Technical Specification (Annexure-VI)

HEAT LOAD DETAILS OF NIELIT, KOLKATA CENTER AT BF-267, SALT LAKE

SL. NO.	DESCRIPTION	AREA IN SQ.METER. (APPROX)	AREA IN SQ.FT. (APPROX)	Dehumified CFM	AC TR	ELEC LOAD FOR AC	AC TR (ROUNDED)	ODU CAPACITY IN HP	ODU SIZE	IDU CONFIG	IDU SIZE	IDU TR	ODU ELEC LOAD IN KW	IDU ELEC LOAD
SECOND FLOOR PLAN														
1	SERVER ROOM	9.92	106.78	256.27	0.85	0.85	1.00	12.00	978 X 800 X 1950 (VRF)	1.5TR HI Wall	940X 205 X 275	1.00	9.12	0.10
2	DIRECTOR'S ROOM	38.27	411.94	988.65	3.30	3.30	3.50			2 TR HI WALL + 1.5 TR HI WALL	1045 X 235 X 315+ 940 X 205 X 275	3.50		0.35
3	OFFICE	21.59	232.39	557.75	1.86	1.86	2.00			2 TR HI WALL	1045 X 235 X 315	2.00		0.20
4	CLASS ROOM 1	57.22	615.92	1478.20	4.93	4.93	5.00			2x1.5TR CASSETTE + 2TR CASSETTE	610 X 610X 300	5.00		0.50
5	CLASS ROOM CENTRE	65.47	704.72	1691.33	5.64	5.64	6.00	12.00		2x1.5 TR CASSETTE + 2x1.5 TR CASSETTE	610 X 610X 300	6.00	9.12	0.60
6	PA ROOM	8.89	95.69	229.66	0.77	0.77	1.00			1.5 TR HI WALL	940 X 205 X 275	1.00		0.10
7	LAB	20.77	223.57	536.56	1.79	1.79	2.00			2 TR HI WALL	1045 X 235 X 315	2.00		0.20
8	LOBBY	33.12	356.50	855.61	2.85	2.85	3.00			2 X 1.5 TR HI WALL	940 X 205 X 275	3.00		0.30
Total of Second floor		**255.25**	**2747.51**	**6594.03**	**21.98**	**21.98**	**23.50**					**23.50**	**18.24**	**2.35**

THIRD FLOOR PLAN														
1	LAB TEACHER'S ROOM	24.50	263.72	632.92	2.11	2.11	2.00	12.00	978 X 800 X 1950 (VRF)	2 TR HI WALL	1045 X 235 X 315	2.00	9.12	0.20
2	CLASS ROOM 1	42.18	454.03	1089.66	3.63	3.63	4.00			2 X 2 TR CASSETTE	840 X 840 X 300	4.00		0.40
3	CLASS ROOM 2	57.23	616.02	1478.46	4.93	4.93	5.00			2 TR CASSETTE + 2x1.5 TR CASSETTE	840 X 840 X 300	5.00		0.50
4	LAB	20.77	223.57	536.56	1.79	1.79	2.00	12.00		2 TR HI WALL	1045 X 235 X 315	2.00	9.12	0.20
5	LOBBY	33.12	356.50	855.61	2.85	2.85	3.00			2 X 1.5 TR HI WALL	940 X 205 X 275	3.00		0.30
6	CENTRE CLASSROOM	65.47	704.72	1691.33	5.64	5.64	6.00			2x1.5 TR CASSETTE + 2x1.5 TR CASSETTE	610X 610 X 300	6.00		0.60
Total of Third floor		**243.27**	**2618.56**	**6284.54**	**20.95**	**20.95**	**22.00**					**22.00**	**18.24**	**2.20**

TOTAL VRF UNITS = 2

NO. OF HI WALL I.D.U = 12 (of different capacities)

NO.OF CASSETTE = 10 (of different capacities)

TECHNICAL SPECIFICATION FOR VRF / VRV SYSTEM

The work shall be carried out as per the Tender Specifications for Air Conditioning works and generally in accordance with the following:

a. General Specifications for Air conditioning works – 2004.

b. General Specifications for Electrical Works Part I Internal – 2005, amended upto date.

c. General Specifications for Electrical Works Part II External – 1994, amended upto date.

d. General Specifications for Electrical Works Part IV Substation– 1982, amended upto date.

e. As per relevant IE Rules and also as per direction of the Engineer – in – charge.

In addition to above mentioned specification the work shall also be carried out in accordance to the additional specification for Variable Refrigerant flow system mentioned below.

Standards and Regulations

(a) Unless expressly stated to the contrary, all materials and equipment provided under this Contract shall comply with the following Indian Standards amended up-to-date.

