PACKAGE- 4E

TENDER FOR DESIGN AND SITC OF SOLAR WATER HEATER AND HEAT PUMP FOR PERMANENT CAMPUS

AT

NALANDA UNIVERSITY, AT RAJGIR, BIHAR.

TECHNICAL SPECIFICATIONS

A. Solar Water heater System:

1. The manufacturer shall supply all technical literature and drawing considered necessary for the installation, operation and maintenance of the equipment and its fittings. These shall essentially include:
   a) Drawing showing over all dimensions and all other details including sectional view of the equipment's.
   b) List of parts with reference to nos.
   c) Manual of instructions for the operation, maintenance and repairs/equipment and special fittings, if any.
   d) Checking methods and schedule for cleaning the system.
   e) Any other relevant technical data which would be of assistance for efficient operation and maintenance of the system including energy savings etc.

2. The Manufacturer shall have MNRE Certification and approval for manufacturing of ETC type Solar water heater with heat exchanger. The basic idea behind this clause is that the manufacturer's product should be BIS certified and the manufacturer should comply the MNRE standards and specification related guidelines set by the MNRE. The manufacturer should be well known and confirming to the laid down specifications and standards by the MNRE.

3. The supplier ensure the utmost and effective DLP and onsite support as per the NIT conditions. The contractor shall also extend the training to purchaser's personnel for technical know-how and understanding on the system functionality, operation and maintenance of the equipment.

4. The suppliers will have to undertake repair of the system installed by them, in case of any defect arising out of any point of time. Supplier will attend the minor complaints within 48 hours of receiving the complaint otherwise penalty to be recovered per day as decided by the Engineer-in-charge.

5. The system and the solar collector's efficiency guarantee as per the MNRE guidelines.

6. The supplier shall guarantee the performance of the system for the rated output of 55 degree C in terms of quantity of hot water and the temperature in peak winter for which the system is designed. If it is not achieved, the necessary additions/modifications including installation of extra collectors shall be done by the supplier without charging any extra price. However, the purchaser reserves the right to have this job completed for achieving the rated output by other manufacturers/after serving 15days notice to the original manufacturers/contracts at his cost & risk. Kindly refer to schematic diagram and BOQ, the recirculation pump has been already considered for the forced and continuation circulation to avoid any such cold-water packet /layer formations.
   The bidder has to consider the same recirculation pump as force circulation system with fixed temperature only the solution as the electrical backup provision is also considered. The contractor has to consider the power supply from and including CONTROL PANEL. Considering all such losses upto 10 deg, In case of the solar water heater system, bidder may consider its output temperature with forced circulation at 65 deg including all software and hardware.

7. All the elements of the system which fail due to manufacturing defect within the period of guarantee shall be replaced by the tenderer free of cost.

TECHNICAL SPECIFICATIONS

SOLAR EVACUATED TUBE COLLECTOR (ETC)

1. Solar Evacuated Tube collector components	**1.Inner tank Material** **a) Stainless Steel SS 316** **2. Hot water tank insulation density** a) High Density injected PUF insulation: 50mm, b) High des PUF (play urethane foam) Installation of 50mm thickness between inner outer tank ensures maximum heat rotenone ever season (maximum up to 72 hours. **3. Tank Stand and supports** a) Mild Steel with suitable anti corrosive coating. **4. Working pressure of the system** a) Normal, Gravity Feed, Less than 1 Kg/cm2. b) Recommended Operating Pressure:10 Bars. **5. Tank test Pressure** a) Factory Pressure Tested for 2 Kgs/Cm2. **6. Solar Evacuated tube dimension** a) Double walled glass Outer Tube Dia 47+0.7mm, Tube leangth-1500+5mm. & Inner Diameter: 33.4mm. b) Thickness of tube at least 1.60 mm. **7. Tube assembling frame** a) Mild steel section with PP coating. **8. Tube assembling frame size** a) Length-2.10mtrs. Width-3.20mtrs, Height-1.50mtrs. 9. **Cold water tank** a) 2.4 mtrs. From the terrace level. **10. Backup Provide** a) Electrical heaters: - 1.5 kW with thermostat, 2.0 kW with thermostat. **11. Tube coating** a) Copper coated tubes with selective absorptive coating Graded AI-N.

2. GASKET FOR FLANGES	3 mm thick gasket of Neoprene/synthetic rubber gasket shall be used for sealing the joints between flanges.
3.COLLECTOR SUPPORT FRAME	The structure should be designed to ensure that it is in a position to withstand a minimum wind velocity of 150 km/hr. It shall be made with angle iron of 35mmx35mmx4mm; will have vertical support at the top and bottom edge of the inclined plane of the collector at a distance of 1.5 M or less. The vertical support shall be firmly grouted with the roof. The size of structural members as indicated above is minimum. Higher section shall be taken and used as per structural design got done by the contractor. The contractor has to submit the structural GA drawings with associated calculations for approval from the Nalanda University before further initiating the despatch of material and commencement of the work. And, if required then the contractor has to get the design vetted at their own cost from a reputed design institute as per the direction of Nalanda University. The structure shall be designed using latest Indian standard code of practice to ensure overall safety and stability of the structure.
4. PAINTING OF STANDS	Proper cleaning and degreasing of the surface should be done with the help of three in one Solution before painting. Two coats of zinc chromate red oxide primer shall be applied followed by two coats of enamel paint of suitable Colour as per approval from Architect/ Engineer-in-charge.
5. STORAGE TANK(HOT WATER	a) Material Stainless Steel (SS 316/ IS 1730 grade)

