SPECIFICATION FOR
SUPPLY & INSTALLATION OF AUTO COUPLING TYPE WET WELL ELECTRICALY DRIVEN SUBMERSIBLE PUMPS AND ACCESSORIES

(OUT PUT HYDRAULIC POWER ABOVE 30 KW AT THE SPECIFIED OPERATING POINT AS PER THE SPECIFICATION)

DRY WELL ABOVE 30 KW

Revised on 02-09-2017

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SUPPLY AND INSTALLATION OF SUBMERSIBLE ELECTRICALLY DRIVEN DRY WELL TYPE SEWAGE PUMPING SETS AND ACCESSORIES

GENERAL SPECIFICATIONS

1. NATURE OF BID

The Contractor shall carefully study the drawing mentioned under scope of work and fill in the price in the attached bill of quantities. It is to be distinctly understood that the total quantity Bided for is to be complete and comprehensive of all minor deficiencies if any, in the brief description. No variation or extras will be allowed except in respect of alterations, which are specially authorized in writing. No alterations shall be made without the written permission of the Engineer.

2. SURPLUS STOCK

No compensation shall be paid by the Board on completion of the work for any surplus stock of pipes, specials, fittings etc. and materials obtained for the purpose of this Contract. However, on completion of the Contract, the Engineer may retain any surplus stock, which would be useful for the maintenance of the above scheme and pay at prices agreed upon at that time by the Engineer and the Contractor.

3. POWER SUPPLY

The necessary 400V, *3↓ & N* 50Hz electric power will be made available at the CEB meter cubical. The panel for pumps, cabling from CEB point and all other cabling accessories shall be provided and fixed by the Contractor.

All electrical equipment & wiring shall conform to the standards set by the I.E.E., UK as well as Sri Lanka regulations and be acceptable to the Ceylon Electricity Board, Sri Lanka.

4. CALIBRATION OF INSTRUMENT & METERS

All instruments & meters shall be calibrated in the Metric Units as follows ;

(i) Pressure shall be indicated in meter water column.
(ii) Flow shall be indicated in cubic metres/hour or litre/second.
(iii) Quantities shall be indicated in cubic metres.
(iv) Time shall be indicated in Hours
(v) Amperage shall be indicated in Amperes.
(vi) Voltage shall be indicated in Volts.

5. LITERATURE ON EQUIPMENT AND MATERIALS

The Bidder shall supply detailed literature and specifications from the manufacturers in respect of all equipment and materials included in his offer and give the names of all such manufacturers and the countries of origin of the materials and equipment.

6. LOCAL MATERIALS TO BE USED IN WORK

All materials and fittings which are manufactured locally by State sponsored Corporations and other local agencies and which are upto the required standards will not be allowed to be imported and no foreign exchange will be given for the same.

7. INSTALLATION, TESTING AND COMMISSIONING

Refer the specific specifications for Pumping Sets and Accessories.

8. CALCULATION OF OPERATIONAL COST

In the evaluation of bidders, percent worth of operational cost will be considered and followings will be used in calculation of operational cost.

1). Overall efficiency of the pumping unit
1) Economic life of equipment - 10 years
2) Annual operational hours of each pumping unit (As per the specific specifications for Pumping Sets and Accessories)
3) Cost of Electrical Energy – Rs *9.30(present rate)* per kWh
4) Chargers for Maximum Demand – 670/=*(present rate)* per kVA
5) Discounting Rate - 12%

9. WARRANTY PERIOD

The supplier should provide a warranty period of minimum 03 years for trouble free operation of all equipments and accessories supplied under this contract.

During first two years of warranty period all the works describe under the maintenance period have to be attended.
In the third year of warranty, the works describe under item III of maintenance clause have to be attended.

The contractor should provide required materials, labour and spare parts during the warranty period without any charged to NWS&DB. The warranty period *commenced from the taking over date as per the taking over certificate. The contractor* has to assure that he is equipped with sufficient resources to attend any maintenance or major breakdowns immediately after inform by NWS&DB.