IS 325	Three phase induction motors
IS 732	Code of practice for Electrical wiring and fittings for buildings.
IS 900	Code of practice for installation and maintenance of Induction motors.
IS 996	Single phase small AC and universal motors.
IS 1239	Mild steel tubes, tubular and other wrought steel fittings.
IS 124	Direct acting electrical indicating instruments.
IS 155	PVC insulated (Heavy duty) electric cables for working voltages upto (Part I) and including 1100 volts.
IS 761	Method of testing panel type air filters for Air-conditioning and Ventilation process.
IS 520	Standard for positive displacement refrigeration compressor and condensing units.
IS 5111	Code for practice and measurement for testing refrigeration compressor.

The contractor shall make available upon Award of Contract, copies of the above Standards for reference of the Department. Where a Standard is referred to, that Standard shall be the latest published edition thereof unless otherwise stated.

(b) All works performed and equipment and materials supplied under this contract shall comply in every respect with the Rules and Regulations of the Local Authorities.

The entire responsibility for meeting the above requirements and all the statutory obligations and local inspectorates pertaining to air conditioning and ventilation system lies with ACMV Contractor. In case the ACMV bidder finds that the design of the system does not meet any of the above requirements, it is the responsibility to bring to the notice of the Department/Engineer-in-charge such non-conformities at the time of Technical bid submission. Claims for extra cost/extra time to meet the above requirements subsequent to the order placement will not be accepted by the Department /Engineer-in-charge.

c) All design and installation of Air-conditioning shall be in accordance with the Department's latest requirements and in compliance with the standard, where the plant is located and Government of India regulations and relevant Indian Standard Codes of practice. Where any of the requirements are at variance, the most stringent requirements will control between the design criteria and the local installation codes.

PLANT CAPACITIES:

Parameter of the Plant as per the design calculations is as follows:

Site: B+G+3 STORIED IT / ITES BUILDING OF NIELIT (DOEACC SOCIETY), KOLKATA CENTRE, AT BF-267, SALT LAKE CITY, KOLKATA

BASIS OF DESIGN

Site Details

Site location - At SALT LAKE, KOLKATA
Geographical location - Latitude : 22.57 deg N , Longitude : 88.37 deg E
Level - 36 Ft (11 Mtr) above mean sea level.

Outdoor Design Conditions

Outdoor Design Conditions for Kolkata are based on Weather data report published by ISHRAE, corresponding to 0.4% annual cumulative frequency of occurrence and are considered as follows:

- **Summer**

  Dry Bulb Temperature : 107.0 Deg. F (41.66 Deg. C)
  Mean Coincident Wet Bulb Temperature : 86 Deg F (30 Deg. C)

- **Winter**

  Dry Bulb Temperature : 50 Deg F (10.0 Deg. C)
  Mean coincident Wet Bulb Temperature : 44 Deg F (6.6 Deg. C)

- **Monsoon**

  Dry Bulb Temperature : 88 Deg F (31.1 Deg.C)
  Mean coincident Wet Bulb Temperature : 79 Deg F (26.1 Deg. C)

INSPECTION:

The contractor shall obtain all permits /licenses and pay for any and all fees required for the inspection, approval and commissioning of their installation.

THE ELECTRICAL WORK:

ARRANGEMENT WITH ELECTRICAL SUPPLY AUTHORITIES

It is the responsibility of the ACMV Contractor to arrange with the relevant authorities for permission to install connection of supply and to test the installation after completion of works. It is to be clearly understood that final responsibilities for the sufficiency, adequacy and conformity to the contract requirements of the electrical installation work for ACMV services lies safety with the ACMV Contractor.

SUPERVISION:

As the interior work and the other services like lighting, fire fighting agencies and false ceiling contractor are likely to work simultaneously, a close co-ordination of Air-conditioning works will be necessary and full time services of a qualified Engineer should be made available during the erection of equipments.

LIST OF APPENDICES

The basis of design, the selected equipment particulars and other relevant datas are outlined in the following Appendices.

APPENDIX A	DESIGN CRITERIA
APPENDIX B	EQUIPMENT SELECTION
APPENDIX C	DESIGN PARAMETER
APPENDIX D	LIST OF RECOMMENDED MAKE OF EQUIPMENT.
APPENDIX E	LIST OF TENDER DRAWINGS.

APPENDIX-A -DESIGN CRITERIA

A.1 General Description and requirements:

The basis of design, estimated requirements and other relevant data are outlined in this annexure. The detailed specifications and specific requirements are outlined in the subsequent section/annexure. The attached specifications together with the drawings and bill of quantities etc. cover the design, supply, installation, testing, successful commissioning and handing over the complete installation. The areas to be air-conditioned and the parameters that is to be considered in heat load calculations are detailed out under “Basic Info-survey sheet, and Basics of design”

A.4 Basis of Design (Heat Load Parameters)

The air-conditioning plant and cooling requirements shall be designed on the following data to maintain comfort environment in the space being supplied with conditioned air.

