

SUPPLY, INSTALLATION, TESTING AND COMMISSIONING OF VRV / VRF SYSTEM FOR SECOND FLOOR AND THIRD FLOOR AT JAC, JIPMER, PUDUCHERRY

Volume- III TECHNICAL SPECIFICATION

**Tender No: HLL/IDD/CHN/20-21/046
Dated: 06th June 2020**



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TECHNICAL SPECIFICATION:

Common Points:

Contractor should submit the shop drawing for all the works within 10 days of receipt of work order / LOA to Engineer – in - charge and should get prior approvals before executing any type of works along with coordination layout. The contractor should not deviate from the approved drawing at any point of time, in case of deviation while executing proper authorization should be obtained before proceeding further. Decision of HLL stands final.

The contractor should follow the following procedures:

- 1. MAR** – Material Approval Request (Before procurement of any materials the contractor should submit MAR request along with necessary supporting documents to HLL Engineers and the makes should be as per list of approved makes specified in the tender document. Any materials procured without approval will be rejected at any point of time)
- 2. Sample Tag** – After obtaining MAR, the contractor should submit sample tag along with samples (detailed specification can be submitted instead of samples for materials with high procurement values)
- 3. MIR** – Material Inspection Request – After supplying of materials at site, the contractor should submit MIR request for verification of materials (the materials should be as per approved MAR and sample tag). Items deviating against authorized MIR will be rejected at any point of time.
- 4. IR** – Inspection Request – The contractor should submit Inspection request on day to day basis for inspecting the works carried out.
- 5. Billing** – Billing should be as based on the actuals executed at site and the contractor should submit the bills based on HLL billing format along with supporting documents (Dc copy, bill invoice, MAR, Sample tag, MIR, test reports, etc) for the items claimed in the respective bill. 3 sets of original bill and 2 sets of copy should be submitted.
6. All document formats pertaining to the work should be of HLL formats and the same can be issued on request.
7. 3rd party testes through NABL aggregated labs should be carried out for the necessary items executed at site by the contractor as per the direction of HLL without any additional costs.
8. 5 sets of following documents should be submitted during completion/ handing over of the project
 - a. As built drawings (Hard & Soft copy),
 - b. Inventory list,
 - c. Warranty certificates
 - d. Statutory approvals, if any
 - e. Manuals
9. Spares, keys or any other components related to the equipment/ materials installed should be handed over with a list along with separate tags.
10. Hindrance register should be maintained at site.
11. All the debris, remaining should be cleared from the same and disposed within campus lead not more than 4 KM. And the completion certificate will be issued only after clearing the site and making it good.
12. Installation, Testing & Commissioning report for all the works should be provided as per HLL formats.

Hot work permit:

Hot work permit must be obtained prior to the starting of work from concern department of JIPMER.

Supervision:

Contractor shall depute their team of engineer for the supervision of installation, testing, commissioning & handing over at site of work. List of Engineers along with their bio data should be submitted to project office before commencement of the works. And the team should maintain records of daily progress and report the same to HLL Engineers on regular basis. Prior permission for the works carried should be obtained from HLL. All the Engineers should be available at the site during execution of work until handing over without fail.

Security & Storage:

The contractor is responsible for storage & security of all the materials, equipments, piping, wiring and all related accessories till the time of handing over to the customer.

Power & Water:

The contractor should make his own arrangement for electricity & water.

Working Hours & Damages of existing property:

As the work is being executed in running institution building, at most care should be taken during execution of works. Damages caused to the existing property should be rectified at own risk and cost with war foot basis. Time Schedule for the works to be carried should be submitted prior to the work.

Labour camp:

Labour camp will not allow inside the campus and the contractor should take sole responsibility for workers stay outside the campus. Workers should not use any type of alcohol/smoking related items inside the campus.

Co-ordination with Other Agencies

The contractor shall co-ordinate with all other agencies involved in the building work so that the building work is not hampered due to delay in his work.

Structural Alterations to Buildings

- (i) No structural member in the building shall be damaged/altered, without prior approval from the competent authority through the Engineer-in-charge.
- (ii) Structural provisions like openings, cutouts, if any, provided by the department for the work, shall be used. Where these require modifications, or where fresh provisions are required to be made, such contingent works shall be carried out by the contractor at his cost.
- (iii) All such openings in floors provided by the Department shall be closed by the contractor after installing the cables/ conduits/ rising mains etc. as the case may be, by any suitable means as approved by the Engineer-in-charge without any extra payment.