10. LOCATION OF INSTALLATION OF PUMPS & MOTORS

Pumps and Motors shall be installed at …….. (Provide Location of the Pump Installation)

SUPPLY AND INSTALLATION OF SUBMERSIBLE ELECTRICALLY DRIVEN DRY WELL TYPE SEWAGE PUMPING SETS AND ACCESSORIES

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SUPPLY AND INSTALLATION OF SUBMERSIBLE ELECTRICALLY DRIVEN DRY WELL TYPE SEWAGE PUMPING SETS AND ACCESSORIES

CONTRACT No. ……

1. PUMP SPECIFICATION

The *sewage* consist of high content of sand, therefore materials of impeller and housing shall be selected considering this condition.

Each pumping set shall be of the following requirement,

The *sewage* rarely consist of some large matters as cloths, sanitary wears, cotton threads and wooden particles, therefore impeller and casing should be designed to withstand and protect such above situations without affecting to the motor shaft and mechanical seals, If impeller is blocked ,there should be arrangement to easy cleaning of the impeller.

The impeller should be Non-clog type and include special features to prevent frequent blockages inside the pump but pump efficiency will be critically considered in the evaluation of bids.

1.1 As the operating head of the system is going to vary according to the sewerage level in the sump/manhole and the number of pumps in operation, (either solo or parallel), the Q Vs H curve of the pumps should be of the steep type to avoid large capacity variations against small change of head and also should have an efficiency curve flat at the crown over a considerable range of flow for efficient operation.

1.2 Pump shall be suitable for single or parallel operation. As per specified.

1.3 The both upper & lower seals should be of ***double*** **heavy-duty type tungsten** carbide mechanical seals.

1.4 Material of Impeller, Pump casing and Discharge connection shall confirm to following condition to withstand for erosion and corrosion resulting due to high sand content in sewage.

*For the pump rating, power (*Out put hydraulic power above 25 kW at the specified operating point as per the specification)

Ductile iron confirming **to EN-GJS 500(GGG50) with hardness above 200HB or**
Chilled cast iron JN3029

1.5 Pump shaft, shaft sleeves, nuts & bolts, screws & washers etc shall be in stainless steel

1.6 Pump Construction
Pump installation type should be horizontal/ vertical as per the specification.

The impeller shall be precision machined for maximum hydraulic efficiency and dynamically balanced for minimum vibration. The impeller shall be given a *plastic or epoxy coating* to prevent corrosion. .

The volute casing and discharge connection shall be of smoothened on inside. The other surfaces shall be primed with PVC Epoxy (Microns 200) then painted with rubber paint.

All necessary suction and delivery connections and accessories also should be supplied from the pump manufacturer (Pump stand, suction bend, pump bed, reducers, etc.)
The pump housing shall be capable of withstanding 1.5 times closed valve pressure.

The bearing shall be adequately sized and efficiently lubricated with oil greased sufficiently for at least 50,000 hrs continuous smooth and vibration free operation.
Bearing seals shall effectively prevent the ingress of sewage to the bearings or the *motors*.

1.7 Pump Efficiency

The efficiency at the specified duty will be a consideration in the evaluation of the offer. Therefore complete pump performance curves should be given with Biding document. An alternate offer for pumps with lower efficiency may be considered if a suitable offer for a pump of the required efficiency is not received.

Minimum overall efficiency should be greater than 55%

1.7.1 Overall Efficiency Penalise

The penalty (P) applied will be calculated in following way, in event of non compliance with guaranteed overall efficiency

P = Total contract Price x ($E_g - E_a$)
E_g = Guaranteed Overall Efficiency
E_a = Actual Overall Efficiency
Efficiency should be calculated in the sump level at mid point and valves in full open position.

1.8 Performance Curves to be submitted

Pump performance curves (originals) to be submitted with the Bid shall show:

- Head (metres) Vs Flow (l/s)
- Pump efficiency (%) Vs Flow (l/s)
- Overall efficiency (%)Vs Flow (l/s)
- Power required to drive pump (kW) Vs Flow (l/s)
- *NPSH required*

Original performance curves certified by the pump manufacturer should be furnished and photo copies will not be accepted even certified by the local agent.