b) Thickness	**Minimum thickness Tank capacity** 20 gauge (0.91mm)for 100 lpd 20 gauge (0.91mm)for 200 lpd 20 gauge (0.91mm)for 500 lpd 18 gauge (1.2mm) for 1000 lpd 18 gauge (1.2mm) for 1500 lpd 18 gauge (1.6mm) for 2000 lpd
c).Insulation and installation	All sockets and internal fittings of the tanks should be of stainless steel.100 mm thick insulation of 48 kg/cu.m. density having approx. k value_0.03 W/mk and R value 3.34 sq.m deg.C/W to withstand a temp. of 250deg.c.Thin polythene sheet shall be used as covering between the glass wool and the cladding sheet besides the retaining material such as chicken mesh etc. Aluminum sheet of thickness 24 SWG shall be used for cladding the tank insulation. The storage tank shall be properly installed at site using enameled coated appropriate size angle iron stands, girder, cement concrete pedestals of 1:2:3 ratio or any other specific provision suitable to site.To ensure the stability against heavy storm etc. but not less than 1'x1'x6" dimensions. External of the tank should be properly insulated so that hot water temperature does not decrease by more than 5 deg.C in about 16 hrs. Times.
6. PIPING	**a) CPVC PIPING- SCHEDULE 80 as per IS 15778 (Relevant CPWD specifications to be followed for installation)**. **b) Insulation** 25mm thick insulation of 48kg/cu.m. density and K value+0.03 W/MK R value+1.67 sq.m. C/W to withstand and temp. of 250 deg. C be used. Thin plastic sheet shall be used as covering between glass wool and aluminum cladding besides other retaining material like chicken mesh etc .26 SWG thick aluminium sheet shall be used for cladding the insulated pipe. The pipe line should be properly supported and fixed with clamp with the help of suitable size stand/civil structure (cement concrete ratio 1:4) ISI mark strainer of standard make should be fitted in the main cold water supply line before the system.
7. VALVES/NIPPLE/ TESS/BENDS	Gun metal valve ISI marked shall be used. Nipple/tees and bends of ISI marked of CPVC schedule 80 as per IS 15778 shall be used. Air vents in each row are to be provided.
8.INSTRUMENTATION	Temperature gauge: 1 No. (for Hot Water Storage Tank/Outlet) Gun metal strainer: 1 No. (at Cold Water inlet) Water meter -1 at the inlet of cold water tank. Maximum 2 nos. Of chrome plated brass taps for systems up to 200 LPD thereafter 1 tap per 200 LPD superior qualities for distribution line. Suitable Air release valves, safety valves to be provided.
9. STANDS & PEDESTALS FOR THE TANKS	The tanks will be mounted on stands made out of angle iron frame of 35x35x4mm up to 2000 liters and 65x65x6mm for capacity above 2000 liters with each leg duly grouted with PCC 1:2:4 of 1'x1'x1'size. The cold water tanks will be placed over angle iron frame having 4 cross members in 4 legs with 5mm thick MS sheet for full bottom

	support fixed of 4 horizontal members based on the size of the cold water tank. Stands for tank size Upto 2000 Lit- : The minimum size of the angle would be MS iron 65x65x6mm / 75x 40 ISMC C channel or as per the structural design with load calculation by the bidder whichever will be more and it will be approved by the client before its supply and installation. Stands for tank size above 2000 Lit: The minimum size of the angle would be 75X75x6mm / ISMC C channel or as per the structural design with load calculation by the bidder whichever will be more and it will be approved by the client before its supply and installation. Stands for tank size Upto 2000 Lit- : The minimum size of the angle would be MS iron 65x65x6mm / 75x 40 ISMC C channel or as per the structural design with load calculation by the bidder whichever will be more and it will be approved by the client. Stands for tank size above 2000 Lit: The minimum size of the angle would be 75X75x6mm / ISMC C channel or as per the structural design with load calculation by the bidder whichever will be more and it will be approved by the client.
10. SYSTEM LAYOUT & DESIGN	Maximum number of collectors in series should not be more than ten. Maximum number of collectors in parallel in one row without the use of any piping connections should not be more than six. **Air venting** at appropriate places without hindrance of a spring leaded valve to prevent air locking in the system should be provided. For this purpose, the system shall have, at a suitable point, atmospheric pressure conditions preferably in the high temperature zone. System shall have a suitable expansion/make up tank at a high point in the system to ensure that collectors run full all the times. Capacity of this expansion/make up tank should be 1.5% of the system capacity for all systems. For the glycol system, suitable drain tank to be provided as per standard practice. Pumping may be provided on system larger than 600LPD. Control panel shall be provided for the heating element so that the element starts only when the solar panel is not able to provide the required heat for heating the water to required temperature.

