

SECTION-C

Tender No: IPR/TN/PUR/TPT/ET/20-21/13 DATED 10-02-2021

INSTITUTE FOR PLASMA RESEARCH

BHAT, GANDHINAGAR-382 428, INDIA

TENDER DOCUMENT

FOR

Supply, Installation, Testing, and Commissioning of Centrifugal Chiller, Cooling Tower, Pumps, valves, piping, electrical and instrumentation work for Water Cooling Plant.

(Please note that the bidder should sign on all pages)

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ABBREVIATIONS

AHRI - American Heating and Refrigeration Institute
ANSI - American National Standards Institute
ARI - Air conditioning and Refrigeration Institute
ASHRAE - American Society of Heating, Refrigeration and Air conditioning Engineers
ASME - American Society of Mechanical Engineers
ASTM - American Society for Testing and Materials
AWS - American Welding Society
BMS - Building Management System
CI - Cast Iron
COP - Coefficient of Performance
CS - Carbon Steel
CT - Cooling Tower
CWS - Cooling Water System
DAC - Data Acquisition and Control
DM - Demineralized
DP - Dye Penetrant
EQC - Eligibility Qualification Criteria
FAT - Factory Acceptance Test
FRP - Fiber Reinforced Plastic
GAD - General Arrangement Drawing
GI - Galvanized Iron
HDG - Hot Dipped Galvanized
HSC - Horizontal Split Casing type pump
IEEE - Institute of Electrical and Electronics Engineers
IPLV - Integrated Part Load Value
IPR - Institute for Plasma Research
ISO - International Organization for Standardization
KW - Kilowatt, electrical power measurement unit
MOC - Material of Construction
MPR - Motor Protection Relay
MS - Mild Steel
MW - Mega Watt (Heat Load unit)
MWC - Meter Water Column
NPSHR - Net Positive Suction Head Required
OEM - Original Equipment Manufacturer
PFD - Process Flow Diagram
PHE - Plate type Heat Exchanger

PID - Process and Instrumentation Diagram
PLC - Programmable Logic Controller
PMS - Pipe Material Specification
PRV - Pressure Reducing Valve
PTFE - Poly Tetra Fluoro Ethylene
PVC - Poly Vinyl Chloride
QA - Quality Assurance
RCC - Reinforcement Cement Concrete
RPM - Revolution Per Minute
RTD - Resistance Temperature Detector
SAT - Site Acceptance Test
SCADA - Supervisory Control And Data Acquisition
SLD - Single Line Diagram
SOQ - Schedule of Quantities
SS - Stainless Steel
TEFC - Totally Enclosed Fan Cooled
TR - Tonnage of Refrigeration
VSS - Valve Specification Sheet
WPQR - Welding Procedure Qualification Record
WPS - Welding Procedure Specification
XLPE - Cross Linked Polyethylene

FORM – A

DECLARATION

Date:

To
Institute for Plasma Research
Village Bhat, Gandhinagar.

Ref: Tender No: _____

We confirm that if any kind of major or minor fault arises during warranty period, then original parts/spares/components from the OEM (Original equipment manufacturer) shall be used for repairing. Also all consumables like gas/refrigerant, oil etc. will be supplied free of cost for repairing/replacing.

For defects noticed during the warranty period, replacement/ rectification shall be arranged free of cost. In case if any item/component/equipment is required to be taken out from IPR campus, to and fro transport charges (including all taxes, octroy etc.) shall be borne by us. Repair/replacement shall be carried out within reasonable period of such breakdown. All kind of rectification/repair work shall be carried out by us during the warranty period to keep the system in healthy operating condition.

Signature with Seal of the Vendor

Name: _____

Place: _____

Note: This declaration shall be printed on vendor`s letter head duly stamped and signed and submitted along with technical bid

PART- A: DOCUMENTS TO BE PROVIDED.

Prospective Bidders shall satisfy themselves of fulfilling all the eligibility criteria and in possession of all the documents required before submission of tender document. The interested Bidders are required to provide all required documents as per following lists within the period of bid submission:

Note: The Bidders are requested to fill up the facts & figures in the prescribed format.

Sr No.	Information	Checklist (Put ✓ mark)
1.	Work order / Purchase order copy along with completion certificate for eligibility criteria no: 1	
2.	Relevant document to be provided for eligibility criteria no: 2	
3.	Form A	
4.	PAN registration	
5.	Additional information if any to meet the eligibility criteria.	
6.	Technical details to be furnished by bidder.	

Note:

- The evaluation shall be done based on the data provided with the relevant documents to support the same. Therefore the bidders in their own interest shall fill all the relevant information and provide commensurate supporting documents.

Date of submission:

Seal and signature of bidder

SECTION –I

INSTRUCTIONS TO BIDDERS AND TERMS AND CONDITIONS

1. Intent of these specifications is to define the requirements for supply, installation, testing & commissioning of Water Cooling System (WCS). The entire work shall be carried out in accordance with these terms and conditions and generally as per the scope drawings set forth in the documents. The liability of the contractor shall not be limited to the scope of work mentioned, but shall also extend to achievement of the inside conditions as well as complete, safe and satisfactory operation of the system as approved by the Engineer In-Charge. Any instruments, material, labour, tools-tackles, items, temporary arrangements, any kind of consumables etc. required in order to achieve the completeness of the WCS system as above shall be deemed to be included in the scope of the contractor without any extra cost to the client. However, any changes required in installation shall be brought to the notice of the Engineer In-Charge; and due approval shall be obtained therefor.

2. Scope of Work:

The scope of work covered under this tender includes supply, installation, testing & commissioning of the WCS system for the application mentioned, and shall be generally as per the schedule of quantities and scope/tender drawings.

3. Tender Drawings:

- The tender drawings, which are enclosed herewith, shall serve as scope drawings and item quantities are indicative. They indicate the general scheme of the WCS system requirement. However, actual location, distance, levels, etc. will be governed by actual field conditions. All equipments, quantities and technical data indicated in this are based on the engineering by IPR and shall be indicative and for the Contractor's guidance only.

- 1) P & I DIAGRAM for System
- 2) Existing foundation details for chiller, pumps & cooling tower

Actual drawings for execution / construction are to be prepared by contractor at the minimum time frame. Additional drawings including sections may have to be prepared if required and intimated to IPR Engineer In – Charge. All the drawings in the hard and soft copy shall be submitted.

Discrepancies in different plans and actual field conditions or between plans and specifications shall be promptly brought to attention of the Engineer In-Charge for a decision.

4. Schedule of Quantities:

The quantities of Items mentioned in the tender documents are tentative and are given for tenderer's guidance and to have uniform basis for tendering.

5. Codes & Regulations:

- The installation shall be in conformity with bye-laws and regulations of local authorities concerned in so far as these become applicable to the installation. The installation shall also be in conformity with the relevant codes & standards mentioned in SECTION III of this tender. Wherever a reference of Standard specification is made in this document, it should imply the latest revision of that standard, including such revisions/amendments as may be issued by the issuing authority, during the course of the work contract. Compliance with all the applicable laws/rules pertaining to materials and workers/personnel shall be the liability of contractor.
- In case the drawings and/or specifications require something which violates the bye-laws and regulations then the bye-laws and the regulations shall govern the requirement of this installation and the fact shall be brought to the notice of the Engineer In-Charge.

6. COMPLETION PERIOD:

- The total completion period is **12 Months from the date of Purchase Order whichever is earlier.** The work in totality must be completed within the completion time period. The entire project is to be completed at the earliest.

7. RESPONSIBILITY OF THE CONTRACTOR: The contractor shall have sufficient supervisory work force so that one supervisor may be available for day-to-day site work. The contractor shall have to arrange day-to-day planning and execution of each job. All measuring instruments, tapes (of steel), scaffolding and ladders which may be required for installation and taking measurements shall be supplied by the contractor. The scope also includes all kind of materials and equipment handling, lifting, shifting, positioning, loading, unloading required necessary for the completion of the project. The materials used by the contractor shall be new, free from defects and of the best quality and workmanship and shall be in conformity with the latest and best engineering practice.

8. Whole work must be carried out to IPR satisfaction and as per instruction of IPR EIC.

9. *Quality is essential part of the whole project and no compromise will be entertained as far as the quality of the work is concern in all respect of the work.*

10. Any material supplied by the contractor, if damaged in any way during cartage or execution of work or otherwise, shall be made good or replace with new one by the contractor at his own cost.

11. Accompaniment to Tender:

- (a) The contractor should check all the drawings attached with the tender document, for the areas made available for installing his equipment and machines for proper and efficient functioning of his equipment. Any changes required to be made in the building and/or structure should be clearly brought out in a separate letter to be submitted along with the tender document.
- (b) Absence of specific comments on this issue by the Bidder along with quotation will be deemed as acceptance of the spaces available for WCS equipment.

12. Execution Drawings:

On award of the work, the contractor shall submit to the Engineer In-Charge detailed Working Drawings as mentioned below for approval. The shop/working drawings shall also contain details of other services that are required for installation/completeness of system.

- 1) P & I DIAGRAM for System
- 2) Foundation details for chiller, pumps & cooling tower
- 3) GA drawing (Plan, Elevation & Side view) of chiller, cooling tower, pumps and piping with valves
- 4) Any other relevant drawings if asked by IPR Engineer In Charge

14. Site acceptance

System components or system as a whole shall be tested for performance as per the approved technical specifications. All the system components shall meet the guaranteed performance requirements to the satisfaction of IPR.

Necessary replacement / modification / rectification shall be carried out by the contractor with the approval of Engineer In-charge. The installation shall be tested again after removal of defects and shall be commissioned only after approval by the Engineer In-charge. System will be accepted and taken over by IPR for regular operation only after satisfactory performance testing in all respect.

15. Handing over:

1. Site clearance:

The Scope of work includes site clearance (after completion of job), hence all the area shall be cleared of debris and excess material left due to the contract and related work. Any debris or items which have been removed from the existing systems shall be handed over to the IPR and shifted to the designated place in the IPR campus.

2. Handing over Documents:

On completion of the work in all respects, the contractor shall furnish 3 sets of handing over documents (2 hard copies and 1 soft copy in hard disc) in a good quality file containing:

- ❖ Equipment technical data, Operation and maintenance manuals, Material test reports, Performance curves etc.
- ❖ Inspection and performance test reports (Including pre-dispatch, site test reports).
- ❖ Operation instructions.

❖ Complete set of detail as-built drawings.

16. Guarantee / Warranty: The material/goods/equipment offered by the bidder should be guaranteed for a minimum period of twelve months from the date of handing over of whole system, against defective materials, design, workmanship, operation or manufacture. For defects noticed during the Guarantee period, replacement/ rectification should be arranged free of cost within a reasonable period of such notification. During warranty period if system is in breakdown condition then warranty period will be extended by adding the repair/replacement period.

17. WATER AND ELECTRICITY:

IPR shall provide free power and water for the requirement of this project. However the contractor shall maintain his entire electrical installation, appliances etc. in good and safe condition as required under relevant rules and codes of practice.

18. CLEANING, PROTECTION AND ADJUSTMENT

Cleaning:

Upon completion of the work, clean the exterior surface of equipment, accessories. Clean, polish equipment and accessories.

Protection of Surfaces:

Protect new and existing surfaces from damage during the work execution period. Provide plywood or similar material under equipment or materials stored on floors or roofs. Provide protection in areas where work may damage building surfaces. Surfaces damaged during the work shall be repaired or replaced by the Contractor at his own cost. The method of repairing or replacing the surface shall be approved by the IPR

Protection of Services:

Protect new and existing services from damage during the work execution period. Repair, replace and maintain in service any new or existing utilities, facilities or services (underground, Over ground, interior or exterior) damaged, broken or otherwise rendered inoperative during the course of work. Equipments and Services damaged during the work shall be repaired / replaced by the Contractor at his own cost. The method used in repairing, replacing or maintaining the equipment and services shall be approved by the IPR.

The Contractor shall have to repair all damages to the building, property, and existing equipment and articles etc, what so ever arising during the execution of work. The method used in repairing or replacing shall be decided and approved by the IPR.

During erection the Contractor shall at all times keep the working and storage areas free from waste or rubbish. On time-to-time, as directed by engineer in charge, he shall remove all temporary structures, debris, insulation bitumen, EPS wastage and leave the premises neat and clean in a satisfactory condition.