If the offered empeller is not original standard size (Manufacture is going to trim the impeller) The performance curves before trim the impeller also should be forwarded with the offer and it should be clearly marked as 'Performance curves before trim the impeller'

A dimensioned cross sectional drawing of the pumps complete with materials of manufacture shall be provided with the Bid.

Pumps shall be provided with all type test certificate in accordance with an internationally recognised standards, such as Australian Standard AS 2417 – Rotodynamic Pumps, Hydraulic Performance Tests – Grade 2 or ISO 9906; 1999 (E)

1.9 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 torsional stress exceeding 2.4 x 107 N/m2.

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.

1.10 Factory Testing

1.10.1 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.

1.10.2 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.

1.10.3 Performance Tests

Pumps shall be factory tested for performance in accordance with BS 5316: Part 1: 1976 or *ISO 2548* 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 may witness these tests.

1.10.4 Vibration Tests

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

2. MOTOR SPECIFICATION

2.1 Motor

The motors shall be squirrel-cage *induction type*, 400v, 3 phase 50Hz.

The windings shall be of class F insulation but operating within class B temperature rise.

All motors shall have submersible cables sufficiently long to reach from the control panel to the pump and in any cases of minimum length ***(specified in specific specification)*** and the cable shall be highly suitable for sewerage operation. Index of motor protection shall be to IP 68.

Motor windings thermal protection, Moisture sensors, Water in oil sensors should be available as per the application. Moisture detectors & thermal sensors shall be included in motors.

Motors shall be enclosed in rugged quality cast Iron housing. The outer surface of the housing shall be primed with PVC Epoxy (*thickness 200 microns)* and then painted with rubber paint.

Stator shall be of the locally rewoundable type. Voltage variations of up to + 6 % shall be possible without over heating the windings.

The pumping sets shall be capable of daily continuous operation and capable of a maximum of 10 starts per hour with a *starting system as per the specification.*

Motor RPM should be as per the specifications or should be less than 1500 RPM

Following details should be mentioned in the motor nameplate except to the standard notifications
Make, Model, Serial number, maximum rated current, rated power out put ,Cos∅, Voltage, RPM, Frequency
Motor bearing temperature sensors should be installed and displayed in relevant panel.
The continuous power rating of the motor shall be at 15% greater than the power required to drive the pump over the full operating range.
A dimensioned cross sectional drawing of the motors complete with materials of manufacture shall be provided with the Bid.
The efficiency at the specified duty will be a consideration in the evaluation of the offer. Therefore complete motor performance curves should be given with Biding document.

When design the motor cooling jackets followings should be considered critically

- Even sufficient cooling
- Easy and sufficient water circulation in side jackets
- Prevent air taps in side jackets and easy air release method
- Prevent any settlements inside jackets

For the water cooling motors inlet and outlets of the water jackets should be sufficiently large to prevent deposit of any materials inside the jackets.

Motors shall be provided with all type test certificate in accordance with an internationally recognized standards.
Motor shall be **continuous operation type & specially design for high efficient operation with efficiency higher than 90%.**

2.2 Motor Tests

Motors shall be tested in accordance with *NEMA* and *IEE* Procedures. The tests shall include,

(a) Routine Tests

1 No load current.
2 Locked Rotor Current.
3 Winding Resistance.
4 High Potential Test.

(b) Complete Tests

1 Rated Load Temperature Rise.
2 Slip.
3 Locked Rotor Torque.
4 Breakdown Torque.
5 Efficiencies at 100, 75 and 50 percent of Full Load.

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

2.3 Cables

2.3.1 Submersible Power Cables

All submersible power cables shall be supplied by the motor manufacturer and shall consist of cable assembly with the required number of conductors including the ground cable.

All conductors shall be of 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. Cable entry to the motor shall be designed to incorporate both a seal and strain relief function.

2.3.2 Power Cables (Others)

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

All directly buried cables shall be PVC/SWA/XLPE, Cu 4 core with copper conductors.