Place of Installation Kolkata

1	Outside Design conditions	Summer	DBT/WBT - (107/86 deg F), RH- 49%
		Monsoon	DBT/WBT –(88/79 deg F), RH-85%
	Inside	Room	24 deg C ± 1 deg C DBT RH- around 55%
2	Constructional details	As per bid drawings and documents.	
3	Power Supply	The power supply variation limits for 230V and 415V shall be as following. All electrical equipment shall perform satisfactorily under these conditions Voltage variation +/- 10% Frequency variation +/-5% Control wiring – 230V, 1Ph, 2 wire, 50Hz	
4	Inside desired condition	24 Deg C ±1Deg C DB. The temperature of ± 1 Deg C on the DB will be maintained with suitable automatic thermostat control. No winter heating is envisaged.	
		Dust filter section level 20 Microns. The noise level within the air conditioned space shall be restricted to 35-45 dB NC Level	

APPENDIX -B- EQUIPMENT SELECTION.

Floor	Heat Load (TR)	Outdoor Unit capacity			Indoor unit capacity			VRF Indoor Unit	
		12 HP			~~1 TR HI-Wall~~	1.5 TR HI-Wall	2.0 TR HI-Wall	2 TR Cassette	1.5 TR Cassette
2nd		2				5	3	1	6
3rd		2				2	2	3	6
Total		**4**				**7**	**5**	**4**	**12**

APPENDIX-C- DESIGN PARAMETERS (STANDARDS & GUIDELINES) :

VARIABLE REFRIGERANT FLOW (VRF) / VARIABLE REFRIGERANT VOLUME (VRV)

General

The scope of this section comprises the design, supply, erection, testing and commissioning of inverter technology based / Digital scroll VRV/VRF type system of air conditioning conforming to these specifications and in accordance with the requirements of Drawing and bill of Quantities. The prices quoted shall include all the equipment ancillary material as specified and all such items whatsoever and which may be required to fulfill the intent and purpose as laid down in the specification and the approved drawings. The contractor shall calculate equipment capacity based upon design parameters specified for the system design & verify all the quantities and sizes of refrigerant pipe, fitting/cables, control cable, pipes, insulation, indoor units, outdoor units etc. before placing the order to avoid any shortfall or surplus. The bidder shall also include all necessary civil work/MS frame work for installation of outdoor and indoor units in VRV/VRF based air-condition system. The cost quoted by bidder shall also include the refrigerant gas R-410A & its charging for proper & specified functioning of air-conditioning system.

Civil work/MS frame work for indoor and outdoor units related to VRV/VRF equipments, all cuttings should be properly finished as existing surrounding. The installation of outdoor unit on the terrace of building should be checked up structurally & their mounting should be structurally safe of the out door unit to ensured in such a way that after installation

1. Cutting of walls and floors/ceiling.
2. Making holes.
3. Sleeves.
4. Foundation.

The scope in the tender schedule also covers detailed designing of complete air-conditioning system based on inverter technology based/Digital Scroll VRV/VRF air-conditioner with air-cooled outdoor units system capable of cooling as per individual or season requirement suitable for operation on 415V, 3 phase, 50 Hz AC electric supply.
The outdoor units shall have cooling mode, consisting of one/multiple outdoor unit with single circuit of refrigerant piping and multiple indoor units of various types. Each indoor unit should have capability to cool as per seasonal weather changes. This shall also include complete capacity calculation for indoor and outdoor units complete with AUTOCAD drawing, designing & layout of following.

I. Outdoor units.
II. Indoor units.
III. Refrigerant piping.
IV. Condensate drains water piping & disposal.
V. Supply air ducting of FA units.
VI. Power & Control Cables between Outdoor units & Indoor units.
VII. Building Management system for HVAC

While designing the system care should be taken to select outdoor units of suitable capacity based on design data provided & to economize on available floor area for installation of outdoor units as well as

optimum utilization of outdoor units. The indoor units should be designed based upon the heat load calculations for individual rooms/areas to be air-conditioned and over capacities should be avoided. The designing of HVAC PC based BMS (Building Management System) so that complete system shall be monitored & controlled from one location for optimum utilization of system & for keeping monthly as well continuous log of important parameters/ events of complete air-conditioning system. The design should also specifically take care of disposal of condensate drain water so that there is no leakage of condensate water inside the room as well in the route of condensate water pipe line. The layout of refrigerant piping is to be designed in such a way so that it should not disturb the aesthetic of the building / room, inadvertent damage in the route of pipe should not occur in failure & optimum length of pipe line for efficient air-conditioning. After completion of the work four set of 'as erected/commissioned drawing' of activities listed above shall be submitted.

Design Data

The work of air-conditioning (outdoor 16/24/32 HP with R22 / R410A based refrigerant) and indoor units as specified in BOQ of this document is required to be carried out. The specified design parameters are only tentative in nature, however, all efforts shall be made to achieve the following specified design parameters and if at any design stage need for higher capacity outdoor capacity is required, necessary approval shall be accorded based on design analysis and discussions on the subject from the Consultant.