All equipment shall be completed with approved safety devices wherever a potential hazard to personnel and surrounding exists and with provision for safe access of personnel to and around equipment for operational and maintenance functions. These items shall include not only those usually furnished with elements of machinery but also covers, guards, crossovers, stair ways, ladders, platforms, handrails etc. which are necessary for safe operation of the system. The contractor must have to abide by all safety guidelines and protocols of IPR.

Storage and Protection of Equipment and Material:

IPR will not provide any covered dedicated store facility for project material. Equipment and materials shall be stored in a manner that shall maintain an orderly, clean appearance. If stored on-site in open or unprotected areas, equipment and material shall be kept off the ground and out of standing water by means of pallets or racks or suitable arrangement, and covered with tarpaulins.

Equipment and material, if left unprotected and damaged, shall be repainted or otherwise refurbished at the discretion of the IPR. Equipment and material is subject to rejection and replacement if, in the opinion of the IPR, the equipment has deteriorated or been damaged to the extent that its immediate use or performance is questionable, or that its normal life expectancy has been curtailed. The contractor shall make his own arrangements for the storage of materials & their safe custody at site.

During the work execution, protect piping and equipment from damage and dirt. Properly cap the piping. Each system of piping shall be flushed to remove grit, dirt, sand, and other foreign matter.

SECTION –II

TECHNICAL SPECIFICATIONS

1. PROJECT INFORMATION:

Existing water cooling system installed and commissioned to cater the heat load of various experimental systems in IPR. It consists of 03 nos. of 310 TR each centrifugal chillers, 03 nos. of 610 TR each cooling towers, condenser pumps, chilled water pumps, heat exchangers, process pumps, piping systems with valves, Electrical panels with cabling, SCADA systems, storage tanks etc.

At the time of commissioning of the existing water cooling system, provision for future expansion with flange end connections were kept in existing piping headers. Foundations are also available to put the future equipment (i.e. chiller, cooling tower, pumps, piping etc.) and to be hooked up them to the existing water cooling system.

SITE CONDITION:

- i. Site: Institute for Plasma Research Opp. Bhat village, Near Indira Bridge, Gandhinagar, Gujarat. -382 428.
- ii. Site Location: 4 km away from Ahmedabad Airport. Nearest port: Mumbai / Kandla/Mundra. Nearest Railway station: Ahmedabad.
- iii. Outdoor design conditions:

Weather	Dry bulb temp (° C)	Wet bulb temp. (° C)	Relative humidity (%)
Summer	42.3	24.1	47
Monsoon	34.3	28.7	85
Winter	11.5	9.0	50

- iv. Extreme ambient conditions:

Temperature: Max. 47 °C. Min. 4.5 °C
RH: Max. 95%. Min. 17%

- v. Rainfall Average 823 mm.
- vi. Wind data:
Max. Wind speed : 130 Kmph. Wind direction : SW to W. Design wind pr. : 100 kg / m²
- vii. Site Elevation 55 m above MSL

2. SCOPE OF WORK:

- Supply, Installation, testing and commissioning of:

(1) 01 No. of 310 TR Water-cooled centrifugal compressor water chilling machine, (2) 01 No. of Induced Draft FRP Cooling Tower, (3) 01 No. of chilled water Pump-set, (4) 01 No. of cooling tower pump-set (for chiller condenser circuit), (5) 01 No. of process cooling tower pump-set for heat removal of experimental system (6) Power cabling & wiring, and associated electrical works (7) MS piping, valves, strainers, MS work (8) Instruments & controls and (9) Associated minor/major civil works, as per the details available with IPR confirming to tender specifications, drawings, relevant codes, in accordance with proposed schedule of quantities.

- The purpose of the new centrifugal compressor water chilling machine is to cater the heat removal need of the SST1 experimental systems in IPR. We have 3 nos. of centrifugal chillers of 310 TR capacities. One new centrifugal

chiller shall be hooked up with existing three centrifugal chillers. New chilled water, condenser water and process cooling tower pump set shall be hooked up with existing respective pumps and to be connected to respective pipe headers. New cooling tower shall be hooked up with existing three cooling towers.

- The Bidder shall carry out work in every respect in conformity with the contract documents and with the directions of the Engineer in-charge.
- Selection of new cooling tower should be such that its sump water level will match with the existing cooling towers sump water level.
- If require, contractor has to cut the existing pipes to bring the chiller inside plant room and reinstall the same pipes without any extra cost to IPR.

Exclusions:

- Feeders with starters for the chiller, pumps and cooling tower fan are available in the existing MCC panel so excluded from the scope of this tender
- Integration of new equipment with existing SCADA system is not in a scope of the contractor.

2. TECHNICAL DETAILS:

A. Centrifugal Chiller (Water Cooled):

Scope	Semi-hermetic Centrifugal compressor (Single Compressor model only) with lubrication and control system, evaporator, condenser, refrigerant control device, DP switch, Star-Delta Starter operating panel and any other components necessary for a complete and operable chiller package with following specifications. <ul style="list-style-type: none"> • Including providing necessary documentation. All materials shall meet or exceed all applicable referenced standards, and local requirements, and conform to codes and ordinances of authorities having jurisdiction.
Type :	<ul style="list-style-type: none"> • Microprocessor / PLC Controlled-Water-cooled – Positive pressure –Semi hermetic Centrifugal type-bolted together- Flooded type
Refrigerant	<ul style="list-style-type: none"> • R-134a
Performance : Capacity :	<ul style="list-style-type: none"> • Actual Delivered Capacity 310 TR At CHW leaving Temp. 7°C. CHW entering Temp 12 °C CTW entering Temp. 32°C. CTW leaving Temp 36 °C Power supply: 3 Phase, 415 V ± 10 %, 50 Hz.
Operation / Capacity Control	<ul style="list-style-type: none"> • Reliable, Stable operation. • Efficient part load operation as per ARI standard. • Refrigerant flow control by self actuating thermostatic expansion valve or by electronic expansion valve or suitable expansion device
Compressor	<p>Semi-hermetic drive centrifugal compressor type</p> <ul style="list-style-type: none"> • Semi-Hermetic drive centrifugal compressor type. <p>Semi Hermetic Drive Motors:</p> <ul style="list-style-type: none"> • Refrigerant cooled with internal thermal overload protection devices embedded in the winding of each phase. • The motor shall be capable of successful operation when running at rated load with variations in voltage and frequency. Terminal box of sturdy construction shall provide enough space for terminating, connecting and earthing of PVC / XLPE - insulated aluminum/copper conductor cable. All terminal boxes shall have terminal and cable glands suitable for cables specified.

Lubrication System	<p>Unit shall have :</p> <ul style="list-style-type: none"> Independent lubrication system to provide lubrication to all moving parts by a positive displacement submerged oil pump or work on positive differential pressure created within the system.
Condenser / Evaporator / Heat Exchangers	<ul style="list-style-type: none"> Chiller capacity selection shall be based on a water side fouling factor of in evaporator tubes and in the condenser tubes as per BOQ values. Chillers shall be rated in accordance with the latest edition of ARI Standard 550/590 and shall conform to the latest edition of ASHRAE 15 Safety Code. Shell and tube type using welded steel shells and copper tubes with integral fins, rolled or silver brazed to tube sheets. The evaporator shall be designed such that refrigerant liquid is to be distributed evenly across the evaporator and that potential of having liquid refrigerant carryover into the compressor is eliminated. Refrigerant baffles in the condenser to distribute entering gases and to concentrate non-condensable gases. Water Pipe Connections: <ol style="list-style-type: none"> Evaporator and condenser connections shall be flange pipe connections. Design pressure of waterside evaporators and condensers should be 150 PSI. Provide taps in water boxes for vents, drains, and control connections. Refrigerant pressure relief valves shall be provided. Chiller shall be insulated with multi-layer thermal insulation with vapour barrier, thermal insulation material.
Accessories	<ul style="list-style-type: none"> NRV at discharge side of compressor. Isolation valves for service and system pump-down. Moisture indicating sight glass. Evaporator, suction line and any other component subject to condensing moisture shall be insulated with closed cell insulation. All joints and seams shall be carefully sealed to form a vapor barrier. Vents and drain shall be provided. Provide Pressure switches factory mounted and wired for no operation with no flow. The contractor shall supply serrated rubber pads for field mounting under unit feet for vibration isolation.
Motor Starter	<ul style="list-style-type: none"> All contactors are to be continuous duty AC magnetic type and capable of carrying the specified current on a continuous basis. The starter shall be: <ul style="list-style-type: none"> Star Delta starter based on latest technology The starter shall be coordinated with the chiller package(s) marking all terminals properly according to the chiller manufacturer's wiring diagrams. The Star – Delta starter shall be equipped with motor control relays (MCR) with all the protection features. The relays interconnect the starters with the unit control panels and directly operate the main motor contactors for tripping. There shall be electronic overloads/thermal overload in each phase of motor. Each starter shall include the following protective devices: <ol style="list-style-type: none"> Phase failure and reversal protection.
Micro Computer Control Panel	<p>A microprocessor/PLC based control panel with locked enclosure shall be fully wired and factory mounted on the chiller and has the following features:</p> <ul style="list-style-type: none"> The display shall have Messages in plain English language. Coded two or three character displays are not acceptable. Must have OPEN PROTOCOL for integration with all DACS systems and easy operator interface. The chiller control panel shall provide control of chiller operation and monitoring of chiller sensors, actuator, relays and switches. The panel shall be a complete system for stand-alone chiller control and include controls to safely and efficiently operate the

	<p>chiller. The panel shall be equipped with building automation system (BAS) interface for connectivity to Master Controller.</p> <ul style="list-style-type: none"> • Safeties: The chiller control panel shall monitor such safeties as motor starting and running, time between compressor motor starts, low chilled water temperature, high condenser refrigerant pressure, low evaporator refrigerant temperature, evaporator and condenser water flows, low oil pressure, high oil temperature, and proper operation of unit controls and sensors. • Provide steel control cabinet containing the following operating and safety controls: <ol style="list-style-type: none"> 1. Automatic capacity control. 2. Automatic current limiting overload device. 3. Operating hour counter. 4. Anti-recycle program timer. 5. Refrigerant Suction pressure and Discharge pressure 6. Oil pressure. 7. Low chilled water temperature control 8. Motor temperature cutout 9. High refrigerant pressure cutout with manual reset 10. Low refrigerant temperature cutout with manual reset 11. Low oil pressure cutout 12. Guide vane time delay control to prevent vane opening until compressor has obtained full speed. 13. On-off maintained contact switch for control circuit. 14. Chilled and condenser water pressure or flow switches. 15. Electronic chilled water temperature controller. 16. The front of the chiller control panel shall be capable of displaying the following: <ol style="list-style-type: none"> a. Entering and leaving evaporator water temperature. b. Entering and leaving condenser water temperature. c. Chilled water set point. d. Chiller operating mode. e. Chiller operating parameters. f. Chiller diagnostic codes. 17. Facility Management system interface module fully compatible with BAS. 18. The controller shall be able to set chilled water temperature.
Factory Testing	Refer : Section - III

B. SPLIT CASING PUMPS

Scope :	<ul style="list-style-type: none"> Water pumps shall conform to following Specifications and in accordance with requirements of Schedule of Quantities.
Type :	<ul style="list-style-type: none"> The type and size of all chilled water, condensing water, drain pumps shall be in accordance with requirement of Drawings and Schedule of Quantities.
Capacity :	<ul style="list-style-type: none"> Water flow rates and head of the pumps shall be in accordance with the requirements of Drawings and Schedule of Quantities.
Split Casing Pumps	<ul style="list-style-type: none"> Pump casing shall be closed-grained cast iron of heavy section, horizontally-split, making possible complete servicing of rotating parts without opening piping or motor connections. Motor to pump connection shall be of flexible coupling type. Suction passage shall be volute in form, promoting smooth entry to impeller and increased efficiency. Impeller shall be bronze/CF8M/CF8, enclosed type, hydraulically and passages smooth finished for minimum friction and maximum efficiency. Impeller rings shall be secured from relative movement by tongue and groove fittings. Shaft shall be steel, protected by metal sleeves extending through stuffing boxes. Stuffing Boxes shall be extra deep, water sealed, with renewable bushes. Shaft shall be supported on ball/journal bearings, grease-lubricated, and contained in easily removable housings. Pump shall be fitted mechanical seals, an air valve, grease lubricators, drain plug, water seal connections, and coupling-guard. Motor shall be totally enclosed, fan-cooled, class-F insulation, of approved make. Motor shall be 4-Pole and specially designed for quiet operation. The motor rating shall be such as to ensure non overloading of the motor throughout its capacity range including the pumps operating in parallel. Motor shall be suitable for 415 ± 10% volts, 3 phase, 50 cycles AC, and power supply. Base shall be of a size suitable for the pump, motor and shaft and shall be constructed of cast iron or welded steel. A guard mounted on the common base shall protect flexible coupling. Performance: All the pumps must perform according to selected duty point and respective performance curve.
Lubrication	<ul style="list-style-type: none"> Upon installation of the complete system and before testing, the pump shall be lubricated in strict accordance with the manufacturer's instructions. A metal instruction plate shall be attached to the pump in a location where it is clearly visible.

