.6.3 Fabrication

Baseplates shall be manufactured of either:

- hot rolled steel sections.
- bent plate (with the overall length not more than 200 x plate thickness).

Practical requirements for providing accessibility for surface preparation and coating shall be taken into consideration. Inaccessible pockets shall be avoided. Hollow spaces which cannot be accessed by blast and spray equipment shall be avoided or shall be welded closed. All such hidden surfaces shall not be permitted.

Inspections of carbon steel fabrications will generally be done after fabrication is complete.

PS WPE 5.2.6.4 Materials

Baseplates shall be fabricated from Grade X42 steel.

PS WPE 5.2.6.5 Corrosion Protection

Steel baseplates shall be hot dip galvanized in an approved factory specialising in hot dip galvanising.

PS WPE 5.2.6.6 Fasteners

Anchor fasteners shall be galvanised mild steel or similar approved.

A minimum of six anchors shall be provided for pumps with an inlet of DN 150 and smaller or to suit the existing mounting arrangement. Eight or more anchors shall be provided for pumps with an inlet larger than DN 150 or to suit the existing mounting arrangement.

Pumps with an inlet of DN 100 or smaller shall have anchor bolts of at least 12 mm or to suit the existing mounting arrangement. Pumps with an inlet larger than DN 100 shall have anchor bolts with a diameter no less than 12 + (Ø-100)/25 or to suit the existing mounting arrangement.

PS WPE 5.2.6.7 Installation

Not more than three shims may be used at any point and these must be made of a corrosion resistant material.

Concrete surfaces under baseplates shall be scabbled before the baseplate is placed and shall be blow clean using compressed air immediately before grouting.

Baseplates shall be designed and grouted to eliminate collection points for water or dirt. Except where otherwise approved in writing by the Engineer, all baseplates on concrete plinths shall be fully grouted in. Grouting holes must be provided on baseplates having a continuous top plate. Tapped holes and fixing setscrew protrusions shall be suitably protected. The material used for grouting shall be a non-shrink, cementitious grout (ABE Duragrout 1000, or equivalent). ABE Epidermix 324, or equivalent, is acceptable if the Contractors' design requires an epoxy grout to be used. The initial grouting shall be overseen by the grout supplier's technical representative.

Preliminary alignment of equipment mounted on baseplates shall be done at the factory to ensure that the baseplate has been correctly manufactured, but final alignment shall always be done on Site after installation and grouting has been completed. Alignment shall be accurate and to the approval of the Engineer and a final alignment check witnessed by the Engineer must be carried out by the Contractor prior to start up.

PS WPE 5.2.6.8 Inspections

The Contractor shall arrange for the Engineer to inspect the fabrication of the baseplate before it is hot dip galvanised.

PS WPE 5.2.7 Auxiliary Pipe Systems

Recirculating piping systems for gland oil, gland leakage, lubrication oil and accessories such as gauges and valves, shall be provided by the Contractor, fully assembled to facilitate easy maintenance.

Material used for all auxiliary piping and valves shall be suitable for the designed duty of the pumps, and all items shall be properly cleaned before assembly. They shall be installed in a manner which prevents vibration of the pump.

PS WPE 5.2.8 Pressure Gauges

Glycerine-filled pressure gauges ("Wika or similar approved") with a dial at least 120 mm in diameter and with a full-scale reading of 1.5 times the maximum pressure shall be provided on each pump suction and discharge. Gauges shall be supplied with SANAS accredited calibration certificates.

Gauges connected on the delivery pipework on suitable half inch BSP welded socket and an in-line stopcock/bleeder-valve shall be provided before each pressure gauge to isolate it from the mains.

Pressure gauge installation shall comply in all respects to the standard specification.

PS WPE 5.2.9 Pump Vent and Drain Fittings

Stainless steel vent cocks shall be provided and fitted at all local high points on each pump casing. These cocks shall be of adequate size to enable the entrapped air to be released freely. Copper/Stainless Steel drain pipes shall be neatly led from priming cocks, gland and casing drain points to a suitable discharge point/drain. Galvanised drainage pipework of adequate size shall be provided and installed to collect the waste water from each pump set and to lead it to the pumphouse sump. Drain pipework shall be fitted with T sections at every bend to enable rodding in the event of a blockage occurring.

PS WPE 5.2.10 Drip Tray

Each pump shall be equipped with a condensate drip pan manufactured from 3CR12 sheeting. The pan shall be installed on the bedplate of the pump and shall be big enough to cover the drip area under the pump.

A drain connection shall be installed at the bottom of the drain pan and a drainpipe shall be run from each drain connection to a discharge point/channel//sump.

PS WPE 6 COUPLINGS

Shaft couplings shall be selected to reduce transmission of misalignment forces and of torsional oscillations between the driving and driven machine. Couplings shall, wherever practical, be of the rubber tyre or rubber compression type, keyed to the shafts.

Elastomeric elements shall be urethane based. Flexible metallic elements shall be of stainless steel. Couplings shall not require lubrication.

Spacer couplings shall be used in all cases where this will assist maintenance.

PS WPE 6.1 GENERAL

The pumps and motors shall be direct coupled with a suitable type of coupling which will take up minor misalignment or off-setting of the motor and pump shaft satisfactorily. Couplings shall be statically and dynamically balanced.

The coupling shall be designed in such a manner that no axial or radial loads will be imposed on the motor and pump bearings in excess of the loads approved by the motor and pump manufacturers respectively for the installation offered. Spacer couplings shall be provided with pumps of the back pull out type or where frequent maintenance is likely to be required.

The couplings shall be robust, shall be readily dismantled and reassembled, and shall have a service factor of at least 1,5.

Elastomeric elements shall be urethane based. Flexible metallic elements shall be of stainless steel. Couplings shall not require lubrication.

Coupling guards shall comply with the requirements of the OHS Act and shall be to the approval of the Engineer.

Pulley belts are to comply in accordance with the OHS Act 85 of 1993 and are to be approved by the Engineer. Pulley belts are to be a like for like replacement or/and to comply with industry standards. Tensioning and lining of belt to be completed as per the Engineers instruction.

After installation, the alignment of all couplings shall be checked by the Contractor in the presence of the Engineer or a person delegated by him. Laser Alignment shall be accurate and to the approval of the Engineer.

PS WPE 6.2 MACHINE GUARDS

Guards shall comply in all respects with the Occupational Health and Safety Act of 1993 as amended and the following points shall also be noted:

Guards are required to cover all moving or revolving components of machinery. Guards which do not adequately cover moving protrusions such as keys, lock nuts, lockwashers, setscrews, etc., or irregularities such as keyways, will under no circumstances be accepted.

Guards shall be neatly and rigidly constructed and fixed and shall not vibrate or cause noise during operation.