<table>
<tr><td></td><td>Kindly refer to the schematic, circulation pump has been considered in the design drawings and BoQ as well which refers the forced circulation system. The bidder has to consider the suitable circulation pumps and forced circulation system with timer and control communicable interlocked auto systems. There must be manual or bypass options also for the warrant and compelling circumstances.</td></tr>
<tr><td>11.HEAT EXCHANGER</td><td>(a) Shell-in-Tube Type (i) Material Copper for forced systems only. Shell in tube type heat exchanger may be used if U-type construction is not employed and if V-type construction is employed, then minimum 4 Nos. of heat exchangers will be used in series. Shell shall be designed for 1.5 times of the designed operating pressure and shall be tested for two times the operating pressure. In case of mild steel shell, corrosion allowance of 1.6 mm shall be provided. Shell shall be designed as per the BIS-2825. All the elements of heat exchanger shall be as per relevant Indian Standard or as per TEMA Class C construction. (ii) Tube Thickness Minimum 22 SWG, but may be higher depending upon the designed pressure requirements.
(b) Coil-type Heat Exchanger For thermo-siphon systems only. May be used by incorporating Cu/SS coils/retender inside the storage tank. (i) Material Copper/SS tube of ¾” dia. (ii) Thickness Minimum 22 SWG. May be higher depending upon the pressure requirements. (iii) No. of coils and flow Pattern. Shall be so designed to ensure the pressure drop less than 0.3 kg/cm. The surface area of the heat exchanger should not be less as per sq.m of the absorber area of the system (for 100 LPD system the copper tube length of 7 meter is required).
It will be finalized as per the design reports. The tabulated report is reflected herein for reference. However, final specifications and area etc will be finalized as per the design report to fulfil and achieve the temperature output requirement for required volume per day.

<table>
<tr><td>Capacity (LPD)</td><td colspan="3">Tube size</td><td>Collector Area (Sq.m)</td></tr>
<tr><td></td><td>Dia:47mm Length:1500mm</td><td>Dia:47mm Length:1800mm</td><td>Dia:58mm Length:1800mm</td><td></td></tr>
<tr><td>100</td><td>14nos</td><td>12</td><td>10</td><td>1.5</td></tr>
<tr><td>125</td><td>18</td><td>15</td><td>13</td><td>1.93</td></tr>
<tr><td>150</td><td>21</td><td>18</td><td>15</td><td>2.25</td></tr>
<tr><td>200</td><td>28</td><td>23</td><td>19</td><td>3.0</td></tr>
<tr><td>250</td><td>34</td><td>28</td><td>23</td><td>3.75</td></tr>
<tr><td>300</td><td>40</td><td>33</td><td>27</td><td>4.5</td></tr>
<tr><td>400</td><td>52</td><td>43</td><td>35</td><td>6</td></tr>
<tr><td>Above 500LPD</td><td>12 Tubes per 100LPD</td><td>10 Tubes per 100LPD</td><td>8 Tubes per 100LPD</td><td>1.3sq.m/100LPD</td></tr>
</table>
The more details of the heat exchanger area confirming to the LPD will be required to be designed by the bidder, may be as per the</td></tr>
</table>

	widely used method of calculating the heat transfer capacity UA and eventually sizing the heat exchanger is the logarithmic mean temperature difference LMTD method, applied between the inlet and outlet of the heat exchanger as per the MNRE standards.
12. ELECTRICAL BACK UP (only upto 1000 lpd) **Including**	For 100 lpd -2 KW For 200 lpd2 KW **For 300 lpd-2x2 KW** **For 400 lpd-2x2 KW** For 500 lpd-2x2 KW Including Electrical wiring of minimum 2:5 mm sq. multi core copper conductor, un-armoured cable or suitable size of conductor thermostat of approved Make with FP MCB of 25 Amp.

- The system shall have timer and auto level-based operation with necessary interlocking as per BOQ item details for recirculation of Hot water.

Please refer to the BoQ sheet, the sizes of the het pumps are mentioned.

The BoQ Item No 2 is for Approx. Heating Capacity - Heat Pump Mode: 7.0 KW

The BoQ Item No 3 is for Approx. Heating Capacity - Heat Pump Mode: 10.0 KW

The BoQ Item No 4 is for Approx. Heating Capacity - Heat Pump Mode: 17.0 KW

- The electrical sizes are required to be designed by the successful bidder to undertake the adequate circulation of the system.
- However, it is mentioned that minimum Flow = 6 Cum per Hour
- Head = 15 meter.
- Whatever will be adequate size to undertake the force circulations confirming to the site requirements (Hostel 28 users per cluster – like I1 =I2----=I8=G1=-----G8=H1-----=H8 wherein 1 heat pump on each building has been considered. Herein one I1 =I2----=I8=G1=-----G8=H1-----=H8 are individually considered as one building.
- Similarly, all Bungalows, Apartments and others buildings are tabulated herein below.

The system distribution is tabulated below to understand, design and calculate the actual force circulation of the hot water within the same line items of circulation pump under the same price.