(iv) All chases required in connection with the electrical works shall be provided and filled by the contractor at his own cost to the original architectural finish of the buildings.

Coordination Layout:

Coordination layout must be submitted along with the shop drawings and approval must be obtained before execution of works.

MAINTENANCE DURING LIABILITY PERIOD

Complaints

The contractor shall receive calls for any and all problems experienced in the operation of the system under this contract, attend to these within 10 hours of receiving the complaints and shall take steps to immediately correct any deficiencies that may exist.

Repairs

All equipment that requires repairing shall be immediately serviced and repaired. Since the period of Mechanical Maintenance runs concurrently with the defects liability period, all replacement parts and labour shall be supplied promptly free-of charge to the Owner.

HVAC system:

Drawing / design approval:

The contractor shall prepare and furnish all relevant shop drawings along with the sections after inspection at the site for approval to the Engineer-in-charge. The execution work shall commence only after the shop drawings/design are approved by the Engineer-in-charge and also responsible for the fitment of equipment and accessories. The contractor will submit shop drawing/ design to the project office, within 10 Days after getting LOA for approval. The list of shop drawings shall be as follows:

- a. Detail plans for each area.
- b. Refrigerant piping routes with sections.
- c. Condenser / Evaporative unit location along with the location of MCB.
- d. Electrical panel and control scheme.
- e. Mounting stand & foundation details. (to be designed by structural engineer employed by the contractor and approved by HLL).
- f. Any other detailed drawing required for the system.
- g. Drain piping layout with section.
- h. Control cabling detail along with sizes.
- i. Power cable sizes and earthing wire sizes along with cable tray details.
- j. Cu pipe support details.
- k. Drain line clamp details.

Defect Liability Period (DLP):

The contractor shall guarantee the equipment against all defects of materials and workmanship for the period of twelve months from the date of commissioning & handing-over of the equipment to JIPMER as certified by the Engineer-in-charge. However, compressor should have the manufacturer warranty. Any defects arising during the guarantee period shall be rectified and made good by the vendor at his own risk & cost to the satisfaction of HLL/JIPMER.

Inspection:

Routine performance testing of equipment shall be carried out at works in the presence of the HLL Engineers/ representatives.

Test:

The contractor will perform summer or monsoon and winter test and confirm the performance of units as specified in the design data. Along with this the contractor should perform 12 hours continuous test for the entire system in full load condition until the satisfaction of the HLL engineers and should submit a detailed test report of the same in HLL format.

Civil work:

Chasing, cutting and finishing of the brick work or floor for laying the drain pipe and copper pipe to be in contractor scope. Chasing, cutting will be carried out only by chase cutting machine. Chisel and hammer shall not be allowed. All the damages made during the work should be made good/ rectified at own risk and cost.

Technical specification:

Basis of design as specified by HLL Engineers

VRV / VRF system:**LIST OF BUREAU OF INDIAN STANDARDS CODES**

IS : 554 – 1985 (Reaffirmed 1996)	Dimensions for pipe threads where pressure tight joints are required on the threads.
IS: 659-1964 (Reaffirmed 1991)	Air Conditioning (Safety Code)
IS:660-1963 (Reaffirmed 1991)	Mechanical Refrigeration (Safety Code)
IS : 732-1989	Code of practice for electrical wiring
IS : 822-1970 (Reaffirmed 1991)	Code of procedure for inspection of welds.
IS : 1255-1983	Code of Practice for installation and maintenance of Power Cables up to and including 33KV rating (Second Revision)
IS : 1554 – 1988 (Part – I)	PVC insulated (Heavy Duty) electric cables for working voltages up

	to and including 1100 volts
IS : 2379 – 1990	Colour code for the identification of pipelines.
IS : 2551 – 1982	Danger notice plate
IS : 3043 – 1987	Code of practice for earthing
IS : 3103 – 1975	
(Reaffirmed 1999)	Code of practice for Industrial Ventilation
IS : 3837 – 1976	
(Reaffirmed 1990)	Accessories for rigid steel conduit for electrical wiring
IS : 4736-1986	
(Reaffirmed 1998)	Hot-dip zinc coatings on steel tubes
IS : 5133-1969	
(Part-I)	
(Reaffirmed 1990)	Boxes for the enclosure of electrical accessories.
IS : 5424-1989	
(Reaffirmed 1994)	Rubber mats for electrical purposes.
IS : 5578	
& 11353-1985	Marking and identification of conductors
IS : 6392-1971	
(Reaffirmed 1988)	Steel pipe flanges.
IS : 13947-1993	
(Part – V)	Control Circuit Devices
BS : EN:779-1993	Filters

ASHRAE (American Society of Heating Refrigeration & Air-conditioning Engineers) Hand Books

Application 1999 Fundamentals 1997
Systems & Equipment 1996
ASHRAE Indoor air quality Standard 62-1982
IEC Relevant Sections

Equipment Selection Criteria:

(a). As per design conditions the apparatus dew point should be 51°F.