Guards shall completely enclose drives and shall entirely prevent a person from touching any moving protrusion. Allowance must be made for adjustment on belt guards or where adjustment will be required. It shall be possible to remove the guard easily for maintenance purposes.

Guards shall preferably be fabricated of 1.6mm steel sheeting hot dip galvanized or 3CR12 epoxy powder coated (colour to be determined prior to painting). Guards are to be primed and painted. Fasteners shall be M10 or larger and shall be hot dipped galvanised.

PS WPE 7 SINGLE STAGE AXIALLY SPLIT VOLUTE CASING HORIZONTAL PUMPS

PS WPE 7.1 PERFORMANCE CRITERIA

The pump manufacturer must be ISO 9001:2015 certified, with scope of registration including design control and service after sales activities.

The pump manufacturer must be registered to the ISO 14001 Environmental Management System standard and as such is committed to minimizing the impact of its activities on the environment and promoting environmental sustainability using best management practices, technological advances, promoting environmental awareness and continual improvement.

PS WPE 7.2 PUMP SET FOR TRENANCE 3 :

Make:	KSB or similar and equal approved
Type:	Omega 150-290B (GC Std) or similar and equal approved, horizontal single stage axially split volute casing pump
No of Stages	1
Speed	1470 (TBC by supplier)
Impellor Diameter	TBC by supplier
Efficiency	TBC by supplier
Impeller and shaft :	Stainless Steel
Free passage:	Potable Water
Casing:	Cast Iron
Seal:	Gland Packing
NPSH required	TBC by supplier
Suction and discharge port diameters	TBC by supplier
Sensors	Pump Case Temp Sensors DE & NDE Bearing Temp Sensors DE & NDE Bearing Vibration Sensors

PS WPE 7.3 OPERATING DATA:

Fluid handled:	Water
Flow rate:	374.0 m³/h

Head:	19.7 m
Max. fluid temperature:	20 °C

NOTE: The pump must be capable of operating within minus 5%/plus 10% of the BEP flowrate at the specified duty.

PS WPE 7.4

DRIVE:

Drive Rating	37kW
Nominal voltage:	400V
Nominal frequency:	50Hz
Motor Speed	1470 RPM
Starting method:	VSD
Rating	IP65
Explosion protection:	Without
Max. fluid temperature:	20 °C
Thermal motor protection:	Pt100 (1Per Phase)
Efficiency class:	Equivalent min. IE3 to IEC Standard
Insulation Class	Class F
Nominal motor power P2:	TBC by pump supplier
Nominal motor power P1:	TBC by pump supplier
Motor efficiency:	TBC by pump supplier
Nominal current:	TBC by pump supplier
Speed:	TBC by pump supplier
Seal Cable gland Submersible motor:	n/a
Cable supplied with motor	n/a
Motor heaters	Yes 220Volts
Other sensors provided with motor	DE & NDE Bearing Temp Sensors DE & NDE Bearing Vibration Sensors

PS WPE 7.4.1 Pump Performance Certifications

The pump to be supplied shall be a KSBS Omega 150-290B or similar and equal approved designed for pumping potable water and should operate free from any solids or blockage material.

All internal passages, impeller vanes, and recirculation ports etc shall pass the full flow without any hinderance. Smaller internal passages that create a maintenance nuisance or interfere with priming and pump performance shall not be permitted. Upon request from the engineer, manufacturer's certified drawings showing size and location of the recirculation port(s) shall be submitted for approval.

PS WPE 7.4.2 Reprime Performance (Applicable for re-prime pumps only)

Consideration shall be given in which debris is expected to lodge between the suction check valve and its seat, resulting in the loss of the pump suction leg, and siphoning of liquid from the pump casing to the approximate center line of the impeller. Such occurrence shall be considered normal, and the pump must be capable of automatic, unattended operation with an air release line installed.

During unattended operation, the pump shall retain adequate liquid in the casing to ensure automatic repriming while operating at its rated speed in a completely open system. The need for a suction check valve or external priming device shall not be required.

a. No restrictions in the pump or suction piping will prevent the siphon drop of the suction leg
b. Impeller clearances shall be set as recommended in the pump service manual.
c. Repeatability of performance shall be demonstrated by testing five consecutive reprime cycles. Full pump capacity (flow) shall be achieved within five minutes during each cycle.
d. Liquid to be used for reprime test shall be water.

e. Upon request from the engineer, certified reprime performance test results, prepared by the manufacturer, and certified by a registered professional engineer, shall be submitted for approval prior to shipment.

PS WPE 7.4.3 Certified Pump Performance Test

Tests shall be conducted in accordance with ISO 9906 2012 at the specified head, capacity, rated speed, and horsepower. The performance tests will validate the correct performance of the equipment at the design head, capacity, and speed.

For pumps utilizing up to (13 HP) motors; but larger than (1.3 HP), tests shall be conducted in accordance with Hydraulic Institute Standards 14.6.3.4.1, as the specified head, capacity, rated speed, and horsepower.

PS WPE 7.4.4 OEM Warranty

1. The pump manufacturer shall warrant the pump equipment to be of quality construction, free of defects in material and workmanship. A written warranty shall include specific details described below.

2. All equipment, apparatus, and parts furnished shall be warranted for twelve (12) months starting from the date of the commissioning, excepting only those items that are normally consumed in service, such as oils, grease, packing, gaskets, O rings, etc. The pump manufacturer shall be solely responsible for warranty of the pump equipment and all components.

3. Components failing to perform as specified by the engineer, or as represented by the manufacturer, or as proven defective in service during the warranty period, shall be replaced, repaired, or satisfactorily modified by the manufacturer.

PS WPE 7.5 PUMP

PS WPE 7.5.1 General

1. The specifications and project drawings depict equipment and materials manufactured by KSB or similar and equal approved which are deemed most suitable for the service anticipated. It is not intended, however, to eliminate other products of equal quality and performance. The contractor shall prepare his bid based on the specified equipment for purposes of determining low bid. Award of a contract shall constitute an obligation to furnish the specified equipment and materials.

2. After execution of the contract, the contractor may offer substitutions to the specified equipment for consideration. The equipment proposed for substitution must be superior in construction and performance to that specified in the contract, and the higher quality must be demonstrated by a list of current users of the proposed equipment in similar installations.

3. In event the contractor obtains engineer's approval for equipment substitution, the contractor shall, at his own expense, make all resulting changes to the enclosures, buildings, piping or electrical systems as required to accommodate the proposed equipment. Revised detail drawings illustrating the substituted equipment shall be submitted to the engineer prior to acceptance.

4. It will be assumed that if the cost to the contractor is less for the proposed substitution, then the contract price shall be reduced by an amount equal to the savings.