Sr. No	Parcel	Building Name	Floors	Rooms	Occupancy Per Room	Total Occupancy	Hot Water Demand (LPCD)	Hot Water Demand (LPD)	Diversity	Hot Water Demand (LPD)		Heating Capacity- 7 KW	Heating Capacity- 10.0 KW	Heating Capacity- 17 KW
1	Hostel	I 1	G+2.5	14	2	28	50	1400	75%	1050			1	0
		I 2	G+2.5	14	2	28	50	1400	75%	1050			1	0
		I 3	G+2.5	14	2	28	50	1400	75%	1050			1	0
		I 4	G+1.5	10	2	20	50	1000	75%	750			1	0
		I 5	G+0.5	6	2	12	50	600	75%	450		1		0
		I 6	G+1.5	10	2	20	50	1000	75%	750			1	0
		I 7	G+1.5	10	2	20	50	1000	75%	750			1	0
		I 8	G+2.5	14	2	28	50	1400	75%	1050			1	0
		H 1	G+1.5	10	2	20	50	1000	75%	750			1	0
		H 2	G+1.5	10	2	20	50	1000	75%	750			1	0
		H 3	G+1.5	10	2	20	50	1000	75%	750			1	0
		H 4	G+0.5	6	2	12	50	600	75%	450		1		0
		H 5	G+1.5	10	2	20	50	1000	75%	750			1	0
		H 6	G+1.5	10	2	20	50	1000	75%	750			1	0
		H 7	G+1.5	10	2	20	50	1000	75%	750			1	0
		H 8	G+1.5	10	2	20	50	1000	75%	750			1	0
		G 1	G+1.5	10	2	20	50	1000	75%	750			1	0
		G 2	G+1.5	10	2	20	50	1000	75%	750			1	0
		G 3	G+1.5	10	2	20	50	1000	75%	750			1	0
		G 4	G+2.5	14	2	28	50	1400	75%	1050			1	0
		G 5	G+2.5	14	2	28	50	1400	75%	1050			1	0
		G 6	G+2.5	14	2	28	50	1400	75%	1050			1	0
		G 7	G+2.5	14	2	28	50	1400	75%	1050			1	0
		G 8	G+1.5	10	2	20	50	1000	75%	750			1	0
		E 1	G+2.5	14	1	14	50	700	75%	525		1		0
		E 2	G+2.5	14	1	14	50	700	75%	525		1		0
		E 3	G+2.5	14	1	14	50	700	75%	525		1		0
		E 8	G+1.5	10	1	10	50	500	75%	375		1		0
		A 1	G+1.5	5	3	15	50	750	75%	563		1		0
		A 6	G+2.5	7	3	21	50	1050	75%	788			1	0
		A 7	G+2.5	7	3	21	50	1050	75%	788			1	0
		A 8	G+2.5	7	3	21	50	1050	75%	788			1	0
2	Faculty Apartment													
		2BHK	G+3	8	5	40	50	2000	60%	1200			7	
		3BHK	G+3	8	5	40	50	2000	60%	1200			7	
		3BHK +	G+3	8	6	48	50	2400	60%	1440			5	
3	Faculty Bungalow													
		45 nos	G+1	1	5	5	60	300	100%	300				
4	VC Bungalow													
		1 nos	G+1	1	5	5	60	300	100%	300		1		0
5	Campus Inn	1 nos	G+3	72	1	72	60	4320	50%	2160				2
6	International Center	1 nos	G+2	51	1	51	60	3060	50%	1530				2
7	Sport Complex	1 nos												1
8	Medical Center	1 nos				20	50	1000	75%	750			1	0

AIR COOLED HEAT PUMP

A. Introduction

The specifications and contents laid down in the tender are for design, manufacturing, inspection, and testing at works, packing and forwarding, supply and unloading at site, installation and supervision during erection and commissioning of Heat pump and providing performance guarantee, with other associated accessories, as defined in detailed specifications. Installation , testing and commissioning of Heat Pump shall be done by OEM approved installer only.

The system designed by the contractor should be very safe against any type of hazard. The equipment's should be designed for complete personal safety and ease of operation and maintenance.

B. Scope of work of vendor/supplier

The scope covers design, manufacturing, inspection, and testing at works, packing and forwarding, supply and unloading at site, installation and supervision during erection and commissioning,

Hot water at a maximum temperature of 55 Deg. C., at having all necessary safeties, accessories, instruments, control panel etc., with Heat pump, at a maximum efficiency, and providing performance guarantee, with other associated accessories, as defined in detailed specifications. Scope also includes training of purchaser's operation and maintenance crew, and third-party inspection for Heat pump and its associated accessories. AHRI certification is not mandatory, but the performance parameter must be met.

A. Codes & Standard:

The water-cooled liquid chilling packages shall conform to the latest edition of following standards: -

ASHRAE 15	Safety code for Mechanical refrigeration
ASHRAE 23	Methods of testing and rating positive displacement refrigerant compressors and condensing units
ASHRAE 30	Methods of testing liquid chilling packages
ASME SEC VIII DIV I	Boiler and pressure Vessel code
ANSI B 31.5	Code for refrigeration piping
ARI 550/590 (1998)	Standard for reciprocating and rotary water chilling packages
ARI 575	Standard for method of measuring machinery sound within an equipment space
ISO 1940	Mechanical vibration – Balance quality requirements of rigid rotors
ISO 10816-1	Mechanical vibration – Evaluation of machine vibration of measurements on non-rotating parts. General guidelines
ASHRAE 90.1	Energy Efficiency compliance.
ANSI/NFPA Standard 70	*National Electrical Code* (NEC).
Conform to Intertek	For construction of chillers and provide ETL/ETL Listing label.