3 CONTROL PANEL

3.1 General

The control panels shall be completely designed, fabricated assembled, wired, checked and tested at the factory as per standards and per descriptions given below.

The design arrangement and finish shall be elegant and workmanship shall be of a high order with hinged and lockable door. Door should be connected with flexible links to the body of the panel to ensure earthing of the door. The switch board and its components should be suitable for the operation on 400 volts $\pm$ 6% 3 phase 4 wire, 50Hz AC Supply.

3.2 Construction

The panels shall be of sheet metal, outdoor type and floor mounted *or wall mounted* as per the specification The design shall be totally enclosed, dust and rain splash-proof as per *IP 55* of IEC publication 34-5. The housing of the panel shall be fabricated of 14 SWG. The outer and

inner surface of the panels shall be primed and painted with corrosive resist PVC ,Epoxy or plastic, marine grade special coating , colour as specified.

The panel board structure should be constructed using Grade 20 concrete as shown in the Drawing (***Please refer pump specification***)

The equipment shall be logically neat and confirming to the specification stipulated.

Access to all equipment mounted inside shall be from the front.

Switch gears and earth bus bar, main connections and auxiliary wiring shall be arranged and marked in general compliance with relevant British standards.

3.3 Earthing

A suitable earth terminal should be provided to facilitate the connection of the main earth. Earthing arrangement should be complies with BS 7430 and earth resistance of the main earth should not be exceed 5 Ω.

3.4 Wiring

Control wiring shall be concealed by taking through neatly arranged PVC wire trays and all control wires shall be terminated with cable lugs or compression type terminals. All Current carrying bolts and nuts shall be of high conducting material.

3.5 Control Panel Equipment, Controls and Protections
The equipment to be mounted on the control panel of each pump shall consist of the following **and starting method as per the specification.**

3.5.1 One number 3 phase moulded case circuit breaker (MCCB) of adequate capacity with thermal magnetic overload and earth fault trip as an incomer. The MCCB should have a handle for manual operation and ON, OFF and TRIPPED positions.

3.5.2 Suitably rated 04 pole circuit breakers for each starter.

3.5.3 One number three phase earth leakage protected spare MCCB of capacity as per the specification for ancillary lighting etc.

3.5.4 Four Number surge arresters for each phases and neutral.

3.5.5 The starting method should be auto transformer or as per specified. If the starting system is Auto Transformer starter, its transformer coil capacity (KVA) **should be at least 1.2** times of Motor apparent power (Motor rated power divided by the motor power factor) and coils should be consisted with thermal protections.

3.5.6 One number voltmeter with a selector switch for monitoring the supply voltage phase to phase and phase to neutral and separate ammeter with selector switch for incomer.

3.5.7 (a) Indicator lamps (03 Nos.) for 3 phase to indicate 'Power On'

(b) Indicator lamps for running, stopped, tripped for overload and tripped for low level for each pump.

(c). Indicator lamps for low-level indication of the sump water level.

(d). COS ∅ meter, Energy meter and power analyser should be install in the power incomer

3.5.8 Hour run meters and ammeters for each pump.

3.5.9 A relay shall be incorporated in the control panel to monitor the voltage/phase sequence and phase in balance on incoming supply and to cut off the pump (pumps) in operation in the event of phase failure, in the event of incorrect phase sequence. (Imbalance should be adjustable), under and over voltage.

3.5.10 ANUAL/OFF/AUTO Operation mode selector switches (one for each pump) to select operations mode of the pumps.

3.5.11 Push buttons for start stop and reset for each pump.

3.5.12 One number delay relay to prevent simultaneous starting of both pumps (if applicable)

3.5.13 Dimensions of the panel Cubical should be selected to keep sufficient space between each items and wall to items as per

3.5.14 Following protection relays should be included in the panel for motor winding thermal protection & higher motor bearing temperatures, auto transformer thermal protection, Moisture sensors in the motor , water in oil sensors in the oil chambers, dry run protection, automation facilities as per specified.