PS WPE 7.5.2 Pump Design

Pumps shall be horizontal single stage axially split volute casing type, designed specifically for handling potable water. Pump capability and performance criteria shall be in accordance with requirements listed under **PS WPE 7**.

The pump manufacturer must be ISO 9001:2008 revision certified, with scope of registration including design control and service after sales activities.

PS WPE 7.5.2.1 Materials and Associated Construction Features

PS WPE 7.5.2.1.1 Pump Casings

Pump casing shall be cast iron Class 30 with integral volute. Casing shall incorporate following features:

a. Mounting feet sized to prevent tipping or binding when pump is completely disassembled for maintenance.

b. Fill port cover plate, 3 1/2" diameter, shall be opened after loosening a hand nut/clamp bar assembly. In consideration for safety, hand nut threads must provide slow release of pressure, and the clamp bar shall be retained by detente lugs. A Teflon gasket shall prevent adhesion of the fill port cover to the casing.

c. Casing drain plug shall be at least 1 1/4" NPT to insure complete and rapid draining.

PS WPE 7.5.2.1.2 Coverplate assembly

Coverplate assembly shall be cast iron Class 30. Design must incorporate following: maintenance features:

a. A lightweight inspection coverplate, retained by acorn nuts, for access to pump interior for removal of stoppages. Designs that require removal of complete coverplate assembly for access to the impeller will not be accepted.

b. Retained by acorn nuts for complete access to pump interior. Back coverplate removal must allow service to the impeller, seal, wear plate or check valve without removing suction or discharge piping. Back coverplate shall incorporate an obstruction free flow path by combining four support posts into a two-point “webbed” plate design for increased durability, reduced clogging, and increased operational efficiency.

c. Aggressive Self-Cleaning Wear Plate

   i. A replaceable wear plate secured to the back cover plate by studs and nuts. Wear plate shall be self-cleaning design ensuring that debris is cleared away and does not collect on the impeller vanes.

   ii. The nature of the conveyed medium poses significant challenges to the continuous operation of the pump. Of particular concern is the clogging of the impeller by debris in the pumped medium including but not limited to long rags, fibers, and like debris which are able to wrap around the impeller vanes, stick to the center of the vanes or hub, or lodge within the spaces between the impeller and the housing.

   iii. The aggressive self-cleaning wear plate shall have integral laser cut notches and grooves in combination with a “tooth” designed to disturb and dislodge any solids which might otherwise remain on the impeller in dynamic operation. Wear plate is designed to clear the eye of the impeller constantly and effectively without the use of blades or cutters.

d. In consideration for safety, a pressure relief valve shall be supplied in the inspection coverplate. Relief valve shall open at 75-200 PSI.

e. One O-ring of Buna-N material shall seal inspection coverplate to back coverplate.

f. Two O-rings of Buna-N material shall seal back coverplate to pump casing.

g. Pusher bolt capability to assist in removal of inspection coverplate or back

coverplate. Pusher bolt threaded holes shall be sized to accept same retaining cap screws as used in rotating assembly.

h. Easy-grip handle shall be mounted to face of inspection coverplate.

PS WPE 7.5.2.1.3 Rotating Assembly

Rotating assembly, which includes impeller, shaft, mechanical shaft seal, lip seals, bearings, seal plate and bearing housing, must be removable as a single unit. Design shall incorporate following features:

a. Seal plate and bearing housing shall be cast iron Class 30. Separate oil filled cavities, vented to atmosphere, shall be provided for shaft seal and bearings. Cavities must be cooled by the liquid pumped. Three lip seals will prevent leakage of oil.

   i. The bearing cavity shall have an oil level sight gauge and fill plug check valve. The clear sight gauge shall provide easy monitoring of the bearing cavity oil level and condition of oil without removal of the fill plug check valve. The check valve shall vent the cavity but prevent introduction of moist air to the bearings.

   ii. The seal cavity shall have an oil level sight gauge and fill/vent plug. The clear sight gauge shall provide easy monitoring of the seal cavity oil level and condition of oil without removal of the fill/vent plug.

   iii. Double lip seal shall provide an atmospheric path providing positive protection of bearings, with capability for external drainage monitoring.

b. Impeller shall be stainless steel single stage, non-clog, with integral pump out vanes on the back shroud. Stainless steel impellers are required for this application.

c. Shaft shall be AISI 4150 alloy steel unless otherwise specified by the engineer, in which case AISI 17-4 pH stainless steel or bronze shall be supplied. Stainless steel shafts will be a requirement for this application or project.

d. Bearings shall be anti-friction ball type of proper size and design to withstand all radial and thrust loads expected during normal operation. Bearings shall be oil lubricated from a dedicated reservoir. Pump designs which use the same oil to lubricate the bearings and shaft seal shall not be acceptable.

e. Shaft seal shall be cartridge oil lubricated mechanical type. The stationary and rotating seal faces shall be tungsten titanium carbide alloy. Each mating surface shall be lapped to within three light bands flatness (35 millionths of an inch), as measured by an optical flat under monochromatic light. The stationary seal seat shall be double floating by virtue of a dual O-ring design; an external O-ring secures the stationary seat to the seal plate, and an internal O-ring holds the faces in alignment during periods of mechanical or hydraulic shock (loads which cause shaft deflection, vibration, and axial/radial movement). Elastomers shall be Viton; cage and spring to be stainless steel. Seal shall be oil lubricated from a dedicated reservoir. The same oil shall not lubricate both shaft seal and shaft bearings.

f. Pusher bolt capability to assist in removal of rotating assembly. Pusher bolt threaded holes shall be sized to accept same caps crews as used for retaining rotating assembly.

PS WPE 7.5.2.1.4 Suction Check Valve

Suction check valve shall be moulded Neoprene with integral steel and nylon reinforcement. A blow-out center shall protect pump casing from hydraulic shock or excessive pressure. Removal or installation of the check valve must be accomplished through the coverplate opening, without disturbing the suction piping. Sole function of check valve shall be to save energy by eliminating need to reprime after each pumping cycle. Pumps requiring a suction check valve to assist reprime will not be acceptable.

PS WPE 7.5.2.1.5 Other

Spool flanges shall be one-piece cast iron, class 30 fitted to suction and/or discharge ports. Each spool shall have one 1-1/4" NPT and one 1/4" NPT tapped hole with pipe plugs for mounting gauges or other equipment.

PS WPE 7.5.2.2 Serviceability

i. The pump manufacturer shall demonstrate to the engineer's satisfaction that consideration has been given to reducing maintenance costs.

ii. No special tools shall be required for replacement of any components within the pump.

PS WPE 7.6 INSTALLATION

The following is to be undertaken by the Contractor, but not limited to:

1. Install, level, align, and lubricate pump(s) as indicated on project drawings. Installation must be in accordance with written instructions supplied by the manufacturer at time of delivery.