OUTDOOR UNIT

i. For testing and evaluation consideration, JIS B8616 or equivalent standard shall be applicable.

ii. The outdoor unit shall be factory assembled, weatherproof casing (Material of construction of casing shall be vendor's standard design), constructed from heavy gauge GI sheets steel panels and coated with baked enamel finish. The outdoor unit shall be completely factory wired, tested with all necessary controls & filled with first charge of refrigerant before delivering at site.

iii. The inverter technology based VRV/VRF equipment should be capable so that refrigerant piping between indoor units and outdoor unit shall be Extendable upto 100m with maximum height difference between outdoor & indoor unit of 50m &level difference between two indoor unit maximum upto 15m. However such long pipeline and head difference may not be applicable for this project.

iv. **The minimum acceptable value of Coefficient of Performance (COP) of the offered system, in conformance with JIS B8616 or equivalent, shall be not less than 4.1 at 50% rated load with 40.5 deg C outdoor and 28.3 deg C wet bulb conditions for 30TR or equivalent nearest size outdoor unit as per OEM standard catalogue**. In case, tests have been done to work out COP from other than JIS B 8616, the standards alongwith necessary test procedure shall be furnished alongwith the tender.

*The tenderers will, however, be at liberty to supply outdoor units in ratings as specified above or higher.

1. The above COP values, as indicated in (iii) above are required to be furnished, in original, by the tenderer directly from the original equipment manufacturer (OEM) with OEM's seal and

signatures on all the documents pertaining to the back up information for example cooling capacity at capacity indexes varying from 130% to 30% (in steps of 10%) for outdoor temperature (deg C DB) varying from 32 to 41 deg. and indoor temperature (deg C WB) varying between 24 deg. duly indicating the total cooling capacity and power input in kW.
The data shall be preferably in steps of 2° C. The final testing shall be carried out as per required standards to verify the values as furnished by OEM.

2. The tenderers may please note that above guaranteed figures may be checked by the client, at any stage of the work, through its nominated inspection agency either at OEM's works or duly certified laboratory in accordance with J15B8616 or equivalent standard.

3. During the above inspection/testing, if the results are found exceeding i.e. 1.5% than quoted in clause (a) above, a penalty of 5% of the contract value or higher shall be imposed besides.

4. The outdoor unit shall be factory tested and filled with first charge of refrigerant R-410A before delivering at site.

5. **The compressors installed in the outdoor units shall be preferably equipped with at least one inverter / digital scroll compressor upto 10 TR, two inverter / digital scroll compressors upto 20 TR, three inverter/digital scroll upto 30 TR and 4 inverter and Digital scroll compressors beyond 30 TR so that operation is not disturbed on failure of any of the compressor.**

Note: - Bidder can offer from their standard product feature nearer to the range indicated.

1. The outdoor unit shall be suitable for mix match connection of all types of indoor units.
2. It should be provided with duty cycling for switching the starting sequence of multiple outdoor units.
3. The outdoor unit shall be modular in design and should be allowed for side-by-side installation.
4. The unit shall be provided with its own microprocessor control panel with provision for integration with the Building Management System for air-conditioning System.
5. The outdoor units should have anti corrosion paint free plate for easy mounting of unit.
6. The machine must have a sub cool feature to use coil surface more effectively thru proper circuit/bridge so that it prevents the flushing of refrigerant from long piping due to this effect thereby achieving energy savings.
7. The outdoor unit should be fitted with low noise level and should not be more than 67 db (A) at normal operation when measured at 1.5m distance from ground level.
8. The outdoor unit should be fitted with low noise aero spiral design fan with aero fitting grill for spiral discharge airflow to reduce pressure loss.
9. The outdoor units are connected to multiple indoor units of various types as such the combined operating loads of indoor units may touch 120 to 125% of the nominal capacity. The outdoor unit shall be able to perform at the combined loads demands as indicated above.
10. In case of trouble occurs in an indoor unit(s), the continuous operation of system should be possible.
11. The unit shall be designed in such a way that cleaning of drain Pan should be easy & inspection/replacement of compressor should be easy.
12. The condensing unit shall be designed to operate safely when connected to multiple fan coil units.

Compressor

i. The compressor in inverter based/ Digital Scroll system shall be highly efficient. The system should response efficiently in accordance to the variation in cooling or heating load requirement.

ii. The inverter shall preferably be IGBT type for efficient & quiet operation.

iii. All outdoor units shall have multiple steps of capacity control to meet load fluctuation and indoor unit individual control. All parts of compressor shall be sufficiently lubricated stock. Forced lubrication may also be employed.

iv. Oil heater shall be provided in the compressor casing or as per manufacturer standard equipments.

Oil Recovery system

i. Unit shall be equipped with an oil recovery system to ensure stable operation with long refrigeration piping lengths.

ii. The system must be provided with oil balancing circuit to avoid poor lubrication.

Refrigerant Circuit

i. The refrigerant circuit shall include liquid and gas shut-off valves and a solenoid valves at condenser end.

ii. The equipment must have inbuilt refrigerant stabilization control for proper refrigerant distribution.

iii. All necessary safety devices shall be provided to ensure the safe operation of the system.