Testing Services, formerly ETL,	
OSHA	Occupational Safety and Health Act

B. Design Condition:

The machine must meet the following performance parameters:

Air Cooled Heat Pump utilizing Factory assembled, single-piece, liquid Heat Pump shall consist of compressor, motor, lubrication system, cooler, condenser, initial oil and refrigerant operating charges, microprocessor control system, and documentation required prior to start-up. Compressor motor starter shall be mounted on the chiller, wired and tested by the chiller manufacturer. Chiller contained within the unit cabinet shall be all factory wiring, piping, controls, refrigerant charge (R410 A / R134 A), required prior to field start-up. A mono / twin rotor, 2960 rpm (50 HZ), direct drive, screw compressor using refrigerant. The Chiller shall have Single / Multiple compressors and Single / Multiple refrigerant circuits. **Chillers using CFC refrigerants such as CFC-11, 12 or 500 shall not be acceptable.** Unit shall be designed, manufactured and tested in a facility with a quality assurance system certified ISO 9001. Unit shall be manufactured in a facility with an environment management system certified ISO 14001. Unit shall be tested at the factory.

Technical data:	
Ref. capacity	(Refer Schedule of Quantity)
Refrigerant	R410 A / R134 A
Minimum COP (Heating) at Actual	3.5 kW/kW at Dry-bulb Temp. 20°C or at AHRI conditions Wet-bulb Temp. 15°C and Water Outlet Temp 55°C,. (AHRI/eurovent certification guidelines suitable for the Rajgir area to be followed),
Ambient temperature for operation	0°C to 48°C

C. Heat pump

1 Basis of design

• Heat pump

The heat pump system for the project is designed to cater for hot water requirement domestic usage

2 System description

• Heat Pump Extent of Work: -

The heat pump shall be complete with all ancillaries as feed water lines, hot and cold water piping between the unit and the storage tanks. MCC, controls, instrumentation, safety interlocks, circulation pumps, all the power cabling and control cabling for the heat pump and the circulation pumps from terrace DB, etc.

The brief of design is as follows:

Water Distribution: -

The water distribution in the scope of tender is between the heat pump and the storage tanks that will be storing the hot water generated by the heat pump.

Each Heat pump shall comprise of the following:

A Compressor

- The Heat pump shall be provided with Single-Stage direct connected Positive Displacement Semi-Hermetic Rotary Screw or Scroll Compressor of the Oil injected type driven a two pole Motor.
- The Screw Compressor shall be of Single/multi-screw type, with the Provision of each compressor operating in isolation,
- All the moving parts in the Compressor shall be dynamically balanced to minimize the operating noise, vibration and ensure longer life of the Compressor.
- The Pure Rotary Motion of the compressor shall ensure uniform flow of gas, even torque and positive displacement. The intake and Discharge Cycles shall overlap.
- The load of each rotor shall be evenly distributed through the use of Anti-Friction Roller Bearings.
- Each Compressor shall include an integral Oil Separation system, Oil Sump and Oil filter. The oil temperature shall be controlled during operation throughout the lubrication system.
- Each Compressor shall have a suction check valve, suction filter, suction service valve and discharge check valve. Isolation valves shall be provided on all connection to the compressor to allow condenser to be used as a pump down receiver.

a. Compressor Motor

- The driving motor shall be TERC squirrel cage type or suitable hermetic as required, protected against damage by means of built in protection devices.
- The compressors and Motors shall be fully protected against abnormal operating conditions by high and low pressure switches, thermal relays, overload relays and safety controls and Phase failure protection.
- The compressors shall be fitted with gauge connections for reading oil, suction and discharge pressure, and shall be fitted with sight glass, internal motor protection.
- The motor shall have solid state protection to prevent the motor from operating at unsafe operating temperatures.
- The profile of Screws shall permit safe operation up to a speed of 2900 RPM for 50 Hz operation.
- The starter type shall be DOL up to 7.5 HP and Star Delta for above 7.5 HP for reduced starting currents.

b. Microprocessor based control

It should be possible to set the Leaving hot water temperature by inputting the same via the Chiller Control Panel. Microprocessor control shall be provided for the Chiller Unit to monitor Analog and Digital inputs to the Chiller and to control the operational and protective function of the unit.

The Control Panel shall have a display panel. It shall be possible to display the following parameters without an experienced operator:

- Discharge Pressure
- Discharge Temperature
- Compressor Status

The Following Automatic Protection Controls shall be provided to insure system reliability:

- Low Suction Pressure
- High Discharge Pressure
- High Oil Temperature
- Freeze Protection
- High Motor Temperature
- Power Loss
- Chilled water Flow Loss
- Phase Unbalance
- The supplier shall provide the Motor Electrical Data and the Part Load Performance curves for the Chiller being offered.
- The design, manufacture and performance of refrigerant Compressor shall comply with all currently applicable statutes, regulations and safety codes in the locality where the equipment will be installed. The equipment performance shall also conform to the latest applicable AHRI/ Eurovent Standards. Nothing in this specification shall be constructed to relieve supplier of his responsibility.
- The compressor shall be in accordance with the specification prescribed in the attached Data Sheet. The type of accessories, controls and instrumentation shall be as indicated in the data sheets. The motor, included in Supplier's scope of supply shall comply with the Motor Specification indicated in the Data Sheet or the latest prevalent standards.
- The Equipment shall be packed on metallic skids to permit easy installation.
- Hydrostatic and refrigerant leak tests shall be carried out at the manufacturer's works before the dispatch of the Chiller.