C. COOLING TOWER:

Scope:	<ul style="list-style-type: none"> Cooling towers in accordance with requirements of Drawings and Schedule of Quantities.
Type :	<ul style="list-style-type: none"> Cooling Towers shall be induced draft type, single cell in accordance with requirement of Drawings and of the Schedule of Quantities.
FRP Induced Draft Cooling Tower :	<p>Fiber-reinforced plastic Cooling Tower shall be suitable for outdoor use. Tower shall be vertical, induced draft, counter flow, fiber reinforcement plastic construction, in square, complete with fan, motor, surface and spray section, eliminators, steel supports, and where called for in Schedule of Quantities.</p> <p>a. Capacity : The cooling tower capacities shall be as per Schedule of Quantities.</p> <p>b. Side Casing : This shall be made out of FRP with minimum resistance to air flow. It shall have sufficient structural strength to adequately withstand high wind velocities and vibration with UV protection from sun rays. The casing shall be installed in the fiberglass reinforced basin. The tower supporting structure shall be made out of hot dip galvanized steel frame. Air intake shall be all along the sides so that tower can be installed quite independent of prevailing wind direction. Anodized aluminum or PVC louvers integrated with fill shall be provided at air intake. Sufficient clearance between casing and water basin shall be provided to enable servicing and periodic cleaning.</p> <p>c. Cold Water Basin : Cold water basin shall be a deep fiberglass reinforced sump on which cooling tower super structure shall be supported. Basin fittings shall include the following :</p> <ol style="list-style-type: none"> Bottom outlet. Screened suction assembly fixed to the casing.

	<p>iii. Drain point connection. iv. Overflow fixed to inside of casing side sheet. v. Ball type automatic makeup water valve. vi. Equalizing piping connection.</p> <p>d. Distribution System : Hot water distribution system shall comprise of HDPE/PVC /Suitable and branch arms system with nozzle / Gravity flow system.</p> <p>e. Fillings : Fillings shall be made of corrosion proof, UV protected and rigid virgin PVC film in honey comb design and arranged in square / rectangular form or fill sheets shall be suspended from H.D.G steel structural tubing supported from the lower structure & shall be elevated above the floor of the cold water basin to facilitate cleaning and easy replacement. They shall be arranged in such a manner to ensure negligible resistance to air flow and to eliminate back water spots and prevent fouling through scales that may form. In order to reduce carry-over losses through entrapment of moisture drops in air stream, virgin PVC drift eliminator shall be installed.</p> <p>f. Mechanical Equipment : Fan shall be of the propeller type cast AL alloy / FRP, light-weight rotor fitted with multiple aerofoil blades. The entire fan assembly shall be made of Al casting, statically and dynamically balanced. Fan shall be directly/geared driven by $415 \pm 10\%$ volts, 3 phase, 50 cycles, AC supply, IP55 motor, totally-enclosed, fan-cooled, weather- proof construction, designed and selected to operate in humid air stream. Fan shall be protected by fan guard & shall be easily accessible for inspection and maintenance. A service ladder shall also be provided for greater convenience. The mechanical equipment assembly shall be adequately supported on a rugged steel base welded to tubular support assuring vibration-free support. Fan guard shall be provided to prevent birds from nesting during idling periods. Canopy shall be provided over the fan motor for protection against rain water. Care shall be taken that fan air is not restricted. Motor terminal box shall be made water tight.</p>
Operating Weight	<ul style="list-style-type: none"> <i>Operating Weight of cooling tower must not exceed 12000 Kg.</i>

D.INSTRUMENTS AND CONTROLS :

Scope :	<ul style="list-style-type: none"> The scope of this section comprises the supply, erection, testing and commissioning of automatic controls and instruments conforming to these Specifications and in accordance with the requirements of Drawings and Schedule of Quantities.
Type :	<ul style="list-style-type: none"> All automatic controls shall be electro-mechanical controls as described in the various sections of these Specifications.
<u>Instruments :</u>	<p>Instruments required for different types of machines have been described in the various sections of these Specifications and shown on the Drawings. Following instruments may be provided as per the requirements indicated in the Schedule of Quantities.</p> <p>a. Temperature gauge : shall be dial type 100 mm dia. Thermometers capillary shall be sufficiently long installed on, supply and return at chillers , condensers as included in Schedule of Quantities. Range of scales shall be 0-50 degree C for Chilled water applications of cooling only. Gauges shall be connected to the pipes by SS thermowell with sufficient length.</p> <p>b. Pressure Gauges: shall be installed on suction and discharge sides of pumps, chilled water supply and return , inlet and outlet at chillers and condensers and as shown on the Drawings and included in Schedule of Quantities. Suction side gauges at pumps shall be compound gauges with 100 mm dia, range 0 - 10 kg/cm² pressure. Discharge sides gauges at pumps and at all other locations shall be of 100 mm dial size, range 0-10 kg/cm² (0-150 psi) pressure or higher as indicated in SOQ.</p>
Calibration and Testing :	All automatic controls and instruments shall be factory calibrated and provided with necessary instructions for site testing.

E.PIPING :

The scope of this section comprises the supply, site fabrication and laying of pipes, pipe fittings and valves, testing and balancing of all water piping required for the complete installation as shown on the Drawings. All piping inclusive of fittings and valves shall follow the applicable Indian Standards.

a. Welder Qualification:

All welding shall be done by qualified welders and shall strictly conform to BIS Code of practice for manual metal arc welding of Mild Steel. First butt weld of each welder shall be fully DP and radiography tested. Cost of DP and radiography shall be borne by the contractor. Upon approval of welding joints the concerned welder shall be allowed to carry further welding of the pipes. Rest of the welds shall have 100% visual inspection. Before welding of pipes, make proper ‘V’ notch at the joints by chamfering the end of pipe with surface grinder. All electrodes shall be selected to match the mechanical and chemical properties of the parent material.

b. Piping Specifications:

- **Water Piping:** Pipe and all fittings shall be MS Class ‘C’ (Heavy Class) conforming to relevant BIS Codes.
- **All pipes** and their supports shall be thoroughly cleaned and given one primary coat of bituminous paint before being insulated. All welded piping shall be subject to the approval at site.
- **Fittings** shall be malleable casting of pressure rating suitable for the piping system. Fittings used on welded piping shall be of the weldable type.
- **Piping Installation :**
Tender Drawings indicate schematically the size and location of pipes. The Contractor, on award of the work, shall prepare detailed shop drawings, details of fittings, locations of isolating valves, drain and air vent with valves, and all pipe supports. He must keep in view the specific openings in buildings and other structures through which pipes are designed to pass.
- Piping shall be properly supported with proper support and clamps, or stands- clamps, as specified in SOQ. The Contractor shall adequately design all the brackets, saddles, clamps and hangers and be responsible for their structural sufficiency.

Pipe size	Spacing between supports
Up to 12 mm	1.5 Meter
15 to 25 mm	2.0 meter
30 to 150 mm	2.0 meter
Over 150 mm	2.0 – 2.5 meter

- Vertical risers shall be parallel to walls and column lines and shall be straight and plumb. Risers passing from terrace floor, suitable flashing shall be provided to prevent water leakage. Pipe shall have a suitable clean out at the lower point and air vent at the highest point.
- All piping work shall be carried out in a workmen like manner, causing minimum disturbance to the existing services, buildings, roads and structure. The entire piping work shall be organized, in coordination with other agency’s work, so that laying of pipe supports, pipes and pressure testing for each area shall be carried out in one stretch.
- Auto purge valves shall be provided at all high points in the piping system for venting. Air valves shall be 15 mm pipe size valves with screwed joints.
- **Pressure testing shall be done for piping** at-least 1.5 times the working pressure.

F. INSULATION:

- **Scope:** The scope of this section comprises the supply and application of insulation conforming to these Specifications.
- **Material:** Insulation material shall be TF quality expanded polystyrene. For expanded polystyrene the thermal conductivity shall not exceed 0.034 kcal/(hr-sq.m-deg C/meter) or 0.23 BTU/(hr- sq.ft-deg F/inch at 32 deg C (90 deg F) mean temperature and density shall be not less than 24-kg/ cu.mt. Thickness of the insulation shall be as Specified for the individual application. Each lot of insulation material delivered at site shall be accompanied with manufacturer’ test certificate for thermal conductivity values and density. Adhesive used for setting the insulation shall be non-flammable, vapour proof adhesive, Shalimar CPR compound, or approved equal, cold setting compound.
- **Piping Insulation:** All chilled water piping shall be insulated in the manner Specified herein. Before applying insulation, all pipe work and fittings shall be brushed and cleaned, and dust, dirt, mortar and oil removed. All MS pipes shall be provided with a coat of bituminous paint, followed by two coats of cold setting adhesive / bitumin compound. Thermal insulation shall then be applied as follows:

Pipe size (mm)**Thickness for expanded polystyrene (T F Quality- mm)**

- | | |
|-------------|----|
| • 10 to 40 | 25 |
| 50 to 125 | 50 |
| 150 & Above | 75 |

- Premoulded pipe sections shall be placed over the pipes, the longitudinal joints of this pipe section shall be sealed with the adhesive compound. The traverse joints shall also be sealed with adhesive compound. The insulation shall be continuous over the entire run of piping, fittings and valves. Clean the surface and fix the insulation tightly with cold elastomeric membraneous bitumen (Eniroof EMB) or hot bitumen as recommended by insulation manufacturer. The joints shall be suitably sealed.

Insulation shall be applied only after the piping system has been satisfactorily tested for leaks at 1.5 times the working pressure or at minimum 10 kg/sq.cm. Test pressure. All insulated pipes shall be covered with layer of thick polythene sheet as vapour barrier. PVC straps at 400 mm centre shall be used to hold insulation and vapour barrier together. Insulation material shall be covered with a continuous sheet of thick polyethylene (for protection from water and moisture), before wrapping with GI chicken wire-mesh and then 15 - 20 mm thick sand-cement plaster will be provided. After Insulation IPR approved synthetic enamel paint should be provided on sand cement plaster insulated pipes.

Skilled workmen specially trained in this kind of work shall carry out all insulation work. After insulation work flow direction of fluid shall also be marked.

G. Valves:

- **Butterfly valves** shall have CI/CS/WCB body with black Nitrile/EPDM rubber seat. All butterfly valves shall be provided with locking devices.
- **Balancing valves** shall be provided at return chilled & condenser water line. The valves shall have built-in pressure drop measuring facility to compute flow rate across the valves. The test cocks shall be long enough to protrude out of pipe insulation.
- **NRV** shall be of swing check type Class -150, CI/WCB body and all SS 304 wetted parts, including matching flanges and metric thread fasteners. Valve shall comply leakage class VI.
- **Ball valves** shall be of three pieces with SS body, SS 304 wetted parts, PTFE seat including matching flanges and metric thread fasteners.

H. ELECTRICAL INSTALLATION:**I. Scope**

Feeders with starters for the chiller, pumps and cooling tower fan are available in the existing MCC panel. Contractor has to supply, lay and terminate power/control/signal cables and earthing from these existing feeders to pump motors, cooling tower, chiller panel as per SOQ. The following shall be taken as “minimum” requirements. The following specifications shall be considered as additional or supplementary specifications; and the Project’s overall electrical standards and specifications shall prevail wherever the latter are more stringent or demanding.

General

The design, materials, construction, manufacture, inspection, testing and performance of Panel shall comply with all currently applicable statutory regulation and safety codes in the locality (Gujarat) where the equipment will be installed. The equipment shall also confirm to the latest applicable standards and codes of practice.

