TENDER DOCUMENT

FOR SUPPLY COOLING TOWER FOR DREAMS MALL, KOTTIYAM, KOLLAM

TENDER NO: DREAMS MALL/2022 DTD 02/03/2022

CLIENT

M/s DESINGANADU RAPID DEVELOPMENT & ASSISTANCE CO-OP SOCIETY LTD, Q – 1666,

KOTTIYAM P.O., KOLLAM, KERALA.

ARCHITECTS

M/s ABHILASH ARCHITECTS,

NEAR ART OF LIVING ASHRAMAM,

KOLLAM, KERALA, INDIA -691012

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INDEX

NOTE:

Vendor/Tenderer/Contractor - here means Approved Makers.

Architects – here means M/s Abhilash Architects

Client – M/s Desinganadu Rapid Development & Assistance Co-op Society Pvt. Ltd.

SECTION A

NOTICE INVITING TENDER

M/s Desinganadu Rapid Development & Assistance Co-op Society Pvt. Ltd. is inviting tender for "Supply for cooling Tower for DREAMS MALL, KOTTIYAM, and KOLLAM".

The Due date of Submission of Tender is 11/04/2022.

i) The tenderers are required to submit their tender as per the information mentioned in the tender documents and if there is any deviation in tender specification, the same shall be submitted separately along with the tender documents. Tenderers are required to fill the tender technical specification sheets without fail.
To qualify for an award. Each tenderer shall have comply the following requirements

ii) The successful Tenderer will be required to enter into a formal agreement with Client after the issue of Letter of Intent.

iii) The tender hard & soft copies should be sent to M/S Desinganadu Rapid Development & Assistance Co-op Society Pvt. Ltd. (dreamsmall.engineering@gmail.com) by 16 00Hrs on or before 11/04/2022.

iv) Tenders shall be valid for days (ninety) from the date of opening of tender.

v) Client reserves the right to accept or reject any tender and also shall modify the tender dates without assigning any reason depending upon the site conditions. Further, the client does not bind himself to accept the lowest tender.

vi) The tender should be signed by an authorized official of the company. The tender should be handed over in a sealed cover.

vii) Client reserves the right to increase or decrease the no. of units proposed before finalization of the order or reserves the right to nullify the tender if needed without assigning reasons.

SECTION B

Terms of Payment AND Taxes & Duties:

1. Terms of Payment:

a. 10% of the Contract Value shall be payable as advance immediately upon signing the Contract and against the submission of Bank Guarantee.

b. 70% of the Contract Value shall be payable against delivery of material at site/Letter of Credit as per rules

c. 10% of the Contract Value shall be paid after completion of testing & commissioning and handing over of equipment.

d. 10% of the Contract Value shall be payable as retention after warranty period. However, this amount can be released against the submission of retention Bank Guarantee.

2. Taxes & Duties:

- The prices are inclusive of all taxes, duties, levies, and transport charges etc.

SECTION C

TECHNICAL SPECIFICATIONS

A. CHILLER PLANT ROOM

1. INDUCED DRAFT COOLING TOWER

(a) Scope

Scope of this section includes the supply, installation, testing and commissioning of induced draft cooling tower conforming to the specifications and in accordance with the requirement of drawings and of the Bill of Quantities.

(b) General Information

The cooling tower manufacturer shall be responsible for the design, fabrication, and delivery of materials to the project site, and for the erection of the tower over supporting grillage provided by HVAC contractor.

The Cooling Towers shall be of induced draft - FRP type induced draft cross flow design construction and shall be low noise type. Each cooling tower shall be complete with motor, low speed fan, casing, PVC filling, FRP water distribution basin and accessories as described below. The Cooling tower shall be of mechanical draft type. The Low Speed Fans may be located on the air inlet side or the air exit side.

(c) Construction

Cooling tower main frame shall be of a 3 steel hot dipped galvanized. The casing and cold water basin shall be FRP construction. The basin design shall be of bottom type and sloped to centre with a channelled sump for cold water piping connection at the bottom. The hot water distribution system shall be gravity feed type fitted with removable target nozzles to ensure equal water distribution over the fill.

