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නව ජල මෝටර මිලදී ගැනීම .

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Specifications for pumps

Bookandayaya WSS

Suitable pump Details (Request prices for each bulleted items)

- Electrically Driven submersible borehole type pumping set (400 V, 50 Hz) with capacity of 10 m³/h @ 90 m Head. The unit consist of 20 m of submersible cable, cooling sleeve, cable joint kit etc.
- DOL starter for above motor with PFR, EFR, surge arrestors, Level monitoring relay and other necessary motor protection and controlling should be included.
- 2" GI pipes & fittings , Non-return valve, Pressure gauge – 02 Nos, Volumetric flow meter – 2" should be along with the offer to complete the pumping system
- Installation of above accessories for satisfactory operation (rate to be included for construction of suitable concrete foundations and supporting arrangement with concrete steps and for necessary excavating and earth works)
- Spares (Set of impeller, set of neck rings, set of bush bearings,cable joint kit)
- Testing and commissioning

Kudagoda WSS

Suitable pump details (Request prices for each bulleted items)

- Electrically Driven submersible borehole type pumping set (400 V, 50 Hz, 3000 rpm) with capacity of 12.5 m³/h @ 80 m Head. The unit consist of 30 m of submersible cable, cooling sleeve, cable joint kit etc.
- DOL starter for above motor with PFR, EFR, surge arrestors, Level monitoring relay and other necessary motor protection and controlling should be included.
- 3" GI pipes & fittings , Non-return valve, Pressure gauge – 02 Nos, Volumetric flow meter – 2" should be along with the offer to complete the pumping system
- Installation of above accessories for satisfactory operation (rate to be included for construction of suitable concrete foundations and supporting arrangement with concrete steps and for necessary excavating and earth works)
- Spares (Set of impeller, set of neck rings, set of bush bearings,cable joint kit)
- Testing and commissioning

**SPECIFICATIONS FOR BORE HOLE TYPE
SUBMERSIBLE PUMPING SETS AND ACCESSORIES**

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**SPECIFICATIONS FOR BORE HOLE TYPE SUBMERSIBLE
PUMPING SETS AND ACCESSORIES**

1.0 PART 1 - GENERAL

1.1 SCOPE

Each pumping unit shall consist of a submersible bore hole type pump and motor, delivery pipes, submersible cable, stainless steel cable, low water level cut – off, electrical switch gear and all necessary appurtenances to provide a complete pumping system. The contractor shall require that the pumping units specified herein to be supplied by a single manufacturer. The contractor shall supply install, commission and hand over all equipment to the satisfaction of the Engineer.

The Bidder must visit the site and inspect the space requirement and other installation requirements before making the bid.

1.2 TYPE

Each pump shall be of the Submersible, centrifugal type suitable for installation in a dug well/Deep well of the specified size.

1.3 UNIT RESPONSIBILITY

The contractor shall cause all equipment specified under this contract to be furnished by the pump manufacturer who shall be responsible for the adequacy and compatibility of all pumping unit components. Any component of each pumping unit not provided by the pump manufacturer shall be designed, fabricated, tested and installed by factory authorized representatives experienced in design and manufacture of such components. This requirement, however, shall not be construed as relieving the contractor of the overall responsibility for this portion of work.

1.4 DESIGN REQUIREMENTS

The arrangements shown on the drawings are based upon the best information available to the Engineer at the time of design and is not intended to show exact dimensions peculiar to any specific equipment unless otherwise shown or specified. Therefore, it may be anticipated that the structural supports, connecting piping and valves shown in part or whole, may have to be changed in order to accommodate the pumping equipment furnished. No additional payment will be made for such changes. Any such changes shall be submitted to the Engineer for his approval.

Pumping units shall be designed to operate without over loading cavitations or damaging vibration at the specified speed, flow and head conditions. The shut off head of the proposed pumps shall be at least 10% more than the specified head at the specified capacity.

Motor rating shall be at least 10 % more than the power required by the pump at the specified duty point in case of pump running solo. In case of pumps running parallel, rating of each motor should be higher than the maximum capacity required by each pump.

The pump base shall be designed for installing in a borehole. The motor shall be connected to the pump by means coupling.

No vertical hydraulic thrust shall be transmitted to the floor above from the pump below.

1.5 CRITICAL SPEEDS

Each complete system, including pump, motor and all appurtenances, shall have no dangerous critical or resonance frequencies or multiples of resonance frequencies within 20% above and 35% below the operating speed of the pump.