2. Suction pipe connections are vacuum tight. Fasteners at all pipe connections must be tight. Install pipe with supports and thrust blocks to prevent strain and vibration on pump piping. Install and secure all service lines (level control, air release valve or pump drain lines) as required in wet well.

3. Check motor and control data plates for compatibility to site voltage. Install and test the station grounding prior to connecting line voltage to control panel.

4. Prior to applying electrical power to any motors or control equipment, check all wiring for tight connection. Verify that protective devices conform to project specifications. Verify line voltage, phase sequence and ground before actual start-up.

5. After all anchor bolts, piping and control connections are installed, completely fill the grout dam in the pump station base with non-shrink grout.

PS WPE 7.7 FIELD QUALITY CONTROL

Prior to acceptance of the installation by Engineer, an operational test of all pumps, drives, and control systems shall be conducted to determine if the installed equipment meets the purpose and intent of the specifications. Tests shall demonstrate that all equipment is electrically, mechanically, structurally, and otherwise acceptable; it is safe and in optimum working condition; and conforms to the specified operating characteristics.

After construction debris and foreign material has been removed from the suction manifold and the reservoir, contractor shall supply clear water volume adequate to operate station through several pumping cycles. Observe and record operation of pumps, suction and discharge gage readings, ampere draw, pump controls, and liquid level controls. Check calibration of all instrumentation equipment, test manual control devices, and automatic control systems.

PS WPE 8 ELECTRIC MOTORS EQUIPMENT

This specification shall be read in conjunction with the Electrical, Control & Instrumentation Particular Specification.

PS WPE 8.1 SPECIFICATION FOR ELECTRIC MOTORS

The supply , installation and erection of all items of electrical equipment shall be carried out by qualified electrical contractors and shall conform to the Specification below and to be in accordance with the Code of Practice for the wiring of premises, SANS 10142: Latest Amendment.

Motors:

a) Uninstall applicable existing pumps with motors and deliver to Employers Stores in Springfield.

b) Supply new motors for driving of the new pumps as per specifications.

c) Install new motors, align with pump, fit coupling and coupling guard. (where applicable)

d) Testing and commissioning as per specifications.

PS WPE 8.2 GENERAL

Motors shall be AC squirrel cage induction type electric motors of the ratings specified or to match the pumping or other load. The motors shall be framed totally enclosed forced fan cooled with cooling fins. The motors shall be low voltage (LV) operation suitable for operation on a 400V 3 phase supply at a frequency of 50Hz. The motors shall be cast iron continuously rated drip proof IP65 rated, duty class S1. Motors shall comply with IEC/EN standards. The connection / cable termination boxes shall have an IP55 rating. Motors are to be WEG or similar approved or other approved motor supplied as an integral unit with the pump.

Preference will be for motors with a speed of 1500 r/min and below as agreed to by the Engineer and Employer.

The motors shall be capable of operating continuously under actual service conditions at their rated output without exceeding the specified temperature rises, determined by resistance, at any frequency between 45 and 52 Hertz, together with any voltage between ± 5% of the nominal value.

Unless otherwise specified, the slip in speed of the motors at 80 percent (80%) of the nominal voltage at 50 Hertz shall not exceed the percentage stated by the manufacturer and the motors shall be capable of operating at this voltage for a period of five minutes without injurious heating.

Rotors shall be statically and dynamically balanced.

All motors shall operate with the least practicable amount of noise to the relevant IES/EN standards. Motors larger than 100 kW shall be subjected to sound level tests in accordance with IEC/EN 60034-9.

All dimensions and design parameters shall be in accordance with the International Metric System (SI).

The motor design and construction shall be such that no damage to the motor will result from a supply voltage recovery, following on a brief supply voltage interruption. The designer or manufacturer should bear in mind that the supply voltage may be 180 degrees out-of-phase with the rotor induced voltage when the supply voltage is restored. Special attention shall be given to effects of electrical and mechanical stresses imposed on the motor over this period.

The guarantee efficiency of each motor shall be determined in accordance with IEC/EN 60034-30.

All motors shall be premium efficiency (minimum IE3) to IEC60034-30-1.

PS WPE 8.3 REFERENCE SPECIFICATION, STANDARDS AND CODES

All electric motors shall comply fully with the relevant IEC/EN standard specifications.

PS WPE 8.4 ENCLOSURE

Motors shall be provided with suitable means of drainage to prevent accumulation of water due to condensation.

Motors shall be supplied with anti-condensation heaters suitable for 230 V AC supply. Heater terminal boxes shall be fitted in an approved position and shall have an approved cable gland. Cable termination or connection boxes shall be IP55 rated.

The motors shall be provided with two machined bosses each tapped for a bolt, of suitable size, for earthing purposes. The machined bosses shall be located on opposite sides of the motor frame. The motors and parts thereof including auxiliary equipment supplied under the Contract shall be provided with suitable arrangements for lifting.

Painting of the motor casings shall comply with industry standards and to RAL5009be electric orange (B26). The paint colour shall match pumping applications and must be confirmed with the Employer prior to painting.

PS WPE 8.5 MOTOR STARTING GENERAL REQUIREMENTS

The motors are to be suitable for VSD starting at full voltage and at 50 Hz frequency.

Additionally, the motors shall be capable of accelerating the load specified from zero to full speed when supplied with 0,9 p.u. of normal voltage at 50 Hz.

All motors shall be suitable for starting under specified load conditions with 75% of the rated voltage at the motor terminals

Motors shall be capable of the following minimum starting conditions:

STARTS	MINIMUM NUMBER OF CONSECUTIVE STARTS
Number of consecutive start-ups with initial temperature of the motor at ambient level (cold)	3
Number of consecutive start-ups with initial temperature of the motor at full load operating level (hot)	2

PS WPE 8.6 MOTOR WINDING DETAILS AND INSULATION

The winding insulation shall be Class F, with temperature rise limited to that specified for Class B insulation to IEC/EN 60034-1.

Details of the stator insulation shall be to the relevant standard approvals. The outside of all end windings shall be coated with oil resisting non-hygroscopic varnish or compounds, and the coils shall be supported to prevent injurious movement. The stator winding tails shall be of sufficient cross-sectional area and adequately braced to withstand the nominal three-phase symmetrical short circuit specified and the current density under these conditions shall not exceed 400 A/mm2. The power frequency voltage withstand level of the interturn insulation of the stator windings as well as the impulse withstand level as a whole shall be stated by the Tenderer.

Provision shall be made, for the inclusion of the imbedded temperature detectors (thermocouple or platinum resistance or thermistor type) in the windings for motors.

All motors above 11kW rating shall have embedded in their stator windings, one PT100 thermistors per phase, suitable for Class B temperature rise. All motors rated 110kW and larger, shall have embedded in their stator windings, one PT100 thermistors per phase.