The structural framework of the cooling tower including all members shall be designed for the load encountered during the normal operation of the cooling tower and its maintenance. The structure shall be rugged and rigid to prevent distortion and shall include tie arrangements as may be necessary.

- **Base**

An induced draft, cross flow type, factory assembled, industrial duty, fiberglass reinforced plastic casing and basin with Hot – Dipped galvanized steel frame construction cooling tower as shown in the drawings / equipment schedule. Overall dimensions of the tower shall be as indicated in the drawings / equipment schedule

- **Casing & Fan**

The casing and fan deck shall be of heavy gauge galvanized steel, and shall be capable of withstanding the loads.

The fan shall be low speed, multi-blade axial flow type, made of aluminium alloy or FRP. The fan assembly shall be statically and dynamically balanced.

Fan shall propeller type, incorporating heavy duty blades of cast aluminium alloy or high strength, inert composite material (GRP). Blades shall be individually adjustable. Fan shall be driven through a right angle, industrial duty, oil- lubricated, geared speed reducer. Speed reducers employing pulleys and belts will not be acceptable.

- **Motor & Drive**

Fan motors shall suitable for 415V +/- 10%, 50 Hertz, 3 phase, AC supply. It shall be EFF1 type squirrel cage, totally enclosed fan cooled motors. Motors shall be specially designed for quiet operation and motor speed shall not exceed 1450 RPM. Fan motors shall be mounted inside the tower with gear arrangement.

Motor shall be TEFC weather proof, squirrel cage induction type. Speed and electrical characteristics shall be less than 1500 RPM, singly winding, 3 phase, 415 +/- 10 % Volts, 50 Hertz. Motor shall be located outside the humid interior of tower, in a corner on the fan deck. Fan motor shall be totally enclosed fan cooled squirrel cage type conformity to IP-55 protection for outdoor operation. The motor shall be provided with water tight terminal box & GSS canopy.

- **Fins louvers & drift eliminators**

Fill shall be film type, vacuum – formed PVC, with louvers and drift eliminators formed as a part of the fill sheets. Fill sheets shall be individually suspended from HDG steel structural tubing supported by the tower columns and intermediate HDG steel panels, and shall be elevated above the floor of the cold water basin to facilitate cleaning.

Air inlet faces of the tower shall be free of water splash – out, and guaranteed drift losses shall not exceed 0.005% of the design water flow rate. The inlet area shall be provided with stainless steel SS-304 louvers.

The filling shall be of PVC. Thickness of PVC fills shall not be less than 0.2 mm. These shall be of such construction as to provide low air resistance, large wetted surface for a high heat transfer efficiency and east to replace ability.

Drift eliminators of PVC shall be provided for maximum removal of entrained water droplets. The spacers and tie rods used shall be of plastic material.

The air intake shall be from openings all along the sides of the casing near its base. These openings shall be covered with hot dip galvanized expanded metal mesh screens.

- **Basin & accessories**

The FRP cold water basin shall be sealed watertight, and shall include a float – operated mechanical make – up valve, a 100 mm diameter overflow connection, and HDG steel debris screen with bottom outlet. Basins with flange at bottom are not acceptable.

The basin shall have a holding capacity adequate for operation for at least 30 minutes without addition of make-up water to the basin. The construction should be such as to eliminate the danger of drawing air into the pump when operating with minimum water in the basin.

The basin fittings shall include the following:

1. Bottom / side outlet.
2. Drain connection with valve.
3. Float valve type automatic make-up connection with valve.
4. Overflow connection.
5. Bleed off with valve, from inlet header to overflow pipe.

