

TENDER DOCUMENT

FOR

**DESIGN AND CONSTRUCTION OF STEM CELL & BMT
UNITS AT MALABAR CANCER CENTRE, THALASERRY IN
KANNUR DISTRICT**

**PART-III
PRICE BID**

TENDER NO. HLL / ID / 13/82

NOVEMBER 2013

**HLL LIFECARE LIMITED
INFRASTRUCTURE DEVELOPMENT DIVISION**

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1. COMMERCIAL CONDITIONS

- 1.2.1. The tendered rate shall inter alia be deemed to include for the provision of all materials, process, operation and special requirements detailed in the particular specification irrespective of whether these are mentioned in the description of equipment schedule and Bill of quantities or not. It is an express condition of the contract that the tendered rates for various items in the Bill of Quantities shall be deemed to include for the full, entire and final condition of the contractor respective items of the works in accordance with the provision of the contract.
- 1.2.2. The tendered rate shall include for all taxes, duties, etc. as applicable and shall be quoted on the works contract basis for **Design & Construction of Stem Cell & BMT units at Malabar Cancer center, Thalassery.**
- 1.2.3. The tendered rate shall remain firm and free from variation due to rise in the cost of materials/equipment labour or any other reasons whatsoever during the contract period and valid extension on the case may be.
- 1.2.4. The quantum of excise duty included in the tendered price, the rate at which they were assumed etc. shall be indicated in the tender.

1.1 UNIT RATES

- 1.1.1 Only approved work will be measured on completion and priced as per rates quoted against the respective items.

1.2 BRIEF DESCRIPTION OF PRICING

- 1.2.1. The tenderer shall furnish duly certified break up of material and labour separately for each item of work.
- 1.2.2. Unforeseen difficulties for which provision has not been made in the tender will in no way relieve the successful tenderer from the full execution of the work.
- 1.2.3 The price quoted shall be the final amount for this finished work.

1.3 PRO-RATA VALUE

The detailed break up of prices for various items of materials if any should be provided by successful tenderers within fifteen days from the date of letter of intent to facilitate the employer for assessment and verification and to certify payment.

1.4 INCOME TAX

Any payment to the contractor as per contract will be made after deducting income tax as per the rules and regulations.

1.5 SALES TAX AND EXCISE DUTY

The tenderer shall clearly indicate sales tax, Excise and other duties as applicable in his offer for carrying out this work.

1.6. SUBMISSION OF BILL

1.6.1. The contractor shall from time to time prepare and submit interim bills of the work executed and on completion of the contract, he shall prepare and submit the final bill. The measurements sheets in support of the interim and final bills shall be prepared by the contractor on the basis of measurements taken by him jointly with the project engineer and the said measurement sheets shall be submitted by him with the relevant bill.

1.7. EXTRA ITEMS

The contractor is bound to carry out any items of work necessary for the completion of the job even though such items may not have been included in the schedule of probable quantities or rates, such items being necessary or essential for completing the job. Variation order in respect of such additional items and their quantities will be issued in writing by the employer.

1.7.1 All shavings, cuttings and other rubbish as it accumulates from time to time during the progress of work and on completion including that of the sub-contractors and special tradesman and all materials condemned by the project engineer shall be cleared and removed from the site by the contractor without any extra charge.

1.7.2 All measuring steel tapes, scaffolding, ladders instruments and tools that may be required for taking measurements shall be supplied by the contractor.

1.8. OVER TIME WORK

If the contractor is required to work night or on holidays in order to maintain the time schedule he shall take prior approval from the Engineer-in-charge. He should also provide and maintain at his own cost sufficient lights as may be necessary to enable the work to proceed satisfactorily during the night.

- 1.8.1. The contractor shall give full facilities to all other contractors working on site. He shall also arrange his programme of work so as not hinder the progress of other trades. The decision of the Engineer-in-charge on any point of dispute between the various parties shall be final and binding.
- 1.8.2. It is specifically pointed out that the contractor shall not be entitled to any compensation whatsoever on account of delay in procurement or supply of controlled materials and the rates quoted in the contract are fixed till the completion of the contract.
- 1.8.3. The contractor shall co-operate with other agencies appointed by the owners for the work to proceed smoothly with the least possible delay and to the satisfaction of the owners, architects and the consultants.
- 1.8.4. The owners shall provide a source for power supply at one convenient point at site. The contractor shall at his own cost install a separate meter at the said source and lay additional cables from the said source also at his own cost. For the electricity consumed by the contractor he shall pay the owner the actual cost at the rate charged by the local authority for power for constructional purposes. The contractor shall also obtain the necessary permit for utilizing power for constructional purposes.

1.9. TERMS OF PAYMENT

- 1.9.1 The rate of payment for the contract value under this contract shall be as per the certified running account bills as per the clause 7 of GCC.

The Security deposit will be deducted at the rate of 5% from the gross amount of each running bill till the sum along with the sum already deposited as earnest money, will amount to security deposit of 5% of the tendered value of the work. It will be released after defect liability period from the date of actual completion. However this will be released against submission of Bank Guarantee for equivalent amount with a validity period of one year.

2 SPECIAL CONDITIONS

2.1. EXECUTION WORK

2.1.1. The item wise bill of quantities with unit rates shall be submitted as per the proposed design. The whole of the work as per the approved design (including bills of materials, specification and all drawings pertaining thereto) and as advised by the Engineer-in-charge from time is to be carried out and completed in all parts to the entire satisfaction of the Employer. Any minor details of construction which are obviously and fairly intended, or which may not have been definitely referred to in this contract, but which are usual construction practice and essential to the work, shall be included in this contract.

2.2 GUARANTEE/ DEFECTS LIABILITY PERIOD

2.2.1 The contractor shall without any extra cost carry out for a period of 12 months after the work is taken over by the owners, the maintenance and attend to any difficulties.

2.2.2 The contractor shall associate with him the Employer staff during guarantee period/ defects liability period of 12 months.

2.3. CERTIFICATE OF COMPLETION

2.3.1 The contractor shall intimate to the Engineer-in-charge in writing as and when the works are completed and put into beneficial use in order to enable the consultants to check certify to the owners to take over the plants.

2.3.2 The work shall not be considered as completed and put into beneficial use until the consultants have certified in writing that the same has been completed and put into beneficial use.

2.3.3 The defects liability period shall commence from date of such completion or any specific date mentioned therein.

TECHNICAL SPECIFICATIONS

HVAC SYSTEM

4.1 SCOPE OF WORK

The complete scope of work shall cover design, preparation of drawings, supply, fabrication, erection, testing and commissioning of all items for Air Conditioning Works.

4.1.1 Basis of Design

The entire system has been designed based on climatological data available as given under the section basis of Design. The technical requirements given under here is only indicative and not descriptive and the contractor shall ensure that the whole system supplied is complete in all respects for the smooth operation of the plant and should be suitable for the rated performance.

4.1.2 Terms and Definitions

The following terms have been used in the tender specifications, drawings, etc.

BIS	Bureau of Indian Standards
ASHRAE	American society of Heating, Refrigeration and Air-conditioning Engineers, USA.
ASME	American Society of Mechanical Engineers.
ASA	American Standard Association.
B.S	British Standards
CMH	Cubic Meter per Hour
CFM	Cubic Feet per Minute
US GPM	US Gallons per Minute
IGPM	Imperial Gallons per Minute.
RPM	Revolutions per Minute
BTU/Hr.	British Thermal Unit per Hour
KCal/Hr.	Kilo Calories per Hour
HZ	Hertz
H.P.	Horse Power
Kg/CM ²	Kilo Gram per Square Centimeter
SG	Supply Air Grilles
SD	Supply Air Diffuser
SAF	Supply Air Filters
FD	Fire Damper
VCD	Volume Control Damper
RG	Return Air Grilles
RD	Return air diffuser
FAD	Fresh Air Damper
RH	Relative Humidity
DB	Dry Bulb Temperature
WB	Wet Bulb Temperature
MV	Mechanical Ventilation
DP	Drain Point.

RO Rate Only

The design, manufacture, identification of material and testing of the equipment covered in this specification shall comply with the latest edition of the appropriate standard of the following:

- 1) Duct Work
IS:655 (latest edition)
- 2) Pipes
IS: 1239 Mild steel, black ERW pipes, with fittings.
IS: 3589 For MS Class '2', black ERW pipes 200 mm dia, and above, with fittings.
- 3) Steel Pipes for Water
IS:3589
- 4) Refrigeration and Air-conditioning
As per ASHRAE/ISI air-conditioning and refrigeration institute standards.
- 5) Sluice Valves for Water Lines
IS:778-1980
- 6) Copper alloy Gate/ Globe / Check Valve for water lines
IS:778
- 7) Steel pipe flanges
IS:6392
- 8) Non return valve for water lines
IS:5312 (Part I) 1984
- 9) Colour code for the identification of pipe lines
IS:2379-1963
- 10) Horizontal centrifugal pumps
IS:1520
- 11) Wrought aluminum and aluminum alloy sheet and strip for general engineering purposes
IS:737
- 12) Mild steel tubes, tubular and other wrought steel fittings
IS:1239
- 13) Bourdan tube pressure & vacuum gauges
IS:3624
- 14) Galvanized steel sheets
IS:277-1977
- 15) Glossary of terms used in refrigeration and air-conditioning
IS:3615
- 16) Code for practice for standard for selection of standard worm and helical gears
IS:7403
- 17) Gun metal gate, globe and check valves for general purposes
IS:778
- 18) Wrought aluminum and aluminum alloy sheet and strip for general engineering purposes
IS:737
- 19) Expanded Polystyrene (EPS) : IS 4671.
- 20) Bonded mineral wool : IS 8183.
- 21) Specific requirements for the direct switching of the individual motors
IS:4064 (Part-II)-1978

- 22) PVC insulated (HD) Electric Cables for working voltage up including 1100 Volts
IS:1554 (Part I)
- 23) Starters IS:8554 (Part-I) 1979
- 24) HRC Cartridge fuse links upto 650 Volts
IS:2208
- 25) Inspection and testing of installation
IS:732 (Part-III) 1979
- 26) Three phase induction motors
IS:325
- 27) PVC insulated (heavy duty) electric cables for working voltage upto and including 1100 watts: IS:1554 (Part-I)

4.1.3 Safety Codes

The following IS codes shall be followed:

Safety code for mechanical refrigeration

IS:660

Safety code for air-conditioning

IS:659

Safety code for scaffolds & ladders

IS:3696

Code of practice for fire precautions in welding & cutting operations

IS:3016

Code for safety procedures and practices in electrical works

IS:5216

Indian Electricity Act 1910

Electricity Supply Act and Indian Electricity Rules.

4.2 CHILLER

The scope of work under this heading shall cover design, supply, erection, testing, commissioning of air cooled scroll chiller units as per specification enumerated below and as per parameters laid down in the equipment schedule.

The standard constructional features of manufacturer are acceptable for chiller consisting of compressor, condenser, evaporator etc. However salient Features are listed here for reference. Imported chillers with ARI certificate is acceptable.

For imported chillers ARI certification has to be produced and test certificates of routine tests shall be submitted. Pre dispatch factory inspection shall be carried out by CLIENT/CONSULTANT for chiller. Sufficient advance notice shall be given to CLIENT/CONSULTANT for inspection.

4.2.1 Compressor

The compressor shall be scroll type, single stage, open/semi hermetic/hermetic type using refrigerant R134a.

4.2.2 Bearing

The compressor must incorporate the necessary design features which eliminate both the axial and radial thrusts. The bearings shall be pressure lubricated during operation and shall be completely sequenced and interlocked with the start up of the machine in such a way that the oil pump should start earlier than the machine and the machine should automatically start after some time provided the oil temperature and pressure is maintained during the start-up period.

4.2.3 Lubrication System

The lubrication system should form one integral part of the compressor assembly and must enforce complete force feed lubrication (at a pressure and controlled temperature) to all bearing surfaces under any speed conditions at start-up, at shut down and during operation at various loads, suitable arrangement shall also be provided to take care of lubrication during failure of power. Then full lubrication must be available to the machine during acceleration and deceleration periods through a suitable mechanism. The lubricating system shall be as per manufacturer's standard for meeting the site requirements. The required protection shall be incorporated in the lubricating system. Suitable means shall be provided to prevent the leakage of refrigerant along with the shaft during shut down periods.

4.2.4 Capacity Controls/ Compressor control panels

The compressor must be equipped with an in built automatic capacity control mechanism for regulating its capacity. It should be possible to go down to 20% of full load as per latest ARI standards.

The various controls/ gauges shall be mounted on compressor control panel of compressor.

Micro processor based control panel is preferred. Following controls required for the system shall be incorporated. The motor should stop automatically if the safety device operates and with simultaneous audio visual indication shall be incorporated.

- Low oil pressure cut-out
- Low evaporating pressure/temperature cut-out
- High condensing pressure cut-out
- High oil/ discharge temperature
- Chilled water flow switch
- Condenser water flow switch
- Motor overload
- One set of time delay relay.
- Antifreeze thermostat
- Flow switches/differential switches

4.2.5 Electric motor

The electric motor driving the compressor shall be as per manufacturer's standard for this compressor and motor shall be suitable for operation on 400 V, 50 Hz, 3 phase or other conventional A.C. supply. The motor shall be continuous duty rated for the application. The motor shall be selected such a way that the motor rating is for actual requirement.

The motor shall be provided with suitable bearing to take care of any axial thrust. Necessary lubricators shall be provided to enable the bearings to be correctly greased as required.

The tenderer shall also calculate IKW/TR for part load conditions of 40%, 50%, 60%, 70%, 80% and 90%. The manufacturer's computer print out for performance of the chiller at NPLV shall be submitted which will be sent to ARI for verification.

4.2.6 Evaporator and condenser

The evaporator and condenser shall be as per manufacturer's standard to meet the operational requirement.

Evaporator (Chiller)

Chiller shall be provided with eliminator to prevent liquid carry over to the compressor. The chiller shall be provided with liquid level sight glass and a relief device (of the bursting type) to prevent excess pressure in the heat exchanger. The cooler shall be horizontal, flooded, shell and tube type. The chiller shall be selected for a fouling factors of 0.0001 Hr.Sqft.Deg.F/BTU or any other value if required depending on special circumstances as per latest ARI-550-92.

The chiller shall be provided with the following connections and accessories:

- a) Refrigerant inlet and outlet connections.
- b) Water inlet and outlet connections with industrial type thermometers.
- c) Drain and vent connections with stop valves.
- d) Pressure gauges on inlet and outlet connections.

Water chiller shall be insulated as per manufacturer's standards and as approved by the Engineer-in-Charge.

Condenser

Condenser shall have a refrigerant side design working pressure of 15 psi and shall be pneumatically pressure tested at 30 psi for R134a.

The condenser shall be complete with the following accessories.

- a) Refrigerant inlet and outlet connections and necessary shut off valve.
- b) air vent, test cocks.
- c) Any other standard accessories with the equipment if required.

4.2.7 Thermometers/Pressure gauges.

Thermometers shall be provided to show lube oil temperature, entering & leaving condenser water temperature and entering & leaving chilled water temperatures. Pressure gauges shall be provided for inlet & outlet of chillers and condensers.

4.2.8 Installation

The chiller shall be installed over suitable foundation and shall be adequately isolated against transmission of vibrations to the building structure special attention shall be paid to the alignment of the driver and driven shafts. Final alignment shall be checked at site in presence of the Engineer-in-Charge using a dial indicator.

4.2.9 Testing

The chiller unit whether imported or indigenous, as selected by the firm shall have ARI certificate.

Before the performance tests are made at site, the contractor shall carry out such preliminary tests as necessary to satisfy himself that each machine meets the contract requirements. Unit capacity shall be computed from the temperature readings and water flow measurements. Flow measurement shall be through flow meter duly calibrated. Chilled water lines computed results shall tally with the specified capacities and power consumption shall tally with the figures furnished with the tender. All instruments and services needed for the testing shall be furnished by the contractor at no extra cost. Test measurements shall be acceptable only if steady conditions of water flow rates, water temperatures and motor load prevail for atleast fifteen minutes prior to taking each set of measurements.

