



प्रसार भारती : PRASAR BHARATI
[भारत का लोक सेवा प्रसारक : INDIA'S PUBLIC SERVICE BROADCASTER]
दूरदर्शन केंद्र : DOORDARSHAN KENDRA



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No. 2(1)2026-27/E/DKT/STORES/
To

Dated : 30.07.2026

All Authorized Air Conditioner Manufacturers

Subject: Invitation for Budgetary Quotations for SITC of 3 × 20 TR VRV/VRF DX Type Air-Cooled Package Air Conditioning Plants for Studio-I at Doordarshan Kendra, Thiruvananthapuram along with dismantling of AHU.

Sir/Madam,

Doordarshan Kendra, Thiruvananthapuram proposes to undertake the Supply, Installation, Testing and Commissioning (SITC) of 3 × 20 TR DX VRV/VRF Type Air-Cooled Package Air Conditioning PLANTS for Studio-I, along with dismantling of one AHU of 60TR & its associated works for installing the Package unit.

In this connection, you are requested to submit a budgetary quotation for the above work based on your latest products and prevailing market rates. The detailed technical specifications of the proposed system are enclosed herewith for your reference and necessary action. You are requested to furnish your budgetary quotation in accordance with the enclosed specifications.

The budgetary quotation should include the cost of dismantling & its associated works and safe removal of one of the existing Air Handling Unit (60 TR AHU). Supply, installation, testing and commissioning of the Package Unit, refrigerant piping, electrical cabling, control wiring, indoor and outdoor units, accessories, mounting arrangements, and all other items required for the complete and satisfactory execution of the work in accordance with the enclosed technical specifications.

The budgetary quotation is being invited solely for the purpose of budget estimation and preparation of the estimate/tender documents. Submission of the quotation shall not confer any right or claim for award of the work, and Doordarshan Kendra, Thiruvananthapuram reserves the right to modify or cancel the proposal without assigning any reason.

You are requested to submit your budgetary quotation on your company's letterhead, duly signed by an authorized representative, on or before 17.08.2026 by post to the following address.

Firms can inspect the site on any working day from Monday to Friday (excluding holidays).

Deputy Director General (E)
Doordarshan Kendra
Kudappanakunnu PO
Thiruvananthapuram
Kerala-695043

Encl.: Technical Specifications for SITC of 3 × 20 TR VRV/VRF DX Type Air-Cooled Package Air Conditioning Plants (Attached).

Yours faithfully,

(RAMITHA R S)

SENIOR ENGINEERING ASSISTANT (STORES)
For DEPUTY DIRECTOR GENERAL (E)

SPECIFICATION FOR SITC OF 3X20 TON DX TYPE VRF/VRV AIR COOLED PACKAGE AIR CONDITIONING PLANTS FOR STUDIO I OF DDK THIRUVANANTHAPURAM

SECTION - I

GENERAL

1.1 SCOPE

1.1.1 This specification for SITC of 3X20 Ton Direct Expansion Type VRF/VRV (or similar Technology) Air-Cooled Packaged air-conditioning Plants for Studio I of DDK, Thiruvananthapuram, at site, including installation, testing and commissioning of complete equipment. The plants shall work on ecofriendly Non-ODS refrigerant as per ASHRAE standards 34 Class A-1 refrigerant.

Air Handling Unit is to be integrated to the existing ducting system with suitable modification (if required) as per local prevailing condition. Whole AHU room will act as return area. Suitable opening is to be done in false ceiling for return air.

The plants shall deliver the specified tonnage, both in summer and monsoon seasons. The AC plants are expected to work for about 20 hours a day, 365 days in a year. However, out of three plants, required units shall be working as per the cooling demand and other shall be the relieving set/stand by.

AHU of the 3X20TR AC plant shall be installed in the AHU-8 room (After dismantling AHU-8) so that ducts can be connected easily without break in service and corresponding Air condensing units shall be installed at a suitable place after inspection of the site.

1.1.2 The following items of work will be carried out by the indenter and need not, therefore, be included in the tender.

(a) Main power-supply connection terminated in a cable box near the main switchboard in the plant room.

1.1.3 The prevailing mean Summer/Monsoon dry/wet temperature at these places are as follows:

Sl. No.	Station	Temp - Summer (March to May)		Temp - Monsoon (June to October)	
		Dry °C	Wet °C	Dry °C	Wet °C
1	Thiruvananthapuram	32° C	30° C	29° C	26° C

1.2 GENERAL CONDITIONS OF CONTRACT

Payment terms, insurance cover, SITC schedule and time of completion, inspection, testing and commissioning of equipment and guarantee terms, penalty for delay etc. would be applicable as per Doordarshan terms and conditions on the subject framed by the indenter, namely, Additional Director General (South Zone), AIR & DD, Chennai. The schedule of measurements would be applicable as given in Section-IV.