(d) Tower Installation

Cooling tower shall be suitable for installation on Terrace and high Wind & Storm. Design Wind Pressure shall be 156 kg/sq.m at Terrace Level.
Cooling towers shall be assembled rigged and installed in accordance with the manufacturer's recommendations. The tower shall be mounted on concrete plinth supports as per the approved shop drawings
To ensure safety of personnel at the time of working on cooling tower a steel ladder shall be provided in such a manner and location as necessary to give safe and complete access to all the parts of the cooling tower requiring inspection or adjustments. The ladder shall be bolted to the tower at the top and grouted in masonry at the bottom end.

(e) Performance

Heat rejection capacity shall be computed at site. Flow / temperature measurements devices shall be accurately calibrated. The temperature gauges shall be mercury-in glass thermometers. Computed results shall conform to the specified capacities and quoted ratings. Power consumption shall be computed from measurements of incoming Voltage and input current.

The following parameters shall be measured and recorded for test results :

1. Water Temperature – Entering : °C.
2. Water Temperature – Leaving : °C.
3. Wet bulb Approach : °C
4. Fan Motor current : Amps
5. Fan motor Voltage : Volts

6. Fan motor speed : RPM

2. CENTRIFUGAL WATER PUMPS

(a) Scope

This specification covers the supply, installation, testing & commissioning of horizontal end suction centrifugal pumps of mono block type.

(b) Requirements

The design, materials, construction, manufacture, inspection and performance testing of end suction horizontal centrifugal pumps shall comply with all currently applicable statutes, regulations and safety codes in the locality where the equipment is to be installed. Nothing in this specification shall be construed to relieve the CONTRACTOR of this responsibility. The equipment supplied shall comply with the latest applicable Indian, American, British or equivalent standards.

Pumps shall be of the non-overloading, centrifugal, horizontal split casing and end suction type. Pumps shall generally be selected for duty conditions as specified in the BOQ. However, the contractor, after preparing the shop drawings shall re-calculate the pump head requirements, submit the same for approval, and shall then only organize for procurement of pumps. .

Pump volute shall be Class 30 CI. Impeller shall be cast bronze enclosed type, dynamically balanced. Internally flushed mechanical seal with ceramic seal seat and carbon seal ring suitable for continuous operation shall be provided. Replaceable bronze shaft sleeve shall completely cover the wetted area under the seal. Pumps shall be rated at minimum 175 psi working pressure. Volute shall have gauge tapings, vent and drain tapings.

Motor and pump shall be factory aligned. It shall be suitable to work in open ambient conditions. Base plate shall be of structural steel or fabricated steel channel with fully enclosed sides and ends and securely welded cross members.

A flexible type, center design drop out coupler, capable of absorbing tensional vibration shall be used between the pump & motor. Coupler shall be shielded by a coupler guard. Pump set shall be factory painted with weather protected paint.

Pump overall efficiency shall not be less than 70%.

The pump shall be directly coupled through flexible coupling to the drive motor. The pump and drive motor shall be mounted on a common base plate. The capacity of the drive motor shall be at least 25% in excess of BHP of the pump plus the drive motors shall confirm to IS: 325 (Latest Edition) in all respects and provided with medium duty bearing with easily accessible grease nipple.

The drive motor shall be provided with starters conforming to IS: 1822. The starters shall be totally enclosed metal clad and dust proof constructions. The motors of 7.5 hp and below shall be provided with DOL starters while those above 7.5 hp shall be provided with automatic star-delta starters and the starter shall have thermal overloads on all the phases, under voltage and single phasing protection. Suitable number of extra contacts for interlocking, indicating lamps, and ammeter with CTS shall be provided for starters of motors.

Motors shall meet scheduled horsepower, speed, voltage, and enclosure design. Pump and motors shall be aligned, and shall be realigned after installation by the HVAC contractor in presence of manufacturer's representative. Motors shall be TEFC type shall meet IEC specifications.

The pumps shall be Suitable for standard operations at 225 Deg F and minimum 175 PSIG working pressure or optional operations at up to 250 Deg F and 250 PSIG working pressures.