II. TECHNICAL SPECIFICATIONS

- **Wiring System:**

All LT power cabling between MCC and motors shall be carried out with 1100 volts grade PVC insulated, overall PVC sheathed aluminum / Cu conductor, steel armoured cables. Cables shall be sized by applying proper derating factor for the service conditions they are required. All control wiring shall be carried out by using 650 volts PVC insulated copper conductor wires in race ways or in conduit. 1100 volts grade PVC insulated copper conductor in conduits or armored power cables suitable for 415+10% volts 50 cycles 3 phase.

Control wiring shall be done using 650 V grade PVC stranded wire 1.5 sq.mm for control and 2.5 sq.mm for CT circuit.

- a) As a standard practice, all control cables shall be neatly bunched together with ferrules at either end of each wire. As per application colour ferrules shall be provided.
- b) For safety and reliability, cable bunch shall be routed through flexible metallic conduit wherever it passes through HV compartments like breaker, PT chamber etc.
- c) If Chiller starter is housed as a free standing unit then all the control, signal cables between starter panel and Chiller control panel shall be housed in flexible metallic conduit.

• **Materials:**

All materials shall be of the best quality complying with the BIS (Bureau of Indian Standards) Specifications. Materials used shall be subject to the approval of the Engineer-in-charge and samples of the same shall be furnished where required.

III. CABLE LAYING

- a) Cables shall be laid generally in accordance with Bureau of Indian Standard Code of Practice. Cables shall be laid in perforated GI/MS cable trays as indicated on the Drawings/BOQ or as approved by the Engineer. Easy access to all cables shall be provided to allow cable withdrawal/replacement in future. Where more than one cable is running proper spacing shall be provided to minimize the loss in current carrying capacity.
- b) Cables shall be suitably supported with wooden cleats when run on wall/floor/ducts. When buried, they shall be covered with a layer of soft sifted sand and protected with cement concrete tiles. Special care shall be taken to ensure that cables are not damaged at bends.
- c) Where cables are run on walls, proper saddling and dressing shall be done. The runs from wall to equipment shall be through suitably sized GI pipes, preferably below the floor surface.

IV. Power Cables Sizes:

For all single phase/ 3 phase cabling, 1100 volts grade PVC insulated copper conductor cables shall be used. All the cables inside the control panel shall be neatly dressed and plastic beads shall be provided at both the ends for easy identification in control wiring.

Minimum power cabling and earthing sizes for different motor ratings shall be as per following table. However, if cable derating is necessitated in any particular situation, suitable higher size cable shall be used.

Power cabling shall be of the following sizes:

Sr. No.	Motors Rating	Power Wiring / Cables Sizes
i.	Up to 5 HP motors	3C x 4 sq.mm copper conductor wires / armoured cables
ii.	From 6 HP to 7.5 HP motors / 6 kW to 7.5 kW heaters	3C x 6 sq.mm copper conductor wires / armoured cables
iii.	From 10 HP to 15 HP motors	2 x 3C x 6 sq.mm copper conductor armoured cables
iv.	20 HP motors	2 x 3C x 10 sq.mm aluminum conductor armoured cables
v.	From 25 HP to 35 HP motors	2 x 3C x 16 sq.mm aluminum conductor armoured cables
vi.	40 HP motors	2 x 3 ½ C x 25 sq.mm aluminum conductor armoured cables
vii.	50 HP motors	2 x 3 ½ C x 35 sq. mm. aluminium conductor armoured cables
viii.	From 60 HP to 75 HP motors	2 x 3 ½ C x 70 sq.mm aluminum conductor armoured cables
ix.	100 HP motors	3 ½ C x 150 sq.mm aluminum conductor armoured cables
x.	150 HP motor	2 x 3 ½ C x 240 sq.mm aluminum conductor armoured cables
xi.	250 HP motor	2 x 3 ½ C x 400 sq.mm aluminum conductor armoured cables

Earthing:

- a) The earth bus shall be robust and capable of carrying full short circuit current for 1 sec.
- b) Doors, covers and all non-current carrying metallic parts shall be earthed through flexible copper wires. This should also include instrument casing and cable armour, which should also be connected to the earth bus.

The earth bus shall have provisions for terminals at each end for connecting to grid earthing

Earthing shall be copper strips / wires. The main panel shall be connected to main earthing system of the power supply. All single phase metal clad switches and control panels are earthen with minimum 3 mm diameter copper conductor wire. All 3 phase motors and equipment shall be earthen with 2 numbers distinct and independent copper wires / tapes as follows:

i. Motors up to and including 10 HP rating.	2 Nos. 3 mm dia copper wires.
ii. Motors 12.5 HP to 40 HP. capacity.	2 Nos. 4 mm dia copper wires.
iii. Motors 50 to 75 HP capacity.	2 Nos. 6 mm dia copper wires.
iv. Motors above 75 HP.	2 Nos. 25 mm x 3 mm copper tapes.
All switches shall be earthed with two numbers distinct and independent copper wire's tapes as follows:	
i. 3 phase switches And control panels up to 60 amps rating.	2 nos. 3 mm dia copper wires.
ii. 3 phase switches, and Control panels 63 amps to 100 amps rating.	2 Nos. 4 mm dia copper wires.
iii. 3 phase switches and control panels 125 amps to 200 amps rating.	2 Nos. 6 mm dia copper wires.
iv. 3 phase switches, control panels, bus ducts above 200 amps rating.	2 Nos. 3 mm X 25 mm copper tapes.

The earthing connections shall be tapped off from the main earthing of electrical installation. Sweated lugs of adequate capacity and size shall be used for all termination of wires. Lugs shall be bolted to the equipment body to be earthen after the metal body is cleaned of paint and other oily substance and properly tinned.

V. Testing:

Refer section: III

SECTION –III

INSPECTION, TESTING & MEASUREMENT OF WORKS

(i) **INSPECTION AND TESTING:**

1. Inspection (Pre-dispatch & site), Testing & Acceptance.

All the system equipment, parts shall be checked for physical damage, before commencing the installation work. Complete fabrication, installation and commissioning work shall be jointly supervised and shall be carried out as per the specifications and instructions of IPR Engineer In-charge. All the rotating equipment shall be checked for static and dynamic balancing, minimum operating vibration and noise.

All the system / equipment shall be checked before / after satisfactory commissioning, at site as may be required for the approved technical specifications, performance data provided by supplier / manufacturer. Actual capacity of equipment shall be calculated based on the test readings, recorded jointly, for design conditions / operating conditions. Performance acceptance is subject to comparison of test results with supplier / manufacturer's performance data and contract specification. Acceptance is subject to satisfactory Installation, commissioning and performance testing with respect to technical specifications. Rejected items must be replaced or rectified for the defects / performance. In case of system modification / rectification complete performance tests are to be repeated. Site test readings shall be jointly recorded.

2. In general following Inspection / tests are involved. Type of test, duration of test, testing procedure / parameters, will be as per the applicable codes and standard. However the detail Inspection and test procedure shall be worked out jointly by the purchaser and the contractor along with the approval of drawings.

2.1 GENERAL

- a. Pre-dispatch Inspection and testing at manufacturers shop / factory.
- b. Physical Inspection at site.
- c. Welding joint inspection and testing at site.
- d. Pressure testing at site.
- e. Performance testing at site. (Capacity, power consumption, pressure drop, vibration, etc.)

Sr. No.	ITEM/ EQUIPMENT	Inspection /Test Involved.
1.	Water chilling machines	a, b, e
2.	Pumps	a, b, e
3.	Piping and fittings - MS & GI	b, c, d
4.	Valves / Control valves and strainers	b, d

- All the arrangement for the said inspection and testing must be made and contractor shall absorb charges. The purchaser shall be intimated sufficiently in advance for 'a' and 'b'.
- Pre-dispatch inspection and clearance issued by purchaser / representative of purchaser, will not relieve the contractor from responsibility of showing the performance of the integrated system at IPR.

2.2 PRE-DISPATCH INSPECTION & TESTING OF CHILLER:

Chiller performance must include an ARI approved selection method. Demonstrate stable operation at minimum load during the factory performance test.

The performance test shall be run with clean tubes in accordance with ARI 550/590-03 to include the following:

- i. A downward temperature adjustment shall be made to the design leaving evaporator water temperature to adjust for the specified fouling of the tubes.
- ii. An upward temperature adjustment shall be made to the design entering condenser water temperature to adjust for the specified fouling of the tubes.

- iii. There shall be no exceptions to conducting the performance test with clean tubes and with temperature adjustments per items 1 and 2. The manufacturer shall clean tubes, if necessary, prior to the test to obtain a test fouling factor.
- iv. A certified test report of all data shall be submitted to the Engineer prior to Substantial Completion. An officer of the manufacturer's company shall sign the factory certified test report. Preprinted certification will not be acceptable; certification shall be in the original.

The equipment will be accepted if the test procedures and results are in conformance with Ratings and Parameters mentioned in the BOQ & committed by Vendor. If the equipment fails to perform within allowable tolerances, the manufacturer will be allowed to make necessary revisions to manufacturer's equipment and retest as required.

Factory testing of the chiller before dispatch will be done in the presence of IPR engineers as per ARI 550/590 on AHRI certified test bed. Run test, performance test, checking of safety & cutouts will be performed. Performance test shall include capacity & power consumption at 100%, 75%, 50% & 25% load points.

Pre-dispatch inspection and testing at manufacturer's place shall be carried out by IPR representatives of Water cooled chiller for routine factory tests.

2.3 PRE-DISPATCH INSPECTION & TESTING OF PUMPS:

- i. Visual inspection of pumps
- ii. Hydrostatic Tests: Hydrostatic test shall be conducted for pressure containing parts at 1.5 times the max. operating pressure or 10 bar pressure (whichever is higher) and the duration of the test shall not be less than 30 minutes.
- iii. Performance Test: Performance test shall be conducted at rated speed with water and job motor to ascertain head, power, and efficiency against capacity. At least six points on the characteristic curve including shut off, minimum continuous stable flow, midway between minimum continuous stable flow and rated flow, rated point, 120% of rated flow shall be plotted. Permissible/ Acceptable tolerances on rated performance parameters for the test shall be as per the data sheet. Vibration for all pumps measured on the bearing housing during the performance test at rated speed. The results of the testing shall be approved by the IPR. The rotor assembly including impeller, shaft etc. shall be statically and dynamically balanced by the Contractor /Vendor prior to assembly. The noise level produced by the rotating equipment and vibration level shall not exceed that specified in the Data Sheets.

3. Test Certificates :

Contractor shall furnish following Test certificates.

- Material testing of various components of the equipment/ system parts.
- Fabrication inspection / test certificates
- Performance test certificates carried out by manufacturer.
- Hydro test certificates of valves
- Performance curves of pump, along with operation and maintenance manual.

4. Site Inspection and Testing of equipment and whole cooling water system at site:

- All the tests shall be carried out in the presence of the representative of IPR. All instruments, services, required for the tests shall be provided by the contractor. All the system components (Including the parts cleared after pre-dispatch inspection and testing) will be physically inspected and tested before and after installation according to approved specifications and drawings.
- Capacity ratings and power consumption with operating points clearly indicated shall be submitted and verified at the time of testing and commissioning of the installation. Manufacturer's tests certificates shall be furnished for all equipment / materials.
- The contractor shall demonstrate the capacity and the power consumed by all the equipments. The contractor shall also demonstrate the proper operation of all controls, Instruments and other equipment. Hydrostatic test for all pressure piping shall be carried out. Alignment of drives, checking of vibration isolation, running tests for pumps, chiller, cooling tower etc. shall be carried out.
- Water piping, fittings shall be tested to hydraulic test pressure of at-least one and half (1.5) times the maximum operating pressure, but not less than 10 Bar, for a period of not less than 24 hours. Any leaks, defects shall be rectified and re-tested in same manner. After completion of the installation, all water system equipment such as pumps, chiller, Cooling tower, valves, instruments etc. Shall be adjusted and balanced to deliver the water as specified.

- **Acceptance**

System components or system as a whole shall be tested for performance as per the approved technical specifications. System can be accepted and taken-over by IPR for regular operation only after satisfactory performance testing in all respect. All the system components shall meet the guaranteed performance requirements to the satisfaction of IPR. Necessary replacement / modification / rectification shall be carried out with the approval of Engineer In-charge. The installation shall be tested again after removal of defects and shall be commissioned only after approval by the Engineer In charge.

The following aspects shall be considered for performance testing.