(b). The quantity of indoor units and outdoor units is fixed as provided space at site. The vendor has to check heat loads and accordingly select Indoor & Out door equipments after obtaining clearance from HLL engineers. The vendor should be fully responsible to achieve the inside conditions as per design data.

Outdoor unit:

- The outdoor shall be factory assembled weather proof casing constructed from heavy gauge MS panels and coated with baked enamel finish of color approved by architect. The unit should be completely factory wired tested with all necessary control.
- All ODU shall have minimum 2 Rotary/Scroll Compressors and be able to operate even in case one of the compressors is out of order.
- The outdoor units shall be capable of connecting all types of indoor units.

- It should also be provided with duty cycling for multiple Inverter/Digital Compressor switching starting sequence of multiple ODU.
- The ODU shall be modular in design and should be allowed for side by side installation the unit shall be provided with its microprocessor control panel along with provision for integration with Building Management System using BACNET/MODBUS protocol. The odu unit should have anti-corrosive paint free galbarium base plate for easy mounting of the unit.
- The outdoor unit shall be compatible for three phase 415V 50 Hz AC supply. All outdoor units shall have minimum two compressors so that in the event of failure of one compressor, other can work.
- The ODU should be filled with low noise, aero-spiral design fan with grill for spiral discharge airflow to reduce pressure loss and should be fitted with DC Fan Motor to better efficiency. The unit should also be capable to deliver of adequate external static pressure.
- The outdoor unit shall be delivered with first charge of refrigerant.
- Note: The Outdoor machines shall be preferably compact machines for Purpose of space saving and smaller foot print shall be preferred.
- The condensing unit shall be designed to operate safely when connected to multiple fan coil units.
- Noise level shall not be more than 60 dB (A) at normal operation measured horizontally 1 M away and 1.5 M above ground.
- Control Wiring from ODU to IDU shall be contractor's scope.
- Mounting of outdoor should be as per HLL directions.

Compressor :

- 1- The compressor shall be Highly Efficient Hermetic Scroll type and shall be capable of DC Inverter Control. It shall change the speed in accordance to the variation in cooling load requirement or the refrigerant volume thru loading or unloading.
- 2- All outdoor units shall have multiple steps of capacity control to meet load on fluctuation and indoor unit should have individual control. All parts of compressor shall be sufficiently lubricated stock. Forced lubrication may also be employed.
- 3- ODU heater to be provided in compressor casing.
- 4- The inverter shall be IGBT (insulated gate bipolar transistor) type for efficient and quiet operation.

Heat exchanger

- 1- The heat exchanger shall be constructed with copper tubes mechanically bonded to Aluminum fins to form a cross fin coil.
- 2- The Aluminum fins shall be treated with anti-corrosion resin film (Blu fins). Extra mesh type materials can be provided along the fins to prevent the damage of the same.
- 3- The unit should be with E- bypass / Split type Heat Exchanger for good efficiency of condenser.
- 4- The unit shall be provided with necessary number of direct driven low noise level propeller type fan arranged for vertical/ horizontal discharge. Each fan shall have safety guard.

Refrigerant circuit

- 1- The refrigerant circuit shall have liquid and gas shut off valve or a solenoid valve at condenser end.
- 2- All necessary safety devices shall be provided to ensure the safety operation of the system.
- 3- Refrigerant should be R410a Only. The refrigerant piping between indoor and outdoor units shall be constructed from soft seamless up to 19.1mm and hard drawn copper pipes above 19.1 mm with copper fittings and silver soldered joints. All joints in copper piping shall be sweat joints using low temperature brazing and or silver solder. After the installation, the piping shall be pressure tested using nitrogen at 20kg/cm² and 10 kg/cm² for low side. The sizing and flow of refrigerant shall be designed as specified by the manufacturer. All refrigerant pipelines shall be properly supported and anchored to the building structure using steel supports/brackets/clamps of adequate size to support the load.