Pumps shall be provided with a cast iron or fabricated steel bed plate of ample size to hold both pump and motor in correct alignment. Pump and motor shall be accurately aligned when running at normal temperature. Bed plates of horizontally split pumps shall have raised lips and drain connections. A drain pipe shall be run from each drain connection and terminated with an approved air gap over the nearest drain point.

Contractor should collect and verify the selection documents before ordering the pump.

The pump internals shall be capable of being services without disturbing piping connections, electrical motor connections or pump to motor alignment.

The pumps shall be suitable for continuous operation in the system. The head and discharge requirements shall be as specified in the tender documents for the respective circuits. The discharge rating shall not be less than the flow rate requirement of the respective equipments through which the water is to be pumped. The head shall be suitable for the system and shall take into consideration the pressure drops across the various equipments and components in the water circuit as well as the frictional losses. The pumps offered shall be of high efficiency not less than 70 %.

(c) Performance specifications

The pump characteristic curve shall preferably be continuously rising towards the shut off. In case of unstable (drooping) characteristic the duty point shall be well away from the unstable region. The shut off head shall be atleast 110% of the total head. The required net positive suction head (NPSH) shall be less than minimum 1meter from available NPSH. Pump motor shall be statically and dynamically balanced and noise level shall be not more than 75 dbA at a distance of 2 M from the pump set. The power rating of the pump motor shall be either the maximum power required by the pump from zero discharge to zero head, or 110% of the power required at the duty point.

Pumps of certain category shall be identical and suitable for parallel connection with equal load distribution.

(d) Construction Features

- **Casing**

Material of construction:- CI/Caste Steel with PN25 rating

The casing shall be of heavy close grained CI/Caste Steel with PN25 rating, to bear high tensile strength with smooth waterways and fitted with bronze wear ring. Casing shall have tapped openings for priming, vent, drain and gauge connections.

- **Impeller**

Material of construction:- Bronze

The impellers on end suction pumps shall be semi-open type carefully balanced for smooth operation. The impeller is hydraulically as well as dynamically balanced. Balancing openings shall be provided near hub of the impeller to reduce pressure on the stuffing box to approximately suction pressure. The impeller shall be secured to the shaft by feather and nut.

- **Wearing Rings**

Wearing rings are provided to maintain close running clearance and to minimize pressure leakage between suction and discharge chambers of the casing. The casing bearing rings shall protect the casing against wear and shall be locked in pump casing to prevent rotation.

Pump shall be provided with renewable type casing ring. Pump having capacity 2,000 m^3/hr and above shall be provided with impeller ring in addition to casing ring. The hardness of impeller ring shall be 50 BHN higher than that of casing ring.

- **Shaft**

Material of construction: - Stainless steel / High tensile steel

The shaft shall be with optimum diameter to provide maximum strength with minimum shaft deflection. Replaceable shaft sleeves shall be provided to protect the shaft where it passes through stuffing box. Stuffing box shall be of such design that it can be repacked without removing any part other than the gland and lantern ring.

The pump shall have mechanical shaft seals of extra hard carbon ceramic type.

- **Bearings**

Material of construction: - Heavy duty ball/roller bearings

The bearings shall be precision heavy duty ball/roller bearings. The bearings shall be located and positioned on to shaft by means of lock nut.

Bearing shall be grease lubricated and shall have a minimum life of 40,000 hours of working.

- **Coupling**

Pump shall be furnished complete with flexible coupling in accordance with IS 6392. Back-pull out pump shall be provided with spacer type coupling. Coupling guard made of expanded metal and bolted to the base plate shall be furnished for all coupled pumps. All accessories required for proper and safe operation shall be furnished with pumps. All incidental piping (including valves) required for sealing, lubrication and cooling for stuffing box packing and / or bearing of pump shall be furnished by the contractor.

- **Alignment**

The pump and motor shall be aligned by the pump manufacturer. The pump manufacturer shall provide certification to the effect that the pump and motor coupling has been carried out by them and checked by them. On completion of the installation, grouting and connection of all piping, the pump and motor shall be rechecked for alignment by means of accepted methods, by the pump manufacturer/sole agent.