3.5.15 Panels' manufacturer should have ISO quality certificate for the panel manufacturing and **relevant ISO quality certificates** for the relative products being used to install the panel. Before installing the panel, concern letter (authorized letter for the panel) and two years warranty certificate should be forwarded from the panel manufacturer.

4 SPARES

The Bidder shall provide an itemized price list for the following of spares.

(1). Contactors (With coils)	01 Set of Each
(2). Overload Relays	01 Set of Each
(3). Timer for Starter	01 Set of Each
(4). Timer for Delay Relay	01 No
(5). Indicator Bulbs	30 Nos
(6). Float Switches	02 Set (If applicable)
(7). Control Relay (Phase failure, Earth leakage, etc.,)	01 Set of Each
(8). Cable Entry Seal Assy	01 for each pump
(9). Pump Upper Seal Unit	02 for each pump
(10). Pump Lower Seal Unit	02 for each pump
(11). 'O' Rings	02 complete sets for each pump
(12). Impeller	01 for each pump
(13). Water in oil sensors	01 for each pump
(14). Auto transformers(If applicable)	01
(15). Bearing temperature sensors	01 set

5 INSTALLATION TESTING AND COMMISSIONING

All installation work shall be carried out in accordance with relevant International Standards and codes of practice.

When all installation work is satisfactorily completed, the contractor shall inform the Engineer in writing that equipment are ready for handing over and the Engineer shall then fix a date for taking over.

a). At the taking over all equipment shall be tested for a period as per the application to determine the following.

- That pumping sets are capable of delivering specified quantity against specified head.
- Those equipment are in satisfactory mechanical conditions.
- That motor control centre functions properly.
- The efficiency and other specified characteristics.

b). To test equipment, the contractor should be used and provide following equipment

- Pressure gauges
- Portable flow meter for flow reading
- Power & harmonic analysers to analysis power
- Vibration monitors
- Sound level indicators.
- Thermo meters

If the Engineer is not satisfied with the performance of the equipment or other installation, he may refuse to take over the equipments until necessary improvements are effected. Any time necessary for this additional work will be considered as contractor's delay.

6 MAINTENANCE PERIOD

The pumping units and other equipment shall be satisfactorily maintained for a period of 24 months from the date of pumping sets is taken over. During the maintenance period, the contractor should attend to

I. All periodical service (schedule of periodical service should be submitted with the bid)
II. Maintain a maintenance record (format of maintenance record shall be submitted with bid)
I. Attending to all the repairs and replacements to avoid any failure of the system with in a time period not less than 10 days from the date the contractor has been notified.
II. In addition to the equipment which fails, the equipments that do not give satisfactory performance during the period of maintenance shall be replaced by the contractor with in 3 weeks from the date the contractor has been notified.

The expenses involved in this connection shall be born by the contractor who should take this in to consideration when biding.
If the contractor is not attended to the repair within the time specified as above, the engineer has the right to rectify the fault and claim the cost thus incurred from the contractor.

7 PRESSURE GAUGES

Pressure gauges should be installed in the discharge line with the ball valves and above pressure gauge.

- Calibration in water column in m.
- Diaphragm type or gleserine filled stainless steel pressure gauge and sufficiently large the dial to read easy (not less than …….. cm dia)
- Calibration range should be within the range of (130 % of pump shut off head ≤ Calibration range ≤ 160% of pump shut off head)

8 TECHNICAL LITERATURE (SUBMITTALS)

8.1 The following technical literature for the pumps, pannel, motors, and accessories, shall be forwarded along with offer.

a) Technical Specification of the pumping sets (Features, dimensions, cross Sectional drawing of the pump showing materials, etc.)

b) Pump selection catalogues, family curves and available standard pump curves

c) Original of all pump characteristic curves certified by the manufacturer

d) Details and diagram of control panel including control circuit, power circuit, etc. Details of electrical items inside the panel should be mentioned including ratings, make, model, country of origin, manufactures country etc.

e). Technical Specification of the motor (Pump selection catalogues, other technical details)

f). Letter of conformation from the manufacturer for fiver years guarantee for impeller and pump housing (volute)

g). The following reports on materials of pump casing and impeller should be provided from the pump manufacturer