c. Condenser

- The condenser shall be Single/Multi pass.
- The Condenser vessels shall be cleanable shell and tube type with integral finned copper tubes mechanically expanded into heavy fixed steel tube sheets.

d. Evaporator

- The Dry Expansion/flooded Evaporator shall be cleanable shell and tube with seamless carbon steel shell, with grooved copper tubes mechanically fixed into heavy fixed steel tube sheets. OD of tubes should be minimum 19 mm & with thickness of 0.63 mm.

- The dry expansion evaporator/flooded shall have complete accessories i.e. Electronic expansion valve, filter drier, necessary temperature sensor and connections for drain and vent.

- The dry expansion evaporator/flooded shall have a built in distributer for feeding refrigerant evenly under the tube bundle to produce a uniform boiling action and baffle plates shall ensure vapour separation.

- The water heads shall be of carbon steel and designed for easy removal for mechanical tube cleaning and/ or tube removal. It shall be designed for multiple pass arrangement for optimum water velocity through tubes for efficient heat transfer and lower pressure drop.

B Electrical control board which is made up from following accessories

- Main isolating switch and fuse protection of auxiliary and power circuit.
- Compressor remote control
- Fan reverse regulator for condensation control
- Pump relay or motor overload protection and remote control
- Main alarm on/ off contacts.
- Re-circulation pump controls.

C Microprocessor for the control of the following function

- Regulation of the water temperature with inlet control;
- Anti-freeze protection;
- Compressor timing;
- High pressure pre-alarm management (to prevent unit block)
- Enabling of summer/winter changeover
- Automatic defrosting;
- Alarm signals;
- Alarms reset;
- Self-adaptable regulation to allow optimal functioning in the case of low water content in the plant
- Digital input for summer/winter remote changeover

D Display, with following facility

- Outlet water temperature
- Condensation temperature;
- Set temperature and differentials set
- Description of the alarms

- 400V/3N~/50Hz power supply for heat pump.

C. Controls and safety devices:

Each Heat pump shall be provided with followings:

- Utility water temperature control probe (situated at entry of heat pump);
- Anti-freeze probe that activates the anti-freeze alarm (with automatic re-arm at limited intervals)
- High pressure gauge (with manual re-arm);
- Low pressure gauge (with automatic re-arm at limited interventions);
- Mechanical flow switch supplied as standard
- Condensation pressure control by means of rev. regulator for functioning with low external temperatures
- High pressure safety valve
- Compressor internal over-temperature protection
- Compressor external over-temperature protection
- all the necessary control cables between the heat pump and hot water storage tank is included in the scope of work.

D. Testing

Following listed tests shall be conducted after installation of the heat pumps:

a) Capacity test to confirm heat output for Heat pump

b) All controls and safety tests.

c) Efficiency test.

d) Safety valve flow test.

e) Hydraulic test.

All necessary equipment or instruments required for conducting above tests shall be arranged by the contractor. Heat pump will be accepted subject to clearance of above tests.

E. Drawings

Contractor shall furnish following drawings in triplicate within one month from the date of order to the consultants.

a) Foundation details of Heat pump and storage tanks.

b) Dimension detail of Heat pump and storage tanks and Piping arrangement.

c) Heat pump electrical wiring diagram.

d) Heat pump operation manual.

e) P & I diagram.

f) General arrangement & Terminal point details.

F. Pre-commissioning

On completion of the entire erection of equipment, piping, connection to the pipe system and electrical system, contractor shall fill the entire system with cold water and test for leakage and other erection defects. All such defects shall be removed. All motors shall be tested and shown for its operation as per the parameters of the OEM and as approved by the NU.

G. Commissioning & testing

On completion of all procedures at pre-commissioning stage, Heat pump shall be tested by the respective supplier and all adjustments shall be carried out in valves and other accessories for the related equipment's. Heat pump shall be allowed to run till the desired temperature in the system is obtained. Any defect noted shall be rectified immediately.

RE-CIRCULATION PUMPS:

- Pumps shall be vertical, centrifugal, multistage directly coupled to motor. Pump to be with SS AISI 316 stage casing, AISI SS 316 impellors, SS Suction chamber, SS 316 Pump shaft, steel base plate, carbon mechanical shaft seal and suction and discharge casing as per IEC standards, connected to TEFC Ventilated induction motor of 2 pole, 2900 RPM, suitable for 400/440 Volts, 3 phase, 50 Hz A.C.. Impeller shall be hydraulically balanced and keyed to shaft.