(e) Pump Installation

- **General Information**

Pumps shall be installed as per manufacturer's recommendations. Contractor has to obtain pumps installation manual from the manufacturer prior to installation.

1) The pump and motor assembly shall be mounted and arranged for ease of maintenance and to prevent transmission of vibration and noise to the building structure or excess vibration to the pipe work.
2) Pump set shall be mounted on concrete inertia block which in turn is mounted on vibration isolation fittings. The concrete foundation will be provided by the client to the drawings and specifications of the contractor and the isolation pads shall be supplied by the contractor. The contractor shall, however, ensure that the foundation bolts are correctly embedded.
3) The inertia block shall be vibration isolated from the plant room floor by 25 mm thick neoprene rubber pads or any other equivalent vibration isolation fittings. The pump motor sets shall be properly aligned to the satisfaction of engineer in charge. These concrete foundation blocks shall be poured in a steel pan of a shape conforming to the shape of the bed plate.
4) Pumps sets shall preferably be factory aligned. However, necessary site alignment shall be done by competent persons. Before the foundation bolts are grouted and couplings bolted, the bed plate levels and alignment results shall be submitted to the engineer.
5) High tensile bolts to be used of SS-416 construction which do not rust in a wet surrounding. Alignment to be checked with dial gauge.

- **Insulation**

The thermal insulation of the pump casing for chilled water circulating pumps shall be of the same type and thickness as provided for the connected pipe work.

- **Painting**

Pumps must have two coats of weather resistant epoxy paint at site, after installation and testing.

(f) Pump Inspection & Testing

Tenderers shall submit the performance curves of the pumps supplied by them. They shall also check the capacity and total head requirements of each pump to match their own piping and equipment layout.

On completion of the entire installation, pumps shall be tested, wherever possible, for their discharge head, rate of flow and BHP and test results shall be furnished as per section – test readings.

A standard hydrostatic test shall be conducted on the pump casing with water at 1.5 times the maximum discharge head or twice the rated discharge head, whichever is higher. While arriving at the above pressure, the maximum suction head shall be taken into account. All the instruments/ equipments required for this testing shall be arranged by the contractor.

Tenderers shall submit the performance curves of the pumps supplied by them. They shall also check the capacity and total head requirements of each pump to match their own piping and equipment layout.

(g) Pump Pre Commissioning Checks

Following parameters to be checked prior to the commissioning of the pumps sets

1) The alignment and motor coupling of the pump.
2) The pump fixed on vibration isolating spring.
3) The motors and pumps are lubricated.
4) The direction of rotation is correct.
5) The pressure gauge and thermometers are installed at the correct location
6) The panels and switchgears are cleaned.
7) The overload relay is set properly.
8) The wiring of the motor terminals.
9) The fuse ratings are correct.
10) The design voltages in all phases.
11) Check whether any loose component in the electrical circuit.

(h) Pump Commissioning Checks

Following parameters to be checked during the commissioning of the pump sets.

- **Pump Shut-off Head Test**

1) To verify the performance of the pump, the following tests shall be carried out in order to measure and compare against the manufacturer pump data.
2) Connect a suitable differential pressure gauge across the suction and discharge pressure test points of the pumps.

3) Set all the supply, return valves and control valves in the system at full open position (Cooling coil valve fully open to cooling coil, chilled water flow through AHU, FCU etc.)
4) With the pump on running condition, slowly close the discharge valve for a period of less than 1 minute. Effort should be made to obtain the readings as rapidly as possible in order to minimize the time that the pump is shut off.
5) Determine the shut-off pressure differential, check against the manufacturer data to zero flow then slowly re-open the discharge valve.
6) Where the test results coincides with the manufacturers test data proceed to next paragraph. Where this is not the case, draw a curve parallel to that shown on the published data, starting at the shut-off head pressure.
7) Record the total pressure with the differential pressure gauge at full flow rate and read the actual flow from the manufacturer's data, or from the corrected graph curve as appropriate.