1.3 DESCRIPTIVE TECHNICAL LITERATURE AND DRAWINGS

1.3.1 Site visit

Pre-bid meeting is mandatory. In addition, in case the tenderer desires to have guidance regarding the existing electrical & refrigerant layout of equipment in plant room, they are advised to inspect the site before submitting their tender. The installation is to be carried out in phases in order to avoid shut down of the existing A/C Plants, as DDK, Thiruvananthapuram is a working station.

1.3.2 Tender Documents

As a part of the technical bid, the tenderer shall submit the following in duplicate along with their tender.

- a) Descriptive and technical leaflets giving complete mechanical and Electrical data about the equipment offered including detailed dimensions of the equipment.
- b) A Statement of bill of quantities, technical particulars (see Annexure-I) and performance specifications of the equipment offered in the proforma as per Section-II and Section-III of the specifications.
- c) Tentative details showing cable sizes and length, equipment capacities, switch-gear rating and number, rating, and number of control components.
- d) A tentative piping drawing showing layout for the entire refrigerant piping with all diameters, lengths, sizes, and number of valves etc. shown clearly.
- e) A schedule giving time period from start to finish of the complete work.

1.3.3 Installation Drawings

In the event of an order being placed, the tenderer shall supply to the indenter 3 copies each of the following for approval within 1 month from the date of placement of the order.

- a. Dimensional drawings (including sections) giving complete details for erection of plants including foundation in case existing foundation cannot be reused and new foundation is necessary.
- b. Electrical wiring diagram and control circuits of all electrical equipment showing cable sizes and electrical rating of the related equipment.
- c. Electrical Panel layout/diagram showing various sizes.
- d. Instruction manuals of various equipment of the A/C plants detailing all adjustment, operation & maintenance/servicing procedures.

Before taking up the installation work at site, the tenderer shall ensure that the indenter approves the installation drawings.

1.3.4 COMPLETION DRAWINGS AND OTHER INFORMATION

Three sets of complete drawings comprising the following shall be submitted by the tenderer while handing over the installation.

- a. Electrical drawings for the entire electrical equipment showing cable sizes, equipment capacities, switchgear ratings, control components, control wiring.
- b. Schematic control drawings giving detailed notes to explain the sequence of operation of the control circuit.
- c. Piping drawing showing layout for the entire piping with all diameters, lengths, sizes and number of valves etc. shown clearly. Isometric drawings showing each of the equipment/units shall also be supplied.
- d. Detailed drawings and specifications in respect of parts likely to be damaged by wear and tear.
- e. Lists of components like thermostats, humidistats, other control components, relays, timers, contactors etc. giving their type, designation, function etc.
- f. Schedule of items of which the tenderer is not the manufacturer/the manufacturer's authorised dealer. This should contain the specifications of each item and the agency from which these items are procured.

1.4 INCLUSIONS

The following items of work shall be undertaken, if required, by the indenter and therefore need not be included in the tender.

- a. All the existing supply and return ducts including the plenum chamber & the R.S. joints for the plenum chamber. If required, suitable modification work may be carried out.

1.5 ERECTION

1.5.1 This specification provides complete erection including all the associated civil works like equipment foundation etc. of the air conditioning equipment at site by the tenderer. The entire work shall be carried out as per codes, regulations, detailed in Annexure-II and as per following terms and conditions.

1.5.2 The tenderer shall make his own arrangement for storage of all equipment and materials brought to site from time to time and their safe custody at site till the plants are taken over by the indenter/his representative. The tenderer shall make his own arrangements for providing accommodation for his workmen at site. Tents may, however, be pitched in the site compound at places to be decided upon by the indenter or his representative at site.

1.5.3 The tenderer shall make his own arrangements for procuring necessary labour, skilled and unskilled. He should conform to all local government laws and regulations governing labour and their employment.

1.5.4 The tenderer shall indemnify and hold harmless the purchaser against all claims in respect of injury to any person howsoever arising out of the erection of the equipment in the course of such installation. The tenderer shall discharge all his obligations under the Indian Workmen's Compensation Act in as far as it affects workmen under his employ.

1.5.5 The tenderer and his employees shall comply with the regulations in force for controlled entry into the premises where the air-conditioning equipment is to be installed.

1.6 TENDERER'S LIABILITY FOR DAMAGES CAUSED DURING INSTALLATION WORK AND IMPERFECTIONS NOTICED WITHIN THE GUARANTEE PERIOD

If the tenderer or his/her workmen or servants shall break, deface, injure or destroy any part of the building in which they may be working or any building, road, road kerb, fence, enclosure, water pipe, cable drains, electric or telephone posts or wires, trees, grass or grass lands in the premises on which the work or any part of it is being executed, or if any damage shall happen to the work while in progress from any cause whatsoever. If any defect, shrinkage or other faults appear in the supply/work within 12 months or within five years in case of compressors (after final certificate or otherwise of its completion given by the indenter) arising out of defective or improper materials or workmanship, the tenderer shall, upon receipt of a notice in writing on that behalf, make good at his/her own expense, or in default, the indenter may get the same rectified and deduct the expenses from any amount that may be then due or at any time thereafter may become due to the tenderer or from his security deposit.