- Prevailing conditions shall be as close as to design conditions.
- Type, quantity, location, frequency, duration of test parameters shall be decided and recorded accordingly during the test.
- Rated capacity, power consumption, and other operating parameters shall be checked.

4.1 Water Chilling Machines:

The unit shall be selected and installed for the lowest operating speed and noise level. Capacity ratings and power consumption with operating points clearly indicated, shall be submitted and verified at the time of testing and commissioning of the installation. Measurements of chilled water flow rate and temperature of chilled water in and out of the chilling unit shall ascertain capacity. Power consumption shall be computed from measurements of incoming voltage & input current to the chilling machine.

- **CHILLER PARAMETERS:**

- Chilled Water Inlet Temperature °C
- Chilled Water Outlet Temperature °C
- TR
- Power Consumption
- Corresponding Ambient Conditions
- Suction Pressure (PSI)
- Discharge Pressure (PSI)
- Oil pressure (PSI)
- Check Functioning of Unloading/Capacity Control
- Noise Level @ 1.5 M

4.2 : Pumps :

Pump performance curves and power consumption with operating points clearly indicated shall be submitted and verified at the time of testing and commissioning of the installation. Vibration level, noise level & bearing temperature shall also be recorded.

Pump performance shall be computed from the pump curves provided by manufacturer

4.3: All automatic controls and instruments shall be factory calibrated and provided with necessary instructions for site testing.

4.4: PIPING:

a. All piping including equipment installed, shall be tested to hydrostatic test pressure of at least one and half times the Maximum operating pressure, but not less than 10 kg/cm² gauge for a period of not less than 24 hours. All leaks and defects in joints revealed during the testing shall be rectified and got approved at site.

b. Piping repaired subsequent to the above pressure test shall be re-tested in the same manner.

c. The Contractor shall make sure that proper noiseless circulation of fluid is achieved through all coils and other heat exchange equipment in the system concerned. If proper circulation is not achieved due to air bound connection, the Contractor shall rectify the defective connections. He shall bear all expenses for carrying out the above rectifications including the tearing up and re- finishing of floors and walls as required.

f. The Contractor shall provide all materials, tools, equipment, instruments, and services and labour required to perform the test and to remove water resulting from cleaning and after testing.

Welding: Inspection & Acceptance Standards:

Following Inspection and testing shall be carried out.

- Root and final run for Butt-welds, Nozzle welds, Structural attachment weld, Hanger, Support welds, socket welds etc. shall be checked with –
- 100 % Visual examination + 10 % DP (Dye Penetration) examination

- **Visual Checkup Includes :** Base metal identification, Base metal defects rectification, Edge preparation, Joint - Fit-up checking for both longitudinal and circumferential welding, Check of pipe –dia., Cleanliness, Tacking, Root pass & subsequent pass appearance, Cleaning between the passes, Completed weld appearance, Condition of the base metal in the area adjoining the welds, Excessive distortion if any due to welding.
- **DP examination:** It includes: Check for any crack or linear indication, porosity, or slag inclusion.
- **Repair of Welds:** Welds shall be repaired by additional welding in case of dimensional problem, but new weld joint to be done for deficient quality. Cracks can be removed by grinding, chipping, arc or flame gouging with DP test.

4.5: Electrical:

Necessary pre-dispatch inspection if applicable before supply shall be carried out. All tests shall be carried out in the presence of IPR representative.

- Shop testing like High voltage test, Insulation resistance test, checking of circuit, etc shall be carried out. Testing shall be carried out as per IS testing standards.
- For all **electric motors** the no load test, meggering value, vibration, current, voltage and power shall be recorded.

(ii) MEASUREMENT OF WORK :

- **Measurement for Piping :**

Unless otherwise specified, measurement for piping for the project shall be on the basis of centre line measurements described herewith. Piping shall be measured in units of length along the centre line of installed pipes including all pipe fittings, flanges (with gaskets, nuts, and bolts for jointing), unions, bends, elbows, tees, concentric and / or eccentric reducers, inspection pieces, expansion loops etc. The above accessories shall be measured as part of piping length along the centre line of installed pipes, and no special multiples of pipe lengths for accessories shall be permitted. The quoted rates for centre line linear measurements of piping shall include all wastage allowances, wooden haunches, nuts, check nuts, vibration isolator suspension where specified or required, and any other item required to complete the piping installation as per the specifications. None of these items will be separately measured nor paid for. However, all valves (gate / globe / check / balancing / purge / butterfly / drain etc), strainers, thermometers, pressure gages shall be separately counted and paid as per their individual unit rates, which shall also include their insulation as per specifications. Piping measurements shall be taken before application of the insulation.

Piping rate shall include cost of testing as specified. No extra charge will be paid for the same.

- **Measurement for Structural steel work :**

The weight of structure can be assessed from the approved / fabrication / execution drawing, approved Bill of material, calculation on the basis of IS Hand book/ Manufacturer's data book / Formula. Actual weighing of the fabricated items may be done if required. This excludes all welds and fasteners used. No payment shall be made for temporary structure created by contractor for execution purpose.

Piping supports like MS angle, Channel etc. and piping section support shall be paid on weight basis.

- **Measurement for Insulation :**

Unless otherwise Specified measurement for pipe insulation for the project shall be on the basis of centre line measurements described herewith :

a. Pipe Insulation : Shall be measured in units of length along the centre line of the installed pipe, strictly on the same basis as the piping measurements described earlier. The linear measurements shall be taken for the insulation. It is to be clearly understood that for the insulation measurements, all these accessories including ,valves, orifice plates and strainers shall be considered strictly by linear measurements along the centre line of pipes and no Special rate shall be applicable for insulation of any accessories, fixtures or fittings whatsoever.

c. Plain surface: Shall be measured based on the surface area as per unit indicated in SOQ.

c. Equipment Insulation: Shall be included in the cost of equipment, hence shall not be paid separately.

- **Measurement of power/Control cabling:**

Power cabling and earthing connections from the control panel to the starter and to the motor, shall be measured in RMT (running meter length). The payment for additional quantity (In excess of quantity or limit as specified in SOQ, if any) of cabling shall be made as per unit rate provided with the SOQ. No wastage measurement shall be allowed.

iii. PAINTING- COLOUR CODE

Refer: IS: 2379- 1963 Colour code for identification of piping.

All Equipments shall be supplied with approved finish. Shop coat of paint that have become marred during shipment or erection shall be cleaned off with mineral spirits, wire brushed and spot primed over the affected areas, then coated

with two coat of synthetic enamel paint. Pump base-plate / piping supports subject to water exposure to be painted with rubber paint using zinc base primer.

All Pipes and structure **steel work** shall undergo a process of degreasing, thorough cleaning, and painting with a high corrosion resistant primer. The finishing treatment shall be by application of synthetic enamel paint of approved shade.

• **Standard Colour Code:**

The tentative colour code given below shall be followed. However changes if any will be indicated well in advance. All painting colour code shall be approved before execution.

Item :	Colour:
<ul style="list-style-type: none"> ▪ Chilled water Line – Inlet / Return Outlet / Supply ▪ All supports / Stands / drain ▪ Condenser water piping Inlet / Return Outlet / Supply ▪ Fresh / Raw / Make-up / Waste Water 	<ul style="list-style-type: none"> ▪ Light Blue ▪ Dark Blue ▪ Black/grey ▪ Light Green ▪ Dark Green ▪ Approved Shade

All “Approved shade” shall be duly approved by Engineer In-charge.

iv. List of Codes & Standards:

***Relevant of the following specifications and codes with all amendments will be applicable for the work.**

IS : 3615 – 1967	▪ Glossary of terms used in Refrigeration and Air-conditioning.
IS : 659 - 1964	▪ Safety code for Air conditioning.
IS : 7896 - 1975	▪ Data for outside Summer design conditions for air-conditioning.
IS : 8148 - 1976	▪ Specification for packaged air conditioning units.
IS : 660 - 1963	▪ Safety code for Mechanical Refrigeration.
IS : 732 III - 1982	▪ Inspection and testing of installation.
IS : 2379 - 1963	▪ Colour code for identification of pipelines.
IS : 6272 - 1987	▪ Industrial Cooling Fans
IS : 4894 -1987	▪ Test code for Centrifugal fan.
IS : 3103 -1975	▪ Code of practice for Industrial Ventilation.
IS :778 , 780 - 1980, 210, 318, 5312	▪ Gun metal gate, globe and check valves for general purpose.
IS : 8092 : 1992	▪ Inspection of Steel Castings.
IS : 12992 : 1993	▪ Safety relief Valves
IS : 13095 : 1991	▪ Butterfly valve for general purpose
IS : 9542 : 1980	▪ CF Monobloc pumps
IS : 5659 : 1970	▪ Pumps for process water
IS : 10596 : 1983	▪ Installation , operation and maintenance of pumps

IS : 5111 – 1969	<ul style="list-style-type: none"> ▪ Code of practice and measurement procedure for testing Refrigerant Compressors.
IS : 1520	<ul style="list-style-type: none"> ▪ Horizontal Centrifugal pumps for clear, cold and fresh water.
IS : 1239 I & II - 1982	<ul style="list-style-type: none"> ▪ MS / GI tube, pipes, tubular and other wrought steel fittings. Hot-dip zinc coatings on steel tubes.
IS : 10773 : 1995	<ul style="list-style-type: none"> ▪ Wrought copper tubes for Ref. & AC purposes.
IS : 4736 - 1968	<ul style="list-style-type: none"> ▪ Code of procedure for manual metal arc welding of MS.
IS : 3589	<ul style="list-style-type: none"> ▪ Electrically welded steel pipe for water, gas and sewage. Above: 200 NB, ANSI B 16.9 for pipe fittings.
IS : 3656	<ul style="list-style-type: none"> ▪ Welds testing by DP
IS : 1536 – 1976	<ul style="list-style-type: none"> ▪ Flanges configuration. (ANSI B 16.5)
IS : 6392 - 1971	<ul style="list-style-type: none"> ▪ Steel pipe flanges.
IS : 210	<ul style="list-style-type: none"> ▪ Standard for CI material.
IS : 1538	<ul style="list-style-type: none"> ▪ CI fittings for Pressure piping
IS : 226	<ul style="list-style-type: none"> ▪ Structural Steel.
IS : 638	<ul style="list-style-type: none"> ▪ Gaskets
IS : 628	<ul style="list-style-type: none"> ▪ Rubber gasket, Teflon gasket for SS piping.
IS : 554 – 1975	<ul style="list-style-type: none"> ▪ Dimensions for pipe threads for pressure tight joints
IS : 3016 - 1982	<ul style="list-style-type: none"> ▪ Code of practice for fire precautions in welding and cutting operations.
IS : 655 – 1963	<ul style="list-style-type: none"> ▪ Metal air Ductwork.
IS : 277 - 1977	<ul style="list-style-type: none"> ▪ Galvanised steel wire sheets.
IS : 3069	<ul style="list-style-type: none"> ▪ Glossary of Items symbols and units relating to thermal materials.
IS : 702	<ul style="list-style-type: none"> ▪ Industrial Bitumin.
IS : 4671 – 1984	<ul style="list-style-type: none"> ▪ Expanded polystyrene for thermal insulation purpose.
IS : 7240 - 1981 7413 - 1981	<ul style="list-style-type: none"> ▪ Code for practice for application and finishing of thermal insulation material at temp. From -80°C to 40°C. & 40°C to 700°C.
IS : 8183 - 1976	<ul style="list-style-type: none"> ▪ Specifications for Bonded Mineral Wool.
IS : 10556 : 1993	<ul style="list-style-type: none"> ▪ Storage and handling of insulation material
IS : 11246 : 1992	<ul style="list-style-type: none"> ▪ Glass fibre reinforced polyester resin.
IS : 12436 : 1988	<ul style="list-style-type: none"> ▪ Preformed rigid polyurethane thermal insulation
IS : 13204 : 1991	<ul style="list-style-type: none"> ▪ Rigid Phenolic foams thermal insulation
IS : 13205 : 1991	<ul style="list-style-type: none"> ▪ In-situ pouring of Rigid Phenolic foams thermal insulation
IS : 3624	<ul style="list-style-type: none"> ▪ Bourden tube pressure and vacuum gauges.
IS : 1367	<ul style="list-style-type: none"> ▪ Bolts, nuts, and studs./ threaded fasteners.
IS : 2825 - 1969	<ul style="list-style-type: none"> ▪ Code for unfired pressure vessels.