For the purposes of design, a dangerous vibratory critical speed shall be defined as one, which produces a torsion stress exceeding $2.4 \times 10^7 \text{ Nm}^{-2}$. The contractor shall be responsible for the analysis of critical speeds, which shall be analyzed and certified by a professional engineer regularly engaged in this type of work.

1.6 FACTORY TESTING

1.6.1 Materials

Melt and strength tests of the cast iron used in the manufacture of the pumps' major components shall be performed in accordance with the applicable BS standards as indicated in the specification. The contractor shall furnish the Engineer with certified copies of the results of all tests.

1.6.2 Performance Tests

Pump shall be factory tested for performance in accordance with ISO 9906 by a testing agent approved by the Engineer and shall be to accuracy class C. The supplier shall submit these test curves prior to shipment of the equipment. These test curves shall include Head, Efficiency, Power absorbed and NPSH required against Capacity. The Engineer shall witness these tests.

Pump to be supplied under this contract with motors higher than 30 kW shall be tested with its distinctive contract motor.

1.6.3 Hydrostatic Tests

Each pump shall be hydrostatically tested. Test pressure shall not be less than twice the shut-off head as shown on the approved head-capacity curve.

The test procedure shall be as follows:

	Condition	Time (Minutes)
1	Test Pressure	180
2	Atmospheric	05
3	Test Pressure	15
4	Atmospheric	05
5	Test Pressure	30

At no time during this test shall the casing show undue deflection or signs of weakness at any point, nor shall the external surfaces of the casing show sweating through porous metal or leaking through gasket or cracks or other defects.

The contractor shall furnish the Engineer with certified results of the tests.

1.6.4 Vibration Tests

Vibration tests shall be carried out in accordance with ISO 2372 – 1974.

1.6.5 Motor Tests

Motor shall be tested in accordance with NEMA and IEEE Procedures. The tests shall include,

- a. Routine Tests
 - i. No load current
 - ii. Locked Rotor Current
 - iii. Winding Resistance
 - iv. High Potential Test.
- b. Complete Tests
 - i. Rated Load Temperature Rise.
 - ii. Slip.
 - iii. Locked Rotor Torque.
 - iv. Breakdown Torque.
 - v. Efficiencies at 100, 75 and 50 percent of Full Load.
 - vi. Power factor at 100, 75 and 50 percent of Full Load.

The contractor shall furnish the all certified test results before shipment.

1.7 ENVIRONMENTAL CONDITIONS

1.8 WARRANTY

The contractor shall provide manufacturer's warranty to the employer that the Goods and Services Supplied under the contract will comply strictly with the Contract and shall be first class in every case and shall be free from defects. The supplier further warrants to the Purchaser that all materials, equipment and supplies furnished by the supplier for the purpose of the goods will be new, merchantable of the most suitable grade, and fit for their intended purposes. The supplier shall warrant that the services to be carried out under this contract will conform to generally accepted professional standards and engineering principals.

This warranty shall remain valid for the period the period of **(01) one year**. After the final acceptance, any part of the equipment which fails or does not give satisfactory performance during this period of warranty, shall be replaced within the 03 days from the date the Contractor has been notified to do so.

All expenses involved in this connection shall be borne by the contractor who should take this into consideration when bidding.

PART 2 – PRODUCTS

2.1 PUMPS

These specifications are intended to cover the supply the supply and installation of vertically mounted bore hole type submersible pumps with all accessories, pipe work, valves, fittings and electrical control panels as shown in the drawing

2.1.1 OPERATING CONDITIONS

Pump is required to deliver clear water with specific gravity 1.0, at a maximum temperature of 38.5°C. The pH value will be between 6.5 and 7.5.

The performance of the pumps shall be complying with the requirements indicated in the table below.

Description	Unit	Bookandayaya WSS	Kudagoda WSS
Number of installed pumps	Nos.	01	01
Number of pumps in simultaneously operation	Nos	01	01
Capacity of a pump (at the total head)	m ³ /hr (l/s)	10	4.0 1.11
Operation at normal duty conditions	[mWC]	90	59
NPSH/minimum submergence available	[m]		
Expected overall efficiency	%	50	50
Expected nominal speed	rpm	<3000	<3000
Method of starting	-	DOL	DOL
Number of starts per hour	No/hr	6	6
Connection to pipes	-	Flange	Flange
Media	-	Dug Well	Deep Well
Depth of the Well	ft	22	100
Minimum Water Level	m		
Total Annual Operational hours	Hours	8000	8000

Here Submersible pumps will be provided with DOL starters. Pump unit shall be provided with an arrangement for dry running protection at each location. All necessary for installation of such arrangement, including cabling, relays etc shall be included in the contract.