Heat Exchanger

The heat exchanger shall be constructed with copper tubes mechanically bonded to aluminium fins to form a cross fin coil. The aluminium fins shall be covered by anti-corrosion resin film. The unit should be with bye-pass/e-pass heat exchanger to optimize the path of heat exchanger and for better arranged for vertical discharge. Each fan shall have a safety guard.

Safely Devices

All necessary safety devices shall be provided to ensure safe operation of the system. Following safety devices shall be part of outdoor unit, high pressure switch, fuse, fan drive overload protector, fusible plug, crankcase heater over load relay, overload protection for inverter.

The outdoor roof mounted units shall be provided in such a fashion that these do not affect the overall aesthetics and ambience of the building. If required these units shall be suitably camouflaged to give good aesthetic look. These provisions, however, shall be discussed, if required, at a later date and the prices for the same shall be worked out separately as extra item.

Noise levels for outdoor units shall not be more than 67 db (measured at a point 1 meter in front of the unit at a height of meters.

INDOOR UNITS

General:
All indoor units as specified under this item shall have, in general, noise levels less than 46 db. For critical application noise levels below these limits may, however, be specified during design stage.

h) Each Unit shall have electronic control refrigerant flow rate respond to load variation of the room.
ii) The address of the indoor unit shall be set automatically in case of individual and group control.
iii) In case of centralised control system, it shall be possible to set the address of individual indoor unit through a liquid crystal remote controller.
iv) The fan shall be high static, dual suction, aerodynamically designed turbo, multi blade type, statically & dynamically balanced to ensure low noise and vibration free operation of the system. The fan shall be direct driven type, mounted directly on motor shaft having support from housing.
v) The cooling coil shall be made out of seamless copper tubes and have continuous aluminium fins. The fins shall be spaced by collars forming an integral part. The tubes shall be staggered in the direction of airflow. The tubes shall be hydraulically/mechanically expanded for minimum thermal contact resistance with fins. Each coil shall be factory tested at 21 kg/sq.mtr air pressure under water.
vi) Indoor unit shall have cleanable type filter to an integrally moulded / moulded plastic frame. The filter shall be slide in and neatly insertable type. It shall be possible to clean the filters either with compressed air or water.
vii) Each unit shall have computerized PID control for maintaining designed room temperature. Each unit shall be provided with microprocessor thermostat for cooling.
viii) Each ductable unit shall have with corded remote controller and each high wall & cassette type indoor unit shall be with corded remote controller as standard features. The remote controller shall memorize the latest malfuction code for easy maintenance. The controller shall have self-diagnostic features for each and quick maintenance and service. The controller shall be able to change fan speed and angle of swing flap (for high wall unit) individually as per requirement.

The unit shall be high wall mounted type. The unit shall include pre-filters, fan section and DX-coil section. The housing of the unit shall be powder coated/heat treated galvanized steel. The body shall be light in weight and shall be able to suspend from four comers. The fan shall be aerodynamically designed diffuser turbo fan type.

High wall Indoor type unit

The unit shall be high wall mounted type. The unit shall include pre-filters, fan section and DX-coil section. The housing of the unit shall be powder coated/heat treated galvanized steel. The body shall

be light in light in weight and shall be able to suspend from four corners. The fan shall be aerodynamically designed diffuser turbo type.Unit shall have an external attractive panel for supply and return air.

Control System Components:
The above computers shall be capable of data input/output from intelligent units with bus running between central control systems and indoor units/other associated air-conditioning systems installed in the building. The minimum system configuration shall be as under:-

1. Minimum 300 indoor units with intelligent processor sufficient to handle above system as interface between the main PC and individual equipment controls.

2. Ethernet TCPIP / 10 base / T communication.

3. Intelligent processor units shall have minimum 18 input ports with two digital output ports and shall have stand alone capability for a period of minimum 48 hours.

Management

The software system capable of recoding operational history management generation of reports in graphic and table from daily, weekly and monthly and operation in eco mode shall be provided.
The above management system shall be complete in all respects to enable these functions. The software should be easily installable using just CD. The software should be user friendly & runs on Window 2000 & windows XP Professional/Home with latest version/ updates so that it can easily runs on any PC. It shall have the capability to calculate electricity billed/charged for multiple indoor units connected, schedule monitoring & control, error display with audible alarm & text, operating record of indoor units with accumulated operating time of outdoor unit.

Controls:

The PC system mentioned above shall be capable of individual system control/group control with automatic cool, power failure/release control temperature control and timer etc. The unit shall also be capable of monitoring through graphic user interface operation fault indication, set point indication and any other parameters as may be deemed required.

The system shall be fully compatible with the VRV inverter/digital scroll based equipment/system proposed to be installed against this contract.

All the system designs related to this control system hardware software and control wiring/interfaces shall be included in the scope of work and detailed designing etc. shall be provided before commencement of installation of the system.

PIPING INSTALLATION

Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings. Piping shall be installed parallel with the building lines unless otherwise noted, with appropriate pitch free from traps.

Pipe shall be cut accurately to measurements established at the construction site and shall be worked into place without springing or forcing. Pipes shall be installed as to permit free expansion and contraction without damage to joints or hangers.