4.4 CHILLED WATER, WATER PUMPS

4.4.1 Capacity and Construction:- Pumps required for chilled water and condenser water circulation shall be of capacities indicated in the schedule of equipment. Pumps shall be of horizontal, enclosed impeller centrifugal type. The construction of the pumps shall be as follows:

Sl.No.	Description	Material/Type of Construction
1.	Pump	Horizontal, Split casing, Centrifugal
2.	Casing	Cast iron
3.	Impeller	Bronze
4.	Shaft	High tensile steel
5.	Bearings	Heavy duty ball/Roller bearings as per manufacturer's standard
6.	Base plate	Cast Iron/Fabricated M.S.
7.	Flanges	As per IS
8.	Type of seal	Mechanical
9.	Drive	Totally enclosed fan cooled squirrel cage induction motor suitable for operation on 415 Volts +/-10%, 3 Phase, 50 HZ AC supply
10.	Starter	As per the schedule of equipment

The pumps shall be directly coupled through flexible coupling to the drive motor. The pump and drive motor shall be mounted on a common based plate. The capacity of the drive motor shall atleast be 15% in excess of BHP of the pump. The drive motors shall conform to IS:325 (Latest Edition) in all respects. Motor shall be provided with heavy-duty bearings with an easily accessible grease nipple.

Starter rating shall be as per BOQ. The starters shall incorporate, thermal overload and under-voltage protection. Starters shall also have in built single phasing preventers. Wherever starters are mounted near the motor, they shall be of totally enclosed metal clad and dust proof construction.

The secondary VFD type pump shall be inter connected with primary pumps. The VFD type shall be in operation in case of part load requirement of chiller.

4.4.2 Accessories and fixtures

The following fixtures and accessories shall be provided with each pump along with other standard accessories:-

Coupling guard, One air vent, Lubrication fixtures and seals, Suction and delivery pressure gauges of 100 mm dia and appropriate rating with gauge cocks.
25 mm GI gland drain/drain nipple.

The pump casing shall be designed to withstand discharge pressure plus static head on the system plus at least 50% of the total. However, the minimum design pressure shall not be less than 10kg/Sq. cm. The bearing of the pump shall be effectively sealed to prevent loss of oil and entrance of dirt or water.

4.4.3 Installations

Pumps shall be installed as per the manufacturer's instructions. Vibration isolation arrangement preferably with serrated rubber pads & pre-cast concrete foundation block is desirable. The pump-motor set shall preferably be factory aligned. The alignment and base plate level shall be checked at site and the results submitted.

Wherever necessary, site alignment shall be done by competent persons. Chilled water pumps shall be insulated with foam polystyrene or equivalent material. The pump shall be insulated in such a manner that maintenance could be done without causing damage to the Insulation. The price shall include cost of insulation, tools, labour etc.

4.4.4 Testing

The contractor shall submit performance curves for pumps supplied by him. The capacity of each pump shall be checked with respect of the Contractor's piping and equipment layout. Indirect tests shall be conducted on each pump-set, after completion of the installation with reference to delivery head, flow and BHP. The test results shall correspond to the performance curves subject to a tolerance of 3%. The equipment, instruments and labour required for testing shall be furnished by the Contractor at no extra cost.

4.4.5 Painting

The pump sets along with all accessories and fixtures shall be painted with two coats of enamel paint of approved colour after the completion of installation and testing.

4.4.6 Lubrication

After the completion of the installation and before testing, all the pumps shall be lubricated in conformity with manufacturer's recommendations. Manufacturer's instruction manual shall be furnished along with a recommended list of spare parts.

4.5 AIR HANDLING UNITS

4.5.1 Scope

The scope of work under this heading shall cover design, supply, erection, testing, commissioning of all air handling units as per specification enumerated below and as per parameters laid down in the equipment schedule.

4.5.2 Type

Air handling unit of latest type i.e. Double skin, Horizontal factory manufactured, sectionalized construction.

4.5.3 Components

AHU shall be provided with the following :

- a) Fan Section
- b) Coil Section
- c) Filter Section
- d) Drain Pan

4.5.4 Sectionalized air handling units

Construction Features

Construction features/specifications of sectionalized AHUs shall generally be as per the standard of the manufacturer. The tenderer shall submit detailed Technical Specifications and leaflets of AHU offered by them. The minimum requirements for such AHUs shall be as given below:

- a) AHU casing shall be made of galvanized sheet steel reinforced with hat-section of standard size sheet channels welded in place. AHU frame work shall be of extruded aluminium channels. Outer skin:- 0.6mm PVC laminated/ pre painted G.S.S. or plasticised / powder coated. Inner skin:- 0.6mm plain GSS.
- b) Fan & Coil section shall be minimum 25 mm thick insulated from inside with P.U. Foam with Density of 38 Kg / Cum.
- c) Fan section shall have forward-curved DIDW centrifugal blowers statically and dynamically balanced with suitable static pressure required for supply of air through heap filter.
- d) Cooling coils shall be of plate and fin or tube and fin type with copper coils and aluminium fins. The coil face area and number of rows deep shall be as per equipment schedule and computerized selection shall be furnished along with the tender.
- e) Filter section shall have washable HDPE/synthetic media filters of 6mm thickness (10 micron filtering capacity) with 90% efficiency.
- f) Drive package shall comprise TEFC sq. cage motor of suitable size with design calculation, V-belts and Pulley, motor mounting arrangement, drive guard, etc.
- g) Drain pan shall be insulated and shall be provided with threaded pipe connections at both ends. Drain pan shall be constructed of 18G Aluminium.

4.5.5 Accessories

Air handling units shall be provided with the following accessories:

- Industrial type thermometers with metal guard and thermowell screwed to thermometer pockets at inlet/outlet of the cooling coil.
- Pressure gauge with U tube and gauge cock at inlet and out let of the cooling coil.
- Anti vibration isolation arrangement.
- Provision for installing 3 way mixing/magnetic valve in chilled water connection.
- Air tight access door for coil/fan inspection or openable side panels with powder coated die cast aluminium sheet.
- Differential pressure type Airstats shall be provided with AHUs with alarm indication.

4.5.6 Cooling units

Tube thickness of Cooling coil shall be as per manufacture's standard but not less than 0.41 mm. and the no of fins shall be 4 nos per cm. The thickness of Aluminium fins shall not be less than 0.2 mm. The fins shall be of aluminium and shall have integral spacing collars. The tubes shall be mechanically / hydraulically expanded to provide uniform and permanent fin-tube bonding. The return bends shall be die-formed and brazed to the tubes. A 6mm (1/4 ") FPT plugged vent/drain shall be provided on each nozzle connection. Coil shall be circuited to provide on each nozzle connection. Coil shall be circuited to provide for design water velocity in tubes without exceeding the total water pressure drop as per standards. All coils shall have same end connections regardless of no. of rows deep. Complete coil, including headers, connections & return bends shall be pressure tested.

4.5.7 Fan drive motor, etc.

Fan blowers shall be DIDW centrifugal forward curved designed for discharging the required quantity of air at the specified external static pressure. The blower shall be supported on steel shaft of suitable design. The fan shaft shall be corrosion resistant. Fan wheels / blowers and shafts shall be designed for continuous operation at max. rated speed and motor horse power. The design details and selection of components shall be attached with the offer.

Fan bearings shall be ball-type, self-aligning rubber/steel pillow block or flange type, mounted & located conveniently for re-lubrication.

Drive motor shall be TEFC sq. cage induction motor. The motor shall have class "B" insulation. The drive package shall comprise V-belts, pulleys, adjustable mountings plate for motor, drive guard, etc. The drive motor rating shall be 110% of total BHP of fans.

The AHU panel shall have fully automatic star delta starter with suitable interlocking with Heater / Fire damper etc. The panel shall be complete as per BOQ.

4.5.8 Installation

All civil works including foundation block and anti-vibration mounting etc shall be inclusive in the item rate quoted. AHUs shall be installed in weather maker rooms as shown in the drawings. The unit shall be installed on vibration isolation pads of adequate size and at 6 no of minimum footing. The operation of AHUs shall be smooth and shall not transmit undue vibration to the structure. As per site requirements the AHUs may have to be brought in dismantled condition and assembled in the site.

4.5.9 Testing

Air handling units shall be inspected at the factory for their design performance with respect to Air quantity, Pressure drop across filter and coil as per manufacturer's design.

AHUs shall also be tested for visual examination, free run and motor rating.

4.5.10 Pan type humidifier

The body shall be made out of 2 mm thick stainless steel sheet SS-304, having connections of quick fill, make up, over flow and drain. A round sight glass of 12 mm thick shall be provided to check water level. The top cover shall be openable for access to the inside of humidifier. A

flood light shall also be provided inside the tank for better visibility of water level. The body of humidifier shall be air tight and leak proof.

It shall be insulated with 50 mm thick fibre glass 32 kg/cum and then cladded with 0.8 mm thick Al. sheet. The humidifier shall be divided in two chambers. One bank of heaters shall always kept on to maintain temperature of water between 60 deg C to 70 deg C.

Electrical panel shall be made out of 16 G CRC sheet and painted glossy white from inside and powder coated out side light smoke grey colour. Panel with contactors, MCBs, low level cutout, heating thermostat for individual bank, fault indicating lamp and high temperature cutout heaters internally wired shall also be provided.

4.6 CONTROL SYSTEM

This section deals with supply, installation and testing, commissioning of necessary controls (automatic) and instruments conforming to these specifications and shall be in accordance with schedule of quantities.

The various controls listed below shall be electrically operated and in case of low voltage controls the necessary step down transformer shall be provided with each centre. All automatic controls shall be of approved makes.

4.6.1 Flow Switches

The flow switches shall be provided in chilled water outlets of evaporator of each chiller. These switches shall prevent the compressor from starting unless the water is flowing in the lines.

4.6.2 Thermostats

These shall be electrically operated, fixed / differential type with the sensing elements located in the return air passage of AHUs. The exact mounting arrangements, profile, etc. shall be derived as per location requirements.

4.6.3 Instruments

a) Thermometer:

The alcohol filled thermometer shall be of approved make having range of 0-100 deg.F and easy to read. These shall be provided at inlet/outlet pipelines of chillers & air handling units

b) Pressure gauges:

The pressure gauges shall be dial type of 100 mm dia. of approved make to be installed at inlet / outlet pipelines of chillers, air handling units and at suction and discharge of pump sets.

4.6.4 Testing and calibration

All instruments and controls shall be factory calibrated, completed with installation, calibration literature required at site. These shall be tested at site for ascertaining their accuracy and calibration before installation and commissioning.

4.7 DUCTING SYSTEM

This section deals with supply, erection, testing and commissioning of all sheet metal ductwork conforming to specifications given below. The ducts shall be of factory fabricated.

4.7.1 Material for Ducting

All ducts shall be fabricated from galvanized sheet of 120 gm/sq.m (Class VIII) conforming to IS 277-1962 (revised). The fabrication of duct shall strictly conform to ISS 655-1963. The thickness of the sheet shall be as follows:

Maximum size (mm)	Thickness of sheet (mm)	Type of transverse joint connections	Bracing (if any)
Upto 300	0.63 24 G	S-drive, pocket or bar slips, on 2.5m centres	None
301 to 600 601 to 750	0.63 24 G	S-drive, pocket or bar slips, on 2.5m centres S-drive, 25mm pocket or 25mm bar slips on 2.5m centres drive	None 25x25x3mm angle 1.2m from joint
751 to 1000 1001 to 1500	0.80 22 G	40x40mm angle connections, or 40mm pocket or 40mm bar slips, with 35x3mm bar reinforcing on 2.5m centres	40x40x2mm angle 1.2m from joint
1501 to 2250	1.00 20 G	40x40mm angle connections, or 40mm pocket or 40mm bar slips, 1 m maximum centres with 35x3mm bar reinforcing	40x40x3mm angle / 40x40x3mm angle 60mm from joint.
2251 & above	1.25 18 G	50x50mm angle connections, or 40mm pocket or 40mm bar slips, 1 m maximum centres with 35x3mm bar reinforcing	40x40x3mm angle / 40x40x3mm angle 60mm from joint.

The following points shall be also taken into account while fabrication of ducts.

- a) All ducts shall be as per gauges, etc. indicated on the approved drawings.
- b) All ducts of size larger than 450 mm shall be cross broken.
- c) All ducts shall be supported from RCC/truss by means of MS rods, angles, etc.
- d) The ductwork shall not extend outside and beyond height limits as specified on the approved drawings.
- e) All ducts shall be reinforced, if necessary and must be secured in place so as to avoid shifting of the ducts on its supports.
- f) The vanes shall be provided and securely fastened to prevent noise and vibration.
- g) The rubber gasket shall be installed between duct flanges in all connections and joints.
- h) The ductwork can be modified in consultation with CLIENT/CONSULTANT to suit actual conditions in the building.
- i) All flanges and supports should be primer coated on all surfaces before erection and painted with aluminum paint thereafter.
- j) The flexible joints are to be fitted to the suction and delivery of all fans with double heavy canvass. The length of flexible joints should not be less than 150 mm.

- k) All sheet metal gauges and fabrication procedure as given in BIS specification shall be strictly adhered to. The BIS specification shall form part of this contract.

4.7.2 Grilles/Diffusers

Material of construction - Extruded Aluminum

Supply air and return air grilles shall be continuous type and shall be fixed as given in the approved drawing. The square/rectangular diffusers shall be flush or step down type to match false ceiling pattern. The diffuser blades shall be die formed, flush mounted with single or double direction airflow. Supply of frames for fixing the grilles/diffusers, if required, is also in the scope of the contractor.

Return air grilles shall be with blanks and return air provisions. The size and appearance shall match with supply air grilles. The supply air grilles shall form part of the continuous return air grilles. The fixing of grilles/diffusers should be done in close co-ordination with false ceiling work and as directed by CLIENT/CONSULTANT.

The aluminum grilles/diffusers, etc. shall be powder coated of colours to match the interiors. However, successful bidder shall have to obtain prior approval regarding colour, finish, shape, etc. of grilles/diffusers and sample should be submitted to CLIENT/CONSULTANT for approval.

4.7.3 Slot diffusers/grilles

The slot diffusers shall be fabricated out of high grade aluminium alloy extrusions fixed or clipped to cross stays allowing easy removal of internal vanes and pattern control elements. Linear slot diffusers shall be two flow control vanes fixed to a central element on each slot. The air pattern shall be horizontal to vertical without changing the diffusers.

4.7.4 Testing

The complete duct system shall be tested for air leakage and complete air distribution systems shall be balanced in accordance with the approved drawings for achieving designed values inside the building.

4.8 PIPING WORK AND VALVES

This section deals with supply, installation of pipes, pipe fittings and valves, testing and balancing of chilled water, drain water, etc. as detailed in specifications. All piping, fittings and valves, etc. shall conform to relevant BIS specifications.

4.8.1 Water Piping

The piping, fittings and valves shall be of approved make and shall conform to BIS standards. All pipes for chilled water lines shall be M.S. (Black steel) heavy duty class C as per IS 1239-79 Part I.

All pipes for condenser water / drain water / make up water piping shall be of M.S. (Black steel) heavy duty class C as per IS:1239 Part I and II and IS 3589 for pipes of dia. 200 mm and above with minimum thickness 6 mm. IS:4736 for Hot Dip Zinc Coated Steel Tubes. The make of

pipes shall only be as per approved vendor list. The pipes shall be sized for individual liquid flow and ensure smooth noiseless balanced circulation of fluid.

All pipings and their steel supports shall be thoroughly cleaned and primer coated before installation. All pipe supports shall be applied with enamel paint of approved colour and make.