The pumps will be operated **manually and no auto mode is required** for pump operation. The pump will start only when following initial conditions are satisfied (these initial conditions should be interlocked with motor starters of the pump)

The system power supply shall be normal.

The water level at the *dug well* shall be above dry running protection level.

Once the above requirements are met, an operator can switch on the pump while keeping the common delivery valve in closed position and considering the water levels of the reservoirs which is nearly 700 m away from the *dug well* (*pump will be manually operated according to the water level at this reservoir*).

The system should allow the operator to switch on the pump when water level at *reservoir* is at predetermined level (this level will be decided by the engineer at the time of installation) and switch off the pump when water level at *reservoir* is maximum. But these levels should not be interlocked with motor starters of the pump so the operator can switch ON and OFF the pumps as he wished.

A resettable audio visual buffer arrangement should be activated at pump panel house when pump tripped/other malfunction.

2.1.2 SPEED

Nominal operating speed of the pump shall not exceed 3000 RPM. However, the pumps with higher speed may be considered if no suitable offer is received for the specified pump.

2.1.3 EFFICIENCY

Minimum pump efficiencies expected at the duty point are mentioned in above table. The efficiency at the duty point will be a consideration in the evaluation of the offer. An alternative offer for pumps with lower efficiency will be considered if a suitable offer for pumps with the required efficiency is not received.

2.1.4 CONSTRUCTION MATERIALS

MATERIALS

Component	Material
Pump shaft	Stainless Steel conforming to BS 970 Grade 431S29.
Impeller	Stainless Steel conforming to BS 970 Grade 304S15
Casing	Stainless Steel conforming to BS 970 Grade 304S15
Impeller Neck rings	NBR / Stainless Steel
Diffuser	Stainless Steel conforming to BS 970 Grade 304S15
Bolts, Studs & Nuts	Stainless Steel conforming to BS 970 Grade 304S15

2.1.5 PRESSURE GAUGES

Following gauges shall be installed with pump, with operating and vent cocks.

- a). A pressure gauge of 100 mm. diameter calibrated in meters of water and Kg./cm² with a maximum reading approximately twice the total head of the pump, mounted at the ground level on the delivery side .

2.1.6 CALIBRATION OF INSTRUMENTS & METERS

All instruments & meters shall be calibrated in the metric units as follows.

1. Pressure shall be indicated in metric water meter.
2. Flow shall be indicated in cubic meters/hour or litres/second
3. Quantities shall be indicated in cubic meters
4. Time shall be indicated hours.
5. Amperage shall be indicated in Amperes
6. Voltage shall be indicated in Volts.

2.2 OTHER ACCESSORIES

2.2.1 RISER MAINS

It should comprised of heavy duty Galvanised Iron/Low Carbon steel pipes joined by threaded sockets/flanges complete with discharge bend fitted with an air release valve. The maximum length of the section of the riser pipe shall be according to the drawings given.

2.2.2 WATER LEVEL GUARD

Electrode type water level guard with indication device (prevention of pump running dry) for each pump shall be provided.

2.2.3 PUMP RETAINING CABLE

A stainless steel cable sufficient to retain the pump from falling into the well shall be provided.

2.2.4 PIPE SPECIALS

All items and specials mentioned in the drawings shall also be provided by the supplier.

2.2.5 SURFACE PLATE (PUMP BASE)

The steel surface plate shall be rigid enough to support the entire weight of the suspended parts when filled with water. The plate shall provide suitable openings for the power cable, well vent and low level cut – off as required.

2.2.6 STRAINER

The strainer shall be of stainless steel have a net inlet area equal to at least three times the impeller inlet area . The maximum unit opening shall not be more than 75% of the minimum opening of the water passage through the bowl or impeller.

2.2.8 COOLING SLEEVE

The Cooling sleeve should be submit with the offer and installed with the motor.

2.3 SUBMERSIBLE ELECTRIC MOTORS AND LT EQUIPMENT

2.3.1 MOTORS

All motors shall be of submersible bore hole type Energy Efficient Continuous duty Three phase, squirrel cage , induction type designed for 400 V. 50 Hz conforming to BS 4999/1972 and maximum kVA inrush current shall be NEMA Code F. Design of the motors shall be such that they can operate within $\pm 6\%$ of the normal voltage continuously without damage. Synchronous speed shall be below 3000 rpm.. Each motor shall be provided with a lifting eye bolt and shall have a service factor.