The motors shall be supplied complete with DE and NDE bearing temperature sensors and DE and NDE bearing vibration sensors.
The bearing detectors shall touch the outer bearing race, shall be spring-loaded and shall be of the screw type. The characteristics of these temperature detectors shall match the thermal limitations of the motor electrical installation.

Motors above 11kW shall be supplied and wired with 230 Volt anti-condensate heaters.

The leads from the temperature detectors and heaters shall be brought out to a separate approved terminal box fitted in an approved accessible position onto the motor. This terminal box shall be provided with labels indicating clearly to which detector each terminal is connected. Flexible connections shall be used to avoid damage to the leads by vibration.

During type testing the relationship between the temperature indicated by the detectors and the winding temperature as determined by resistance measurement shall be established for the purpose of alarm and trip settings. This information shall be recorded on the motor test certificate.

The stator windings shall be fully insulated such that the supply leads may be connected to either the "start" or "finish" ends of the winding.

PS WPE 8.7 STATOR FRAME AND CORE

The stator core stampings shall be built up in such a way that the spacing, keying and clamping of the stampings shall result in a uniformly tight core.

The design shall be such that the temperature of all parts of the winding and core is kept as uniform as possible throughout. The frame size shall be to IEC/EN 60072-1, 60034 and EN 50347 standards with the motor being minimum IP65 rated.

When pedestal type bearings are provided the motor shall be complete with base frame.

PS WPE 8.8 ROTOR AND SHAFT DETAIL

The rotor bars or windings shall be locked to avoid longitudinal movement in the slots under starting conditions and shall be designed to minimise the possibility of conductors breaking.

The minimum locked rotor thermal withstand time at rated voltage shall be minimum 10 seconds under cold conditions and minimum 8 seconds under hot conditions.

The rotors shall be properly balanced in accordance with the vibration limits specified in IEC/EN 60034-14. All rotor shaft extensions shall be provided with keys and shall receive an anti-corrosive protection coating despatch from the manufacturer's works.

The shaft shall be manufactured from chrome steel with 316 stainless steel shaft sleeve.

PS WPE 8.9 TERMINAL ARRANGEMENTS ON MOTORS

As required, three or six phase ends of the motor windings shall be brought out to terminal boxes.

All terminal boxes shall be to approval and of the totally enclosed type designed to prevent the ingress of dust and moisture and sealed for the internal air circuit of the motor. All joints shall be flanged and sealed with gaskets of neoprene or other approved material. Motors having fabricated frames shall have terminal boxes, including removable covers fabricated from mild steel plate with fully insulated terminals or connectors. Where specified the terminal boxes shall be of the phase segregated type.

The terminal boxes of motors over 300 kW shall be fitted with an approved phase segregated cable sealing and dividing box and cable gland or adapter plate together with the necessary fittings, including crimping lugs, to suit the cable. Only one cable box shall be provided per motor and this shall be interchangeable between terminal boxes. Terminal box positions are to match the existing arrangement.

The cable box shall be suitable for the termination of three-core high voltage cross-linked polyethylene insulated cables with copper conductors of the specified cross-sectional area. Where star delta starting is used, facilities shall be made in the cable box for termination of two power cables to suit the sizes of cables to be used. Motor terminal box to match existing position to align with cable duct routing. Contractor to verify on site before ordering the motors.

Terminals shall be of substantial design and connections having pinch screws bearing directly on cable cores will not be accepted. The terminal arrangement shall be suitable for the reception of copper cables and permit the motor to be disconnected from its supply cable without disturbing any sealing compound or damaging of cable tails and shall allow separate testing of the supply cable and motor windings. The insulation of the terminals or connectors terminal leads and intermediate disconnecting leads shall be of approved moisture resistant homogeneous material and, in particular, where leads enter any sealing compound, this insulation shall be waterproof. Natural rubber insulation shall not be used.

The electrical clearance and creepage distances with the correct terminations in position shall comply with the requirements of the relevant IEC/EN standards.

Terminal marking shall be made in a clear and permanent manner and shall comply with the relevant IEC/EN standards, where for three-phase motors, irrespective of the rotation required on site, the connections shall be such that then the supply leads L1 - L2 - L3, are connected to motor terminals U1 - V1 - W1 respectively the motor shall rotate in a clockwise direction when looking at the driving end. A permanently attached diagram or instruction sheet shall be provided giving the connections for the required case of motors suitable for both directions of rotation. Motors suitable for one direction of rotation only shall be clearly marked to indicate this.

High voltage line terminal boxes shall be suitable for connection to an electrical system with a nominal three-phase symmetrical short circuit capacity as stated in the Project Specification for a minimum fault clearance type of 0,25s. Unless satisfactory documentary evidence is provided, a prototype of each line terminal box design complete with cable sealing chamber shall be tested under internal short circuit conditions to demonstrate that the terminal box does not suffer damage (other than rupturing of the pressure release diaphragm or jeopardise the safety of personnel). In addition, through fault current tests shall be made to demonstrate that the box is suitable for the short circuit MVA specified.

Cable terminations or connection boxes shall be IP55 rated.

PS WPE 8.10 BEARINGS

Motors shall generally be fitted with heavy duty ball or roller bearings. Re-greaseable bearings are accepted.

The grease lubrication of ball or roller bearings shall be to approval. Grease lubricated bearings shall have relief holes to ensure that the bearings have been correctly packed and these holes shall be positioned so that excess grease can easily be removed.

The manufacturer or supplier of the motors shall recommend if bearing vibration or temperature sensors or RTDs are required for the bearings if failure of the bearings will be at risk. Suitable sensors shall be fitted should they be required. Similarly, requirements for bearing cooling be provided should the bearings require forced cooling or other cooling mediums.

PS WPE 8.11 PUMP MOTOR RATINGS

All fixed speed pump motors shall be continuously rated at a power output equal to at least 110% (with Zero Tolerance) of that required by the pump or other mechanical load when operating at the highest power consumption conditions.

Motors which will be driven from variable frequency inverters shall be rated at a power output of 110% - 115% of that required by the pump when operating at the highest power consumption conditions.

The motor and the load shall be correctly matched. The speed of the motor shall suit the pump load or other load as determined by the pump supplier or other load supplier.

The motor shall be rated for the following operating conditions:

DESIGN OPERATING CONDITIONS	REQUIRED
Altitude	94 -100 msl
Ambient Temperature (min)	-5°C
Ambient Temperature (max)	40°C
Humidity	40-90%

PS WPE 8.12 SURGE PROTECTION AND EARTHING

Earthing of motors shall comply to SANS10142 and SANS60034-1 latest amendments. Motors bearings shall be fitted with earthing rings on the DE and NDE for earthing due to eddy currents cause by VSDs.