4.8.2 Pipe Fittings

The pipe fittings for welded joints shall be weldable quality. Also the fittings shall be suitable for same pressure ratings as for the piping system.

All bends upto sizes 150 mm dia shall be of heavy duty ready made.

All bends in sizes 200 mm and above shall be fabricated from the same dia and thickness of pipe in atleast four sections and having a centre in radius of at least 1.5 times diameter of pipes. Fittings such as tees, reducers, etc. shall be from the same pipe and at least of length twice the diameter of the pipe. The dead ends are to be blanked with 6mm thick plate.

4.8.3 Butterfly Valves

These valves shall be wafer type flangeless design suitable for holding between flanges with hand lever as per IS 4854. (pressure rating PN 1.0) It shall be hand operated upto 250mm and gear operated above 250mm. The constructional features shall be as given below.

Body material	Cast Iron
Disc material	Ductile Iron Gr.450/10 with epoxy coating.
Stem	SS410
Body lining	EPDM integrally moulded

4.8.4 Non-return Valve

These valves shall be flanged wafer design dual plate type as per IS 5312 (pressure rating PN 1.0). It shall be suitable for horizontal and vertical run pipes with negligible water hammer in both positions. The sealed design shall provide metal to metal soft seating. The soft seat shall be integrally moulded type.

Valves of sizes upto 65 mm dia. shall be gun metal and 75 mm dia. and above shall have cast iron body, the disc and seat of these valves shall be gun metal and with flanged ends.

4.8.5 Y-Strainer

Y-Strainer shall have cast iron body . The filter element shall be made out of 3 mm perforated brass sheet. It shall be easily removable when required to be cleaned without disconnecting the main pipe line. A permanent magnet shall be provided with drain plug to attract iron and dust particles from the water.

4.8.9 Balancing Valves

These valves shall be double regulating control and shut off type with built in pressure drop measuring facility. It shall be able to pre regulate flow conditions with tamper proof positioning

by a built in locking device. Valves of sizes upto 80 mm dia. shall be threaded gun metal and 80 mm dia and above shall have cast iron body.

4.8.10 3-way motorised mixing valve

These valves shall be suitable for diverting or mixing of chilled water for two position. It shall be modulating type with linkage actuator, proportionate thermostat, etc. suitable for automatic control of water flow in AHUs. The valve body shall be Cast Iron and spindle shall be SS. It shall be suitable for horizontal or vertical mounting positions.

4.8.11 Supports for Pipes

All pipe supports shall be of steel applied with anti-corrosive paint before installation. In plant room pipe may be supported from ceiling and have steel supports of adequate strength. Adequate number of supports shall be located in such a way that no vibration on piping is transmitted to the building or any other structures. The rate for piping include supply, fabrication and erection of steel supports, painting, etc.

4.8.12 Layout and Sizing of Pipe Lines

The contractor shall prepare and submit detailed drawings after the award of contract for approval. No work at site shall be started before final approval of drawings is given. The drawings shall indicate sizes of pipes, quantity of water flow in each length of pipe. All details of fittings, location of valves, air vents, etc. shall be clearly indicated including pipe supports. Detailed iso-metric drawing shall be submitted.

4.8.13 Laying Over Head (OH) Chilled/Drain/Make-up Water Pipes

- a) All OH pipes shall be securely supported or suspended with stands, hangers, clamps, etc. as required. The contractor shall design all brackets saddles, and anchors clamps and stands hangers and shall be responsible for structural adequacy.
- b) All pipe supports shall be of steel, coated with two coats of anti-corrosive paint and finally finish with black enamel paint.
- c) The pipe supports spacing shall be as follows:

<u>Dia of pipe</u>	<u>Spacing between supports</u>
Upto 25 mm	1.5 M
30 mm to 50 mm	2.0 M
65 mm to 75 mm	2.5 M
100 mm to 125 mm	3.0 M
150 mm to 200 mm	3.5 M
200 mm and above	4.0 M

The pipe hangers shall be firmly fixed on wall or ceiling.

- d) The vertical risers shall run parallel to walls and shall be straight/parallel to wall duly checked with plumb line.

- d) In case of pipes with/without insulation while passing through the wall/slab shall be provided with sleeve of 50 mm of higher size than the pipe with/without insulation.
- e) Wherever insulated pipes are running, it shall be supported in such a way that no extra pressure is put on the insulated pipe. Suitable metal sheet shall be provided between insulation and the clamp.
- f) The expansion-joints or expansion-loops shall be provided to take care of the expansion and contraction in pipes due to temperature rises.
- g) On RCC roof top, pipes shall be supported on brick pedestals. Necessary clamping should be done on to the pedestals.

4.8.14 Laying of Under Ground (UG) Pipes

All UG pipes with insulation shall be supported with PCC blocks at a minimum interval of 3.5 m. At bends and joints also, PCC supports shall be provided on both sides.

4.8.15 Expansion Tank

Expansion tank of HDPE material of approved make with necessary fittings and supports shall be installed at a highest point to take care of expansion of water due to temperature rise. The location of the expansion tank shall be finalised in consultation with CLIENT/CONSULTANT.

4.8.16 Balancing and Testing

- a) The water quantities as required/specified or directed shall be adjusted to deliver required quantity of water.
- b) Manometer shall be used for balancing and adjusting the system.
- c) The three way diverting valves / automatic control valves shall be balanced and adjusted for maximum flow of water.
- d) The Contractor shall submit balancing report for final approval.

4.8.17 Testing of Pipe System

- a) All tools, tackles, services labour shall be arranged by the Contractor at no extra cost.
- b) All pipes shall be hydraulic tested 1.5 times the maximum operating pressure for a period of 2 hours. All leaks occurring during testing shall be rectified to the satisfaction of CLIENT/CONSULTANT. After repairs of leak it shall be tested again at the same pressure.
- c) In case piping is tested in parts, these sections shall be securely sealed and capped.
- d) The contractor shall make sure that the water shall flow in pipes, AHU's coil without noise.
- e) In case no proper circulation/heat exchange is achieved due to any reason, etc., it shall be rectified by the Contractor.

4.8.18 Air Vents

Air valve for purging of air blocked in piping system shall be provided at different points as directed by CLIENT/CONSULTANT and as per requirement.

4.8.19 Pressure Gauges

Bourdan type pressure gauges of 100 mm dia of suitable range shall be provided at the following locations:

- a) Chiller/Cooling coils - inlets and outlets.
- b) Suction and discharge of all pumps.
- c) Inlet/outlet connection of AHU's
- d) All pressure gauges shall be complete with globe valves and conform to IS:3624.

4.8.20 Thermometer

Direct reading industrial type alcohol filled thermometer of suitable range / length shall be provided at the following locations

- a) Chiller /Cooling coil - Inlets and outlets., b) AHU's

4.9 THERMAL / ACOUSTIC INSULATION

This section deals with supply and fixing of thermal / acoustic insulation of ducts, insulation of pipes, etc. as per the specification.

4.9.1 Material of Insulation

a. Chilled Water Pipes

The insulation material shall be expanded polystyrene (EPS) of required thickness as per BOQ. The density of expanded polystyrene shall not be less than 16 kg per cubic meter and the thermal conductivity shall not exceed 0.35 mW/cm °C at 10 deg.C mean temperature. Only fire retardant (TF quality) expanded polystyrene shall be used and shall conform to IS 4671. For pipe sizes upto 200 mm dia preformed pipe section made out of expanded polystyrene and for sizes above 200 mm, insulation of pipes shall be done with uniformly cut pieces from slabs of expanded polystyrene.

b. Supply/return air ducts

Insulation material shall be resin bonded glass wool having thermal conductivity of not more than 0.033 W/m.K at 25°C and having a density of atleast 24 Kg/m³ and faced with aluminium foil of thickness 7 micron and conform to IS 8183.

The thickness of insulation used on ducting shall be as detailed below:-

	Conditioned space	Unconditioned space
a) Supply Air Duct	25mm thick	50mm thick
b) Return Air Duct	Not applicable	25mm thick

The thickness of insulation shall be as specified for the individual application.

Copies of test certificates on thermal conductivity, thickness, density, etc. supplied by the manufacturers shall be submitted for approval. Adhesive used for fixing the insulation shall be non-flammable, vapour proof CPRX compound or bitumen as approved by CLIENT/CONSULTANT.

4.9.2 Method of Insulation

a. Insulation of pipes with EPS (above ground)

- i) The pipe to be insulated should be cleaned thoroughly with steel brush for removing dirt, rust and grease with chemical solution, if required.
- ii) Apply a coat of zinc chromate primer and two coats of cold setting adhesive compound or hot bitumen on Pipes.
- iii) Fix insulation of specified thickness tightly and seal all joints with adhesive compound.
- iv) Insulated surface shall be wrapped with two layers of 125 G polythene sheet with over lapping of 50 mm longitude and transverse joints.
- v) Cover this with 24 G, 19 mm width GI chicken wire netting, butting all the joints and tie down with GI wires.
- vi) Finish the surface with two coats of sand cement plaster (1:4, cement 1 and sand 4) and surface shall be finished smoothly and curing of plaster shall be done using wetted jute bags.
- vii) Vapour barrier mastie of 3 mm thickness in two layers reinforced with RP tissues to be applied.

b. Insulation of pipes with EPS (below ground)

- i) to vi) of above and
- vii) On finished plastered surface of pipe apply one layer of tarfelt with hot bitumen as adhesive and with sufficient overlaps.

c. Valves and Fittings

All valves, fittings, flanges, strainers, etc. in the piping, operating below normal temperature shall be insulated in the same manner as described above. Care shall be taken to ensure that no damage would be caused to the insulation when valves or strainers are operated or serviced. No extra payments shall be applicable for insulation of valves and fittings.

d. Pumps and Accessories

All chilled water pumps and accessories shall be provided with (insulation of the same thickness) as that of pipes to which they are connected.

e. Cold Water and Expansion Tank

All tank such as expansion tank, make-up water tank connected with chilled water shall be insulated to the same thickness as for pipes to which they are connected. The method of application of insulation is as described for outdoor piping.

f. Chillers

The chiller shells shall be insulated as per manufacturer's recommendations.

g. Insulation of ducting

- i) Clean the surface with brush.
- ii) Apply two coats of CPRX/bitumen on the surface.
- iii) Fix fibre glass wool of specified thickness faced with aluminium foil with 50 mm overlap on joints.
- iv) Seal the joints with 50mm wide aluminium adhesive tape.

v) Provide PVC strapping at 0.5m interval

h. Acoustic Lining of the Duct

The material to be used for acoustic lining shall be resin bonded glass wool fixed upto 6 m from the outlets of all AHUs conform to IS 8183. The lining shall be carried out as given below:

- i) Clean the inside surface of the duct.
- ii) Fix the insulation boards faced with RP tissue inside duct.
- iii) Cover the insulation boards and RP tissue with 0.5 mm thick perforated aluminum sheet.
- iv) Screw down aluminium sheet, RP tissue and insulation to the duct surface using brass screws.

i. Under deck insulation

The material to be used for under deck insulation shall be of TF Quality Expanded Polystyrene (EPS) having thermal conductivity of not more than 0.35 mW/cm °C at 10 deg.C mean temperature and having a density 24 kg/m³ and shall conform to IS 4671. The method of fixing is as given below.

- i) Clean the surface
- ii) Apply hot bitumen on the surface with brush and stick the EPS slabs.
- iii) Screw down the EPS on the surface with GI fixtures, supports, etc.

4.10 FIRE DAMPERS

This section deals with supply, erection, testing and commissioning of fire dampers and box type dampers, conforming to general specification and suitable for duty selected, indicated in schedule of equipment/material.

4.10.1 Dampers

- a) The fire dampers of at least two hour rating shall be provided in all return air ducts at AHU room wall crossing.
- b) The fire dampers shall be fabricated out of 1.6 mm galvanised sheet steel and spring actuated type. These dampers shall be multi leaf type. The damper blades shall be provided on both ends using chrome plated spindles in self lubricating bushes. Stop seals shall be provided on top and bottom of the damper housing made of 16G GSS. For preventing smoke leakage side seals shall be provided.
- b) In the normal position the blades of the dampers shall remain open to allow maximum air to flow. The dampers shall be actuated fusible link mechanism. The fire damper shall also close due to temperature rise above 74°C.
- c) All fire dampers shall be mounted on wall with a duct sleeve 400 mm long depending on the wall thickness. The sleeve shall be factory fitted on the fire damper. The joint at the sleeve end shall be slip on type. Minimum thickness of GI sheet used for sleeves shall be 18G.

- d) Control wiring to AHU from fire dampers for automatic AHU motor switch off in case of fire shall also be executed and commissioned.

4.10.2 Hinged Access Doors

In all fire dampers, coil, heaters, plenums or any other equipment requiring regular servicing and inspection shall be provided with hinged access doors or suitable size complete with air tight gaskets. In case of insulated ducts or plenums, the access door shall be insulated. All hinges, tower bolts, etc. shall be of anodized aluminum only.

4.10.3 Exhaust Air Blowers

In line exhaust air flow duct blowers suitable for single phase operations with direct driven class F motor, IP 54 insulation, max 1400rpm, necessary steel frame, and complete with GI box, with an operating sound level not exceeding 60dB at 3m distance.

4.10.4 Hepa Filter

Hepa Filter shall be of efficiency 99.97%. HEPA filters shall be aluminium corrugated and Mini pleat style. All filters shall made up of high quality micro-fine glass fiber media. Filter frames shall made up of Galvanized steel. Hepa filter shall ensure low pressure drop even at high airflows & with Antimicrobial protection.

All filters shall be made in accordance and tested to EN 1822 / ASHRAE 52.2 standards. These filters shall be tested at factory and test certificates from OEM's shall be produced. The Hepa filter shall be fixed in a plenum constructed at the AHU mouth.

4.11 PAINTING WORK

4.11.1 All equipment shall be painted as specified under respective headings. Grilles/ diffusers shall be powder coated as per approved colour matching with interiors. The contractor has to get approval of the quality and colour of paints for all types of painting work.

All pipes for chilled water shall be painted as per standard code of practice and arrows indicating direction of flow of water shall be marked.

4.11.2 Colour scheme for the plant and equipment

- | | |
|--------------------------------|----------------------------------|
| i) Compressor | .. Battle ship grey |
| ii) Condenser | .. Battle ship grey |
| iii) Chiller | .. Light green with white arrows |
| iv) Refrigerant discharge line | .. Red |
| v) Refrigerant liquid line | .. Yellow |
| vi) Steel supports | .. Black |
| vii) Pump sets | .. Battle ship grey |

viii) Condenser water lines	.. Dark blue with white arrows or light blue with white arrows
ix) Chilled water lines	.. Green with white arrows
x) Direction of flow of water	.. White arrows
xi) Electrical panels/sub-panel/remote control console	.. Light grey or any approved colour
xii) Cable trays	.. Black
xiii) Supports for ducts	.. Black.

Materials and equipment shall be catalogued products of manufacturers regularly engaged in production and installation of automatic temperature control systems and shall be manufacturer's latest standard design that complies with the specification requirements.

The contractor or equipment manufacturer of the Air conditioning Management System shall provide documentation supporting compliance with ISO-9002 (Model for Quality Assurance in Production, Installation and Servicing). The intent of this specification requirement is to ensure that the products from the manufacturer are delivered through a Quality System and Framework that will assure consistency in the products delivered for this project.

4.12.1 Execution drawings

Submit all execution drawings for review before proceeding with procurement or site-specific software development and according to a schedule to be established with client.

Submit execution drawings for all equipment to be provided, including but not limited to.

- a) Software packages
- b) DDC
- c) Specification data sheets of each hardware component or software module.
- d) Schematic diagrams showing system configuration and interconnection of management stations and all field panels in accordance with the specified level.
- e) Schematic diagrams for all building systems showing control devices, instrumentation, product interconnection, panel wiring, interlocking and component tag identification as well as written sequence of operation.
- f) Other drawings as appropriate. General advertising type literature is only acceptable as additional support information.