1.7 INSPECTION AND TESTS

1.7.1 Inspection: The equipment will be inspected by the indenter or his authorised representative at manufacturer's works before dispatch in accordance with various standards/procedures specified in Annexure-III in Section-IV or modifications thereof that may be carried out by the indenter in consultation with the tenderer before issuing AT. The tenderer should intimate the indenter in advance about readiness of the equipment for inspection at a date mutually agreed upon by the indenter and tenderer. The tenderer should furnish in advance photocopies of all the relevant test certificates as per IS as applicable before giving inspection call. The tenderer must satisfy themselves about the readiness of the plant as per DDK specifications before asking the indenter for carrying out inspection and tests. If during the inspection, any components/parts fail, the same shall be replaced by the tenderer at his cost.

1.7.2 Acceptance Tests: Soon after erection of the plants at site, inspection of the plants shall be carried out jointly by the Inspecting Officer and the representative of Indenter/consignee in the presence of tenderer's representative before carrying out acceptance tests. The acceptance tests are to be carried out as per Annexure-III and Section-IV of the specification. Separate capacity tests shall be carried out during summer months (preferably during April to mid-July) and monsoon (mid-July to end of August). Before offering the plant for capacity test, the tenderer will conduct trial run of the plant for 20 days subject to minimum aggregate of 120 hours for each plant so as to be sure that the plants are running satisfactorily. In case of a major problem being noticed during initial test run, the period of 20 days/120 hours will start afresh.

1.8 GUARANTEE

The compressors shall be provided with on-site guarantee for satisfactory working for a minimum period of five years. The remaining air-conditioning equipment shall be guaranteed for a minimum period of one year. Various defects arising/reported within the guarantee period as stated above will be rectified by repairs/replacement at site by the tenderer free of charge. This shall also include free supply of the refrigerant and compressor oil etc., if required, by the tenderer for optimum running of the plant during the guarantee period of the compressor. In this regard, the tenderers may also refer to other conditions specified in clause 1.6 above.

1.9 QUOTATIONS IN MKS/S.I. UNITS

Values for performance figures given in these specifications are in MKS/SI units. Full particulars of all figures of performance of the equipment offered shall be furnished in MKS/SI units. The technical data should be furnished in MKS/SI units only. The technical data should be typed or in capitals.

1.10 TRAINING

The tenderer shall undertake to extend free on-site training (for a period of not less than five days) in operation & maintenance of air-conditioning plants offered by them to four technical personnel from DDK, Thiruvananthapuram. Details of the training offered with period (not less than five days) may be indicated. The training shall be arranged at site.

1.11 PAST EXPERIENCE

The tenderer should furnish detailed data on experience certificates regarding his past experience in supply, erection and commissioning of air-conditioning plants of similar or higher capacity and type.

1.12 AFTER SALES SERVICE

The tenderer shall ensure adequate and prompt after sales service in the form of maintenance/servicing personnel and spares as and when required with a view to minimizing the breakdown period. The tenderer has also to give a written undertaking from OEM that spare parts required for air-conditioning plants shall be available off-the-shelf for a period of at least 10 years from the date of commissioning of the plants at site. Sufficient advance intimation shall be given to the indenter before phasing out any spare component/part so that indenter is able to stock the same for future use.

1.13 MISCELLANEOUS

1.13.1 Completeness of tender

In order to avoid correspondence and clarifications at a later date, tenderers are requested to indicate clearly all the technical details and information asked for in Section II & III of this specification. Each column should be filled up. No dash (--) should be written.

1.13.2 Net price may be quoted by the tenderer after taking into consideration of all works

SECTION - II**SPECIFICATION FOR SITC OF 3X20 TR AIR-COOLED PACKAGED TYPE AIR-CONDITIONING PLANTS AT DDK, THIRUVANANTHAPURAM**