- **Flow rate Test**

1) With all valves are fully open, measures and record the total actual flow rate and compare this with the total system design flow rate.
2) Where necessary, close the main regulating valve to provide a flow of approximately 110% design flow rate.

- **Water Balancing**

1) Keep all the DRV's and isolating valves at fully open position.
2) Take the initial flow across the heat exchangers.
3) Record the flow and compare with the design flow.
4) Measure the initial flow at all the branches.
5) Find out the index branch (lower percentage of volume)
6) Keep the DRV of the index branch at fully open position.
7) Throttle the other branches proportionally to the same percentage of total flow measured
8) Monitor the index percentage after throttling each branch as it increases gradually
9) By the time the last branch is complete, the flow is balanced at all branches including the index branch
10) Record all branch readings
11) The same method can be repeated for other branches and sub branches of the fan coil unit and air handling units.

(i) Performance Evaluation Tests

1) Measure the Suction / Discharge Pressure in PSIG / Kpa/ Pa
2) Measure the Operating Pressure / Head in PSIG / KPa / Pa
3) Measure the Shut Off Pressure / Head in PSIG / KPa / Pa
4) Measure the Water Flow Rate in GPM / L/s
5) Measure the Amperage / Voltage / RPM

3. VARIABLE SPEED PUMPING SYSTEM

(a) General Information

The Variable Speed Pumping system are to be provided for the pumping system .This system shall consist of the variable speed drive, differential pressure sensor transmitter, pump control panel and power and control wiring and shall be provided.

The pumps shall be provided with adjustable frequency drives and pump controllers for the automatic adjustment of the pump speed to achieve the desired pumping conditions whenever a change in demand is experienced. The pump controller shall incorporate the adjustable frequency device and shall be of the microprocessor based programmable type dedicated for the pumping system.

The frequency drive shall employ sine wave pulse width modulation control and shall be suitable for operation on a three phase, 415 Volts, 50 Hertz input supply with an input voltage variation of +10% and -15% and frequency variation of 1 Hertz. The drive shall be capable of providing a variable frequency output of 0 to 50 Hertz proportional to a 4 to 20 mA or 0 to 10V input signal obtained from a field sensor/transmitter.

The field sensors/transmitters required for pump control shall be supplied as part of the variable speed pumping system. The sensors/transmitters shall be suitable for measuring the appropriate process parameters (i.e. pressure, differential pressure, temperature, flow etc). The pump controller with the adjustable frequency drive shall be housed in IP65 enclosure. Adequate ventilation shall be ensured for continuous operation at the maximum ambient temperature specified by the manufacturer. All power, control and instrument cabling shall be provided and installed as described elsewhere in this specification.

The control system shall include as, a minimum, the programmable logic pump controller, adjustable frequency drive(s) and DP sensor / transmitters as indicated on the plans. Provide additional items as specified or as required to properly execute the sequence of operation.

The variable speed pump logic controller, adjustable frequency drive(s) and DP Sensor / transmitter(s) shall ship as individual components to the worksite.

Pump logic controller, adjustable frequency drives, sensor/transmitters and related equipment shall be installed by the contractor as shown on the plans.

- **Documents**

1) Documents to be submitted shall include the following:
2) System summary sheet
3) Sequence of operation
4) Shop drawing indicating dimensions, required clearances and location and size of each field connection.
5) Power and control wiring diagram
6) System profile analysis including variable speed pump curves and system curve. The analysis shall also include pump, motor and AFD efficiencies, job specific load profile, staging points, horsepower and kilowatt / hour consumption.

7) Pump data sheets

All above mentioned documents shall be specific to this project. General submittals will not be accepted.