Motor enclosures shall be protected to IP 68.

Suitable precautions shall be taken to prevent sand, silt or foreign matter from entering the motor. A thrust bearing of ample capacity to carry the weight of all rotating parts plus the hydraulic thrust at maximum operating head shall be an integral part of the driver.

2.3.2 INSULATION

Motors shall be of class F Insulation of NEMA standards but the operating temperature rise shall be restricted to that of class B

2.3.3 MOTOR RATING

Motor shall be continuous duty type (duty designation – S1) with minimum 6 starts per hour and the ratings of the motors shall be at least more than the power required at the point of 115% of the capacity at the specified duty point.

2.3.4 BALANCE

Each rotating assembly including coupling half, shaft and rotor shall be dynamically balanced up to 150% of the operating speed prior to final assembly.

2.3.5 PROTECTION OF ENCLOSURE

Motor enclosures shall be protected to IP68.

2.3.6 MOTOR – PUMP COUPLING

The motor shall be directly coupled to the pump with no gears or any other speed changing mechanism in between. The coupling shall be of stainless steel 431S29 of BS 970 and shall be capable of transmitting the total torque and total thrust of the unit.

2.3.7 MOTOR CONTROL CENTRE

All electrical equipment shall be rated to operate on 400 V., Three phase 50 Hz. Supply. They shall basically consist of ;

- a) Panel enclosures
- b) Busbars with MCCB's (Distribution section)
- c) Supply incoming section
- d) Small power distribution section
- e) Motor starting sections
- f) Automatic controllers & indicators
- g) Cabling

2.3.8 PANEL ENCLOSURE CONSTRUCTION

Enclosures shall be of sheet metal construction using 1.5 mm. thick steel sheets with corrosion resistant coat. Fabrication shall be done using seam or spot welding and finish shall be elegant and workmanship of high quality. The interiors of cubicles shall be finished with gloss white paint. The cubicle exterior shall be finished to cream colour. All cut-outs and holes to be drilled in the panel shall be carried out before rust proofing.

All cubicles shall be adequately earthed independent of the earth connection via the cable glands, and cubicle sections shall be electrically bonded to each other.

Enclosure shall be wall mounted.

Enclosure shall be protected to IP 55.

Doors shall be suitably hinged to ensure uniform pressure right along the rubber beading. The rubber beading shall be flat type that provides protection against dust and drops of water. Doors shall be lockable with special type operated locks. Hinges shall be zinc die – castings or stainless steel.

2.3.9 DIMENSIONS

Enclosure dimensions shall be carefully selected so that ample working space is available or easy replacement of components.

Access to the cubicles or cubicle compartments for all normal routine maintenance shall be from the front.

2.3.10 ARRANGEMENT OF COMPONENTS WITHIN ENCLOSURES

Arrangement of components shall be logical, Cable entry shall be from the bottom where knock out flanges shall be fixed. All cables shall terminate at independent terminals installed at the bottom part of the enclosures. Where busbars are used they shall occupy the top portion of the enclosure. Contactors and protective devices shall be in the middle portion of the enclosure. All meters shall be conveniently located for easy reading and MCCB's located at convenient heights. Maximum operating height of the enclosure shall not exceed 2000 mm.

2.3.11 WIRING WITHIN THE ENCLOSURES

Wiring within the enclosure shall be done in neatly arranged PVC cable trays with detachable lids. All wires shall be numbered lugged and connected properly. The control wiring diagram printed on paper (properly laminated) shall be fixed on to an interior wall of the enclosure. Phases of the each end of the cable shall be marked using Red, Yellow and Blue tapes and the neutrals shall be marked using Black tapes.

2.3.12 SUPPLY INCOMING SECTION

Incoming section shall consist of the following basic elements.

- a) One 4 pole moulded case circuit breaker of adequate capacity with thermal magnetic overload and earth fault trip.
- b) One ammeter with selector switch for monitoring phase currents
- c) One power factor meter.