Where required, surge suppression devices of the zorc type, shall be fitted into a compartment forming part of the cable terminal box and shall be connected to the motor terminals.

PS WPE 8.13 SERVICE FACTOR

Motors shall be supplied with a minimum service factor of 1.00.

PS WPE 8.14 GUARANTEES AND GENERAL PARTICULARS

PS WPE 8.14.1 Guarantees

The Contractor shall guarantee certain specified aspects of the performance of the plant, and compliance with these tendered guarantees will be judged on the results of the witnessed factory tests specified for the motors.

Should the witnessed tests for any motor be unsatisfactory, the Purchaser shall have the right to refuse acceptance of such motor. For a period which will still enable the motor in question to be delivered to site in accordance with the requirements of the Contract allowing for normal transportation times, the Contractor shall then be allowed to effect refinements or adjustments in order to overcome the deficiencies of the motor.

If the motor still does not give satisfactory witnessed test results, the Contractor shall be required to replace such motor with a new one which will be subject to the same conditions regarding tests and guarantees as specified herein. Whilst awaiting a replacement motor the Client shall have the right to demand the delivery to site (and erection if required in terms of the Specification) and the use of such unsatisfactory motor.

PS WPE 8.14.2 Samples, Operating and Maintenance Instructions & Installation

PS WPE 8.14.2.1 Operating Instructions

Not less than two weeks before the specified Completion Date of the first motor, the Contractor shall supply Operating and Maintenance Instructions covering all aspects of the motors for discussion with the Engineer and shall submit a further five copies in a form approved by the Engineer.

PS WPE 8.15 TESTS

The manufacturer shall have the type of tests and certification reports for all relevant motors required for Low Voltage Motors and this Specification readily available for the Engineer for inspection.

Not less than fourteen day's notice of all tests shall be given to the Engineer in order that he may be present if he so desires. As many tests as possible shall be arranged together in accordance with a programme to be agreed with the Engineer. Five copies of the Contractor's records of all tests shall be furnished to the Engineer.

All material which is specified for tests at the Manufacturer's Works shall satisfactorily pass such tests before being painted.

All instruments shall be approved and if required shall be calibrated at the expense of the Contractor by the South African Bureau of Standards or such other body as may be approved.

The following tests shall be carried out in order to determine whether the materials and apparatus comply for Low Voltage Motors and this Specification.

PS WPE 8.15.1 Type Tests

No.	DESCRIPTION	ACCORDING TO STANDARD
1	Temperature rise test	IEC 60034-1
2	Load test	IEC 60034-2-1
3	Breakdown torque test	IEC 60034-1
4	Speed – Torque curve	-
5	Measurement of efficiency and power factor at 100%, 75%, 50% and 30% load	-

PS WPE 8.15.2 Batch Tests

All batch tests carried out by manufacturer shall be under his care and his expense. Upon request from the Engineer, the supplier shall supply the batch test reports. Batch

tests shall be carried out by the manufacturer as part of their quality control procedure as per table below.

No.	DESCRIPTION	ACCORDING TO STANDARD
1	Winding resistance – cold	IEC 60034-1
2	Tests with locked rotor	IEC 60034-1
3	No-load tests	IEC 60034-2
4	Withstand Voltage test / Dielectric test	IEC 60034-3
5	Insulation resistance test (before and after dielectric test)	-
6	General visual checks, nameplate details, mounting, terminal box location and gland sizes	-
7	Measurement of shaft centre height dimensions	-
8	Measurement of clearances in terminal box	-
9	Verification of direction of rotation	-
10	Verification of type of terminals	-

PS WPE 8.15.3 Basic Tests

The motor shall be subjected to Basic Tests, Type Tests and Batch Tests in accordance with IEC 60034-1-2. and other relevant tests. Noise level tests to prove compliance shall be in accordance with IEC/EN 60034-9.

In addition to the above, the guarantee of slip at 80 percent normal voltage shall be proved.

These tests may also be carried out on randomly selected additional motors where such selection and additional number of motors shall be determined by the Engineer. The tenderer shall therefore quote a unit price per such additional test.

Apart from the basic tests, test measurements and/or calculation to obtain values for the following parameters, shall be carried out.
Inertia of rotor (Im) in kg m2, i.e. mass in kg x (radius of gyration in m2) Winding ratio (q).

- Stator resistance per phase at 75°C (r1) in ohm.
- Stator reactance per phase (x1) in ohm.
- Rotor resistance per phase at 75°C (r2) in ohms.
- Full load speed (nn) in radians per second.
- Break-away torque in Newton meter.
- Pull-out torque in Newton meter.

PS WPE 8.15.4 Duplicate Tests

Each motor shall be subjected to duplicate Tests in accordance with the relevant IEC/EN standards with the following additional tests:

1) Measurement of winding resistance (cold).
2) On over-voltage test at 1,5 times rated voltage applied with the machine running at no load for a period of 3 minutes to test inter-turn insulation.
3) Insulation tests and measurements as described in the relevant IEC/EN or other standards) shall be carried out on each motor. The Test results shall be recorded in the form as given by Table 2 of the abovementioned report.

4) Vibration measurements shall include measurements taken on each bearing housing and shall consist of at least three readings as follows:-
    a. Vibration in the horizontal plant perpendicular to the shaft axis.
    b. Vibration in the horizontal plant parallel to the shaft axis.
    c. Vibration in the vertical plane perpendicular to the shaft axis.
5) Measurement of the air gap between rotor and stator shall be taken and recorded for each motor before and after the heat run.

PS WPE 8.15.5 Material tests on component parts

Test specimens shall be taken from the main forgings and castings; drawings giving the positions of all test pieces are to be submitted to the Engineer for approval. Before removing test pieces, these together with the forgings and castings which they represent, shall be hard branded in the presence of the Engineer. Forgings and castings shall be in the final heat treated condition before detaching test specimen.

All test specimens shall be tested in the presence of the Engineer. All mechanical test certificates shall include full details of chemical analysis and heat treatment. The materials used shall include chemical analysis and mechanical properties tests as appropriate.

PS WPE 8.15.6 Non-Destructive Testing

PS WPE 8.15.6.1 General

The Contractor shall submit for approval, well in advance of the commencement of forging, casting, rolling or fabrication, details of the techniques and procedures of examination to be employed on the principal and other times which shall include the following:

PS WPE 8.15.6.2 Rotor

- Examination prior to brazing of end rings.
- Witness brazing of first rotor end rings.
- Witness ultrasonic test of brazing first rotor end rings.
- Examine reports of ultrasonic tests on subsequent rotors and carry out spot checks if necessary.