(b) Pump Logical Controller

The pump logic controller assembly shall be listed by and bear the label of Underwriter's Laboratory, Inc. (UL). The controller shall meet Part 15 of FCC regulations pertaining to class A computing devices. The controller shall be specifically designed for variable speed pumping applications. The enclosure of the controller shall ne NEMA1

The controller shall function to a proven program those safeguards against damaging hydraulic conditions including:

1) Motor overload
2) Pump flow surges
3) Hunting
4) End of curve protection

The pump logic controller, through a factory pre-programmed algorithm, shall be capable of protecting the pumps from hydraulic damage due to operation beyond their published end-of-curve. This feature requires an optional flow meter for activation.

The pump logic controller shall be capable of staging and de-staging pumps based on an Efficiency Optimization Program to provide the lowest KW draw. This optimization program requires an optional flow meter, KW meter, and system differential pressure sensor for activation.

The pump logic controller shall capable of accepting 16 analog inputs from zone sensor/transmitters, indicated on the plans. The controller shall scan each analog input a minimum of once every 500 milliseconds. It shall then select the analog signal that has deviated the greatest amount from its set point. This selected signal shall be used as the command feedback input for a hydraulic stabilization function to minimize hunting. Each input signal shall be capable of maintaining a different set point value.

The pump controller shall be capable of controlling minimum 3 pumps in parallel. The controller shall be field expandable to control up to 6 pumps in parallel and accept up to 16 analog inputs. This modification shall consist of nothing more than the addition of analog input modules and shall not require the use of special tools or factory reprogramming. Controllers which are not capable of being expanded to this level shall not be acceptable.

The hydraulic stabilization program shall utilize a proportional - integral – derivative control function. The proportional, integral and derivative values shall be adjustable over an infinite range.

The pump logic controller shall be self-prompting. All messages shall be displayed in plain English. The operator interface shall have following features:

1. Multi-fault memory and recall
2. On-screen help functions
3. LED pilot lights and switches

4. Soft-touch membrane keypad switches.

The pump logic controller shall a LCD/LED display monitor which display following parameters

1) Flow in GPM
2) Pressure in PSIG
3) Differential pressure in PSIG
4) Temperature in degrees F or C
5) Differential temperature in degrees F or C
6) BTU calculation
7) Kilowatt consumption
8) Tons per hour calculation
9) Wire to water efficiency calculation

Pump logical controller shall be BMS compatible with following inputs

1. Remote system start/stop
2. Failure of any system component
3. Process variable
4. VSD speed

The operator interface shall have the following features

1) Multi-fault memory and recall last 10 faults and related operational data.
2) Red fault light, yellow warning light, and Green power on light
3) Soft-touch membrane keypad switches.
4) The display shall have four lines, with 20 characters on three lines and eight large characters on single line
5) Actual pump information shall be displayed indicating pump status.

Controller shall be capable of performing the following pressure booster function:

1) Low suction pressure cut-out to protect the pumps against operating with insufficient suction pressure.
2) High system pressure cut-out to protect the piping system against high pressure conditions.
3) No flow shut down to turn the pumps off automatically when system demand is low enough to be supplied by hydro pneumatic tank. No flow shutdown shall require any

external flow meters, flow switches, nor does pressure switch to determine when a no flow condition exists.

(c) Variable Speed Drive

The variable speed drive shall be PWM (pulse with modulation) type , microprocessor controlled design, wall mounted or free standing as per ampere rating. A hand-off auto switch and potentiometer shall be functional via VSD keypad.

VSD shall utilize a diode bridge rectifier to convert three phase AC to a fixed DC voltage. Power factor shall be remaining above 0.98 regardless of speed or load. VSDs with power factor correction factor shall be avoided.

IGBT (Insulated Gate Bi-polar Transistors) shall be used in the inverter section to convert the fixed DC voltage to a three phase, adjustable frequency, AC output. An internal line reactor shall be provided to lower harmonic distortion of the power line to increase the fundamental power factor.