IS : 7403	▪ Cooling tower structure.
IS : 875, 1893	▪ V belts, and pulleys for Industrial purpose.
IS : 5141	▪ Code for shell and tube type heat exchanger.
IS : 325- 1970	▪ Specification for three phases Induction motor.
IS : 4029	▪ Testing of three phase Induction motor.
IS : 900	• Code of practice for installation of Induction motor.
IS : 996	▪ Single phase small AC and universal motors.
IS : 4064 1978 –II	▪ Switches for domestic & similar purpose.
IS : 2959 : 1975	▪ Contractors for AC up to 1100 V.
IS : 2516- I &II	▪ ACB
IS : 3854 – 1969	▪ Accessories for electrical wiring
IS : 3837 – 1976	▪ Code of practice for electrical wiring and fitting for building.
IS : 732 –1963 , 1973	▪ Code for practice for installation and Testing of electrical wiring.
IS : 694 - 1977	▪ PVC insulated electric cable for working up to and including 1100 volts.
IS : 1554 : 1981	▪ PVC insulated (HD) electric cable for working up to 1.1 kV and 11kV volts.
IS : 1248	▪ Direct acting electrical indicating instruments.
IS : 1822	▪ Starters.
IS : 8544 - I to IV 1979	▪ Motor starters for voltage not exceeding 1000 Volts.
IS : 2208 - 1979	▪ HRC fuse and links, up to 650 Volts.
IS : 2147 – 1962	▪ Degree of protection provided by enclosures for low voltage switch gear and control gears.
IS : 10118: 1982	▪ Code of practice for installation and maintenance of Switchgear.
IS : 3043 : 1966	• Earthing.
ISO R281	▪ Rolling Bearings - Dynamic Load Ratings and Rating Life.
IS : 4758 : 1968	▪ Methods of measurement of noise emitted by machines.
IS : 14280 : 1995	▪ Mechanical vibration – balancing.
IS : 12065 : 1987	▪ Permissible limits of noise level for rotating electrical machines
Other / Equivalent Applicable Codes:	
ARI 550/590	▪ Air -Conditioning and Refrigeration Institute Standard for Centrifugal or rotary Screw Water Chilling Packages (General) Specifications, Testing and rating.
ASME Code	▪ All applicable / equivalent American Society of Mechanical Engineers'
ANSI - B89.1	▪ American National Standards Institute Safety Code for Unfired Pressure Vessels - Section VIII (Design, construction, testing and certification of pressure vessels).
ANSI - B31.5	▪ American National Standards Institute Safety Code for Mechanical Refrigeration (Overall general safety requirements, relief device sizing. etc.)

ANSI - B31.1	▪ American National Standards Institute- Code for Pressure Piping. Code for Refrigerant Piping.
ANSI - B36.19	▪ Stainless Steel pipe.
TEMA Code	▪ Tubular Exchanger Manufacturer's Association.

**SECTION – IV:
LIST OF MAKES**

A. MAJOR EQUIPMENTS

SR.NO.	DESCRIPTION	MANUFACTURERS NAME
1	Semi hermetic Centrifugal Compressor Water Chilling Machines	Carrier/Climaveneta/Daikin-McQuay/Trane/York/Kirloskar/Blue star/Voltas/Hitachi
2	Cooling Tower	Paharpur /Bell / Mihir / Advance / United cooling system / Marley
3	Split Casing centrifugal pump	KBL / Beacon / CG / Johnson / Grundfoss / KSB /Mather & Platt / Wilo /Armstrong / Bell & Gossett

B. PIPINGS

SR.NO.	DESCRIPTION	MANUFACTURERS NAME
1	MS class C / GI	ITC/Jindal/Surya/Tata /Ratnamani / Prakash
2	PVC	Astral/ Finolex /Supreme

C. VALVES , STRAINERS AND ACCSESSORIES

SR.NO.	DESCRIPTION	MANUFACTURERS NAME
1.	Butterfly Valves & Non-return valves	Audco / Advance / Intervalve /L&T/ Weir-BDK / CRI/ Virgo/ Fisher control / Saunders / Crescent/ Deltech/kitz / C & R
2.	Balancing Valves	L&T/Forbes Marshall/ Advance / Danfoss/ Honeywell/ CRI/ Saunders / Weir-BDK
3.	Ball Valves	L&T/ Forbes Marshall/ Virgo/ Velan / Saunders / Accuflow / Weir-BDK /Trishul / Crescent/ Unimac/ CRI/ Audco/ Aptek / Lodha/ Ped-Lock / Rapid Control / Emerald / Honeywell / Lehry
4.	Actuators (2-way on / off valve)	Krohne Marshall/ Rotex/ Samson/ Honeywell/ Johnson Control/ MIL/Sauter/ Siemens/ Bellimo/ Marsh
5.	Strainers	Trishul / Triveni / Unimac / Rex/ Emerald / Sant/Leader/ Advance / Flowtech/ Flairs / Honeywell

D. INSTRUMENTS AND CONTROLS

SR.NO.	DESCRIPTION	MANUFACTURERS NAME
1	Dial type temp and pressure gauges	Forbes Marshall / Emerald / WIKA/ Baumer / Waree

E. INSULATING MATERIALS

SR.NO.	DESCRIPTION	MANUFACTURERS NAME
1	Expanded polystyrene	Lloyds Insulation / Beardsell./ Cooline / Owens/Armacell/ K-flex / Armaflex/Superlon / Aeroflex/ Arcoflex/Supreme

F. ELECTRICALS

SR.NO.	DESCRIPTION	MANUFACTURERS NAME
1	Pump Motors	Siemens / NGEF / Kirlosker / ABB / CGL / Havells / Marathon/ Bharat bijlee / GE
2	Starters, Contactors, Push Button,	Schneider/Siemens/ABB/ L & T/GE Powercontrols
3		
4	MCCB (Moulded case circuit breaker)	Schneider /Siemens/ABB/ L & T / Legrand/GE Power controls/ C&S/Havells
5	MCB (Miniature circuit breaker)	Schneider /Siemens/ABB/ L & T/ Legrand/Havells/GE Powercontrols/Indo kopp/Alstom
6	SPP, OLR	Minilec / Telemecanique / Siemens / Schneider/ABB/ L & T/ GE Power controls
7	Power Cable	Finolex / Gloster / Universal / Polycab /Incab /RR cable /

		Havells / Avocab / KEI / Torrent
8	Control cables & PVC Insulated wires	Finolex / Gloster / Universal / Polycab / Incab / RR cable / Havells / Avocab / KEI

Note: If there is no make available for any item then contractor shall suggest the make which will be assessed and approved by IPR

SECTION – V

TECHNICAL DATA SHEET

(List of technical information to be furnished by Bidder to IPR)

- **EQUIPMENTS:**
- **TECHNICAL DETAILS :**

Note:

- Separate Technical data sheet shall be furnished for different type / model / configuration for any item.
- The entire data sheet shall be endorsed with stamp and signature by bidder.
- Contractor has to provide minimum technical details as enclosed herewith, however shall also provide remaining / additional details for approval. All the Items shall be ordered only after Technical specification approval.
- Attach Technical leaflets, performance curves, etc. for all products / system parts offered.

1. DATA SHEET TO BE FURNISHED BY CONTRACTOR (Along with tender, Refer tender for technical details):

(ALL DATA AT ACTUAL OPERATING CONDITIONS)

1.1 WATER CHILLING MACHINES

<u>Sr No</u>	<u>Details</u>	<u>IPR Requirement</u>	<u>Details to be filled by vendor</u>
1	Type	Semi hermetic Centrifugal	
2	Make / Model	Makes as mentioned in tender	
3	Refrigerant	R-134a	
4	Refrigeration Capacity at entering CT water temp. 32 °C and leaving chilled water temp. 7 °C		
a.	Nominal (TR)		
b.	Actual (TR)	310 TR	
5	Power consumption (IKW)		
a.	At Full Load :		
b.	75 % Load :		
c.	50 % Load :		
d.	25 % Load :		
	IPLV	≤ 0.6	
6	COP	≥ 6	
7	Compressor		
a.	Make:		
b.	Speed (Minimum / Operating / Maximum) RPM :		
c.	Type of drive, bearing , coupling		

d.	Capacity control : Method :		
e.	Steps / Range of Capacity control (% of full Load) :		
f.	Safety devices included :	Yes	
8	Compressor Motor :		
a.	Type		
b.	Manufacturer / make :		
c.	HP / RPM :		
d.	Electrical supply :	415 V \pm 10 %, 50 Hz	
e.	Starter Type / manufacturer (to be included in the Package)		
f.	Class of Insulation :		
g.	Current: Amp.		
h.	Full Load Amp. / Rated Amp.		
i.	Locked Rotor Amp.		
10	Evaporator :		
a.	Type :		
b.	Manufacturer/ make / model:		
c.	Shell Material / Dia mm / Length mm :		
d.	Tube Material / Gauge – wall thickness mm. :		
e.	Tube Dia. (OD) mm. / No. of tubes / Length mm. :		
f.	No. of passes	Two	
g.	Refrigerant Temp. (SST) °C :		
h.	Water flow rate : LPM		
i.	Water Temp.(Entering) °C	12 °C	
j.	Water Temp.(Outlet / Leaving)	7 °C	
k.	Heat rejection capacity (TR) :		
l.	Pressure drop in MWC :	≤ 10	
m.	Water side design pressure :	$\geq 10 \text{ kg / cm}^2$	
n.	Refrigerant side design pressure: kg / cm²		
o.	Safety devices and other accessories included :	Yes	
11	Condenser :		
a.	Type :		
b.	Manufacturer/ make / model:		
c.	Shell Material / Dia mm / Length mm :		
d.	Tube Material / Gauge – wall thickness mm. :		
e.	Tube Dia. (OD) mm. / No. of tubes / Length mm. :		
f.	No. of passes :	Two	
g.	Refrigerant Temp. (SDT) °C :		
h.	Water flow rate : LPM		
i.	Water Temp.(Inlet / Entering) °C :	32 °C	

j.	Water Temp.(Outlet / Leaving) °C :	36 °C	
k.	Heat rejection capacity (TR) :		
l.	Pressure drop in MWC :	≤ 10	
m.	Water side design pressure : Kg/cm ²	≥ 10 kg / cm ²	
n.	Refrigerant side design pressure: kg / cm²		
o.	Safety devices and other accessories included :	Yes	
12	Others :		
a.	Qty of Refrigerant and oil per chiller package (Initial charge) :		
b.	Overall dimensions of chiller (Lx W x H) mm.		
c.	Overall Weight : Kg : Shipping :		
d.	Operating Weight (Max.)		
e.	Noise level in dBA (at 1.5 m)	Max. 85 dB	
f.			