Provide final documentation to serve the diverse needs of personnel concerned with instruction, operation, procurement, installation and maintenance.

Execution drawings and final documentation will be reviewed to ensure that such documents are in keeping with the intent of this specification and fully meet the requirements in terms of content and format. Make all required changes to this documentation at no additional cost.

4.12.2 Reference standards

Provide electrical material and installation in accordance with the appropriate requirements, and in accordance with applicable sections of the current edition of the applicable local codes for electrical work and signalling systems

Provide a AMS system which allows future support of the ANSI/ASHRAE BACnet Standards.

Provide Terminal Unit Controls that is LonMark compliant.

Modem interfacing provisions shall meet EIA RS232C. Modems shall comply with the local required communication protocol with a minimum transmission rate of 56 kbps.

All equipment and systems installed under this Contract shall meet following specifications on electromagnetic compatibility:

- a) Interference immunity according to EN50082-2
- b) Emitted interference according to EN50081-1.

Provide equipment which functions and meets all detailed performance criteria when operating in the following minimum ambient condition ranges:

- a) Operating Temperature - 0 to 50 deg C
- b) Relative Humidity 10% to 85% non -condensing
- c) Electrical power service of single phase, 230V AC +/- 10%, 50 Hz nominal

The limits above are minimums and shall not take precedence over ranges detailed in this or the manufacturers specification.

4.12.3 Variable Frequency Drive (VFD)

Variable frequency Drives (VFD's) shall be integrated into the AMS system utilizing a serial communication protocol that enables a full " read & write" seamless interface between the VFD & AMS. The VFD's selected, shall be supplied and installed by the contractor. The Contractor shall bear full responsibility for delivering & maintaining this "interoperability" solution.

The VFD shall provide, via serial communication, access to the following VFD features as a minimum.

Motor Current

Motor Kw

Total Motor KWH

Total Motor Run Hours

Manual/Off/ Auto position feedback

Full PI control access, set points adjust etc (Where used for Pressure/temp control e.g.: VAV Systems, Cooling Towers, and AHUs etc)

Specific alarm indication (General Alarm not acceptable)

Sleep Mode function for Cooling Tower Fan

Run & Trip status

Airflow status/ alarm (Utilizing VFD CT's)

Dirty Filter Status /alarm (Utilizing VFD high frequency alarm)

Fault Log history (Minimum last 10 faults/alarms)

Remote dial in capability for service diagnosis and remote fault reset.

The VFD shall provide the following selectable physical I/O to the AMS system.

- 8 x DI 0/24 VDC (PNP) Read only/ status points
- 2 x Relay Outputs (1 x 240v, 1 x 50 V) Read/ Status or on/off control points (e.g.: damper /valve open/ close control).
- (1 x AI)-10 V or thermistor Read/.Write Points (e.g.: temperature/Pressure sensors, set points, etc)
- 2 x AO/DO 0/4 -20 Ma or 0-24 Vdc Read/Write points
- 1 x 0-24 v DC pulse Output
- Cascade control for multi staging upto 5 no. fan or pump applications (optional where selected)

The VFD shall included the appropriate communication board & protocol, to enable RS485 serial communication with the AMS system. The contractor shall provide all necessary hardware and software required to interface with the VFD either directly through compatible protocols or gateway interface.

The contractor shall provide the client with a list of physical I/O points that will be utilized within the VFD for each specific project. There shall also be a list of additional pseudo points (e.g.: Lw, KwHr, Amps etc) accessible from the VFD without the need for any additional programming.

The VFD shall be capable of operating via serial bus communication and hard wired digital inputs simultaneously. It shall have the following protective features:

1. Electronic motor overload protection.
2. Protection to motor and FC against input transients, loss of AC line phase, short circuit, under voltage, over voltage, phase imbalance, motor over temperature. The frequency converter must display all faults in plain English text. Codes are not acceptable.
3. The frequency converter must be fully protected from switching at the output e.g. switching at the isolator switches near the ventilation fan motor without any additional switch gear.
4. The frequency converter must be fully protected from phase to phase short circuit or earth fault at the motor terminals.
5. To prevent breakdown of motor winding insulation, the U peak must be below 1000 V.
6. A thermistor input must be available in the frequency converter for monitoring actual motor winding temperature.
7. The local Control Panel (keypad of FC) of FC shall display in 4 line alpha- numeric characters in plain English language, the following operating parameters:
 - 1 Energy consumed in kW-Hr.
 - 2 Power consumed by motor in kW
 - 3 Run time of motor in Hours.
 - 4 Current drawn by the motor in Amperes.

- 5 Voltage applied to motor terminals by FC in Volts
- 6 DC link voltage in Volts
- 7 Output frequency in Hz.
- 8 Percentage of maximum out put frequency in %.
- 9 Motor Speed in RPM
- 10 Thermal Load on Motor in %
- 11 Thermal Load in FC in %
- 12 Warning Messages such as over current, Current Limit, Motor over temperature, Inverter-over temperature, under voltage, Over Voltage, Main failure, Out of frequency range, serial communication time out.
- 13 Alarm message such as circuiting, each fault, current limit, over current, motor overheated, inverter overheated, under voltage, over voltage, mains phase fault, motor phase missing, heat sink temperature too high, serial communication time out.

TESTING OF AIR-CONDITIONING SYSTEM

4.13 Routine and type tests for the various items of equipment of the system shall be performed at the Contractor's own cost and test certificates are to be submitted.

4.14 The performance tests to determine whether or not the full intent of the specification is met shall be conducted by the contractor. After notification to Purchaser that the installation has been completed and the system has run continuously for a period of at least one week, the contractor shall conduct under the direction and the presence of Purchaser such tests as specified to establish the capacity of various equipment supplied and installed by the contractor.

4.15 The contractor shall operate, test and adjust the air-conditioning system units, fan, motors, all air handling appliances including adjustment of regulators, dampers, etc. All testing equipments, labour, operating personnel, oil, refrigerant or any other item required for these tests shall be provided by the contractor to enable the plant to be put in a continuous running test.

4.16 Test procedure

4.16.1 Design Conditions:

The inside and outside conditions shall be recorded on hourly basis. The outside and inside dry bulb and wet bulb temperatures shall be recorded by means of a sling psychrometer with mercury thermometers. The relative humidity shall be computed from the psychrometric chart. The inside dry bulb temperature and relative humidity shall fall within the specified limits.

The contractor should conduct performance such tests as indicated in the rated Technical Part and produce sufficient documentary proof that the plant is operating at the rated capacity.

The following readings shall be recorded hourly during the tests and capacity of the plant shall be computed.

1. **Compressor**
 - a. Suction pressure - Kg/cm² (psi)
 - b. Suction temperature - °C (°F)
 - c. Discharge pressure - Kg/cm² (psi)
 - d. Condensing Tempr. - °C (°F)
 - e. Oil pressure - Kg/cm² (psi)
 - f. Compressor Speed - RPM
2. **Compressor motor**
 - a. Rated capacity - HP
 - b. Rated volts - Volts
 - c. Rated current - Amps
 - d. Starting current - Amps
3. **Chiller**
 - a. Rated capacity - HP
 - b. Chilled water flow in temp - degC
 - c. Chilled water flow out temp - degC
 - d. Chilled water flow in - m³hr
 - e. Chilled water flow out - m³hr
4. **Chilled water pumps**
 - a. Rated capacity - HP
 - b. Rated volts - Volts
 - c. Rated current - Amps
 - d. Starting current - Amps
 - e. Chilled water flow - m³hr
5. **Inside unit**
 - a. Air velocity - M/Hr. (FPM)
 - b. Face area - M² (SFT)
 - c. Air quantity - M³/Hr. (CFM)
 - d. Entering air temp. DB - °C (°F)
 - e. Entering air temp. WB - °C (°F)
 - f. Leaving air temp. DB - °C (°F)
 - g. Leaving air temp. WB - °C (°F)
6. **Air Grilles**
 - a. Area of Grilles - M² (Sft)
 - b. Velocity - M/Hr (FPM)
 - c. Air flow rate - M³ (FPM)
 - d. Temperature DB - °C (°F)
 - e. Temperature WB - °C (°F)
7. **Air Diffusers**

- a. Area - M^2 (Sft)
 - b. Velocity - M/Hr (FPM)
 - c. Air flow rate - M^3 (FPM)
 - d. Temperature DB - $^{\circ}C$ ($^{\circ}F$)
 - e. Temperature WB - $^{\circ}C$ ($^{\circ}F$)
8. **Filters**
- a. Total area - M^2 (Sft)
 - b. Effective area - M^2 (Sft)
 - c. Velocity of air - M/Hr (FPM)
 - d. Quantity of air - M^3 (CFM)

TECHNICAL DATA

(To be submitted along with the tender)

5.0 The following data shall be furnished along with the offer: (REFER LIST OF APPROVED MAKES)
(Attach catalogues, brochures, etc.)

1. Chiller

Manufacturer
Model
Actual capacity TR
Overall dimensions
Over all weight
Operating weight
Refrigerant

Compressor

Manufacturer
Model
Type
Capacity at the specified water temp. and flow rates - in TR
Type of capacity control provided
Type of lubrication
KW / TR

Motor

Model
Manufacturer
Number of motors
Capacity HP
Whether provided with part winding
Type
Class of insulation
Speed RPM
Characteristics
Type of starter
Rating
Whether the following protections are provided.

- | | |
|--|--------|
| i) Overload | Yes/No |
| ii) Under voltage | Yes/No |
| i) Single phase protection
(for three phase motor starters) | Yes/No |

2. Inside units

Manufacturer

Model

Type of fan

Fan speed (R.P.M.)

No. of fans.

Fan wheel diameter (mm)

Drive arrangement

Material and thickness of fan wheel and blades.

Materials and thickness of housing.

Fan outlet area

Outlet velocity.

Total air quantity

Static pressure at outlet. (mm. of water)

Whether statically and dynamically balanced.

B.H.P. Consumed

Total weight of all items

Cooling Coil

Material of Tubes

Material of fins

Tube diameter

Tube thickness

Fin thickness

Method of bonding of fins

No. of fins/cm.

Total tube surface outside

Test pressure

Coil face area

Filter

Manufacturer

Type of filters

Filter medium

Material of frame work and its thickness

Face area

Face velocity across filters

Pressure drop across filters (mm of water)

Motor

Manufacturer

Model

Number of motors

Capacity HP

Type

Class of insulation

Speed RPM

Characteristics

Type of starter

Rating

Whether the following protections are provided.

- | | |
|--|--------|
| i) Overload | Yes/No |
| ii) Under voltage | Yes/No |
| iii) Single phase protection
(for three phase motor starters) | Yes/No |

3. Ducting

Material

Manufacturer

4. Insulation (for ducting)

Manufacturer

Material

'k' Value at 10 (°C) mean temperature

Thickness.

Density

Fire Retardant property

Note : Any other data relevant to each equipment shall also be furnished.

Approved make of items -HVAC

1.	Chiller	-	Blue star/ Kirloskar/ Carrier /Hitachi/ Trane/York/Dhanambush
2.	AC Compressor	-	Danfoss/Koplan/Emerson
3.	AHU	-	Blue star/ Carrier /Hitachi/VTS/Zeco
4.	Ductable/Packaged AC	-	Blue star/ Voltas/ Carrier/ETA/Hitachi
5.	Split AC		Blue star/ Voltas/ Carrier
6.	Pumps	-	Kirloskar, Mather platt, Beacon, Grundfoss
7.	Three phase motors	-	Siemens/Kirloskar/Crompton/Bharath Bijlee / ABB / Alsthom
8.	MS pipes	-	TATA/Gindal
9.	Copper Pipes	-	Totaline/Piyush/Mandev
10	Stabilizer	-	V Guard/VOLTAS
11	GI Sheets	-	SAIL/TATA/JINDAL
12	Resin bonded Glass wool	-	UPTWIGA /Owens Coning/KIMMCO
13	Nitrile Rubber Insulation	-	Armaflex/K Flex
14	Grilles/Diffusers	-	Airmaster/Carryaire/Air Flow/Ravistar
15	Pressure gauges	-	Feibig/H-Guru/Jaspin
16	Industrial type thermometers	-	Feibig/H-Guru/Jaspin
17	Fire Dampers	-	Carryaire/ Airmaster/ Air Flow/ Ravistar
18	Volume Control Damper	-	Carryaire/ Airmaster/ Air Flow/ Ravistar
19	Exhaust/ Duct Fans	-	System Air/Kruger/Nicotra
20	Paints	-	ICI/Asian/Berger
21	PVC pipe	-	Any ISI marked
22	Motors		Siemens, Kirloskar, Crompton, Bharath, Bijlee, ABB, Alsthom, NGEF
23	Hepa Filter	-	Aerofoil/Pyramid/AAF
24	Valves	-	Audco, Leader, Kirloskar, Crawley, Divine, Advance, Bankim Sarkar.

25	Motorized Valves	-	Honeywell/Siemens/ Belimo
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**TECHNICAL SPECIFICATIONS
FOR
FIRE FIGHTING SYSTEM**

1.0 TECHNICAL SPECIFICATIONS FOR FIRE FIGHTING SYSTEM

1.1 General

Work under this subhead is time-bound and has to be completed within the time limit set in the tender. Work shall be executed in accordance with an agreed schedule which shall be submitted by the tenderers along with offer and agreed to by owners.

1.2 Scope of Work

The scope of work in this subhead shall consist of furnishing all labour, materials, equipment and appliances necessary and required to completely do all work relating to the supply, installation, testing & commissioning of Fire Detection & Fighting System Works for MCC, Thalassery as described herein after and shown on the drawings. The scope of work in general shall include the following.

- i) Fire Fighting Pumps & Accessories and related electrical works
- ii) External & Internal Fire Hydrant System.
- iii) Sprinkler system.
- iv) Fire Detection System.
- v) Hand Held appliances.

Without restricting to the generality of the foregoing, the work shall include the following:

A Hydrant System Covering the entire complex and consisting of the following:

- A. Three number of Pumps - One number Main electric split casing Pump of 2280 LPM at 56 M head, one number Diesel Standby split casing Pump for Hydrant Systems of 2280 LPM at 56 M head, and a Jockey Pump for System pressurization of 180 LPM at 56 M head.
- B. Other piping system ancillaries such as Suction and Delivery Headers, Air Vessel, Pressure Gauges, Pressure Switches, Pump Panel etc. as required.

- C. External Hydrant Ring Main with single headed Yard Hydrants, RRL Hose, Branch Pipes, etc. all housed in a Hose Box.
- D. Internal Hydrant system where required with single headed landing valves accompanied by 1 number swinging type Hose Reel, 2 numbers RRL Hoses, Branch Pipe etc. all housed in the niche. Bidder shall provide front frame with shutter for niche.
- E. Sprinkler system as indicated in the drawing.
- F. Hand appliance as per Bill of Quantities.
- G. To obtain the approval of the relevant drawings before actual installation at site and to get the complete installation inspected and passed by the concerned authorities, as may be necessary as per local bye laws. (Any fee payable to the local bodies for such activities shall be reimbursed by the CLIENT/CONSULTANT on production of receipt).

1.3 **Contractor's Experience**

- 1.3.1 Contractors shall engaged specialist agency only for this work of Fire Fighting systems.
- 1.3.2 The selected specialist agency must have sufficient experience in the execution of turn-key projects as specified.
- 1.3.3 Contractor must submit with the tender a list of similar jobs carried out by him as required along with the name of works, name and address of clients, year of execution, capacity of plant and value of work.

1.4 **Technical Information**

- 1.4.1 Contractor shall submit along with the tender copies of detailed specifications, cuts, leaflets, and other technical literature of equipment and accessories offered by him.
- 1.4.2 Contractor's attention is specially invited to the special conditions and other clauses in the agreement which required the contractor to :-
 - a. Submit detailed shop drawings.
 - b. Use material of specific makes and brands.
 - c. Obtain all approvals from Fire Fighting authorities.
 - d. Execute the entire work on a turn-key basis so as to provide a totally operating plant.