When pre-charged, coiled tubing is furnished with split system, the excess tubing shall be coiled and placed out of view.

Arrange piping to allow inspection and service of compressor and other equipment. Install valves and specialties in accessible locations to allow for service and inspection. Installed piping shall not interfere with the operation or accessibility of doors or windows and shall not encroach on aisles, passageways, and equipment.

Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation. Use sleeves through floors, walls, or ceilings, sized to permit installation of full-thickness insulation.

Pipe shall be provided with capped or plugged ends when shipped and as erected, to prevent contaminating the system.

When gauges are shown on the drawings, the Contractor shall install appropriately ranged continuous duty temperature and pressure gauges designed for refrigeration service. Pressure gauges shall be installed to sense compressor suction and discharge pressures. Connect pressure gauges to the system using service valves. Suction and liquid lines shall be insulated. Hot gas lines shall not be insulated.

All pressure relief valves shall be installed with a 3-way dual shut-off valve and a second relief valve, in parallel.

Discharge from pressure relief valves shall be piped full size and extended to the outside of the building structure not less than 15 feet above adjacent grade and not less than 20 feet from any window , ventilation opening or exit.

On built-up systems and packaged systems 20 tons and over, the contractor shall initially install a type "HH" filter drier to remove start-up contaminates. Final filter drier shall be installed after refrigeration system has been charged and has been in continuous operation for one week.

Oil Return: Manufacturers specifications shall be followed for oil return on risers of 20 ft. or more (i.e., oil separators, p-traps or inverted p-traps).

On built-up systems, install flexible connectors at or near compressors.

HANGERS AND ANCHORS:

A. All piping shall be rigidly supported from the building structure by means of adjustable ring-type hangers. (WELDING TO BUILDING STRUCTURE WILL NOT BE PERMITTED.) Unistrut type trapeze hangers shall be used where pipes run side by side. Hanger spacing shall be as follows:

Horizontal:

Copper Piping Maximum Spacing
3/8" and under 4'-0"
1/2" through 3/4" 6'-0"
1" through 1-1/2" 8'-0"
2" and larger 10'-0"

Vertical: Copper piping shall be supported at 10 feet intervals maximum.

B. Round rods supporting the pipe hangers shall be of the following dimensions:

2" pipe and under 3/8" rod
2-1/2" to 3" pipe 1/2" rod

C. Soft copper tubing where permitted shall be fastened to the building structure with Unistrut type clamps and Unicushion inserts. Clamps shall not be spaced greater than 4'-0" apart.

Y-joint/Ref net separation
Supply & installation of the Y-joint/ref.-net separation refrigeration pipe joints and headers in the appropriate orientation to enable correct distribution of refrigerant. The distribution joints should be factory insulated with pre-formed section of Expended polystyrene/Equivalent.

BRAZED JOINTS:

A. When brazing, remove solenoid-valve coils and sight glasses; also remove valve stems, seats, and packing, and accessible internal parts of refrigerant specialties. Do not apply heat near expansion valve bulb. Joints shall be cool before reassembling valve.

B. Tubing shall be cut square, reamed, and burrs removed.

C. Both inside of fittings and outside of tubing shall be well cleaned with an abrasive cloth or stainless-steel wire brush before brazing. Steel wool is NOT permitted.

D. During brazing an inert gas (such as dry nitrogen, argon) shall be continuously passed through the system at a flow rate sufficient to maintain an oxygen-free environment to prevent the formation of copper oxide scale.

E. Care shall be taken to prevent annealing of fittings and tubing when making connections.

F. Copper to copper joints shall be brazed with a copper-phosphorous brazing alloy containing a minimum of 15% silver and conforming to AWS A5.8, BCuP5.

G. Copper to brass joints shall be brazed with a silver brazing alloy containing a minimum of 50% silver and conforms to AWS 5.8, BAg-7.

H. Copper to stainless steel joints shall be brazed with a silver brazing alloy containing a minimum of 50% silver and conforms to AWS 5.8, BAg-7.

I. All brazed joints shall be cleaned to remove residual flux.

LEAK TESTING OF REFRIGERATION PIPING SYSTEMS

The high side and low side of each completed refrigeration piping system shall be pressure tested at a pressure not less than the lower of the system design pressure or the setting of the pressure relief device protecting the high side or low side of the system

Exception: Field installed systems with copper tubing not exceeding 0.625" O.D., shall be tested by means of refrigerant charged into the system at the saturated vapor pressure of the refrigerant at 68oF minimum.
The testing media shall be dry nitrogen. The contractor shall perform the leak test before insulating, evacuating and charging, in the presence of Engineer-in-charge or his authorised representative.
Isolate the compressor from the leak test by firmly closing the suction and discharge valves.
Where pressure relief valves are installed, position the three-way dual shut-off valves so that full test pressure is applied to both relief valves.
Do not attempt to repair any leak while the system is pressurized. If any leaks are found, relieve the test pressure and perform repairs.
Recharge the system, as previously described, and allow it to remain under pressure for 24 hours. Maximum pressure drop shall be 5 psig in 24 hours, at constant ambient temperature. For every 10 degF drop in ambient temperature, from start of test, the maximum pressure drop may increase by 3 psig.