PS WPE 8.15.6.3 Stator

Investigate quality of welding and proposed procedures. Examine assemblies before welding and after completion and check stress relieving evidence. Check loading dimensions and concentricity of bearing locations in relation to stator bore.

PS WPE 8.15.6.4 Bearings

Examine bearing housings after machining and check dimensions. Check bond of white metal to shells (ultrasonic test certificate acceptable).

PS WPE 8.15.6.5 Windings

Examine stator and rotor windings before assembly of motor.

PS WPE 8.15.6.6 Bearing Housings

Bearing housings shall be subjected to leak testing using oil or paraffin.

PS WPE 8.15.7 Routine Tests on Site

The following tests shall be carried out on Site on each motor and in the following order:

PS WPE 8.15.7.1 Drying out

The motors shall be dried out by the Contractor before any voltage is applied to them. The dry out shall be achieved by any approved method but the only evidence of dry conditions which the Engineer will accept is an insulation resistance curve against time together with a polarisation index curve against time obtained during the drying out.

PS WPE 8.15.7.2 High Voltage Tests

The high voltage tests shall be carried out at voltages to be approved by the Engineer.

PS WPE 8.15.7.3 Direction of Rotation and No-Load Tests

Test to ascertain correct sense of shaft rotation followed by a 24-hour continuous no-load run during which the following will be monitored:

1) Winding temperature as registered by the embedded detectors.
2) Bearing temperatures (where applicable).
3) Vibration on each bearing.

PS WPE 8.16 INSTALLATION AND TERMINAL BOXES

The motor shall be foot mounted and shall be on a common base plate with the pump or other load or shall be on a separate base plate. Other mounting arrangements shall suit the pump or other load requirements and shall be confirmed with the Employer.

The motor and pump or other load shall be laser aligned by the pump/motor supplier to prevent vibration, bearing damage or shaft damage. Approved type couplings and guards shall be fitted between the motor and pump or other mechanical load.

The positions of the terminal boxes shall be confirmed with the Employer. The position shall suit the incoming cable supply or cable duct layouts.

PS WPE 8.17 SPECIAL REQUIREMENTS

1) The motor shall be supplied with new coupling and coupling guard to align and fit with the new pump shaft alignment and size.
2) The motor is to suit the speed of the pump.

PS WPE 9 MATERIAL, TRANSPORT, OFF-LOADING AND STORAGE

The Contractor must take due allowance in their tenders for the transport, off-loading of materials and the storage and safe custody thereof according to manufacturers' specifications on or off site until such can be accommodated or is required on site.

The motors shall be wired into temporary power supply and switched on during storage to prevent condensation forming in the motor windings.

PS WPE 9.1 INSPECTION OF LOCALLY MANUFACTURED SUPPLIES

Where locally manufactured plant or materials are offered, the Employer reserves the right to inspect such plant or goods during manufacture and to reject items that do not conform to the owner's requirements. Where a number of units are ordered by the owner the contractor shall notify the representative of the Employer when one unit has been completed so that the representative of the Employer may inspect and approve it.

PS WPE 9.2 ORDERING MATERIALS

The Contractor shall order the applicable mechanical equipment within 2 weeks of commencement of works and is warned to place all orders for materials or special materials as early as possible as he will be held solely responsible for any delay in the delivery of such goods.

PS WPE 9.3 PACKING

The contractor will be held responsible for packing all plant and other goods in such a

manner as to ensure any loss or damage in transit. Unless otherwise specifically agreed upon, receptacles will not be returned or paid for and no additional charges will be allowed for packing or packing materials.

PS WPE 10 PUMP INFORMATION PLATES

Each pump shall be provided with a substantial information plate, preferably chromed or stainless steel, securely fastened to the pump casing in a readily visible position, and clearly and indelibly marked with the following details:

- Maker's name, pump type, serial number,
- Year of manufacture
- Rated duty of pump in litres per second,
- Head in metres at rated duty,
- Pump speed in rpm,
- Mass of upper casing in kg, (for horizontal split casing pumps,)
- Mass of lower casing in kg, (for horizontal split casing pumps,)
- Mass of complete rotating element in kg,
- Mass of completely assembled pump in kg.

Letters and figures shall be engraved, or embossed, NOT STAMPED.

Number plate: in addition, each pumping unit shall be provided with a chromium plated or stainless steel number designation plate not less than 100 mm square indicating "1", "2", etc., mounted in a position readily visible from the control console area. Pumps are normally numbered from the loading bay of the pump station (No 1 closest to the loading bay) but number order shall be confirmed by the Engineer.

PS WPE 11 ALIGNMENT

The pump and motor shall be laser aligned. Before turning on the pump and motor on site, the laser alignment shall be re-checked to ensure it has not shifted during delivery and installation of the pump set.

The pump unit shall be accurately aligned and levelled on Site by the Contractor, should the Contractor dismantle the pump set at the factory for transport, using which ever means necessary. The anchor nuts shall then be drawn tight against the base. The pump and motor shall then be checked for alignment. If alignment needs improvement, metal shims or wedges shall be added at the appropriate places under the base. The Contractor shall align the units using laser alignment and shall ensure that the measured deviations nowhere exceed those recommended by the manufacturers of the motors, pumps and flexible couplings respectively. The readings shall be made available to the Engineer upon request.

Where required, the Contractor shall then grout up the units solidly, filling the voids inside and under the baseplate with an approved non-shrink grout.

After the pumps have been in operation at least one day, the foundation bolts shall be finally tested for tightness, the alignment checked and dowel pins fitted in the pump and motor feet in the approved manner.

When the grout has thoroughly dried (about 14 days after grouting), the exposed edges shall be painted using an approved oil paint of the same colour as the pump baseplate.

Both the suction and discharge piping shall be supported over the pumps with rigid supports and/or anchors to prevent strain from the pipework acting directly on the pump.

The suction pipework shall be completely airtight and installed in a manner to ensure that no air can be trapped in the suction pipe (and manifold).

PS WPE 12 PERFORMANCE GUARANTEE & FAT

The Contractor shall guarantee that each pump unit shall achieve the duty specified to within a tolerance of -0% and +3 % on flow and 5 % on power absorbed when operating under the specified head and pumping water of the specified quality. The Engineer will require that the contractor perform site tests to demonstrate the pump compliance.

The contractor shall take whatever steps are necessary to achieve the specified pump performance in accordance with the Engineer's instructions. The Engineer will not accept the pump units unless the specified performance is adequately and reliably demonstrated.

Pumps may be required to be witnessed tested for performance at the factory or assembly plant and test results submitted to the engineer prior to delivery to site.

The Engineer is to witness the FAT of the pumps at the manufacturer's premises. All costs associated with these tests are to be borne by the contractor.