- Mechanical properties of pump casing and Impeller material (Tensile strength, Hardness, etc,.)
- Chemical composition of pump casing and impeller material (C, Cr, Mo, S, Ni, P, etc,.)
- Relevant BS/ISO/DIN/standards for materials
- Micro structures details
- Coating materials

8.2 Following details for valves, the DI pipe and fittings shall be forwarded along with offer.

a). Following details of Non return valves should be forwarded(As per the specifications)

- Details of non slamming mechanism
- Details of rapid closure mechanism
- Soft sealing features

b). Details of DI pipes and fittings

c). Details of sluice valves

- Details of gear mechanism
- Soft and zero leakage sealing features

8.3 The successful bidder shall provide three complete set of following documents(information's to be provided)

- Pump installation details manual
- Pump operation and maintenance manual (pump assembling and disassembling, maintenance details should be included, oil types, clearances, etc.)
- Inbuilt control and power circuit
- Pump spare parts manual

8.4 Pump manufacture's address, telephone no, Email & nearest agent's address, telephone no, Email, etc and other details should be included

9 SPECIFIC SPECIFICATIONS

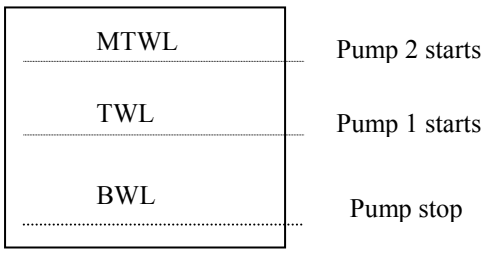
Each pumping set shall be of the following requirement,

Item No	Description	Unit	Figure
1.	Number of pumps to be installed	Nos.	(As per design)
2.	Number of pumps in parallel operation	Nos.	(As per design)
3.	Type of installation(vertical/horizontal)		(As per design)
4.	No of standby pumps	Nos	
5.	Pump Capacity at Duty point	[l/s]	(As per design)
6.	Pump Head at Duty Point	[mWC]	(As per design)
7.	NPSH available at the critical operation	[mWC]	(As per design)
8.	Minimum possible Pump Operating Head	[mWC]	(As per design)
9.	Maximum possible Pump Operating Head	[mWC]	(As per design)
10.	Expected overall efficiency at duty point	%	**(As per design)**
11.	Expected nominal speed	rpm	(As per design)
12.	Method of starting	-	(As per design)
13.	Number of starts per hour	No/hr	10
14.	Connection to pipe	-	Flange
15.	Media to be pumped	-	Sewerage
16	Average PH value		
17	Average Ambient temperature		
18	Average media temperature	^{0} C	(As per Site condition)
19.	Average Specific gravity	-	1.05
20.	Average Viscosity	gm/cm/sec	0.020
21.	Solid particle size to be handled	Diameter in mm	(As per design)
22.	Total Annual Operation Hours	Hours	(As per design)
23.	Submersible power cable length	meter	……
24.	Panel board (colour, etc….)	As per Drawing No……..	
25	Max. allowable suction flange dia.		
26	No of Stations	Refer scope of work	

Table No ….

10. The content of paragraphs under this sub heading in this page should be modified to suit the design requirement

10.1 An automatic control system shall be incorporated to start the pumps successively at different start levels as the sump level rises for each pump houses. When the level drops all the pumps shall stop at the bottom Water Level (BWL) as shown below. The starts shall be re-distributed among the pumps (to maintain equal running hours of each pump). (When selected 'Auto' mode the Duty Selector Switch should be by passed).



A Series of float switches or any other PLC system shall be used to monitor the level of fluid in the sump and the control system shall be monitors these float switches and determines which pump is to be started. The pump operating system shall be as follows.

If waste water level rises above TWL, while one pump is running the second pump shall start.

10.2. For the designed method of pump operation, the levels in the sump shall be sensed by means of bulb type float regulators or ultrasonic level sensors. These regulators shall be acid resistant and totally enclosed and shall be suitable for sewerage operation.