1.5 Exclusions

1.5.1 Work under this contract does not include the following work:-

1.5.2 Electrical cables upto incoming motor control centre.

1.6 Site Accessibility

1.6.1 The equipments are to be located in pump house located within the Service block.

1.6.2 The equipment must be carried from the goods receiving station to the site in an extremely careful manner to prevent damage to the equipment building or existing services.

1.6.3 Contractor must visit the site and familiarize himself with above problems to ensure that the equipment offered by him are of dimensions that they can be carried and placed in position without any difficulty.

1.7 Approvals

The contractor shall prepare all submission drawings and obtain all approvals of fire fighting works from fire fighting authorities.

1.8 System Description

1.8.1 The Hydrant System shall comprise of AC motor driven pump set, standby diesel pump set, jockey pump set for pressurization with all required accessories including valves, special fittings, instrumentation, control panels and any other components required to complete the system in all respects.

1.8.2 The Hydrant System shall be semi automatic in action and shall be laid covering the entire area externally and all the floors internally with independent piping system. For the Sprinkler System, a separate piping system shall be installed.

1.8.3 The Hydrant System shall be kept pressurized at all times. The proposed Jockey Pump shall take care of the leakages in the system, pipe lines and valve glands.

1.8.4 The pressure in the hydrant pipe work shall be kept constant at 7 Kg/cm². In the event of fire when any of the hydrant valve in the network is opened, the resultant fall in header pressure shall start the AC motor driven fire pump through pressure switches automatically. There shall be one Diesel Engine Driven pump as standby for hydrant system. In case of failure of electricity or failure of Electric Pump to start on demand, the standby Diesel Pump shall automatically take over.

- 1.8.5 However, shutting down of the pump set shall be manual except for the Jockey Pump which shall start and stop automatically through pressure switches. In addition to auto start arrangements, the main pump shall also have an over-riding manual starting facility by push button arrangement.
- 1.8.6 The piping for the hydrant system in the yard shall be laid in soil 1 Metre deep or in rectangular Trench. The pipe laid in soil shall be protected as specified in para 1.9.3 below. The scope of work includes necessary excavation of trench and back filling the same. The scope of work also includes necessary watering, ramming, removing the surplus earth from the site and construction of brick pedestal at 3 Mtrs intervals of size as indicated in the Bill of Quantities. Pipes shall be cleaned before wrapping and coating.
- 1.8.7 The yard hydrants shall be placed at a regular spacing of 30m - 45m centre to centre. The following accessories are proposed near each yard hydrant.
- i) One no. gunmetal single headed hydrant valves.
 - ii) Two nos. RRL Hoses of size 63mm dia x 15m long.
 - iii) One nos. gunmetal Branch pipe.

Gun metal hydrant valve, RRL hose and gunmetal branch pipe will be accommodated in an aluminium hose box mounted on brick pedestals.

- 1.8.8 The Internal Hydrant System shall be provided at points as indicated on the drawing on each floor.
- 1.8.9 The hydrant point shall be directly tapped from the Riser pipes, and shall be furnished with required accessories such as
- i) One no. gunmetal single headed hydrant valves.
 - ii) Two nos. RRL Hoses of size 63mm dia x 15m long.
 - iii) One no. first aid Dunlop hose reel full swinging type 20mm dia x 30m long.
 - iv) One no. gunmetal Branch pipe.

The hydrant risers shall be terminated with air release valve at the highest points to release the trapped air in the pipe work. At each tapping from the Riser an Orifice Plate shall be located in the lower floors to reduce the pressure at no extra cost.

- 1.8.10 Sprinkler system shall be distributed so as to cover 10-12 sq. m area with one sprinkler.

Sprinkler risers shall be provided with instantaneous control valve with alarm gang. The alarm valve assembly shall be complete with all accessories as required for the performance.

A suitable drainage arrangement with bye pass valves shall be provided to facilitate maintenance of sprinkler pipe work.

1.8.11 To compensate for slight losses of pressure in the system and to provide an air cushion for counteracting pressure surges/water hammer in the underground pipe work Air Vessels shall be furnished in the pump room near fire pumps. The air vessel shall be normally partly full of water and the remaining being filled with air which shall be under compression when the system is in normal operation.

1.9 GENERAL SPECIFICATIONS

1.9.1 Pipes and Fittings

Pipes upto 150mm dia shall conform to IS-1239. Pipes with dia 200mm and above (6mm thick) shall conform to IS-3589. All pipes shall be I.S.I. marked. Fittings for black steel pipes shall be malleable iron suitable for welding or approved type cast iron fittings with tapered screwed threads.

1.9.2 Jointing

Joint for black steel pipes and fittings shall be metal-to-metal tapered thread or welded joints. A small amount of red lead may be used for lubrication and rust prevention in threaded joints.

Joints between C.I. or black steel pipes, valves and other apparatus, pumps etc. shall be made with C.I. or M.S. flanges with appropriate number of bolts. Flanged joints shall be made with 3mm thick insertion rubber gasket.

Note: Joints for pipes and fittings upto 50mm diameter shall be threaded joints using Teflon Tape or equivalent bonding tape on the threads. Joints for pipe and fittings above 50mm diameter shall be welded joints.

1.9.3 Pipe Protection

- a) All pipes in under ground masonry trenches/service tunnels, above ground and in exposed locations shall be painted with one coat of red oxide primer and two or more coats of synthetic enamel paint of approved shade.
- b) Pipes in wall chases shall be protected from corrosion by 2 coats of bituminous paints.
- c) Protection of Underground Pipes:

The underground steel pipes shall be protected by coating and wrapping. The coating and wrapping shall be done, in general, as per IS:10221-1982.

It specified in Bill of Quantities, the proprietary pipe protection system shall be provided as per the Manufacturers recommendation. The proprietary system shall be of approved make.

1.9.4 Installation of Pipes

All pipes shall be adequately supported from ceiling or walls by structural clamps fabricated from M.S. structural e.g. rods, channels, angles and flats. All clamps shall be painted with one coat of primer and two coats of black enamel paint. The contractor shall provide inserts at the time of slab casting or provide suitable anchor fasteners.

The pipe supports or hangers shall be designed to withstand combined weight of pipe, pipes fittings, fluid in pipe and insulation. Pipe supports shall be of steel and coated with rust preventing paint and finished with two coats black enamel paint. The maximum spacing for pipes supports shall be as below:

Pipe (MM)	Spacing (MTR)	Size of support
Up to 25	2.0	6mm
32 to 65	2.4	8mm
75 to 125	2.7	10mm
150 & above	3.0	12mm

Pipes supports shall be spaced at maximum interval of 1.5 mtrs. on either side of heavy fitting and valves. Wherever piping passes through walls, pipes sleeves of diameter larger than that of piping shall be provided. Pipe sleeves shall be of steel or cast iron pipe.

The underground piping shall be supported with cement concrete blocks of suitable size and strength provided at an interval of 2.5 mtrs. The pipes shall be laid at 1 mtr depth (top of the pipe) and trench excavated for sufficient width. The rate for pipe shall include the scope of excavation/refilling the trench. 1:2:4 concrete thrust blocks are also to be provided at turning of pipe. The cost of installation includes concrete pedestals etc. as required and to be included in the item rate.

1.9.5 Orifice Flanges

Contractor shall provide orifice flanges fabricated from 6mm thick stainless steel plates on the branch lines feeding different zones/floors so as to allow required flow of water at a pressure of 3.5 kg/sq.cm. for each hydrants and 2 bar at installation valve for sprinkler system. The contractor shall design the orifices to ensure the required pressure. No extra cost shall be paid for the orifice plate.

1.9.6 Valves & Other Accessories

1.9.6.1 General

Each valve body shall be marked with cast or stamped lettering giving the following information's:

- a) The manufacturer's name or trade mark
- b) The size of the valve
- c) The guaranteed working pressure

Isolating valves on the water supply lines shall be full bore ball valve type for pipe diameters upto 50mm. For 65mm dia and above these shall be butterfly valves.

1.9.7 Full Way Ball Valve

The valves shall be of full bore type and of quality approved by the Consultant/Owner. The body and ball shall be of copper alloy and stem seat shall be of Teflon.

1.9.8 Sluice Valve (SV)

1.9.9

It shall be of IS 780 standards. Construction shall be of inside screw, non-rising stem for water purpose and flanged type. Pressure class shall be of PN 1.0 and tested to 15 kG/Sq.cm pressure. Seat ring shall be of gun metal as per IS 318. Gasket packing shall be of CAF / Graphited asbestos

1.9.9 **Non-Return Valves**

Non-return valves are to be IS:778-1984 manufactured from gun-metal or dezincification resistant brass.

1.9.10 **Drain Valve**

Drain Valves are to be provided at all low points in the system for draining the water. These shall be 40mm dia full way ball valve fixed on 40mm dia black steel pipe.

1.9.11 **Inspection & Testing Assembly**

Inspection and testing of the sprinkler system shall be done by providing an assembly consisting of gunmetal valves, gunmetal sight glass, bye-pass valve.

1.9.12 **Flow Switch**

Flow switch shall be provided on sectional mains and branch lines as indicated on drawings, or necessary and required and directed by the Engineer-in-charge.

Flow switch should be suitable to actuate at a minimum of flow and shall be suitable for connection to a central annunciation panel.

1.9.13 **Pressure Switches**

Pressure switches shall be differential type for operation of all pumps and for the various duties and settings required. Pressure switches shall be for heavy duty operation and of approved make. All pressure switches shall be factory calibrated.

1.10 **External Fire Hydrants**

Yard Hydrant valves shall be single headed as per IS : 5290. The valve shall be complete with hand wheel, quick coupling connection spring loaded type and gun metal blank cap. The Yard Hydrant shall be laid on 125 and 100mm dia pipe as per standards. Hydrant Ring Main, branched off to 80 mm dia and Stand Post of 80mm dia.

1.11 **Internal Landing Valves**

The internal landing valves shall be single-headed made of gun metal and conforming to IS:5290. It shall be complete with hand -wheel, quick coupling connection spring loaded type and blank cap.

1.12 **Hose pipes, Branch Pipes and Nozzles**

Hose Pipe: Hose pipe shall be rubber lined woven jacketed and 63mm in diameter. They shall conform to type-2 (Reinforced rubber lined) of IS:639-1979. The hose shall be sufficiently flexible and capable of being rolled.

Each run of hose pipe shall be complete with necessary coupling at the ends to match with the landing valve or with another run hose pipe or with Branch pipe. The couplings shall be of instantaneous spring lock type.

Branch Pipe: Branch pipe shall be of gunmetal 63mm dia and be complete with male instantaneous spring lock type coupling for connection to the hose pipe. The branch pipe shall be externally threaded to receive the nozzle.

Nozzle : The nozzle shall be of copper or gunmetal, 20mm in internal diameter. The screw threads at the inlet connection shall match with the threading on the branch pipe, the inlet end shall have a hexagonal head to facilitate screwing of the nozzle on to the branch pipe with nozzle spanner.

End couplings, branch pipes, and nozzles shall conform to IS:903-1985. two hoses of 15 mtr. Lengths with couplings shall be provided with each external (yard) hydrant. One nozzle and one branch pipe with coupling shall be provided with each yard hydrant.

1.13 External Fire Hose Cabinet

The external fire hose cabinet to accommodate the hose pipes, branch pipe nozzle and the hydrant outlets shall be fabricated from 1.5m thick sheet steel. This shall be lockable and provided with center opening glazed doors.

The support for hose cabinet shall be of brick work up to a height of 0.5m above ground level. The depth of footing for this support shall be minimum 50cm below ground level, resting on leveling course of minimum 10cm of PCC (1:5:6). The brickwork shall be plastered in cement mortar (1:6). The hose cabinet shall be painted red and stove enameled.

1.14 Internal Fire Hose Cabinet

Each internal fire hydrant valve shall be housed in a niche of size indicated on drawings. Each internal fire hose Cabinet shall hold single headed hydrant, 2 Hoses, 2 Branch pipes and 1 no. Dunlop hose reel mounted on a drum.

- A) The cabinet shutters & frames shall be fabricated from boxed steel sections and MS plate 2mm thick.
- B) The front glass of shutters shall be 5.0 mm thick clear glass and shall be held by means of rubber. Locking arrangement shall also be made with one number of mortice lock of approved make. A separate Key Box of 2 mm thick MS sheet with glass facing shall be provided.
- C) The Shutter shall be given a powder coat finish in post office red colour.

1.15 Hose Reel

The hose reel shall be directly tapped from the riser through a 25 mm dia pipe, the drum and the reel being firmly held against the wall by use of dash fasteners. The Hose Reel shall be swinging type (180 degrees) and the entire Drum, Reel etc shall be as per IS:884. The rubber tubing shall be of approved quality and the nozzle shall be 6 mm dia shut off type.

1.16 **Brigade inlet Connections**

Two sets of 4 ways collecting head Fire Brigade connection shall be provided at the location indicated in the drawing.

The inlet to the riser shall be with 150mm dia sluice valve and non-return valve. The scope shall include providing necessary reducers, tees bends and special fittings as required. Necessary enclosure made of 2mm thick sheet metal with support shall be provided, as in the case of hose cabinets.

1.16 **AUXILIARY PUMPING EQUIPMENT (Jockey Pump)**

1.16.1 **Scope**

This section covers the details of requirements of the auxiliary equipment necessary for the operation of the fire pumps and the wet-riser system.

1.16.2 **Drive**

The pump shall be directly driven from the electric motor. Flexible coupling and coupling guard shall be provided.

1.16.3 **Capacity**

The discharge and head of the jockey pump shall be as mentioned in Bill of Quantities.

Jockey pump shall be Horizontal type. The pump casing shall be of cast iron and parts like impeller, sleeve, wearing ring etc. shall be of non-corrosive metal like bronze, brass or gunmetal. The shaft shall be of stainless steel.

Bearings of the pump shall be effectively sealed to prevent loss of lubricant or entry of the dust or water. The pump casing shall be designed to withstand 1.5 times the working pressure.

1.16.4 **Motor**

The motor shall be squirrel cage A.C. induction type suitable for operation on 415 volts 3 phase 50 Hz, system. The motor shall be totally enclosed fan cooled type confirming to protection clause IP 21 of IS 4691. The class of insulation shall be B, synchronous speed shall be 3000 RPM/1500 RPM. The motor shall conform IS 325-1978 and rated for continuous duty.

1.16.5 **Motor Starter**

The motor starter shall be automatic star delta type with overload trip, but without under voltage/no volt trip. Starter shall conform to IS 1822-1967.

2.0 **MAIN ELECTRIC FIRE PUMP**

2.1 **Scope**

This section covers the details of requirements of the motor, starter and pump for the electrically operated fire pump.

2.2 **General**

The electric fire pump shall be suitable for automatic operation complete with necessary electric motor and automatic starting gear, suitable for operation on 415 volts, 3 phase, 50 Hz. AC system. Both the motor and the pump shall be assembled on a common base plate of fabricated MS channel type or cast iron type.

2.3 **Drive**

The pump shall be only direct driven by means of a flexible coupling. Coupling guard shall also be provided.

2.4 **Fire Pump**

The fire pump shall be horizontal split casing centrifugal type. It shall have a capacity to deliver 2280 LPM as specified, developing adequate head so as to ensure a minimum pressure of 3 Kg per sq.cm at the highest and the farthest outlet. The delivery pressure at pump outlet shall be not less than 7 Kg. Per sq.cm. in any case.

The pump shall be capable of giving a discharge of not less than 150 percent of the rated discharge, at a head of not less than 65 percent of the rated head. The shut off head shall be within 120 percent of rate head.

The pump casing shall be of cast iron to grade FG 200 to IS:210 and parts like impeller, shaft sleeve, wearing ring etc., shall be of non-corrosive metal like bronze/brass/gunmetal. The shaft shall be of stainless steel.