1.2 CHILLED WATER PUMP SETS:

<u>Sr No</u>	<u>Details</u>	<u>IPR Requirement</u>	<u>Details to be filled by vendor</u>
1.	Make	Makes as mentioned in tender	
2.	Type	Centrifugal Split Casing type	
3.	Model		
4.	Water Flow Rate & Head	3100 LPM @ 40 mwc (Differential head)	
5.	RPM		
6.	Material of Construction of Impeller	Bronze / CF8M / CF8	
7.	Type of Seal	Mechanical Seal	
8.	Overall Dimensions of Pumpset/Footprint of Baseframe		
9.	Operating Weight		
10.	Pump Efficiency		
11.	Motor KW	30 KW or Suitable	
12.	Amp (FLA)		

1.3 CONDENSER WATER PUMP SETS:

<u>Sr No</u>	<u>Details</u>	<u>IPR Requirement</u>	<u>Details to be filled by vendor</u>
1.	Make	Makes as mentioned in tender	
2.	Type	Centrifugal Split Casing type	
3.	Model		
4.	Water Flow Rate & Head	4783 LPM / 35 mwc (Differential head)	
5.	RPM		
6.	Material of Construction of Impeller	Bronze / CF8M / CF8	
7.	Type of Seal	Mechanical Seal	
8.	Overall Dimensions of Pump set/Footprint of Base frame		
9.	Operating Weight		

10.	Pump Efficiency		
11.	Motor KW	45 KW or Suitable	
12.	Power Consumption		

1.4 PROCESS COOLING TOWER PUMP SET:

<u>Sr No</u>	<u>Details</u>	<u>IPR Requirement</u>	<u>Details to be filled by vendor</u>
13.	Make	Makes as mentioned in tender	
14.	Type	Centrifugal Split Casing type	
15.	Model		
16.	Water Flow Rate & Head	4100 LPM / 35 mwc (Differential head)	
17.	RPM		
18.	Material of Construction of Impeller	Bronze / CF8M / CF8	
19.	Type of Seal	Mechanical Seal	
20.	Overall Dimensions of Pump set/Footprint of Base frame		
21.	Operating Weight		
22.	Pump Efficiency		
23.	Motor KW	37 KW or Suitable	
24.	Power Consumption		

1.5 COOLING TOWERS:

<u>Sr No</u>	<u>Details</u>	<u>IPR Requirement</u>	<u>Details to be filled by vendor</u>
1.	Make	Makes as mentioned in tender	
2.	Type	Induced Draft – Counter flow	
3.	Model		
4.	Flow Rate	≥ 7667 LPM (460 CMH)	
5.	Approach	3.5 °C	
6.	Range	4 °C	
7.	Evaporation Loss (Max)	0.8 % of Water Circulation	
8.	Drift Loss (Max)	0.007 % of Water Circulation	
9.	Fan MOC	FRP / Cast Al alloy	
10.	Fan RPM		
11.	Fan Motor HP		
12.	Dimension		
13.	Overall Weight : Kg : Shipping :		
14.	Operating Weight (Max.)	≤ 12000 Kg	

1.5 BUTTERFLY VALVES:

<u>Sr No</u>	<u>Details</u>	<u>IPR Requirement</u>	<u>Details to be filled by vendor</u>
1.	Make	Makes as mentioned in tender	
2.	Type	Rubber lined Wafer type	
3.	Media	Soft water/ Raw Water	
4.	Pressure rating	10 bar	
5.	Operating temperature range	0 to 80 °C	
6.	MOC/ type of Body	CI/ CS/ WCB with single piece body	
7.	MOC of disc and wetted parts	CF8M/ SS 316 / CF8/SS 304	
8.	MOC of Seat	EPDM/ Nitrile/ Neoprene	
9.	Seat leakage	Bubble tight shut off (Class VI)	
10.	General design & face to face dimensions	API 609 / ASME B16.10/ EN 593	

11.	Valve testing	API 598 / equivalent	
12.	Flange standard conformity	Class 150, ASME B16.5 SORF flanges	

1.6 BALANCING VALVES:

<u>Sr No</u>	<u>Details</u>	<u>IPR Requirement</u>	<u>Details to be filled by vendor</u>
1.	Type / Class	Flanged/ 150#	
2.	Make / Model	--	
3.	Material of all body parts:		
4.	Body / Bonnet	CI / Bronze	
5.	Flange specifications	ASME B16.5	
6.	Seat / Disc	--	
7.	Bearing/ sleeve	--	
8.	Gland	--	
9.	Operating wheel	CI/ MS	
10.	Fasteners:	MS	
11.	Pressure rating	10 bar	
12.	Operating range & limits: Temp. (°C).	0 to 80 °C	
13.	Cv value	--	
14.	Test Pressure (Hydro – air) Shell / seat	--	
15.	Leakage class	Class VI	
16.	Position indication	Yes	
17.	Additional features if any:	Tapings for manometer connection	

Note: Please provide value or relevant data against each asked details instead of using words like “Yes, Ok, Noted etc.”

SECTION – VI
SCHEDULE OF QUANTITY

(To be filled in by Bidder and Submitted to IPR)

Notes to Bidder:

- All the items are broadly specified in SOQ, however for detailed specifications **refer to tender**.
- All the system parts, equipments shall be offered strictly as per the approved make only; deviation may be liable for rejection. Prices for each item listed in this schedule must be clearly and completely filled in.
- In the event of error occurring in the amount column of the schedule, as a result or wrong extension of the unit rate and quantity, the unit rate quoted by the Bidder shall be regarded as firm and the extensions shall be amended on the basis of the same rates.
- The rate of each item of work included in the Schedule of quantities shall, unless expressly stated otherwise, includes cost of :
 - a) All materials, fixing materials, accessories, operation, appliances, tools, plant, equipments, transport, labour and incidentals required in preparation for and in the full and entire execution, testing balancing, commissioning and completion of the work called for in the item and as per specifications and drawings.
 - b) Wastage on materials and labour.
 - c) Loading, transporting, unloading, handling/double handling, hoisting to all levels, setting, fitting and fixing in position, protecting, disposal of debris and all other labour, necessary for the full and entire execution and to fully complete the job in accordance with contract documents, good practice and recognized principles.
 - d) Liabilities, obligations and risks arising out of conditions of contract.
- The specifications and drawings wherever available, are to be read as complimentary to and part of the Schedule of quantities and any work called for in shall be taken as required.
- In the event of conflict between Schedule of quantities and other documents including the specifications, the most stringent shall apply and the interpretation of the Engineer In-charge shall be final and binding.
- If the required item is not available in the Contract, the IPR will reimburse the actual cost of procurement of such item (invoice value + 15% overhead charges), for which the Contractor shall submit quotations from three manufacturers among those from the List of suggested manufacturers in Section – IV / IPR approved manufacturers and the procurement should have been made from lowest among these three.
- **All equipments, quantities and technical data indicated in this Schedule (SOQ) are based on the engineering by IPR and shall be indicative and for the Contractor's guidance. Contractor shall have to submit drawings, specifications with the actual system requirement. Contractor shall be paid for the actual quantity of work executed by him in accordance with the approved shop Drawings at the SOQ rates.**

SCHEDULE OF QUANTITY
(To be filled in by bidder and returned to IPR)

Sr No.	Description	Unit	Qty
	<u>CHILLERS, PUMPS, VALVES, PIPING AND OTHER EQUIPMENTS ETC. :</u>		
1.0	<p><u>310 TR CENTRIFUGAL WATER CHILLING MACHINE (Flooded Evaporator chiller):</u> Design, Factory testing, Supply, Lifting, Shifting, Positioning, Installation, refrigerant Charging, Testing, Commissioning and Field Performance Testing of Water Cooled semi hermetic Centrifugal Chiller with high efficiency refrigerant cooled drive motor having thermal overload protection devices embedded in the winding of each phase, factory-wired and tested, Star-Delta Starter, charged with R134A, microprocessor / PLC based control panel supporting OPEN protocols; water cooled shell & tube condenser, evaporator, safety controls, interconnecting refrigerant piping. Operating parameters and performance as below and complying with specifications and scope as per tender documents.</p> <p>Vendor shall demonstrate performance, output & power consumption at full load as well as part load during factory test. Chiller should have flexibility to change chilled water temperature set point.</p> <p>The starter can be integral in the chiller mounted panel or free-standing but it must be provided by Chiller manufacturer to derive optimum performance and integration of chiller. Chiller shall be designed and constructed as per ASME/BIS/relevant Code.</p> <p>Chiller shall comply with the specified field performance and conform to the latest edition of ASHRAE 15 Safety Code.</p> <p>The chiller package should include (but not be limited to) the following main components:</p> <ul style="list-style-type: none"> • Semi Hermetic Centrifugal compressor • Condenser • Evaporator (Chiller) • Isolation valves at compressor suction side • NRV at compressor discharge • Refrigerant piping • Controls, safety cutouts & interlocking, instrumentation & gauges • Automatic capacity control mechanism • Electronic Expansion Valve or Thermal Expansion valve or suitable expansion device • Microcontroller / PLC-based control panel with pass-word protection • Insulation & painting • All other items necessary for the completeness and satisfactory performance of chiller • Interlocking of chiller with Flow / Differential Pressure Switches 	No.	1

	<ul style="list-style-type: none"> • Base frame & vibration isolators • Insulation, painting • Charge of refrigerant (R-134A) & oil • All other items necessary for the completeness and satisfactory performance of chiller. <p>Chiller suitable for 415 ±10% V, 50 Hz, 3φ, AC power with starter supply for following design conditions:</p> <p>Evaporator / Chiller.</p> <ul style="list-style-type: none"> a) Chilled water entering Temp. : 12 °C b) Chilled water leaving Temp. : 7 °C c) Fouling factor: 0.0001 (h ft² F / Btu) <p>Condenser:</p> <ul style="list-style-type: none"> a) Condenser water entering Temp. : 32 °C b) Condenser water leaving Temp. : 36 °C c) Fouling factor: 0.00025 (h ft² F / Btu) <ul style="list-style-type: none"> • Refrigerant: Non CFC, R-134a Refrigerant <ul style="list-style-type: none"> ➤ IPLV (IKw/TR) value : ≤ 0.6 ➤ COP @ AHRI : ≥ 6 <ul style="list-style-type: none"> • Water Chilling machine of 310 TR actual Refrigeration capacity (at 7°C leaving CHW) as described above With Semi- hermetic type compressor (Single compressor model) with R-134a Refrigerant. <p>Note:</p> <ul style="list-style-type: none"> • The chiller evaporator inlet-outlet and condenser inlet – outlet shall be at the same side of the chiller. • Chiller capacity specified above is actual, delivered tonnage at specified design operating conditions; not nominal capacity. • Chiller cost is inclusive of Factory Acceptance testing expenses. • Run test, performance test, checking of safety & cutouts will be performed for chiller. Performance test shall include capacity & power consumption at 100%, 75%, 50% & 25% load points for chiller. • During the FAT, if chiller fails to meet the performance criteria, the bidders shall re-offer the FAT and all necessary expenses for conducting retest shall be borne by the bidder. 		
2.0	<p><u>COOLING TOWER (single cell) :</u> Supply, installation, testing and commissioning of UV protected FRP Induced draft, counter-flow cooling tower, for system. Tower shall be complete with FRP basin, casing, ladders, MS HDG support structure, direct/gear driven propeller fans, virgin PVC fills, eliminators, HDPE / suitable distribution system, minimum IP-55 TEFC induction motor suitable for 415±10% V, 50 Hz, 3φ power supply, weather cover for motor, drain, make up, quick fill , equalizer connection and vibration isolation etc. as per tender specification.</p>		

	<p>Tower selection: On following design conditions:</p> <ul style="list-style-type: none"> • WBT: 28.5 °C. • Approach: 3.5 °C. • Water temperature range of 4 (36 – 32) °C. • Water flow rate: 460 m3/hr <ul style="list-style-type: none"> • Operating Weight of cooling tower must not exceed 12000 Kg. • If cooling tower is having multi fans, then supply of starter panel (with individual feeder provision) with all electrical accessories provision will be made by contractor without any extra cost. 	No.	1
3.0			
3.1	<p><u>CHILLED WATER PUMP SET- Split case type:</u> Supply, installation, testing and commissioning of Split Casing type pump with mechanical seal and bronze/CF8M/CF8 impeller, complete with hot-dip galvanized or epoxy coated steel base frame for pump & motor, coupling, coupling guard, vibration isolators and 4-Pole / suitable TEFC induction motor, for circulation of chilled water for centrifugal chiller. Pump shall be suitable for 415±10% v, 50 Hz, 3φ AC power supply. Quoted price shall include cost of insulation, vibration isolation and all other associated accessories and works.</p> <p>Pump performance characteristics: <u>Pump Set for Chilled water system</u> Head on pump 40 MWC (Differential) Water flow rate @ 3100 LPM) Motor HP 30 Kw or suitable</p>	No.	1
3.2	<p><u>COOLING TOWER PUMP SET- Split case type :</u> Supply, installation, testing and commissioning of Split Casing type pump type pump with mechanical seal and bronze/CF8M/CF8 impeller, complete with hot-dip galvanized or epoxy coated steel base frame for pump & motor, coupling, coupling guard, vibration isolators and 4 – pole / suitable TEFC induction motor, for circulation of chilled water for centrifugal chiller. Pump shall be suitable for 415±10% v, 50 Hz, 3φ AC power supply. Quoted price shall include cost of vibration isolation and all other associated accessories.</p> <p>Pumps performance characteristics: <u>Pump set for cooling tower system</u> Head on pump 35 MWC (Differential) Water flow rate @ 4783 LPM) Motor HP 45 Kw or suitable</p>	No.	1
3.3	<p><u>PROCESS COOLING TOWER PUMP SET - Split case type :</u> Supply, installation, testing and commissioning of Split Casing type pump with mechanical seal and bronze/CF8M/CF8 impeller, complete with hot-dip galvanized or epoxy coated steel base frame for pump & motor,</p>		

	coupling, coupling guard, vibration isolators and 4 – Pole / suitable TEFC induction motor, for circulation of water for cooling tower. Pump shall be suitable for 415±10% v, 50 Hz, 3φ AC power supply. Quoted price shall include cost of vibration isolation and all other associated accessories. Pumps performance characteristics: <u>Pump set for cooling tower system</u> Head on pump 35 MWC (Differential) Water flow rate @ 4100 LPM Motor HP 37 Kw or suitable.	No.	1
4.0	<u>MS CLASS - C PIPING</u> Providing and fixing with painting in position the following MS class -C (Heavy) pipes cut to required lengths and installed with all welded joints, necessary fittings like flanges, elbows, tees, reducers, fasteners, gasket, purge tapings, drain points, wooden haunches etc. <u>COOLING TOWER WATER / CHILLED WATER PIPING:</u>		
4.1	400 NB (for Pot strainer installation in existing bypass line)	RMT	3
4.2	300 NB (for new cooling tower branching and Pot strainer installation in existing bypass line)	RMT	15
4.3	200 NB (Chiller/ CTP-1 / CTP-2 / Pot-strainer installation in existing bypass line)	RMT	40
4.4	150 NB	RMT	3
4.5	100 NB	RMT	3
4.6	40 NB	RMT	5
4.7	25 NB	RMT	3
5.0	<u>GI CLASS B PIPING:</u> <u>FOR COOLING TOWER MAKE UP / DRAIN WATER PIPING:</u> Providing and fixing with painting in position the following GI class ‘B’ pipes cut to required lengths and installed with all screwed/welded joints, all fittings including necessary size and quantity of flanges, elbows, tees, reducers, nipples, couplings, gaskets, hard wares, drain points with valves, etc.		
5.1	100 NB.	RMT	15
5.2	80 NB	RMT	35
5.3	50 NB	RMT	4