  Pump shall be mounted on a concrete foundation, projecting at least 150 mm above finished floor level. The pumps base shall be set on a vibration elimination pad. The pump shall be lubricated in strict accordance with the manufacturer's instructions and shall be factory aligned prior to shipment. All motors and bases shall be painted with approved finish shop coat of paint. The pump shall be selected for the lowest operating noise level and shall be complete with flexible connections, valves, and pressure gauges. The pumps shall include cost of foundation channel complete.
- The Contractor shall supply and install pumps of the type and performance as shown on the drawings and as mentioned in the Bill of quantities. All duties of pumps given in the Tender Drawings shall be checked and where necessary corrected before ordering. All the parts of the pumps that are in contact with water e.g. shaft, impeller etc. shall be of stainless steel construction.
- Pumps shall be so selected that the design duty point is within 5% of the maximum efficiency point. The pump casing so selected shall have ample space to take an impeller one size larger than that capable of performing the design duty.
- The pump shall have a speed of not more than 2900 rpm. However pumps of 2900 rpm with high efficiency and low noise motor can be selected and noise data submitted for approval. All pumps and motors shall be of minimum vibration and noise level during operation. Vibration isolators shall be provided for all pump sets.
- Facilities shall be provided to prevent starting of pumps when the water tank is at low water level. An indicator for this low water level alarm shall be provided.
- Facilities to select which pump to be duty pump and standby pump shall be provided and be interchangeable. Pump to be working in cyclic operation with auto switching feature after every 5 hours.

- Facility for Leakage from pump gland to be drained to the nearest drain point shall be provided by the contractor including all accessories.
- Pump curves for all pumps offered shall be submitted. All curve indicating excessive shut-off head will not be approved.
- Each pump shall be provided with a gate valve at suction and discharge, approved check valve at discharge, approved strainer at suction, flexible connections at pump suction and discharge, eccentric reducer at suction, concentric reducer at discharge, bourdon type glycerin filled pressure gauges at suction and discharge, circulation relief valve and automatic air relief valve.
- Appropriate neoprene vibration isolation mountings shall be provided for each pump sets.
- The system shall have timer and auto level-based operation with necessary interlocking as per BOQ item details for recirculation of Hot water. The system shall have necessary automatic interlockings in mechanical and control panel as well to ensure the proper auto sequence of start of circulation pump and hot water generator system.
- Contractor ensure the system shall have the control wiring in control/ starter panel - that Heat pump running will start only after start of circulation pump i.e. stage control operation of accessories.
- The system shall have timer-based operation and/or temperature-controlled operation of circulation pumps. The design of the interlockings and operations shall be submitted with all aforementioned option for approval by the University. The system shall have the manual operation facility to handle operations in situation of any exigency towards timer and/or thermostat etc. as per the approval of the University.
    - Stands for tank size Upto 2000 Lit- :
    - The minimum size of the angle would be MS iron 65x65x6mm / 75x 40 ISMC C channel or as per the structural design with load calculation by the bidder whichever will be more and it will be approved by the client before its supply and installation.
    -
    - Stands for tank size above 2000 Lit:
    -
    - The minimum size of the angle would be 75X75x6mm / ISMC C channel or as per the structural design with load calculation by the bidder whichever will be more and it will be approved by the client before its supply and installation.
    -
    - Stands for tank size Upto 2000 Lit- :
    - The minimum size of the angle would be MS iron 65x65x6mm / 75x 40 ISMC C channel or as per the structural design with load calculation by the bidder whichever will be more and it will be approved by the client.

    - Stands for tank size above 2000 Lit:

    - The minimum size of the angle would be 75X75x6mm / ISMC C channel or as per the structural design with load calculation by the successful bidder whichever will be more and it will be approved by the client.
    - The electrical sizes are required to be designed by the successful bidder to undertake the adequate circulation of the system.

- However, it is mentioned that minimum Flow = 6 Cum per Hour
- Head = 15 meter.
- Whatever will be adequate size to undertake the force circulations confirming to the site requirements (Hostel 28 users per cluster – like I1 =I2----=I8=G1=-----G8=H1-----=H8 wherein 1 heat pump on each building has been considered. Herein one I1 =I2----=I8=G1=-----G8=H1-----=H8 are individually considered as one building.
- Similarly, all Bungalows, Apartments and others buildings are tabulated herein below.

The system distribution is tabulated below to understand, design and calculate the actual force circulation of the hot water within the same line items of circulation pump under the same price.