Safety devices

- 1- All necessary safety devices shall be provided to ensure safe operation of the system. The outdoor units shall be equipped with the following safety devices.
 - (a.) High Pressure Switch.
 - (b.) Fuse.
 - (c.) Fan Drive OLP.
 - (d.) Fusible plug
 - (e.) OLR (Over Load Relay)
 - (f.) OLP (Over Load Protector) for Inverter/digital.
 - (g.) Single Phase preventer
 - (h.) Oil recovery system

Oil recovery system

Unit shall be equipped with an oil recovery system to ensure stable operation with long refrigeration piping lengths. The system must be provided with oil balancing circuit to avoid poor lubrication.

Anti corrosion treatment

- 1- The portions of machines like side panel, outer panel , bottom frame, which are exposed to corrosive atmosphere, should be alloyed hot-dip zinc coated steel plate, coated with corrosion protection powder polyester resin coating on both inner and outer surfaces in thickness of 64microns or more.
- 2- Finned coil protection net should have coating of resin coating containing ultraviolet ray absorbent. Fan and its fan protective net should be with weather resistant polypropylene resin.
- 3- The copper pipe-aluminum fan shall be with special acrylic resin coated. And internal supports, frame, control box shall also be hot-dip zinc coated steel plate and with rust preventive powder coating of 64 microns or more on inner and outer surface.
- 4- All screws, bolts used in outdoor unit shall be with SUS410, Zinc-Nickel alloy plating, zinc chrome acid film treatment and rust inhibitor coating.

INDOOR UNIT

General

The selection deals with supply installation testing commissioning of various types of indoor units confirming to general specifications. Each indoor unit has Electronic Expansion Valve which senses the temperature based on variation of the load and conveys the same for the outdoor modules to respond accordingly. The indoor unit shall be selected as per the dehumidified CFM.

- 1- Indoor units shall be either ceiling mounted cassette type or wall mounted type or other as specified in BOQ.

Each unit shall have electronic control valve to control the refrigerant flow rate respond to load variations in the rooms.

1.1 The address of the indoor unit shall be set automatically in case of individual and group control

1.2 In case of centralized control, it shall be set by liquid crystals remote Controller.

- 2- The fan shall be 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.

- 3- The cooling coil shall be made out of seamless copper tubes and have continuous aluminum 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/sqm air pressure under water.

4- Unit shall have cleanable type filter fixed to an integrally molded plastic frame. The filter shall be slide away type and neatly inserted.

5- Each unit shall be provided with Electronic Expansion Valve for cooling and heating.

6- Each unit shall be with wireless LCD type remote controller. The controller shall be able to change the fan speed and angle of swing flap individually and changes in set temperature as per requirement.

Ceiling mounted cassette type unit (multi flow type):

1- The unit shall be ceiling mounted type. The unit shall include pre-filter, fan section and DX-Coil section. The housing of the unit shall be powder coated galvanized steel. The body shall be light in weight and shall be aerodynamically designed diffuser turbo fan type.

2- Unit shall have an external attractive panel for supply and return air. Unit shall have four way supply air grilles on sides and return air grilles at center.

3- Each unit shall have high lift drain pump, fresh air intake provision (if specified) Low gas detection system and very low operating sound.

4- All the indoor units regardless of their differences in capacity should have same decorative panel size for harmonious aesthetic point of view. It should have provision of connecting branch ducts. Any fresh air requirement for the unit can be done as per site condition.

Refrigerant

1- Refrigerant should be only R-410A or any other refrigerant as per current industry standard.

2- The entire condensing unit & evaporative unit should be factory assembled and tested. The units should come with an initial charge of referred R-410A from the factory. Any additional required refrigerant shall be added at site free of cost & loss of refrigeration due to defect in equipment or workmanship or workmanship shall also be filled up free of cost during execution and guarantee period.

Refrigerant piping

1- All refrigerant piping for the air-conditioning system shall be constructed from soft seamless upto 19.1mm and hard drawn copper refrigerant pipes for above 19.1mm with copper fittings and silver soldered joints. The refrigerant piping arrangements shall be in accordance with good practices within the air conditioning industry, and are to include charging connections, suction line insulation and all other items normally forming part of proper refrigerant circuits.

2- All joints in copper piping shall be sweat joints using low temperature brazing and or silver solder. Before jointing any copper pipe or fitting, its interiors shall be thoroughly cleaned by passing a clean cloth via wire or cable through its entire length. The piping shall be continuously

kept clean of dirt etc. while constructing the joints. Subsequently, it shall be thoroughly blown out using nitrogen.