5.4	40 NB	RMT	4
5.5	25 NB	RMT	2
6.0	<u>BUTTERFLY VALVE:</u> Providing and fixing in position the following Wafer type Butterfly valves center disc type, with slim seal, CI/CS/WCB body and CF8M/ SS 316 / CF8/SS 304 wetted parts including position indicator, including matching flanges, gaskets and metric thread fasteners. While installing new valves in existing line, proper care should be taken so that unwanted welding debris, dust etc. shall not damage existing valves and chillers. BFV (Manual operation) with handle. <u>FOR COOLING TOWER WATER / CHILLED WATER PIPING :</u>		
6.1	400 NB, PN-10 Class (for Pot strainer)	Nos.	1
6.2	300 NB, PN-16 Class (for CT branching and Pot strainer)	Nos.	3
6.3	200 NB, PN-16 Class with extended stem spindle. Note: Out of 07 valves, 03 valves shall be installed in the existing chilled water line.	Nos.	7
6.4	200 NB, PN-16 Class. Note: Out of 10 valves, 03 valves shall be installed in the existing condenser line.	Nos.	10
6.5	150 NB, PN-16 Class	Nos.	1
6.6	100 NB, PN-16 Class	Nos.	1
6.7	80 NB, PN-16 Class	Nos.	1
6.8	50 NB, PN-16 Class	Nos.	1
7.0	<u>ELECTRICALLY OPERATED MOTORISED ON/OFF BUTTERFLY VALVE:</u> Supply, installation, testing and commissioning of Class 150 motorized ON/OFF butterfly valves. Wafer type Butterfly valves center disc type, with slim seal, CI/WCB/CS body and CF8M/ SS 316 / CF8/SS 304 wetted parts including position indicator, including matching flanges, gaskets and fasteners. Valve should be compatible for operation from SCADA system. Manual ON/OFF operation facility should be available in the valve. (01 valve should be provided with extended stem spindle for chilled water insulated line)		
7.1	200 NB.	Nos.	3
8.0	<u>BALANCING VALVE:</u> Providing and fixing in position of following flange ended Balancing valves – Class 150, CI/WCB body and all SS 304 wetted parts with flow measurement accessories and position indication, including matching flanges and metric thread fasteners. <u>FOR COOLING TOWER WATER / CHILLED WATER PIPING:</u>		
8.1	300 NB (CT branching)	Nos.	1
8.2	200 NB (Evaporator & Condenser outlet lines of Chiller)	Nos.	2
8.3	150 NB (for CT line)	Nos.	1

9.0	<u>NON RETURN VALVE:</u> Providing and fixing in position of following swing check Non return valve – Class -150, CI/WCB body and all SS 304 wetted parts , including matching flanges and metric thread fasteners. Valve shall comply leakage class VI <u>FOR COOLING TOWER WATER / CHILLED WATER PIPING:</u>		
9.1	200 NB	Nos.	3
10.0	<u>BALL VALVE/Air purge valve:</u> Providing and fixing in position of following Ball valves , with SS body, SS 304 wetted parts and PTFE seat. Including matching flanges and metric thread fasteners. <u>FOR COOLING TOWER WATER / CHILLED WATER PIPING:</u>		
10.1	Flange end type three piece full bore 40 NB (for CT Fast filling & Chiller PHE)	Nos.	4
10.2	Flange end type three piece full bore 25 NB (for CT make up)	Nos.	2
10.3	Air Purge (Air Vent) Valve with isolation ball valve. Size: 15 NB	Nos.	5
11.0	<u>Make up water flow control valve for cooling tower</u> 25 NB-SS 304-150# Flanged end auto Level control valve with SS ball float assembly.	No.	1
12.0	<u>POT STRAINER</u> Providing and fixing in position of following Class 150 flange ended Pot strainers , with CI/WCB body and SS 304 filter element 20 mesh including matching flanges and metric thread fasteners. These strainers will be installed in the existing bypass lines.		
12.1	400 NB for CT line for CTP-1	No.	1
12.2	300 NB for CT line for CTP-2	No.	1
12.3	200 NB for CT line for CTP-3	No.	1
13.0	<u>Y – STRAINER for chiller PHE line:</u> Providing and fixing in position of following Class 150 flange ended Y- Type strainers , with GM/WCB body and SS 304 filter 40 mesh element including matching flanges and metric thread fasteners.		
13.1	40 NB	Nos.	1

14.0	<u>INSULATION: FOR CHILLED WATER PIPING :</u> Premoulded pipe sections shall be placed over the pipes, the longitudinal joints of this pipe section shall be sealed with the adhesive compound. The traverse joints shall also be sealed with adhesive compound. The insulation shall be continuous over the entire run of piping, fittings and valves. Clean the surface and fix the insulation tightly with cold elastomeric membrane bitumen (Eniroof EMB) or hot bitumen as recommended by insulation manufacturer. The joints shall be suitably sealed. All insulated pipes shall be covered with layer of thick polythene sheet as vapour barrier. PVC straps at 400 mm centre shall be used to hold insulation and vapour barrier together. Insulation material shall be covered with a continuous sheet of thick polyethylene (for protection from water and moisture), before wrapping with GI chicken wire-mesh and then 15 - 20 mm thick sand-cement plaster		
14.1	200 NB pipe (75 mm expanded polystyrene with 15 - 20 mm thick sand cement plaster)	RMT	25
14.2	40 NB pipe (25 mm expanded polystyrene with 15 - 20 mm thick sand cement plaster)	RMT	5
14.3	25 NB pipe (25 mm expanded polystyrene with 15 - 20 mm thick sand cement plaster)	RMT	3
15.0	<u>MS STRUCTURE WORK:</u> Supply, fabrication, installation of MS structure work for supporting piping, cable tray, panel, equipment, platform etc. at the site to suit the system requirements including one coat of zinc primer and two coat of synthetic enamel/anti-corrosion painting. MS support structure work including plates / channels / checker plates / angles / I-beam etc.	Kgs	2000
16.0	<u>ELECTRICAL POWER CABLE:</u> Supply, Laying, termination, testing and commissioning of 1100 volts grade following Cabling / wiring from existing feeders to equipment with suitable lugs, cable glands, as per the system requirements.		
16.1	3C x 400 mm ² Aluminum conductor XLPE insulated Armoured Power Cable	RMT	55
16.2	1C x 95 mm ² Copper conductor flexible multistrand XLPE insulated Power Cable	RMT	60
16.3	1C x 120 mm ² Copper conductor flexible multistrand XLPE insulated Power Cable	RMT	05
16.4	2x3C X 70 sq.mm Alu. armoured XLPE insulated power cable	RMT	70
16.5	2x3C X 35 sq.mm Alu. armoured XLPE insulated power cable	RMT	85
16.6	2x3C X 25 sq.mm Alu. armoured XLPE insulated power cable	RMT	110
16.7	2x3C X 10 sq.mm Alu. armoured XLPE insulated power cable	RMT	130
16.8	3C X 4 sq. mm. Copper armoured XLPE insulated power cable	RMT	10
16.9	2C X 1.5 sq.mm Cu armoured XLPE insulated control cable	RMT	50
17.0	<u>INSTRUMENTATION CABLE:</u> Supply, Laying, termination, testing and commissioning of 2C x 1.5 sq. mm shielded instrumentation cable with suitable lugs, cable glands, as per the system requirements.	RMT	50
18.0	<u>EARTHING :</u> Supply, Laying, termination, testing and commissioning of following earthing as per the system requirements:		

18.1	2 x 6 mm dia Cu wire for earthing	RMT	25
18.2	2 x 4 mm dia Cu wire for earthing	RMT	15
18.3	2 x 3 mm dia Cu wire for earthing	RMT	25
18.4	25 x 3 mm Cu strip for earthing	RMT	20
19.0	<u>PERFORATED CABLE TRAYS:</u> Supply, Installations and testing of 'C type' cable trays made from 2.0 mm thick hot galvanized GI perforated sheets, with clamping etc., suitable for power cables laying, of the following sizes:		
19.1	200 mm width x 50 mm depth GI perforated cable tray	RMT	6
19.2	100 mm width x 50 mm depth GI perforated cable tray	RMT	35
20.0	<u>LOCAL PUSH BUTTON STATION FOR COOLING TOWER:</u> Weather proof local ON-OFF push button station (or Local Isolator) with lockable OFF button for equipment located away from the respective panel board (e.g. cooling tower). Complete with mounting stand / wall mounting.	No.	1
21.0	<u>PRESSURE GAUGE</u> Providing and fixing in position, water pressure gauges filled with glycerin dial with all accessories like shutoff valve, siphon pipe, etc. with $\pm 1\%$ accuracy. Range: 0-10 Bar. Dial size 100 mm (dial filled with glycerin / relevant liquid), connection size: $\frac{1}{2}$ "	Nos.	10
22.0	<u>TEMPERATURE GAUGE</u> Providing and fixing in position the dial type temperature gauge with SS 304/316 integral parts and SS 304/316 thermo well with all accessories. Range: 0 - 50°C. Dial size 100 mm, connection size: $\frac{1}{2}$ "	Nos.	4
23.0	<u>MINOR / MAJOR CIVIL WORKS:</u> For all equipments covered under Schedule of quantity of this tender, following civil works shall be included. a. Modification and extension of existing RCC foundation of the cooling tower, pumps and chiller if necessary as per new cooling tower, pumps and chiller dimension with RCC work. Work shall be carried out as per instruction of EIC. Frame of the new cooling tower will be properly grouted / anchored to RCC foundation for stability of the cooling tower. b. Other Civil and associated Works require to be carried-out for the Erections / Installations of all the		

	<p>Equipment.</p> <p>c. Dismantling of existing butterfly valves (03 nos., size: 400NB, 300 NB & 200NB) for the installation of strainers in existing cooling tower bypass line. Re-installation of these valves after fixing of strainers.</p> <p>The scope also includes Making, cutting and finishing of hole in roof / floor/ wall, opening for cables, pipe crossings etc. and making good of them. Including digging work/s and minor civil work required for laying / removal of piping or any other equipments. Grouting of supports and finishing good of them. Fixing of all equipment with proper arrangements and all civil repairing work with Painting.</p> <p>Whole Work shall be carried out as per instruction of EIC.</p>	<p>LOT</p>	<p>1</p>
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Important Note:

- IPR reserves the right to add / delete any or all of the items mentioned in SOQ.
- Understand all the specifications, terms and conditions of this tender thoroughly, **visit the site and contact the purchase section for any clarification if necessary.**
- **Deviations if any shall be clearly specified on separate sheet with all details.**
- **The bidder should sign all pages in token of acceptance of the terms and condition, and to be uploaded.**

Place:

Signature of Vendor

Date:

(Office Seal)