EVACUATION AND CHARGING

After completion of the piping pressure test, the refrigeration system shall be evacuated and dehydrated with a vacuum pump. The following procedure shall be used unless otherwise noted:

Connect to the system, an accurate high vacuum gauge with a range of 0 - 1000 microns Hg.
Connect the vacuum pump to both the high and low side of the system. Leave the compressor suction and discharge service valves closed. Start the vacuum pump.
Keep ambient air temperatures above 60°F during the evacuation process.
Operate the vacuum pump until the system is evacuated to 500 microns Hg.
Break the system vacuum with dry nitrogen. Open the compressor suction and discharge service valves and re-evacuate the system to 500 microns Hg.
After the system has been twice evacuated to 500 microns Hg, close the vacuum pump suction valve and stop the pump. Allow the system to stand under a vacuum before system may be charged. This test shall be made in the presence of the Engineer-in-charge or his authorised representative.

The Contractor shall furnish and install full charge of refrigerant required to develop the system to its full rating. Also, during the warranty period, the contractor shall replace, without cost, all refrigerant lost due to equipment failure or system leaks. Refrigerant type and charge shall be as listed on equipment nameplate.
The Contractor shall provide the initial charge of lubricating oil for all refrigeration equipment and related apparatus.

After the refrigeration system has been charged and has been in continuous operation for one week, the contractor shall replace the initial type "HH" filter drier with the final filter dryer.

Copper tubes used for refrigerant piping

Seamless Copper Tube for Air-conditioning and Refrigeration confirming to ASTM B280, IS 10773 : 1995 & IS 5493 : 1981

STRAIGHT LENGTHS					
Standard Size, in.	**Outside Dia. in. (mm)**	**Wall Thickness in. (mm)**	**Weight, lb/ft (kg/m)**	**Nom. Weight, kgs 5.8 metres**	*** Safe Working internal pressures PSI (KPa) 150°F**
3/8	0.375 (9.52)	0.030 (0.76)	0.126 (0.187)	1.09	810 (5585)
1/2	0.500 (12.7)	0.035 (0.89)	0.198 (0.295)	1.71	675 (4654)
5/8	0.625 (15.9)	0.040 (1.02)	0.285 (0.424)	2.46	625 (4310)
3/4	0.750 (19.1)	0.042 (1.07)	0.362 (0.539)	3.13	545 (3758)
7/8	0.875 (22.2)	0.045 (1.14)	0.455 (0.677)	3.92	495 (3415)
1 1/8	1.125 (28.6)	0.050 (1.27)	0.655 (0.975)	5.65	440 (3035)
1 3/8	1.375 (34.9)	0.055 (1.40)	0.884 (1.317)	7.65	385 (2655)
1 5/8	1.625 (41.3)	0.060 (1.52)	1.14 (1.703)	9.85	355 (2450)
2 1/8	2.125 (54.0)	0.070 (1.78)	1.75 (2.609)	15.13	315 (2170)
2 5/8	2.625 (66.7)	0.080 (2.03)	2.48 (3.692)	21.42	295 (2035)
3 1/8	3.125 (79.4)	0.090 (2.29)	3.33 (4.954)	28.73	275 (1895)
3 5/8	3.625 (92.1)	0.100 (2.54)	4.29 (6.393)	37.08	270 (1860)
4 1/8	4.125 (104.8)	0.110 (2.79)	5.38 (8.010)	46.45	255 (1760)

Insulation

All refrigerant copper lines must be free of extraneous chemicals such as corrosive cleaners or building materials' dust prior to the installation of the insulation. The insulation must be cleanand dry prior to installation.

Refrigerant pipe shall be sealed while slipping on insulation to prevent foreign matter from entering the tube.

Insulation is to be slid onto pipe; longitudinal slitting of the insulation is not allowed except on metered sections. Insulation shall be pushed onto pipe, not pulled.

Insulation shall be metered, preadhered and longitudinally slit inside throat to fit over all Ptraps,tees and elbows or bends over 90°.

All butt joints and mitered seams shall be adhered with full coverage of adhesive on both surfaces. Insulation shall not be stretched when adhering.

Insulation must be installed in an adequately ventilated area. It may be necessary to increase insulation thickness if adequate ventilation is not present, Do not crowd the insulation, allow for adequate air movement.

At the beginning, at every 12 to 18 feet, and at the ends of piping runs, the insulation shall be adhered directly to the copper using a 2" strip of adhesive. Insulation should not be adhered to the pipe at the extreme low points in any piping run.

Saddles shall be installed under all insulated lines at unistrut clamps, clevis hangers, or locations where insulation may be compressed.