3- After the refrigerant piping installation has been completed, the refrigerant piping shall be pressure tested using nitrogen as per HLL requirement. Pressure shall be maintained in the system for 24 hours. The system shall then be evacuated to minimum vacuum if 700 mm Hg and held for 24 hours. The air-conditioning supplier shall be design sizes and erect proper interconnections of the complete refrigerant circuit.

4- The thickness of copper piping shall not be less than mentioned below:

Pipe Size in mm (OD)	Wall Thickness in mm
54.1	1.5
41.3	1.3
34.9	1.3
28.6	1.2
25.4	1.2
22.2	1.0
19.1	1.0
15.9	1.0
12.7	0.8
9.5	0.8
6.4	0.8

5- The suction line pipe size and the liquid line pipe sizes shall be selected according to the manufacturers specified outside diameter. All refrigerant pipe shall be properly supported and anchored to the building structure using steel hangers, anchors, brackets, and supports which shall be fixed to the building structure by means of inserts or expansion shields of adequate size and number to support the load imposed thereon.

Drain piping

1- Shall be as per BOQ.

2- The IDU shall be connected to the drain pipe made of rigid heavy duty PVC min 20 MM diameter. The pipe under floor should be 20 Kg/sqcm

3- The pipe shall be laid in proper slope for efficient draining of the condensate water.

Pipe insulation

1- Refrigerant Pipe Insulation:

(a). The whole of the suction and liquid line including all fitting , valves and strainers bodies etc. shall be insulated with 19 MM/13 MM respectively thick class Nitrile Rubber sleeve as per BOQ.

(b). The joint shall be properly sealed with R242 adhesive of polychloroprene to ensure proper bonding at the ends.

(c). Insulation of cold lines shall be carried out as per list of approved makes insulation sheets and tubes of appropriate thickness so that condensation does not occur.

2- Drain Pipe Insulation

- (a). Drain pipe carrying condensate water shall be insulated with 12 MM thick class Nitrile Rubber.
- (b). The joint shall be properly sealed with R242 adhesive of polychloroprene to ensure proper bonding at the ends.
- (c). For proper drainage of condensate U-trap shall be provided in the drain piping (wherever required).
- (d.) All pipe supports shall be of pre-fabricated and pre-painted slotted angle supports properly installed with clamps.

Testing & Commissioning:

1. After completion of installation of units, testing and commissioning should be carried out with at least 12 hours continuous operation to ensure proper operation of entire system including indoor, outdoor, drain system and the same should be carried out after cleaning of entire surroundings and dust free area.
2. Copper pipe should be pressure tested with 1.5 times higher to the normal working pressure of the system.
3. Testing & Commissioning report should be as per HLL format and the same will be provided during carrying out of the respective operations.

Samples:

All the samples should be submitted prior in advance to avoid the delay during execution. Work executed without approved sample of any kind will be summarily rejected at any point of time.

LIST OF APPROVED MAKES:

List of Approved makes		
S.No	Details of Materials/Equipments	Manufacturer name
ELECTRICAL		
1	LT Panels / Synchronizing Panels/ Capacitor Panels	L&T/ ABB / Schneider/ Siemens or their authorized Channel Partner
2	HT & LT Cables (Power & Control Cables, Solar Cables)	Gloster/ Havells/ Nicco/ Finolex/ KEI/Polycab
3	Wiring Cables FRLS	Polycab, Finolex, RR Cables, Havells
4	Modular Switches/ Socket outlets and wiring accessories with moulded cover plate	Siemens (Delta)/ Legrand (myrius)/ L&T (Entice)/ Havells (Crab tree-Athena)/ Anchor (Roma)/ Schnieder (Opale)