The following user editable features shall be provided

1) Acceleration time : 0.1 to 1800 seconds
2) Deceleration time : 0.1 to 1800 seconds
3) Minimum frequency : 0 Hz
4) Maximum frequency : 120 Hz
5) Analog input filter : 0.1 to 10 seconds
6) Analog outputs : 10 to 1 gain
7) Speed reference signal shall be customer selectable for:
   a. 4-20 mA or 0-10 VDC

The VSD shall display the below mentioned information in English language as alphanumeric characters

1) Frequency
2) Voltage
3) Current
4) Kilowatts per hour
5) Fault identification
6) Percentage power
7) Percentage power
8) RPM

(d) Automatic Bypass

Variable speed pumping system shall be equipped with an automatic bypass (Only in case when stand-by pump not provided). Bypass shall consist of a main power disconnect with

ground fault protection, a pair of interlocked contactors and a motor overload relay. All are to be mounted in a NEMA 1 enclosure.

(e) Sequence Of Operation

1) The system shall consist of a pump logic controller, multiple pump/VSD sets with manual and automatic alternation and pump staging, as specified in the above sections.

2) The pumping system shall start upon the closure of customer's contact when the pump logic controller Mode of Operation selector switch is in the REMOTE position.

3) If the pump logic controller selector switch is in nearby location, the pumping system shall operate automatically.

4) Sensor/transmitters shall be provided as specified variable load conditions

5) Each sensor/transmitter shall send a 4-20m a signal to the pump logic controller, indicative variable condition.

6) When all set points are satisfied by the process variable, the pump speed shall remain constant at the optimum energy consumption level.

7) The pump logic controller shall continuously scan and compare each process variable to its individual set point and control to the least satisfied zone.

8) The pump logical controller shall be able to perform pump lead-lag configuration as per the demand load.

9) If the set point cannot be satisfied by the designated lead pump, the pump logic controller shall initiate a timed sequence of operation to stage a lag pump.

10) The lag pump shall accelerate resulting in the lead pumps (s) decelerating until they equalize in speed.

11) When the set point criteria can be safely satisfied with fewer pumps, the pump logic controller shall initiate a timed de-stage sequence and continue variable speed operation.

12) As the case zone deviates from point, the pump logic controller shall send the appropriate analog signal to the VSD to speed up or slow down the pump / motor.

13) In the event of the failure of a zone sensor/transmitter, its process variable signal shall be removed from the scan /compare program. Alternative zone sensor/transmitters, if available, shall controller shall send the appropriate analog signal to the VSD to speed up or slow down the pump / motor.

14) The zone number corresponding to the failed sensor/transmitter shall be displayed on the operator interface of the logic controller.

15) In the event of failure to receive all zone process variable signals, all VSDs shall maintain 100% speed/or default set speed, reset shall be automatic upon correction of the zone failure.

16) PUMP of VSD fault shall be continuously scrolled through the display on the operator interface of pump logic controller until the fault has been corrected and the controller has been manually reset.

SECTION D

LIST OF APPROVED MAKES

SL	ITEM	APPROVED MAKES
1	COOLING TOWER	BELL, ADVANCE, BALTIMORE, PAHARPUR.

NB: Contractors shall strictly follow the list of approved make of materials. Any changes from the above shall bring to the notice of the consultants with valid reason/statement before quoting for the project.

SECTION E

BILL OF QUANTITIES

SL.NO	ITEM DESCRIPTION	UNIT	QTY	RATE	AMOUNT
A	**CHILLER PLANT**				

COOLING TOWER

1	Supply, testing & commissioning of **FRP Vertical induced draft cross flow type Cooling Towers** (CTI Certified) each complete with FRP basin, FRP body, high efficiency fan-motor assembly with water proof motor casing, adjustable angle axial flow fan with fan guard, reduced gear assembly, PVC/equivalent fill media, distribution basin pipe connections, air intake mesh, access ladder etc. as per specifications and drawings. Flow rate :- 570 USGPM (3.0 GPM/TR) Condenser EWT :- 90.5 Deg F (32.5 Deg C) Condenser EWT :- 100.5 Deg F (38.0 Deg C) Ambient WBT :- 85.1 Deg F (29.5 Deg C)	Nos.	3		

GRAND TOTAL

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