Bearing of the pump shall be effectively sealed to prevent loss of lubricant or entry of dust or water.

The pump shall be provided with a plate indicating the suction lift delivery head, discharge speed and number of stages. The pump casing shall be designed to withstand 1.5 times the working pressure.

2.5 **Motor**

The motor shall be squirrel cage A/C induction type suitable for operation on 415 volts 3 phase 50 Hz system. The motor shall be totally enclosed fan cooled type conforming to protection clause IP 21 vide I.S. 4691. The class of insulation shall be B. The motor shall be rated for continuous duty as per relevant IS and shall have a horsepower rating necessary to drive the pump at 150 percent of its rated discharge.

2.6 **Motor Starter**

The motor starter shall be automatic star Delta type conforming to IS:1822-1967. The starter shall not incorporate under voltage or overload trip or single-phase preventor. The starter assembly shall be suitably integrated in the power control panel for the wet riser system.

Each pump shall be provided with vibration isolating pads of appropriate size.

3.0 **DIESEL FIRE PUMP**

3.1 **Scope**

This section covers the details or requirements of the stand by fire pump operated by a diesel engine.

3.2 **General**

The diesel pump set shall be suitable for automatic operation complete with necessary automatic starting gear, for starting on wet battery system and shall be complete with all accessories. Both engine and pump shall be assembled on a common bed place, fabricated with mild steel channel.

3.3 **Drive**

The pump shall be only direct driven by means of a flexible coupling. Coupling guard shall also be provided.

3.4 **Fire Pump**

The fire pump shall be horizontal split casing centrifugal type. It shall have the capacity to deliver 2280 LPM as specified, developing adequate head so as to ensure a minimum pressure of 3 kg. Per sq.cm. at the highest and the farthest outlet. The delivery pressure at the pump outlet shall be not less than 7 kg. Per sq.cm. in any case. The pump shall be capable of giving a discharge of not less than 150% of the rated discharge at a head of not less than 65% of the rated head. The shut off head shall be within 120% of the rated head. The shaft shall be of stainless steel. The pump shall be provided with mechanical seal. The pump casing shall be designed to withstand 1.5 times the working pressure.

Bearings of pump shall be effectively sealed to prevent loss of lubricant or entry of dust or water.

3.5 Diesel Engine

Engine Rating:-

The engine shall be cold starting type without the necessity of preliminary heating of the engine cylinders or combustion chamber (for example, by wicks, cartridge, heater plugs etc.). The engine shall be multi cylinder/vertical, 4-stroke cycle, water-cooled, diesel engine, developing suitable HP at the operating speed specified to drive the fire pump. Continuous capacity available for the load shall be exclusive of the power requirement of auxiliaries of the diesel engine, and after correction for altitude, ambient, temperature and humidity for the specified environmental conditions. This shall be at least 20% greater than the maximum HP required to drive the pump at its duty point. It shall also be capable of driving the pump at 150% of the rated discharge at 65% of the rated head. The engine shall be capable of continuous non-stop operation for 8 hours. The engine shall have 10% overload capacity for one hour in any period of 12 hours continuous run.

The engine shall accept full load within 15 seconds from the receipt of signal to start. The diesel engine shall conform to B.S. 649/IS 1601/IS 10002, all amended up to date.

3.6 Cooling System

The engine cooling system shall be radiator water cooled system. The radiator assembly shall be mounted on the common base plate. The radiator fan shall be driven by the engine as its auxiliary with a multiple fan belt. When half the belts brake remaining belts must be capable of driving the fan. Cooling water shall be circulated by means of an auxiliary pump of suitable capacity driven by the engine in a closed circuit.

3.7 Fuel System

The fuel shall be gravity fed from the engine fuel tank to the engine driven pump. The engine fuel tank shall be mounted either over or adjacent to the engine itself suitably wall mounted on brackets. The fuel filter shall be suitably located to permit easy servicing.

The engine fuel tank shall be welded steel construction (3mm thick) and of capacity sufficient to make the engine to run on full load for at least 8 hours. The tank shall be complete with necessary supports, level indicator (protected against mechanical injury), inlet, outlet, over flow connections drain plug and piping to the engine fuel tank. The outlet should be so located as to avoid entry of any sediment into the fuel line of the engine. A semi rotary hand pump filling the engine fuel tank together with hose pipe 5 mtr. Long with a foot-valve etc. shall also form part of the scope of work.

3.8 Lubricating Oil System

Forced feed Lubricating Oil system shall be employed for positive lubrication. Necessary Lubricating Oil filters shall be provided and located suitably for convenient servicing.

3.9 **Starting System**

The starting system shall comprise of necessary battery/batteries, starter motor of adequate capacity and axle type gear to match with the toothed ring fly wheel. Suitable metallic relay to protect starting motor from excessively long cranking runs shall be included within the scope of the work. The metallic relay protection shall be integrated with engine protection system.

The capacity of the battery shall be suitable for meeting the needs of the starting system but not less than 180 AH.

The battery capacity shall be adequate for 10 consecutive starts without recharging with cold engine under full compression.

The scope shall cover all cabling, terminals, initial charging etc.

3.10 **Exhaust System**

The exhaust system shall be complete with silencer suitable for indoor installation, and silencer piping including bends and accessories needed. The exhaust pipe shall protrude outside the pump room. The total backpressure shall not exceed the engine manufacturer's recommendations. The exhaust piping shall be suitably supported and the pipe used shall be of medium class MS pipe.

3.11 **Engine Shut Down Mechanism**

This shall be manually operated and shall return automatically to the starting position after use.

3.12 **Governing System**

The engine shall be provided with an adjustable governor to control the engine speed within 5% of its rated speed under all conditions of load up to full load. The governor shall be set to maintain rated pump speed at maximum pump load.

3.13 **Engine Instrumentation**

Engine instrumentation shall include the following :-

- a. Lubricating Oil Pressure Gauge
- b. Lubricating Oil temperature gauge
- c. Water temperature gauge
- d. Water pressure gauge

- e. Tachometer
- f. Hour meter
- g. Starting key

The instrument panel shall be suitably mounted on the engine.

3.14 **Pipe Work**

The piping for exhaust outlet as well as fuel piping between fuel tank and the engine shall be with Medium class M.S.

3.15 **Anti Vibration Mounting**

Suitable vibration mounting duly approved by engineer-in-charge shall be employed for mounting the unit so as to minimize transmission of vibration to the structure. The isolation efficiency achievable shall be clearly indicated in the report, which will be submitted to engineer-in-charge before installation.

3.16 **Battery Charger**

Necessary float and boost charger shall be incorporated in the control section of the power and control panel to keep the battery under trickle condition. Ammeter to indicate the state of charge of the batteries shall be provided.

4.0 **POWER AND CONTROL PANEL AND OTHER CONTROL COMPONENTS**

4.1 **Scope**

This section covers the detailed requirements of the power and the control panel for the wet riser system, and also for the various control components in the system.

4.2 **Power and Control Panel**

4.2.1 **Constructional Requirements**

General Features

The power and control panel shall be totally enclosed, free standing floor mounted cubicle type, fabricated out of sheet steel not less than 2mm thick. Where ever necessary, additional stiffening shall be provided by angle iron framework. General construction shall be of compartmentalization and sectionalisation such as mains inlets, electric fire pump, diesel fire pump, pressurization pump, and control, so that there is no mix up of power and control wiring and connections in the same sections as far as possible. The panel shall also have the space for cable trays. The space for cable trays shall be at least 200mm wide to the entire depth of panel. The panel shall be front

operated type with all connections accessible from the front. Front doors shall be hinged type. Back doors shall be hinged type or removable type for inspection. The door hinges shall be of concealed type. The doors for busbar chamber shall be of removable type with the help of bolts. The doors shall be provided with quick fixing doors knobs with indication. The general arrangement of the panel shall be got approved before fabrication the cubicle construction shall be to IP 21 as per IS:2147.

4.2.2 Cable entries and gland plates

All cable entries shall be through gland plates which are removable and sectionalized. Where heavy cables are brought in and terminated, suitable clamps shall be incorporated to relieve the stress on the glands due to the weight of the cable. Cable entries may be from top or bottom depending on the equipment layout and cable scheme as approved.

4.2.3 Busbar and Connections

The busbars shall be air insulated, and of aluminium of high conductivity electrolytic quality (grade E 91 E to IS: 5082) and of adequate cross section. Current density shall not exceed 1.3 amps. Per sq.cm. All connections to individual circuits from the busbars shall preferably be with solid connections. The busbars and the connections shall be suitable covered with PVC sleeves or in an approved manner. Busbars shall be suitably supported using non-hygroscopic insulated supports. High tensile bolts and spring washers shall be provided at busbar joints.

4.2.4 Earthing Arrangement

GI strip 25mm x 5mm shall be run at the rear of the board. 2 nos. earth terminals shall be provided at the ends of the GI strip for connection to earth system.

4.2.5 Terminal Blocks and Small Wiring

Terminal blocks shall be of heavy duty type and generally not less than 15 amps 250V grade upto 100V, and 600V grade for the rest of the functions. They shall be easily accessible for maintenance. All control wiring inside the panel shall be with PVC insulated copper conductor of 2.5 sq.mm. size and 600V grade conforming to IS:694-1977. Suitable colour-coding may be adopted. Wiring harness shall be neatly formed and run preferably function wise, and as far as possible segregated voltage wise. Identification ferrules shall be used at both ends of the wires.

4.2.6 Instruments and Lamps

All indication lamps and instruments shall be flush mounted type in front of the panel. The voltmeter and ammeter shall be of size 100mm nominal (dial size) conforming to clause 1.5 of IS 1248 for accuracy.

Current transformers shall be provided with ammeters.

Indicating lamps to indicate the availability of electric supply shall be provided at the incoming section. Necessary indicating lamps for alarm indications and battery charging shall be provided in the respective sections.

All indicating lamps and meter shall be protected with HRC cartridge type fuses.

4.2.7 Labels

All internal components shall be provided with suitable identification labels. Suitably engraved labels shall be fixed at the panel for all switches, instrument push buttons, indicating lamps etc.

4.2.8 Painting

The entire panel shall be given a primer coat of red lead after degreasing and phosphating treatment and 2 coat of final paint of approved shade before assembly of various items.

4.3 Equipment Requirements

4.3.1 General

The power and control panel shall comprise individual section for the various equipments of the system and controls, in a combined cubicle type design. All switches, MCCBS, MCBS and fuse/fuse switch units shall be conforming to relevant IS.

4.3.2 Incomer Section & outgoing section

(A) Incomer section:

1 no. 630 amps TP MCCB unit complete. One set of 96 mm square digital Ammeter (0-400 Amps) complete with selector switch and CTS. One set of 96 mm square digital Voltmeter (0 - 500 V) complete with control fuses and selector switch. One set of phase LED indicating lights with control fuses. One set of 4 strips of 800 Amps aluminium busbars.

(B) Outgoing feeder

(i) Three numbers of 300 Amps TP MCCB (35 KA, $I_{cs} = I_{cu}$) unit complete, S P Preventer, ML 4 type Contactor for star delta starting, start and stop push buttons, auto-manual switch, digital Ammeter with CTS, ASS, LED phase indicating lights, Auxillary Contactors for interlocking/sequence of operation, control terminals complete in all respect with interconnections for Hydrant Pump and sprinkler pump.

- (ii) Two numbers of 63 Amps rated TP MCCB (25 KA, Ics = Icu) unit- complete, ML 1.5 type Contactor for D O L starting with overload relay, start and stop button, digital Ammeter, CTS and selector switch, phase indicating lights, Auxillary contacts for interlocking/sequence of operation, control terminals complete in all respect for Jockey Pump.
- C Control Wiring from Pressure Switches of different settings in Hydrant and Jockey Pumps, for sequence of operation shall be included to complete the system.
- D Colour code with ferrule marking shall also be made.
- E The cabling shall be XLPE insulated and aluminium / copper conductor cable of 1100 volts grade conforming to IS as required from Fire Pump Board to motor and cable of suitable size as per BOQ.

4.3.3 Electric Fire Pump Section

This section shall incorporate the following facilities.

- a. Suitable capacity MCCBS
- b. Control system components and equipment such as relays, contractors, timers etc. for automatic operation.
- c. Starter Unit, Current Transformer and digital ammeter.
- d. LED Indication lamps, their fuses, terminal block, push buttons, control and selector switches etc. are as required.
- e. Pump lock out devices due to faults or abnormalities as specified in operating sequence.
- f. Visual/audio alarms, indications and communications facility as specified in operating sequence.
- g. Necessary inter-connection and control wiring etc.

4.3.4 Engine Section

The engine section shall incorporate the following facilities:

- i. Control system components and equipment such as relays, contractors, timers etc. for automatic operation.
- ii. Instruments, indicator lamps, fuses terminal blocks, push buttons, control and selector switches etc. as are required.

- iii. Engine shut down and block out devices due to faults or abnormalities as specified.
- iv. Visual/audio alarms and indications as specified.
- v. Inter-connection and control wiring etc.

4.3.5 **Auxiliary Pump Section**

The auxiliary pump section for jockey pump shall incorporate the following:

- a. TP&N MCBS.
- b. Control system components such as relays, times, contractors, etc. as are necessary for functional requirements.
- c. Starter unit, current transformer and ammeter.
- d. Indication lamps, fuses, terminal blocks, push buttons selector, switch etc. as required.
- e. Inter-connections and control wirings etc.

4.3.6 **Control Section**

This section shall incorporate the following:-

- a. Control components integrating the various sections, so as to satisfy the functional requirements.
- b. Battery charger unit with boost/float charge facility with voltmeter, capable of independently charging 2 sets of batteries at a time.
- c. Visual/audio alarms, not covered in individual sections.
- d. Lamps healthy test facility.
- e. Instruments, indicating lamps, push buttons, fuse terminal blocks etc. as are required.
- f. Test facility to simulate operation of hydrants.

4.4 **Other Control Components**

4.4.1 **Pressure Switches**

Pressure switches shall be provided for switching on and off the pressurization pump at preset pressures and also for switching off the fire pump at preset pressure. Being the main component for initiating the signal for the operation of the pumps, the pressure settings shall be totally reliable, sturdy in construction and of long life. The pressure settings shall be adjustable.

4.4.2 Power Supply for Controls

In order to ensure that the control systems remains co-operational at all times the control system shall be designed for 24 VDC operation fed from the battery. This shall be independent of the starting battery for the engine i.e. battery shall remain trickle charged at all times from the separate battery charger at the control section.

5.0 Electrical Work and Earthing

Scope

This section covers the detailed requirements of electrical works including earthing, for the materials installation.

Electric power supply shall be terminated in the incoming switch gear of the power and control panel by the Department. All further connections to the various components of the system shall be the responsibility of the contractor, for a complete and working system, satisfying all the functional requirements.

The scope shall particularly include the following :

Power and Control Panel(s) as given in relevant section.

All inter-connections with multi-core armoured copper cables of size suitable between various control units and control panel(s).

All power cable connections with multi-core armoured aluminium cables of size as specified in BOQ, between panels, motors etc.

Necessary earthing with 2 Nos. G.I. plate electrodes and loop earthing.

The work shall be carried out conforming to CPWD General Specifications for electrical works part-I (Internal) amended up to date and part-II (External) amended upto date.

6.0 Sprinkler System

6.1 Sprinkler Heads

Sprinkler heads shall be of quartzoid bulb type with bulb, valve assembly yoke and the deflector. The sprinklers shall be approved make and type.

6.2 Types

6.2.1 Conventional Pattern

The sprinklers shall be designed to produce a spherical type of discharge with a portion of water being thrown upwards to the ceiling side of wall extras. The sprinklers shall suitable for erection in upright position or pendant position.

A. **Spray Pattern**

The spray type sprinkler shall produce a hemispherical discharge below the plane of the deflector.