10.3. In the event of a fault in the running pump, the automatic control shall switch off the faulty pump and start the other.

11. SPECIFICATION FOR PIPES, VALVES & SPECIALS

11.1 GENERAL

1.0 All pipe works, valves and specials for the delivery pipes of pumps as indicate in the drawing are supplied by the contractor.

1.1 The Bidder should install all pipes and fittings mentioned above Complete with gaskets and/or rubber rings, packing, brackets supports etc. to working order

1.2 Increases and decreases in pipe work diameter from the pump delivery and suction flange to the point of joining the delivery main shall be made by correctly designed tapers.

1.3 All pipe work, fittings & valves shall be suitable for testing on site to a hydrostatic pressure in excess of the maximum surge pressure or twice the total pumping head whichever is greater.

11.2 DUCTILE IRON PIPES

Ductile Iron pipes and specials shall be obtained from a reputed manufacturer, and supplied with flanged joints. The working pressure shall be suitable for the application.

Ductile Iron Pipes and Fittings shall be in accordance with BS EN 598:2000 and shall be internally lined with a cement mortar *sulphur resistor* lining suitable for sewers in accordance with ISO 4179, which shall be painted with an approved *non toxic seal coat*.

11.2.1 REFERENCE STANDARDS

The following standards are referred to:

ISO 2531 : 1998	:	Ductile iron pipes, fittings and accessories for pressure pipelines
BS EN 598 : 2007	:	Ductile Iron pipes and fittings
BS EN 681.1 : 1996 BS EN 681.2 : 2000 BS EN 682	:	Electrometric joint rings for pipe work and pipelines
BS 3416 : 1991	:	Black bitumen coating solutions for cold application
BS 4147 : 1980	:	Hot applied bitumen based coatings for ferrous products
BS EN 1092 Part 2: 1997		Flanges and their joints. Circular flanges for pipes, valves, fittings and accessories, PN Designated, Cast iron flanges.
BS EN 1515 Part 1:2000 BS EN 1514 Part 1:1997	:	Dimensions of non-metallic gaskets for pressures upto 64 bar
S *598-2000*: Part I	:	Flanges and bolting for pipes, valves and fittings : Ferrous
BS 4865 : Part I 1989	:	Dimensions of non-metallic gaskets for pressures up to 64 bar.
ISO 4179 : 2005	:	Ductile Iron pipes for pressure and non pressure pipelines Centrifugal cement mortar lining – General requirement
ISO 6600 : 1980	:	Ductile iron pipes centrifugal cement mortar lining (Composition controls for freshly applied mortar).
ASTM or AWWA CI04 or A21.4	:	Cement Mortar lining for case iron and Ductile iron pipes and fittings for water
ISO 8179 Part 2 : 1995	:	Ductile iron pipes – External Zinc coating – zinc rich point
BS 8010 : Part 2:1987	:	Code of practice for pipe lines on land: design, construction and installation section 2.1 Ductile Iron
BS 5750 Series:1987	:	Quality Systems – Production and installation
ISO 9001 : 2000 Series	:	Quality Management System

11.3 SLUICE VALVE

Sluice valves shall be standard water works pattern double flanged cast iron with resilient seats, gunmetal, nuts, faces and bushes and forged bronze spindles, appropriate for clockwise closing.

All sluice valves shall comply with the general requirements of *BS 1218* and tested to one and a half times the working head.

11.4 NON RETURN VALVES

Non-return valves shall be, swing type or free acting ball type specially designed for use in sewage pumping systems, giving non-slamming closure and raped closing with the optional adjustment mechanisms for the above and with low head loss characteristics when the valve is in the open position.

11.5 SPECIAL SPECIFICATIONS FOR SEWAGE WORKS

11.5.1 All ductile iron pipes and fittings shall be internally lined with sulphate resistant cement mortar in accordance with ISO 4179/BS EN 598 which shall be painted with an approved seal coat.

11.5.2 The material for the joint rings and the gaskets shall be in accordance with the requirements of BS EN 681.1, 681.2 and 682.