- d) One voltmeter with selector switch for monitoring phase to neutral and phase to phase voltages.
- e) One supply voltage monitor with the following features and interlocked with all motor starters.
 - Phase failure protection
 - Supply voltage imbalance (adjustable)
 - Under and over voltage (adjustable)
 - Phase reversal
- f). Lamp indicator to indicate operating condition of supply voltage monitor.
- g). Incoming terminals.
- h) Surge suppression device (surge arrestors)
- i) Duty selector switch with interlocking arrangements.
- j) One no. Three phase 04 pole MCCB of 30 A capacity shall be incorporated in the panel board for an auxiliary power supply
- k) Earth Leakage Relay

2.3.13 BUSBARS

All bus bars (TP&N running over the entire length of panel) shall be copper and of adequate thermal and short circuit capacity to withstand extreme short circuit conditions without permanent damage. An earth bus bar shall be provided at the bottom portion of the enclosure. Current density in busbars shall not exceed 3A per sq mm.

2.3.14 MOTOR STARTING SECTION

Motor starting panel shall be an integral part of the incoming panel with separate cubicles and doors for each section. Method of starting shall be DOL type. All starter should be wired to check the control circuit with the supply but without running the Motor.

Motor starters shall comply with BS 587 or equivalent. Starter shall be adequately rated for the required number of starts per hour and in any case not less than 6 starts per hour. Contactors incorporated in motor starter shall conform to BS 775 and BS 5424 or equivalent. If the method of starting is Auto Transformer, Then over heating protection for the Auto Transformer coils shall be provided.

Motor starter panel to be provided shall consist of the following basic elements.

- a). One 3 pole MCCB with adequate rated capacity and thermal magnetic overload trip to serve as the feeder for the starter.
- b). Contactors wired for DOL starting.
- c). One three phase adjustable thermal overload.

- d). Three ammeters to rated phase currents and ammeters shall be marked according to the phase designations, R – phase Y-Phase, B-Phase etc.
- e). Indicator lamps to indicate following :
 - * Pump running
 - * Pump tripped (overload)
 - * Pump stopped
 - * Pump tripped (low water level)
- f). Hours run meter
- g). set of control relays, timers etc. necessary for operation.
- h). 2 pole – MCB for control supply.
- i). Thermal protector relay connected to thermal sensors, mounted in the Motor windings.
- j). Power factor correction capacitors to correct the power factor to 0.95 lagging for motors of 25 kW and above.
- k). Auto transformers (if applicable).
- l). Outgoing terminals.

2.3.15 AUTOMATIC CONTROLLERS & INTERLOCKS

The following shall be provided.

- a). Automatic cut –off of the pumps when the well level in the sump is below the minimum level.
- b). Control relays, transducers, cables etc. necessary for realizing above shall be provided.

2.3.16 ELECTRICAL PANEL BASIC ELEMENTS

This section specifies the requirements for the basic elements to be used for the construction of Multi Motor starting panels.

2.3.17 MOULDED CASE CIRCUIT BREAKER (MCCB)

MCCB's shall be manually operated type manufactured to IEC 157 – 1 standard or equivalent.

Insulated phase barriers shall shield each pole of the circuit breaker, and circuit breaker contacts shall have adequate arc suppression.

MCCB's shall be fitted with thermal and magnetic overload trips and thermal trip shall be adjustable for all capacities. For capacities exceeding 100 A., the magnetic trip too shall be adjustable.

Breaking capacity according to IEC 157 at 400 V shall be above 20 kA for all MCCB's used.

Each incoming circuit breaker shall in addition be provided with instantaneous earth faults protection.

2.3.18 CONTACTORS

Contactors shall conform to IEC standards or equivalent for motor starting contactors. Capacities of the contactors shall be carefully selected leaving sufficient extra capacity, according to the AC – 3 rating.

2.3.19 AUTO TRANSFORMERS (IF APPLICABLE)

Autotransformers shall be 3 – phase type with tapings at 50%, 65% and 80%. Protection against overheating shall be provided by installing thermal sensors on all links and those shall be connected to the protection relay etc.

2.3.20 AMMETERS AND VOLTMETERS

- Instruments shall comply with BS 89.
- Instruments shall be of sealed type and shall be flush mounted on the cubicles.
- Ammeters fitted to motor circuit shall have a suppressed overload scale and shall operate with current transformers.
- Voltmeters with selector switches to read phase and line voltages shall be provided to read the voltages on all bus bars.

2.3.21 CONTROLS – INDICATORS AND ALARMS

Indication lamps and push buttons shall be colored as follows;

Lamp Marking	Colour
ON	Red
FAULT	Amber
OFF	Green

Button Marking	Colour
START	Green
STOP	Red
RESET	Black

2.3.22 EARTHING TERMINALS

Earthing bar mounted in the lower part of the enclosure (earth bus) shall be marked main earth terminal and shall be completed with screw connections, for earthing conductors.