5	MCB/ MCCB / RCCB/Isolaters / RCBO	Hager/ Havells/ Legrand/ L&T/ Schneider/ ABB/ Siemens
6	Ceiling /Exhaust/Wall fans	Crompton/ Usha/ Orient/ Bajaj/ Havells
7	Cable Gland & Lugs	Comet, Dowels, Hex, Gripwell
8	Cable Jointing Kit / HT termination Kit	Reychem/ Xicon/ 3M
9	Terminal connector	Connectwell, Elmex
10	Outdoor Type Box	Sintex, Legrand, Hensel, Rittal
11	MS & GI pipes	TATA, Jindal, SAIL
12	Cable Tray/ Race ways / Floor trunking / wall channels	MEM/ BEC/ MK/ OBO Bettermann/ Indiana/ Legrand/Sai Metal Craft
13	Data/Telephone/TV Outlets	Systemax/ Belden/ Simone/ MK/ Legrand/ Havells/ Anchor
14	DB's / Pre-wired DB's	Hager/ Havells/ Legrand/ L&T/ Schneider/ ABB/ Siemens
15	Optical Fiber Cable	Sterlite Technologies/ Finolex/ Belden/ Delton/ Skytone
16	PVC insulated FRLS - Aluminum / Copper 1.1 KV grade flexible wires	L&T/ Gloster/ Havells/ Polycab / Finolex/ RR Kable/ KEI/ Batra henlay
17	Indicating Lamps	AE/ Kaycee/ Vaishnav/ L&T/ Siemens/Schnieder/ Teknik/ ABB
18	Industrial Socket	ABB/ L&T/ Legrand/ Siemens/ Hager
19	Insulated Rubber Mat	Premier Polyfilm Ltd/ Polyelectrosafe/ Challenger/ Electro Mat/ Safe Hold
20	LED Light Fixtures and Lamps	Philips/ Wipro/ Trilux /Havells
21	Measuring Instruments (Analog Meter)	L&T/ AE/ MECO/ Rishabh/ Schnieder

22	Measuring Instruments (Digital Type)/ MFM/KWH meter	L&T/ Ducati/ Conzerv/ Secure/ Siemens/ Schnieder/ ABB
23	MS Conduit & accessories	BEC/ AKG/ Steel Kraft
24	Multi-function Meter	L&T/ ABB / Siemens/ Schneider
25	Panel Accessories	L&T/ Teknik/ Rishabh/ Siemens/ Schnieder
26	Push Buttons	Siemens/ L&T/ ABB/ Schneider/ C&S/ Teknik
27	PVC Conduit & Accessories	Clipsal/ Polypack/ BEC/ AKG/ Avon Plast/ Precision
28	Relay / Contractors/ Timers / Starters and Control Panel	Siemens/ L&T/ Schneider/ ABB
29	Selector Switch	Siemens/ L&T/ Teknik/ Salzer/ Schnieder/ ABB
30	Tap-off/ Splitter box	Zinwell/ Novatron/ Catvision
31	Telephone Tag Block/Jack Panel/ Face Plate	Krone/ Phoenix/ Wago/ Beldon/ Panduit/ Huwaei/ HP
32	Network Switch & Accessories	Cisco/HP
33	CAT 6A Wire/ Patch Cord	Amp/Belden/ Simone/Panduit/Legrand/ CISCO
34	Equipment Rack	Rittal/ Netrack/ Cisco/MTS/APW
35	UPS	Emerson (Vertiv)/ Schnieder (APC)/ Eaton/ Socomec

Note: All the materials used in the project must be as per IS standards and in case any materials left in the list of approved makes, the same should be used only after obtaining proper approval from HLL Engineer – in – charge before procurement.

HVAC		
1	AC Outdoor/ Indoor Units/Remote Controllers	Mitsubishi/ Daikin/ Toshiba/ Panasonic/Carrier/Blue star
2	Touch Screen controller & Modbus	Mitsubishi/ Daikin/ Toshiba/ Panasonic/Carrier/Blue star
3	Copper refrigerant pipes & accessories	Mandev, Totaline, Rajco
3	Dampers	Air Master, Caryaire, Ravistar, Air Breeze
4	Insulation - Nitrile Rubber	K-Flex/Superlon/Armacell/Supreme
5	GI sheet	Jindal, TATA, SAIL
6	PVC pipe for drain	Polypack/ Supreme/Astral/Finolex
7	Factory Fabricated Duct & Flanges	Rolastar / Zeco / Ductofab / Technofab/GPS Spiro
8	Split AC Units	Hitachi/ Carrier/ Bluestar/ Mitsubishi
9	Stabilizer	V-Guard/ Microtek/ Everest/ Bluestar
10	PVC Conduit & Accessories	Same as Electrical
11	HT & LT Cables (Power & Control Cables, Solar Cables)	Same as Electrical
12	Wiring Cables FRLS	Same as Electrical
13	Modular Switches/ Socket outlets and wiring accessories with moulded cover plate	Same as Electrical
14	MCB/ MCCB / RCCB/Isolaters / RCBO	Same as Electrical
15	Industrial Socket	Same as Electrical
<p>Note: All the materials used in the project must be as per IS standards and in case any materials left in the list of approved makes, the same should be used only after obtaining proper approval from HLL Engineer – in – charge before procurement.</p>		

END OF VOLUME - III