Sr. No	Parcel	Building Name	Floors	Rooms	Occupancy Per Room	Total Occupancy	Hot Water Demand (LPCD)	Hot Water Demand (LPD)	Diversity	Hot Water Demand (LPD)		Heating Capacity- 7 KW	Heating Capacity- 10.0 KW	Heating Capacity- 17 KW
1	Hostel	I 1	G+2.5	14	2	28	50	1400	75%	1050			1	0
		I 2	G+2.5	14	2	28	50	1400	75%	1050			1	0
		I 3	G+2.5	14	2	28	50	1400	75%	1050			1	0
		I 4	G+1.5	10	2	20	50	1000	75%	750			1	0
		I 5	G+0.5	6	2	12	50	600	75%	450		1		0
		I 6	G+1.5	10	2	20	50	1000	75%	750			1	0
		I 7	G+1.5	10	2	20	50	1000	75%	750			1	0
		I 8	G+2.5	14	2	28	50	1400	75%	1050			1	0
		H 1	G+1.5	10	2	20	50	1000	75%	750			1	0
		H 2	G+1.5	10	2	20	50	1000	75%	750			1	0
		H 3	G+1.5	10	2	20	50	1000	75%	750			1	0
		H 4	G+0.5	6	2	12	50	600	75%	450		1		0
		H 5	G+1.5	10	2	20	50	1000	75%	750			1	0
		H 6	G+1.5	10	2	20	50	1000	75%	750			1	0
		H 7	G+1.5	10	2	20	50	1000	75%	750			1	0
		H 8	G+1.5	10	2	20	50	1000	75%	750			1	0
		G 1	G+1.5	10	2	20	50	1000	75%	750			1	0
		G 2	G+1.5	10	2	20	50	1000	75%	750			1	0
		G 3	G+1.5	10	2	20	50	1000	75%	750			1	0
		G 4	G+2.5	14	2	28	50	1400	75%	1050			1	0
		G 5	G+2.5	14	2	28	50	1400	75%	1050			1	0
		G 6	G+2.5	14	2	28	50	1400	75%	1050			1	0
		G 7	G+2.5	14	2	28	50	1400	75%	1050			1	0
		G 8	G+1.5	10	2	20	50	1000	75%	750			1	0
		E 1	G+2.5	14	1	14	50	700	75%	525		1		0
		E 2	G+2.5	14	1	14	50	700	75%	525		1		0
		E 3	G+2.5	14	1	14	50	700	75%	525		1		0
		E 8	G+1.5	10	1	10	50	500	75%	375		1		0
		A 1	G+1.5	5	3	15	50	750	75%	563		1		0
		A 6	G+2.5	7	3	21	50	1050	75%	788			1	0
		A 7	G+2.5	7	3	21	50	1050	75%	788			1	0
		A 8	G+2.5	7	3	21	50	1050	75%	788			1	0
2	Faculty Apartment													
		2BHK	G+3	8	5	40	50	2000	60%	1200			7	
		3BHK	G+3	8	5	40	50	2000	60%	1200			7	
		3BHK +	G+3	8	6	48	50	2400	60%	1440			5	
3	Faculty Bungalow													
		45 nos	G+1	1	5	5	60	300	100%	300				
4	VC Bungalow													
		1 nos	G+1	1	5	5	60	300	100%	300		1		0
5	Campus Inn	1 nos	G+3	72	1	72	60	4320	50%	2160				2
6	International Center	1 nos	G+2	51	1	51	60	3060	50%	1530				2
7	Sport Complex	1 nos												1
8	Medical Center	1 nos				20	50	1000	75%	750			1	0

Name of Work: Supply, Installation, Testing and Commissioning of Solar Water Heaters at Nalanda University Phase 1, Rajgir, Bihar		
Document: PREFERD MAKE LIST		
Sr. No	**Equipment**	**Preferd Make**
1	Solar Hot Water System	TATA power, Racold, Benchmark, Havels and equivalent as etc. as per EIC approvals
2	Air To Water Heat Pump	AO Smith, Jaquar, Bluebox, Kehems, Balief, Climaveneta , Crompton GREAVES and Racold as per the EIC approvals
3	Mounting Structure	Tata Steel/ Jindal Steel / TISCO / RINL
4	String Monitoring Boxes	Trinity Touch/Hensel/VNT/Fairwood/Spillsberg/Eaton Salaris / Statcon /Machine Pulse
5	TTA LT Panels including switchgears	ABB / Schneider / Siemens
6	Control Relay (Electromechanical and Numeric)	ABB/Siemens/Schneider
7	Meter	Secure / Schneider / L&T / ABB/Siemens
8	Cables	DC Cable: Polycab/KEI/Lapp
9		AC Cable: Polycab/KEI/ RR Kables
10	Plant Lightening Arrestor	Erico /LPI/ Cape /OBO / DEHN
11	SPD	DEHN / Cape / OBO / Socomech
12	Connector	Multi contact/Amphenol/Koyo/Bizlink / Elcon / Stsubli
13	IP Base CCTV	Honeywell/Bosch / Sony
14	Thermostat for Auto Cutoff	Danfoss/Seimens/Honeywell
15	MCBs / RCCBs / RCBO	ABB/Siemens/Schneider
16	LED indication lamps and Push Buttons	ABB/Siemens/Schneider
17	SS HOT WATER TANK FOR SOLAR	Kingspure / Heron/ J Steel or SS 316 Tank as per MNRE approved Manufacturer
18	HOT WATER TANK FOR HEAT PUMP	As per Heat Pump Manufacturer.
19	Hot water pipe and tank Insulation	Lloyd / Rockwool/ As per Heat Pump or ETC solar Manufacturer
20	Aluminum Cladding for Hot water pipe and hot water tank	Jindal / Hindalco /Indal
21	CPVC PIPES	Astral / Finolex / Ashirvaad/supreme
22	VALVES	Zoloto/ Sant / Advance
23	Pressure Guage	H Guru/ Fiebig / Wika
24	Temperature Guage	H Guru/ Fiebig / Wika
25	Heating Element for Hot water tank	Theeta / Kerone / or as per MNRE approved Manufacturer
26	Pumps	Armstrong / Grundfos / ITT Bell & Gossett / Wilo / XYLEM/ Lubi