ELECTRICAL EQUIPMENT AND INSTALLATION WORK :

A. Scope of work :

The scope of work covers execution and completion of the electrical installation work of the proposed project in accordance with drawings and specifications prepared by and under the direction and to the satisfaction of Department

B. Rules and regulations :

The installation shall generally be carried out in conformity with the requirement of Indian Electricity Act 2003 as amended up-to-date and the latest Indian Electricity Rules and supplementary regulations of the State Electricity departments and electricity undertakings. Where the installation is subject to inspection and approval of Fire Insurance and Explosive Authorities, such installation shall be planned and executed to conform their special rules. The installation shall conform in all respects to the Indian Standards code of practice of Electrical wiring installation IS 732-1963 and IS 2274 – 1963.

C. Materials :

All materials, fittings and appliances used in the electrical installation shall be of the best quality obtainable and of approved manufacture and shall conform to the latest Indian Standard Specification wherever these exist.

A. Workmanship

Good workmanship and neat appearance are the pre-requisites for compliance with the various sections of these specifications. The work shall be carried out under direct supervision of a person holding certificate of competency issued by the state government and in accordance with statutory rules and regulations in force. The relevant BIS code of practice shall be followed wherever applicable.

B. Drawings :

The tender drawings indicate only the general scheme of requirement. Exact position of all points, controls, switch boxes and inspection boxes, main and sub distribution boards etc., shall be got approved by the Department before the commencement of the work. Wherever required, detailed drawings shall be prepared and got approved.

The contractor shall provide detailed general arrangement drawing showing each compartments, modules, location of meters and relays etc. and wiring drawing with location of connectors, ferrule nos. Colour code of wires etc., before starting of the manufacturing of panel.

The contractor is requested to obtain necessary approval from the Department before start manufacturing the panel. Any modifications required as per the local authorities shall have to be carried out without any extra cost.

TESTING OF MOTORS

Motors shall be tested in accordance with the relevant Indian Standard Specifications and test certificates furnished for routine, type and high voltage tests.

Induction motor upto 37 KW shall be directly tested with 500 volts D.C meggar for one minute. If the insulation resistance is less than two megohms, the motor shall be dried out till a steady I.R. value of not less than two megohms is achieved.

COMPLETION DRAWINGS:

Before commissioning the Air-conditioning/Ventilation system the electrical installation shall be subject to

(i) an insulation resistance test with a 500 volts megger,

(ii) Earth electrode resistance test, in accordance with Indian Electricity Rules and the result of such tests furnished to the Engineer-in-Charge. SIX sets of completion drawings giving single line diagram run of wiring location along with size of panels, indication / control / interlocking circuits cable with sizes within the building / underground cables showing the location of straight through joints, location of main earthing station shall be furnished within 1 month from the date of completion of the work

APPENDIX-D

LIST OF APPROVED MAKES OF EQUIPMENTS/AGENCIES

1	Inverter type VRF/VRV Outdoor Units & Indoor Units	BLUESTAR / HITACHI / MITSHUBISHI/ CARRIER / VOLTAS / DAIKIN
2	Standalone Split units (highwall type)	BLUESTAR/HITACHI/ MITSHUBISHI/CARRIER/VOLTAS / DAIKIN

APPENDIX -E- TENDER DRAWINGS

The drawings furnished to the bidders shall be interpreted by the use of given dimensions and nomenclature only. They shall not be scaled under any circumstances. Drawings to a large scale have precedence over those to smaller scale. These drawings are general in nature and cannot be regarded as working drawings.

The drawings enclosed along with this tender shall constitute part of this Contract document. The Contractor shall refer to the latest revision of these drawings for the execution of the works. The data given in the drawings and specification is as exact as could be procured, but its accuracy is not guaranteed.

Drawings have been prepared showing the areas to be air-conditioned and the space allocated for plant room, equipment room etc. The equipment offered shall be accommodated within the space provided as far as possible. If nevertheless additional space is required for the equipment offered, the bidder shall bring out this point clearly in the Tender itself. He shall note in this context that claims for additional space, if made at a later date will not be entertained.

Space allocated for major air conditioning equipment shall be taken into consideration before ordering the equipment and they shall fit into the space provided with required clearance all round as per relevant ISS and I.E. rules.

These drawings are issued for Tender Reference only and indicate arrangement of various systems and the extent of work covered in the contract. These drawings indicate the points of supply and termination of services and broadly suggest the routes to be followed. Under no circumstances, shall dimensions be scaled from these drawings. The layout of equipment, duct routing etc., as shown on the drawings represents a feasible scheme. Apparatus may be rearranged in the space allocated, subject to the approval of Engineer-in-charge.

The Contractor shall follow the tender drawing in preparation of his shop drawings and for subsequent installation work. He shall check the drawings of other trades to verify spaces in which his work will be installed.

Maximum head room and space conditions shall be maintained at all points. Where head room appears inadequate, the Contractor shall notify the Engineer-in-charge before proceeding with the installation.

Any changes found essential to co-ordinate installation of mechanical ventilation and air-conditioning work with other services and trades, shall be made with prior approval of the Engineer-in-charge and without additional cost to the Department.