B. **Ceiling (flush) Pattern**

These shall be designed for use with concealed pipe work, these shall be installed pendant with plate or base flush to the ceiling with spray head below the ceiling.

C. **Side Wall Sprinklers**

These shall be designed for installation alongwith the walls of room close to the ceiling. The discharge pattern shall be similar to one quarter of sphere with a small proportion discharging on the wall behind the sprinklers.

6.2.2 **Construction**

i) **Bulb:-** Bulb shall be made of corrosion-free material strong enough to with stand any water pressure likely to occur in the system. The bulb shall shatter when the temperature of the surrounding air reaches a predetermined level.

ii) **Valve assembly:-** Water passage of the sprinkler shall be controlling assembly of flexible construction. The valve assembly shall be held in position by the quartzoid bulb. The assembly be stable and shall withstand pressure surges or external vibration without displacement.

iii) **Yoke:-** The yoke shall be made of high quality gun metal. The arms of yoke shall be so designed as to avoid interference with discharge of water from the deflector. The sprinkler body shall be coated with an approved anti corrosive treatment if the same is to used in corrosive conditions.

iv) **Deflector:-** The deflector shall be suitable for either upright or pendent erection. The deflector shall be designed to give an even distribution of water over the area protected by each sprinkler.

D) **Colour Code**

The following colour code shall be adopted for classification of sprinkler according to nomination temperature ratings.

Sprinkler Temperature Rating

Colour of the Bulb

E. Size of Sprinklers Orifices

The sprinklers shall be of 15mm nominal bore size.

6.2.3 Pipes and Fittings

Pipes for sprinkler system shall be of black steel conforming to I.S. 1239 (medium class).

Fittings for black steel pipes shall be malleable iron suitable for welding or approved type cast iron fittings with tapered screwed threads.

6.2.4 Jointing

Joint for black steel pipes and fittings shall be metal to metal tapered thread or welded joints. A small amount of red lead may be used for lubrication and rust prevention in threaded joints.

Joints between G.I. or black steel pipes, valves and other apparatus, pumps etc. shall be made with G.I. or M.S. flanges with appropriate number of bolts. Flanged joint shall be made with 3mm thick insertion rubber gasket.

6.2.5 Pipes Protection

All pipes above ground and in exposed locations shall be painted with one coat of red oxide primer and two or more coats of synthetic enamel paint of approved shade.

Pipes in chase or buried underground shall be painted with two coats of hot bitumen.

6.2.6 Pipe Supports

All pipes shall be adequately supported from ceiling or walls from structural clamps fabricated from M.S. structural e.g. rods, channels, angles and flats. All clamps shall be painted with one coat of primer and two coats of black enamel paint. The contractor shall provide inserts at the time of slab casting or anchor fastner later.

6.2.7 Valves

Sluice valves of sizes 80mm and above shall be double flanged cast iron conforming to I.S. 780. Check valve shall be of cast iron double flanged conforming to I.S. 5312.

Valves on pipes 65mm and below shall be heavy pattern gunmetal valves with cast iron wheel seat tested to 20 kg/sqcm. pressure. Valves shall conform to I.S. 778.

1. Air Valves

25mm dia screwed inlet cast iron single acting air valves on all high points in the system or as shown on drawings.

2. **Drain Valves**

50mm dia black steel pipe conforming to I.S. 1239 medium class with 50mm gunmetal full way valve for draining and water in the system in low pockets.

6.2.8 **Installation Control Valve**

Installation control valves shall comprise of the followings:

- a) One-man stop valve of full way pattern with gunmetal pointer to indicate where open/shut.
- b) One automatic alarm valve fitted with handle & cover.
- c) One hydraulic alarm motor and gong for sounding a continuous alarm upon outbreak of fire. One combined waste and testing valve including 5mtr of tubing and fittings.
- d) Alarm stops valve.
- e) Strainer
- f) Drain plug
- g) Padlock and strap
- h) Wall box for installation of valve.
- I) All other accessories as required.

6.3 **Pressure Gauges**

Burden type pressure gauges conforming to IS/BS specifications shall be provided at the following locations:

- a. Just above alarm valve.
- b. Just below alarm valve, on the installation stop valve.
- c. One pressure gauge on delivery side of each pump.
- d. Required number of pressure gauges on pressure tank.

6.4 **Installation of Piping**

- a. All above ground piping shall be installed on suitable to pipe hangers/supports as required. The hangers shall be made of MS angles, channels etc. and painted to the required finish with suitable synthetic enamel paint. The maximum spacing of piping supports shall be as follows:

i)	20mm to 32mm dia	2.5 mtr.
ii)	40mm to 65mm dia	3.0 mtr.
iii)	65mm & above	3.0 mtr.

Piping shall be so installed that the system can be thoroughly drained. All the pipes shall be arranged to drain to the installation drain valve. In case of basement and other areas where the pipe work is below the installation drain valve/auxiliary valves of the following sizes shall be provided.

20mm dia valve for pipes up to 50mm dia

25mm dia valves for 65mm dia pipe

32mm dia valves for pipes larger than 65mm dia

Piping shall be of screwed type upto 50mm diameter. Welding of joints will be allowed for pipes of above 50mm dia.

The entire piping shall be pressure tested by hydrostatic method upto a pressure of 1.5 times the working pressure. The piping shall be slowly charged with water so that all the air is expelled from the piping by providing a 25mm inlet with a stop cock. The piping shall be allowed to stand full of water for a period of 2 hours and then the piping shall be put under pressure by means of manually operated test pump or by a power driven test pump. The pressure gauges used for testing shall be accurate and shall preferably be calibrated before the testing is carried out. All the leakage's and defects in joints revealed during the testing shall be rectified to the entire satisfaction of the Engineer-in-charge. The system may be tested in sections/parts as the work of erection of piping proceeds. The piping shall with stand 1.5 times the working pressure for at least 2 hours.

7.0 **Operating Sequence for the Fire Fighting System**

- 7.1 The operating pressure in the mains is to be maintained at 7.0 kg/cm².
- 7.2 The jockey pump shall start automatically the moment pressure drops to 6.5 kg/cm² because any leakage or minor draw-off from the system and stop when the pressure reaches 6.5 kg/cm² again.
- 7.3 In case, after the start of jockey pump, the pressure still keeps on falling, the main fire pump shall start at 6.0 kg/cm² by triggering of the pressure switch. Jockey pump shall stop when main pump starts.

- 7.4 In the event of electrical or mechanical failure of main fire pump to start, the diesel engine driven pump shall cut in when the pressure in the mains fall down to 5.5 kg/cm². The main electric pump shall then be locked out.
- 7.5 If within a preset period the standby pump fails to start or fails to develop adequate pressure, the control system shall shut down the standby pump and lock it out and given an audiovisual indication to that effect at the control panel.
- 7.6 Jockey pump shall be shut down automatically when the fire pump electric or diesel, is operating. Necessary integration of pipe work and controls shall be provided for the purpose. A timer may be employed where necessary to distinguish between slow fall of pressure due to system leaks and sudden fall of pressure due to fire duty by opening of valves and thus prevent parallel start up of both pressurization and fire pumps.
- 7.7 The control panel shall have status selection for each of the pumps for "automatic" as well as "manual" operation.
- 7.8 Pumps when under "manual" status shall be operated manually through relevant push buttons.
- 7.9 The fire pumps once started shall not be stopped automatically.
- 7.10 The fire pumps shall be locked out for operation both for "manual" and "automatic" operations, once the low water controls operates and furnish an audio and visual alarm on the panel the audio alarm can be silenced by accepting the alarm. The visual alarm shall be individual for each equipment. It shall be flashing type and on acceptance remain steady. A reset button shall be provided for each pump for returning the pump for fire duty.
- 7.11 Over load or under voltage/no volt trip devices for electric fire pump shall not be provided in the starter. LED type indication lamps to indicate the availability of power shall be provided.
- 7.12 Once tripped the electric fire pump shall remain locked out for operation irrespective of the position of its operational status selection switch. Lock out indication shall be available on the panel.
- 7.13 Return to normal operational availability shall be feasible only by manual re-set of locked out units by operation of appropriate push buttons.
- 7.14 When fire pumps are brought into operation an audible tone from turbine type alarm operated by water flow in the mains shall be provided to indicate the healthiness of the system. The healthy running alarm shall not be silenced till the fire pump is shut down, but the tone may be mellowed by the operation, if required.

7.15 Alarm for failure and lock out of any pump shall distinct from “healthy” alarm. Failure alarms shall be loud and can be silenced on acceptance.

7.16 Repeat indication of various audio and visual indications on a slave remote panel in fire control room in terminal building shall be available. The slave Remote panel shall have indication lamps to show the status of :

- a) Power healthy in fire pump room.
- b) Jockey pump ‘ON’
- c) Main pump ‘ON’

The slave Remote panel shall also have a hooter, which shall sound in case, any pump is ‘ON’. The slave Remote panel shall have a provision to reset the hooter with the help of a push button.

8.0 Testing

8.1 Testing on Completion of Installation

The entire system shall be tested after completion of installation as per the operating sequence specified.

8.2 Schedule of Inspection

Testing of fittings/equipments shall be carried out either at site or at works in the presence of a CLIENT/CONSULTANT’s representative given below:

- 1. Pumps, motors and engine - Inspection by Client/Consultant at Manufacturers works before dispatch.
- 2. Electrical panel - Inspection by Client/Consultant at Manufacturers works before dispatch.
- 3. Pipes - Visual inspection at site for ISI mark.
- 4. Various valves - Visual inspection at site for ISI mark.
- 5. SFUs, MCBs etc. - Type test certificates.
- 6. Sprinklers - Test certificate from

independent test laboratories.

7. Fire hose, hydrant, extinguisher etc. - Visual inspection at site for ISI mark.

Approvals It shall be the responsibility of the contractor to obtain the approval of drawings and to get the installation inspected and passed by any concerned authorities, as may be necessary as per local by laws, any fee payable to the local bodies for such activities shall be reimburse by the Client/Consultant on production of receipt.

9.0 Standards and Codes

1. IS - 1648 - 1961 Code of Practice for fire safety of building (general) fire fighting equipment and maintenance.
2. IS - 3844 - 1966 Code of practice for installation of internal fire hydrant.
3. IS - 2217 - 1963 Recommendation for providing first aid and fire fighting arrangement in public buildings.
4. IS - 2190 - 971 Code of practice for selection, installation and maintenance of portable first fire appliance.
5. IS - 3589 Electrically Welded Steel pipes (Medium class)
6. IS - 1239 Mild steel tubes, Tubulers and other wrought steel fittings (Medium class)
7. IS - 780 C.I. Double flanges sluice valve.
8. IS - 778 Gun Metal Valves
9. IS - 909 - 1965 External fire hydrant (underground)
10. IS - 5290 - 1969 Internal Landing Valve
11. IS - 884 - 1969 First and hose reel
12. IS - 934 - 1976 Specification for portable chemical fire extinguisher soda acid type.

- | | | |
|-----|------------------|--|
| 13. | IS - 2873 - 1969 | Specification for fire extinguisher for carbon dioxide |
| 14. | IS - 2189 & 2109 | Automatic fire alarm system or BSS 3116. |
| 15. | | National building code |

10. FIRE DETECTION AND ALARM SYSTEM

10.1 STANDARDS

The manufacture, identification of material and testing of equipment covered in this specification shall comply with the latest editions as on date of opening of tenders of the appropriate standards of the following. Unless otherwise specified, Indian Standards are preferred. All the appliances and accessories shall carry IS or International certification and shall be of approved make.

NFPA 72E Standards on automatic fire detection.

IS:2189 Code of practice for selection, installation and maintenance of automatic fire detection and alarm system.

IS: 823 Welding procedure

IS: 1652 Batteries

IS: 694 PVC insulated cables (light duty) for working voltage upto 1100 volts.

IS: 1554 PVC insulated cables (heavy duty) for voltage upto 1100 volts.

IS: 5959 Specification for polythelene insulated PVC sheathed heavy duty electric cables, voltage not exceeding 1100 V

IS: 5578 Guide for marking of insulated conductors

IS: 3043 Code of practice for earthing.

IS: 5216 Guide for safety procedures and practices in electrical work.

In case where the offer deviates from the specified standards, the tenderer shall indicate clearly in the offer the alternative standards proposed and details thereof.

Unless otherwise mentioned, all applicable codes and standards shall be of the latest editions as published by the Indian Standards and all other such as may be published by them during the tenure of the contract, and shall govern in respect of workmanship, properties of materials, installation and methods of testing. In case where suitable Indian Standards are not available, generally accepted codes and practices as approved by CLIENT/CONSULTANT shall be adopted. Any changes or modifications directed by CLIENT/CONSULTANT shall also be incorporated by the contractor during execution of the work.

Automatic fire detection and alarm system consists of fire control panel, detectors, manual call points, hooters, isolators, response indicators, etc. The

equipment and cables of the system shall be independent of any other system in the premises and shall not be shared with any other system. The fire detection and alarm system shall be installed as per NFPA 72E / IS-2189 code.

10.2 DETECTORS AND ACCESSORIES

10.2.1 Detectors

The fire detectors shall be of analogue addressable type to detect one or more characteristic of fire like smoke, heat or flame. It shall be sleek, suitable communication technique with noise immunity, built-in functional test switch, microprocessor based technology, mechanically integrated photoelectric and ionization shared volume smoke chamber, etc. All types of detectors shall be of both electronically and manually programmable type using dip-switches or handheld programmer or from fire control panel. Reversed polarity or faulty zone wiring shall not damage the detector. The detector shall have no moving parts of components subject to wear. It shall be possible to test the detector in the field. The response of a detector shall always be clearly visible from outside by a flashing light on the base. The detector shall connect to the control unit via a fully supervised two-wire circuit. A built barrier shall prevent entry of insects into the sensor. The detector shall be designed for fast and simple cleaning.

All electronic circuits must be solid state devices and virtually hermetically sealed to prevent their operation from being impaired by dust dirt or humidity. All circuitry must be protected against usual electrical transients and electromagnetic interference. All radioactive parts of the source, if any, shall be fully gold plated. The detector shall be inserted into or removed from the base by a simple push-twist mechanism to facilitate easy exchange for cleaning and maintenance.

The smoke & heat detectors shall fit into a common type standard base. The standard base shall be supplied with a seal plate, preventing dirt, dust, condensation or water reaching the wire terminals or the detector points. Detectors shall be provided with a MS box for entry and termination of armoured cable and to protect detectors terminals.

At the time of installation and prior to commissioning, every detector shall be allotted an identification number. All detectors shall have LED blink when it is addressed. Detectors shall not be either partially or totally recessed in ceiling or wall. Detectors shall be suitably protected where they are liable to be subjected to mechanical damage. Detectors should not be painted or coated or covered in any manner after installation as this will adversely affect the sensitive of operation.

10.2.2 Beam detectors

It shall be addressable type linear optical beam smoke detector type. It shall be of a combined transmitter/receiver unit. The minimum range of the detector shall be 50 m. The detector shall operate in the infra - red light spectrum. Numerical indicators shall be provided to aid beam alignment. The indicators shall comply to EN 54- 12 standards. The detector shall operate on the principle of light obstruction utilizing infra-red beam. The detector shall have standby automatic fault and alarm LED indicators visible from the front and bottom. Alignment shall be accomplished via an optical sight and it shall be listed for operation from - 22° F to 131° F. Smooth four square grid reflector shall also be provided reflect the transmitted beam shall also be provided for the satisfactory performance of the system.

10.2.3 Smoke detectors

It shall be of optical-cum-thermal type. Smoke detectors shall quickly respond to smoke containing small particles normally produced and heat likely to be generated and automatically adjusts sensitivity without needing operator intervention.

10.2.4 Heat detector

It shall be of fixed-cum-rate of rise temperature type. Heat detectors shall be suitable for use in situation where sufficient heat is likely to be generated and damage caused by heat generated.