PS WPE 13 TESTING AND COMMISSIONING

The entire installation shall be tested and commissioned in a well-documented procedure to be submitted by the contractor for approval by the Engineer. All test and commissioning data shall be recorded for inclusion in the O & Manuals. The Engineer shall be invited to witness and participate in all tests. One day notice shall be given for these tests.

This testing shall include inter alia the following:

1) The pumps shall be factory assembled and performance tested along with the supplied motor as per ISO 9906 2012.
2) Hydrostatic test should be at least 1.5 times of the rated pressure
3) Pump performance test report in accordance to ISO9906 shall be furnished by the manufacturer along with the supply of the pump. The pump performance shall be tested at no less than 3 points.
4) The pump test report shall bear the stamp of the factory and shall be signed by the testing engineer. The test report shall also bear the complete pump model description and part number/identification number of the supplied pump.
5) Witness performance testing of the pumps shall be arranged.
6) Commissioning activities as per particular specifications.

PS WPE 14 REFERENCE STANDARDS

The following standards are referred to:

1) ISO 9906:2012 – International Standards Organizations hydraulic performance tests for customers' acceptance of rotodynamic pumps.
2) EN-JL1040 / DIN W.-Nr. 2.1050.01 / DIN W.-Nr 0.6025 - European Standard for materials:
3) WRAS- conformance mark with the requirements of the drinking Water Supply (Water Fittings) Regulations 1999 and amendments of UK.
4) NEMA- American standard for Electrical equipment's
5) IEC - International Electrotechnical Commission

Compliance:

1) Pump shall be energy efficient and comply with the EuP Directive (Commission Regulation (EC) No 547/2012) for the minimum efficiency requirement

PS WPE 15 SENSORS

Pump casing temperature sensors (Pt100, one per phase) are to be fitted to all pumps. These are to be supplied as per the pump OEM requirements.

Pump DE and NDE bearing temperature and DE and NDE bearing vibration sensors are required for all pumps. The sensors supplied are to be as per the pump OEM requirements.

Motor winding temperature sensors (one per phase) are required as specified. Motor bearing temperature sensors on the DE and NDE are required. Motor bearing vibration sensors are required on the DE and NDE for each motor.

PS WPE 16 DATA SHEETS

The Tenderer shall complete in full the information on the following data sheets in respect of the following:

- Equipment offered for each pump and motor.
- Pump testing data
- Applicable coupling data.

PS WPE 16.1 PUMP DATA SHEET

Note : Complete one for each equipment supplied or for each pump supplied

Contractual Duty Point specified (PS WPE 1 & 2)		
Number of pumps required	No	
Type of pump		
Manufacturer of Pump		
Country of Manufacture		
Make and Model of Pump		
SANS, BS , ISO or IEC Standards the pump is manufacture to		
Type of impeller		
Number of impellers/ stages		
Mass of fully assembled pump	kg	
Maximum allowable operating speed of pump	RPM	
Speed of pump at the specified duty point above	RPM	
Diameter of impeller offered	mm	
Will the impeller offered enable the pump to meet a duty point ranging from: __m³/hr × ____m to __ m³/hr x ____m	State YES or NO	
Factory test pressure applicable to pump with suction and delivery flanges blanked off	kPa	
Pump efficiency at Duty Point	%	
Head developed by pump at zero discharge	m head of water	
Closed valve head of pump	m	
Moment of inertia of rotation assembly	kgm²	
Power Absorbed		
Power absorbed by pump at specified Duty Point	kW	
Power absorbed by pump at a run point.	kW	
Power absorbed at best efficiency point:	kW	
Maximum power absorbed by pump at run out point of coupling	kW	
Voltage (400V for all pumps)	Volts	

NPSH		
NPSH requirement at specified Duty Point	m head of water	
NPSH requirement at a run point of_____ m³/hr	m head of water	
NPSH requirement at a run out point	m head of water	
Diameter of Pump Components:		
Suction inlet waterway and flange size	mm	
Delivery outlet waterway and flange size	mm	
Shaft (state minimum and maximum diameter if applicable)	mm	
Full size impeller diameter	mm	
Minimum size impeller	mm	
Type and Material of Pump Components:		
NDE bearing		
DE bearing		
Impeller		
% Chrome in impeller		
Shaft		
Shaft sleeves		
Volute Casing		
Diffusers		
Wear Ring		
Mechanical Seals:		
Manufacturer		
Type/model		
Seal materials		
Sensors:		
PT100 pump casing temperature sensors for all pumps		
PT100 pump DE and NDE bearing temperature sensors for all pumps		

PS WPE 16.2 COUPLING DATA SHEET

Note : Complete one for each equipment supplied

Type of coupling and fixing method		
Mass of coupling	kg	
Type of coupling guard		
Approximate mass of coupling guard	kg	
Type of coupling bushing (where applicable)		
Type of coupling pins (where applicable)		

PS WPE 16.3 MOTOR DATA SHEET

Note : Complete one for each equipment supplied or for each motor supplied

Manufacturer		
Place of Manufacture		
SANS, BS, ISO or IEC Standards the motors are manufactured to		
Type Insulation (Class) and temperature Rise Class		
Rated output power (indicate rating such as 37 kW but a different rating may be offered provided there is always the specified minimum margin at the run out point	kW	
Frame size and reference specifications		
Mass of fully assembled motor	kg	
Type of motor cooling		
Maximum allowable ambient temperature to prevent overheating	˚C	
Weatherproof rating (IP)		
Motor efficiency class		
Rated maximum speed	RPM	
Initial starting current	Amps	
Full load current	Amps	
Starting current	Amps	
Minimum starting voltage	Volts	
Mounting type, enclosure and cooling method		
Stator winding material, insulation class and temperature rise		
Slip at full load % of synchronous speed.	%	
Starting torque in star as a % full load torque.	%	

Starting current in star as a % of full load current.	%	
Power drawn from electricity supply at pump duty point	kW	
Power drawn from electricity supply at pump run out point	kW	
Type of DE and NDE bearings and sizes		
Bearing lubrication type and grade		
Efficiency by summation of losses in accordance with BS 269:		
At full load	% / %	
At 3/4 load	% / %	
At 1/2 load	% / %	
Power factor:		
At full load	cos ϕ	
At 3/4 load	cos ϕ	
At 1/2 load	cos ϕ	
Anti-Condensation Heater and Pt100 Temp Sensors:		
Heater Voltage	V	
Heater Power	kW	
Type of Pt100 Temp sensor and number per phase		
Pt100 Temp sensor Voltage	V	
Operation of Pt100 Temp sensor		
Drawing Nos of the drawings supplied by Tenderer with the tender:		
Pump-motor assembly		
Pump characteristics H, Q, Efficiency, NPSH and Power drawn versus Q) for various speeds and impeller sizes		
Drawing Nos of the drawings supplied by Tenderer with the tender:		