2.3.23 SUBMERSIBLE POWER CABLES

All submersible power cables shall be supplied by the motor manufacturer and shall consist of four separate conductors, including the ground cable or a single cable assembly with four conductors including the ground cable.

All conductors shall be copper. Each conductor shall be insulated by synthetic rubber insulation suitable for continuous immersion in water. All cables shall be jacketed. The jacket material shall be oil and water resistant synthetic rubber. Cable sizes shall be

determined in accordance with IEE wiring regulations. The total length of the cable according to the drawings and BOQ of the same.

2.3.24 POWER CABLES

All power cables shall be PVC/insulated, 4 core with copper conductors. Cable sizes shall be determined in accordance with latest IEE wiring regulations.

All underground cables shall be PVC/SWA/4 core with copper conductors.

2.3.25 CONTROL CABLES

All control cables shall have copper conductors with minimum cross section of 1.5 mm².

2.3.26 CABLE INSTALLATION

Method of installation for cables shall be selected in accordance with IEE wiring regulations to suit the specific application. However, the following requirements are to met.

- a). Cables which are to be run on walls, ceilings or other building structures shall be secured on cable trays, ladders or enclosed in conduits or trunking.
- b). Where building structure incorporates covered trench system cable shall be laid on horizontal trays against the sides(s) of the trench
- c). Every cable shall be permanently identified at each end by cable markers with semi rigid black PVC carrier strip which shall be fixed axially by means of 2 PVC straps.
- d). All power cables and control cables to be run external to the buildings shall be in type 400 PVC pipes so that the cable can be pulled out for inspection and easy replacement. Manhole openings shall be provided every 30 m. or after bend and top side of the cable path shall be covered by suitable concrete slabs.

2.3.27 EARTH ELECTRODES

The earth electrode shall be minimum of 50 mm in diameter and be driven in to the ground at least 2 meters below the ground level. Where multiple rods are installed they shall be separated by a distance not less than their driven length. Earth electrodes shall be provided with a non – ferrous clamp and the connections shall be made in a concrete inspection chamber set flush with the finished ground level. The inspection chamber shall be permanently marked “ELECTRICAL EARTH”.

Where said conditions make the use of rod type electrode impractical or uneconomical a grid configuration may be used. The grid shall comprise horizontally buried bare copper tape or multi stranded cables.

Earth resistance of the earth shall not exceed 5 ohms.

2.3.28 EARTH CONDUCTORS

Earth conductors shall be sized in accordance with IEE regulations. PVC cable insulation shall be green. Cable armouring and screens shall not be used as sole earth protective conductor, and earthing shall be arranged in accordance with BS 7430 of 1991.

2.3.29 ITEMS TO BE EARTHED

The following equipment shall be connected to the main earth terminal by means of earthing conductor with cross sectional area as per requirement of IEE wiring regulations;

- a) Panel enclosures
- b) All motor cases
- c) Metal cable trays, supports etc.
- d) Any other metal object which may become under faulty conditions.

2.4 SPARES

Bidder shall quote for the following spares for each pumping set.

A. Spare Parts for each pumping set

1. Bare shaft pump with submersible cable 01 Nos
2. Cable joint kit (resin type) 01 Nos

B. Spare Parts for Starter (each)

3. Main contactor AC3 type 01 Nos (specify)
4. Auxiliary Contacts (if any used for Starter) 01 Set (specify each)
5. Overload trip switch 01 Nos
6. Overload Relay 01 Nos
7. Relay 01 Nos of Each type
8. Indicating bulbs 05 Nos. of each colour
9. Ceramic Fuses (if any used) 03 Nos from Each type
11. Push Buttons 05 Nos of each type
12. Fuses 05 nos. of each type
13. Level protection relays 01 Nos with electrodes
14. Voltage monitoring relays 01 Nos
15. Surge Arrestors 01 Sets

PART 3 – EXECUTION

3.1 INSTALLATION

The contractor shall provide the complete pumping system and factory – trained personnel to supervise installation and initial operation of all components. The pumps shall be aligned, connected and installed at the locations shown and in accordance with the manufacturer's recommendations. Contractor shall certify that the equipment is installed in a manner to ensure proper operation.

3.2 CERTIFICATION

Manufacturer shall supply certified pump performance curves demonstrating compliance with the performance specified herein.

3.3 TESTING

After the completion of installation each pumping unit shall be field tested to ensure compliance with the performance requirements a specified.

Any additional costs that may have to be incurred due to non – performance of the equipment shall be recovered from the contractor as per the clause 1.11 of this specification.