10.2.5. Loop Hooters

The loop hooters shall be so arranged that when any alarm operates all the hooters through out the premises shall be activated. The hooters at the fire alarm shall be electronic type having frequency of suitable frequency range. The hooters shall be capable to produce a sound output of 90 db at 1 m. Hooters shall be of loop powered and no separate power is provided.

'Fault' alarm and 'Fire' alarm in a panel sounder shall be distinctly different. Fire alarm sounders shall not be used for any purpose other than for fire operations. When installed flush with a false ceiling these shall match the ceiling surface. Necessary provisions such as wooden boxing or frame work, if required, to accommodate the sounders shall be made in the ceiling in advance.

These shall be installed at a height not lower than 2.4 m, except when recessed in a false ceiling of lower height. In such cases the sounders shall be recessed at false ceiling level.

The panel sounders in the respective panels shall be actuated automatically as soon as fire alarm signal is initiated from any trigger device connected to them. These shall also be sounded when there is a fault alarm signal within their areas of control. The sound shall be continuous and of the same characteristics from all fire alarm sounders in a building.

10.2.6. Loop Isolators

Loop isolators shall be designed to protect one area or a number of devices which are consecutively wired in a loop. Its function is to isolate a section of the loop if a problem develops within that section, allowing the remainder of devices connected on the loop to function correctly. Loop isolators shall be provided after every 20-30 devices in each loop.

10.2.7. Manual Call Points (MCPs)

It shall be of 'break glass' type, and 1.5mm thick welded sheet steel or 3 mm thick cast aluminium. The front glass shall be breakable. The MCPs shall be recess mounted suitable to support the intelligent addressable panel. It shall form an integral part of the fire detector system. The housing shall be dust/vermin proof properly sealed with rubber lining. The glass frangible element shall keep a push button pressed inside such that in the event of breaking the glass, the push button is released to actuate an alarm in the control panel. MCPs shall be easily resettable with key.

Where sheet steel is used for, this shall be thoroughly cleaned off dust, dirt, grease and rust if any and two coats of anti rust primer shall be given both inside and outside. This shall be followed by two coats of synthetic enamel paint in fire red colour on the external surface that will be visible on installation. In the case of cast aluminium body for a call box, the surface shall be neatly finished with red colour paint. The following words shall be painted on the front of the call box in contrasting colour with a letter size of not less than 5mm.

“BREAK GLASS IN CASE OF FIRE”

Installation requirements:-

Manual call points shall be located at exit space and shall be installed at a height of 1.4 m above the floor at an easily accessible position. They shall be installed at easily accessible, well illuminated positions, preferably in a contrasting background so that they are easily noticeable from either direction. They may be semi-recessed so as to project by 10mm. They shall be installed free from obstructions.

10.2.8. Fire Control Panel

The fire alarm control panel shall be of micro processor controlled and of modular hardware design of intelligent addressable type. It shall be housed in a steel enclosure. It shall also be finished with hard wear textured epoxy paint/powder coated. Cable entries shall be provided on the top and bottom of the panel.

The system capacity shall be based on the number of devices and control modules. Each devices in the system shall be identified by its unique address position on the two wire loop. The panel retains command over the alarm process, LED indicators, automatic test feature and loop hooters. The panel shall be of software programmable. The panel shall be capable of:-

- (a) programmable at site.
- (b) automatic system test activates
- (c) detector sensitivity adjustments
- (d) alarm verification
- (e) Alpha/numerical display
- (f) Relay control module
- (g) Support for bacnet and modbus protocol.
- (h) maintenance alert facilities
- (i) provision to connect to PCs

The panel shall have facility to shut off individual AHUs in case of fire through relay arrangements. The relay shall be suitable to withstand AHU contactor coil current.

The manufacturer of fire control panel, detectors and other detection devices shall have own or authorized service centre in India with spares for carrying out maintenance service during the guarantee and maintenance periods. The tenderer shall submit a brief write-up of the service centre facilities available in India along with the tender.

10.2.9 Power Supply of panel

The power supply shall drive the system from either the main electrical supply single phase supply or the standby power supply. The standby power supply shall be derived from exclusive SMF back-up batteries of reputed make. Standby

power supply shall be capable of maintaining the system in normal operation having a period of not less than 24 hrs. after the failure of normal main supply.

10.2.10. Control Cable

The control cable for wiring fire alarm system shall be of 650 Volt grade. Cables shall be laid as per relevant installation standards. The size of these cables are specified in schedule of requirements.

10.2.11 Cable Glands

Cable glands shall be of heavy duty single compression type of brass, chrome plated. These shall have a screwed nipple with conduit electrical thread and checknut. These shall be suitable for armoured/unarmoured cables, which is being used.

10.2.12 Cable Connectors

Cable connectors, lugs/sockets, shall be of copper/aluminium alloy, suitably tinned, solderless, crimping type. These shall be suitable for the cable being connected and type of function (such as power, control or connection to instruments, etc.)

11. INSPECTION AND TESTING

(Fire detection and alarm system)

11.1 INSPECTION

All materials shall be offered for inspection in cleaned condition, prior to erection. At no event, site fabricated work /material shall be installed in position without inspection and approval by CLIENT/CONSULTANT. The Contractor shall ensure that each stage of fabrication is carried out in compliance with the procedures specified in the IS standards as applicable and/or specified in this document.

The contractor shall conduct sample tests of all the materials supplied at reputed laboratories/agencies as directed by CLIENT/CONSULTANT at his own cost and test reports are to be submitted. Inspecting officials like CLIENT/CONSULTANT, TAC / Local Authorities shall have the right to access the premises of the work at any time with or without giving prior notice. All the formalities or procedures for conducting the inspections by the authorities as required by them shall be arranged by the contractor free of cost.

All testing shall be carried out in the presence of CLIENT/CONSULTANT/ statutory authorities and test registers shall be maintained by the contractor. The contractor shall provide all material, tools, equipment, instruments, services and personnel required to perform the tests and remove debris resulting from cleaning and after testing free of cost.

The original test certificates of all tests conducted are to be forwarded to CLIENT/CONSULTANT. After conducting the tests, any defects found on materials, equipment, piping, etc. shall be got rectified/repaired / replaced by the Contractor without any extra cost.

11.2 TESTING

11.2.1 Fire Detection and Alarm System

The entire fire detection and alarm system shall be tested for continuity and performance as per IS-2189 code. After installation, the visual inspection of all the detectors shall be made to make sure that they are properly installed. Each detector shall be inspected to ensure that it is properly mounted and connected. Heat detectors shall be tested to initiate an alarm by a heat source such as hair drier or a shielded heat lamp. After each heat test, the detectors shall be reset. Smoke detectors shall be tested to initiate an alarm at its installed location with smoke or other aerosol. All detectors found to have the sensibility outside the approved range shall not be used.

Detectors, control and indicating panels, sounders shall be tested at the manufacturer's factory and test certificate be furnished with the supply. Type test certificate to prove conformity to the relevant contract specifications shall be furnished with the supply, from recognised testing institutions or Govt. test bodies in India or abroad.

Following tests shall be conducted in the presence of CLIENT/CONSULTANT and the test certificate shall be furnished with the record of tests.

11.2.2 Continuity test

Test for insulation resistance of the wiring work and the control and indicating panels.

11.2.3 Test for system operation.

Tests for detectors shall be conducted using a test fire at normal floor level. The system operation for fault conditions shall be conducted by introducing faults such as open circuit, short circuit, removal of detector, open/short circuit in a sounder circuit etc. Tests relevant to loop isolators shall also be conducted to confirm that it functions as required.

12. TECHNICAL DATA

(Fire detection and alarm system)

(To be submitted along with the tender)

Note: Refer list of preferred makes of items in Section IV. (Please attach catalogue, etc. of items from the original supplier)

Beam Detectors

Make

Model No.

Size:

Beam range:

Alignments : Horizontal & Vertical :

Reflector size:

Operating temp range:

Voltage range:

LED display status:

Air velocity:

Protocol used

IP rating

Smoke Detectors

Make

Model No.

Size:

Operating temp range:

Voltage range:

LED display status:

Air velocity:

Protocol used

IP rating

Heat Detectors

Make

Model No.

Size:

Operating temp range:

Voltage range:

LED display status:

Air velocity:

Fixed temp. set point:

Rate of rise temp:

Sensor:

Protocol used:

IP rating

Loop isolators

Make

Model No.

Spacing of isolators

Operating voltage

Temp. range

Size:

IP rating

Loop hooters

Make

Model No.

No. of tones

Sound output

IP rating

Size

MCPs

Make

Model No.

Size:

IP rating

Fire control panel

Make

Model No.

Maximum No. of programmable loops

Maximum No. of devices per panel

Maximum devices per loop

Maximum control cable length

Maximum resistance per loop

Length per loop

No. of slots for additional cards

Networking facilities

No. of auxiliary output for AHU shut off.

No. of repeater output

No. of hooters per loop

No. of isolators per loop

Operating voltage

Operating current

No. of display characters

Support for bacnet and modbus protocol.

Size

Weight

Makes of following items

PVC insulated FRLS

armoured Cu. Cable :

PVC insulated armoured Cu. Cable :

PVC insulated FRLS cu. wire :

PVC conduits :

MS conduits :

TECHNICAL DATA

(Hydrant System)

(To be submitted along with the tender)

Note: Refer list of preferred makes of items in Section IV. (Please attach catalogue, etc. of items from the original supplier).

1 Diesel engine driven pump

1.a Pump details

Make

Type

Model

Overall dimensions

Weight (Kgs)

Material

Pump casing

Impeller

Shaft sleeve

Base plate

Type and material of steel

Operating speed (R.P.M.)

Head (Mtr)

Efficiency

Performance curves (whether enclosed with the tender).

Yes/No

1.b Engine details

a) Make

b) Model

c) HP

d) RPM

e) SFC

Oil consumption

Weight

Overall dimension

Exhaust pipe dia

2 Battery & Battery Charger

Make of battery charger

Make of batteries

Model No. of batteries

Voltage

AH

- No. of batteries
- Model No. of battery charger

- 3 Electric motor driven pump
 - 1.a Pump details
 - Make
 - Type
 - Model
 - Overall dimensions
 - Weight (Kgs)
 - Material
 - Pump casing
 - Impeller
 - Shaft sleeve
 - Base plate
 - Type and material of steel
 - Operating speed (R.P.M.)
 - Head (Mtr)
 - Efficiency
 - Performance curves (whether enclosed with the tender).
 - Yes/No
 - 1.b Motor details
 - a) Make
 - b) Model
 - c) HP
 - RPM
 - Weight
 - Overall dimension
 - Class of insulation

- 4 Jockey pump
 - 1.a Pump details
 - Make
 - Type
 - Model
 - Overall dimensions
 - Weight (Kgs)
 - Material
 - Pump casing
 - Impeller
 - Shaft sleeve
 - Base plate
 - Type and material of steel

Operating speed (R.P.M.)
Head (Mtr)
Efficiency
Performance curves (whether enclosed with the tender).
Yes/No

- 1.b Motor details
- a) Make
 - b) Model
 - c) HP
 - d) RPM
 - g) Weight
 - h) Overall dimension
 - i) Class of insulation

5 Makes and model numbers of following items

MS Pipe :
GI & MS fittings :
Valves :
Strainer :
Instrumentation :
Pressure guage :
Pressure switch :
Hardware :
Paint :
Polymeric mix :
Hydrant valve :
CP hose :
Branch pipe :
Hose Reel :

TECHNICAL DATA
(Sprinkler system)

(To be submitted along with the tender)

Note: Refer list of preferred makes of items in Section IV. (Please attach catalogue, etc. of items from the original supplier).

Alarm valve
Make
Model No.
Size

Sprinklers
Make
Model No.
Size
'Y' strainer
Make
Model No.
Size

MS pipes
Make
Model No.

APPROVED MAKES OF ITEMS

HYDRANT/SPRINKLER/DETECTION/SYSTEMS

Motor	: Kirloskar/ Siemens/ ABB/ Crompton Greaves
Pump	: Kirloskar/ Mather & Platt/ KSB/ Beacon
Diesel Engine	: Kirloskar/ Cummins/ Greaves
MS Pipe	: Tata/ Jindal/ SAIL/ GST/ Zenith
GI & MS fittings	: Tube weld/ Tube products/ Punjab steel/ TNT
Valves	: Kirloskar / Kalpana / Updhaya / Leader / Advance
Strainer	: Sant/ Emerlad/ Teleflo/ Jaypee/ Grandpix
Pressure guage	: Fiebig/ H.Guru
Pressure switch	: Indfoss/ Switzer/ Schneider
Hydrant valve & Fire brigade point	: Newage/ Steelage/ Arihant/ Shah Bhogilal
Branch pipe	: Newage/ Arihant/ Shah Bhogilal
CP hose	: Newage/ Shah Bhogilal/ Pyroline
Hose Reel	: Newage/ Chathariya/ Shah Bhogilal
Hose cabinet	: Newage/ Zenith/ Shah Bhogilal
Hardware	: TATA/ Sundaram fasteners/ GWK
Paint	: Asian/ ICI/ Nerolac/ Berger
Polymeric mix	: IWL

Fire extinguisher	: Ceasefire/ Minimax / Safex / Bharat / Safeguard.
Alarm valve	: HD / Tyco (UL listed)
Sprinkler	: HD/ Tyco (UL listed)
Smoke/heat detectors (UL approved)	: Edwards/Morely/Essar/Siemens/Notifier
Fire alarm panel	: Edwards/Morely/Essar/Siemens/Notifier
Manual call points	: Edwards/Morely/Essar/Siemens/Notifier etc. (UL approved)
FRLS Cable	: Havells/Finolex/Polycab/RR Kabel

ADDITIONAL CONDITIONS

1. Scope of work: The scope of work shall include planning, design, engineering, preparation of drawings, supply, installation, testing, commissioning and validation of the complete system required for the new Stem cell & BMT unit on turnkey basis. The work broadly includes civil, interior, plumbing and sanitation, Air-conditioning, electrical, fire fighting, bio-medical requirements, gas piping, bed head panels, PA system, access control system, CCTV, voice, data system, UPS, Nurse call system etc and necessary services required for the successful operation and performance of the Stem cell & BMT unit.
2. The contractor must obtain all necessary certification and validation for the successful operation of stem cell and BMT unit.
3. The contractor must prepare all the design, detailed engineering and co-ordination drawing required for the interior, AC, electrical, fire alarm and all required services and get vetted by the HLL / MCC technical and bio-medical team. The contractor shall have prior experience in the execution of jobs of the similar nature and should have successfully completed at least one job of this nature ie; BMT, Stem Cell, Clean room etc.
4. All materials used for the construction of stem cell and BMT unit shall be with respect to the latest International / Indian standards.
5. The preferred make of all materials considered for the construction of stem cell & BMT unit shall be submitted with technical bid of tender and got approved by the HLL / MCC technical and HLL bio-medical team.
6. The contractor must inform in advance regarding the facilities to be got from the client (MCC) like water, power requirement, drain etc. The client will provide the same at one point from which all the distribution to the new Stem cell & BMT unit is in the scope of the contractor.

7. The contractor has to do all liasoning works and obtain statutory approval from Electricity Board, Electrical inspectorate, PCB and any another body for the successful energisation of electrical supply to the new Stem cell & BMT unit. No charges will be paid to the contractor in this regard. However, statutory fees if any will be paid by client. All necessary drawings and documents required for the same has to be prepared and submitted by the Contractor with the concurrence and approval of the HLL / MCC technical and bio-medical team.
8. General Arrangement & control drawing of the electrical LT panels shall be approved by the HLL / MCC technical and bio-medical team.
9. The LT panels shall be manufactured from manufacturer having valid CPRI certificate for similar types of panels and shall be as per the guidelines of Kerala state Electrical Inspectorate.
10. All the test certificates of the equipments shall be submitted along with the delivery of the materials at site.

BILL OF QUANTITIES

Proposed Item wise Bill of Quantities with unit rates and total project cost shall be submitted.