S.No	Particulars	DDK's Requirement	Tenderer's Offer
1	Packaged Air-Conditioner		
	Capacity	20 Ton +/- 5%	
1.1	Nominal cooling capacity	60478 kcal/Hr +/- 5%	
1.2	Power Supply		
1.2.1	Operating Power supply	3 Ph, 415 V, +/- 10%, 50 +/- 3% Hz	
1.2.2	Starting Current	Not to exceed the limits stipulated by the local electric supply company. Provision of reduced inrush starting system to be confirmed by the tenderer.	
1.2.3	Normal (full load) running current	To be indicated by the tenderer	
1.3	Working Noise	Silent and smooth-noise level not to exceed 85 dBA at a distance of 1 m from the machine.	
2	AHU – Indoor unit	Supply, Installation, Testing & Commissioning of DX type Double skin floor mounted, dual coil horizontal/vertical air handling unit made of 40 mm thick sandwiched panels with polyurethane foam (PUF) insulation, complete with Plug type fan, VFD driven electric motor, coil section, filter section, drain pan along with VFD Panel etc. The Cooling coil is of copper tubes and aluminium fins of 6 rows deep. Filter section with 50 mm thick metal viscous/washable synthetic type air pre-filters efficiency 80% down to 10 micron. TEFC sq. cage induction motor suitable for 415 ± 10% volts, 50Hz, 3 Phase AC supply including mounting and fixing arrangements, IE3 Motor Plug fan anti vibration springs/isolator bearings etc., drain connections, stainless steel (18G) drain pan with PUF insulation. 24000cfm, 60 Ton, 50mmwg	
2.1	AHU Capacity	1 AHU of 60 Ton capacity	
2.2	AHU Casing	Double skinned panels shall be made of galvanized steel with 40 mm PUF insulation fixed to 2.5 mm thick aluminium alloy thermal break profile framework with stainless steel screws. Outer sheet: galvanized 0.6mm pre-painted/pre-plasticised sheet; inner: 0.6mm GSS. Aluminium profiles shall have internal round corners to avoid dust accumulation. Housing deliverable in total/semi knocked-down condition; framework assembled with mechanical joints for a sturdy, strong frame. Casing shall consist of an independent structural steel frame, reinforced and braced for maximum rigidity, with individually removable double-skin insulated panels, sectionalised into fan section, coil section, access sections, filter section, mixing box section and drain pan. Minimum 450mm access door shall be provided for easy access to filters, coils, fans etc., with nylon handles and GM chrome-plated locks, heavy-duty die-cast aluminium hinges with SS pivots, and a safety trip-switch to cut power when the door is opened. Sections joined with continuous gasketing for an airtight enclosure. Enclosure panels fastened with thread-cutting sheet-metal screws, sealed with 3mm minimum continuous neoprene gasketing. Inspection/service doors for interior access, filter removal and coil inspection, full height/width of their sections.	

S.No	Particulars	DDK's Requirement	Tenderer's Offer
		Cooling coils, special and standard filters shall be housed in a separate enclosure of suitable size and length. Inspection doors shall have neoprene rubber T-section seals, hinges and locking arrangements. Gaps between filter frames and housing shall have synthetic rubber packing to eliminate air leakage. All filter frames shall be epoxy painted. Flat filter section suitable for mounting filters vertically.	
2.3	AHU Blower Fan and Fan Section		
2.3.1	Type	Centrifugal	
2.3.2	Direction of discharge	Vertical	
2.3.3	Nominal fan discharge	24000 CFM	
2.3.4	Fan Features	Fans shall be centrifugal, double inlet double width type with heavy-duty backward curved blades and scroll type housing, pre-greased ball bearings sealed for life. Fan casing and wheels shall be made of galvanized steel sheet.	
2.3.5	Static pressure at nominal discharge	75 mm WG	
2.3.6	Fan speed	Not exceeding 1800 RPM	
2.3.7	Fan Motor	Rated for continuous duty, conforming to IS:325 'Three phase induction motors'. BEE Star Rating of 5. Squirrel cage, totally enclosed, Class F insulation, EFF1 rating, specially designed for quiet operation. All rotating parts dynamically balanced individually; complete assembly statically and dynamically balanced. Fan and motor mounted on an integral base frame erected on cushy foot /spring mounts, isolated from the casing with heavy-duty rubberised mounts. Electrical interlock to trip the fan on opening of AHU door. Supply: 3 phase, 4 wire, 415V +/-10% / 50Hz. Fan should be direct driven from VFD motor	
2.3.9	Variable Frequency Drive (VFD) for AHU Motor	Supply, Installation, Testing & Commissioning of 3-Phase VFD Drives with AC Choke. Input voltage 3 phase 380V-480V, permitted fluctuation -15% to +10%. LED digital keyboard, communication port for BMS integration (open protocol RS-485). 5 DI, 2 AI, 2 AO, 1 DO. IP Rating IP20 with built-in C3 filter. Housed in IP54 enclosure with complete wiring and termination, Auto/Manual selector switch, Speed Raise/Lower provision, Start/Stop push buttons and indication.	
2.4	AHU AIR FILTER		
2.4.1	Filter Type	Factory-assembled pre-filter (EU-4) with non-woven synthetic washable media of 10 micron particle size, 90% efficiency, before cooling coil; fine filter (EU-7/F7) with synthetic fibre media, aluminium-anodized flanged rigid media frame, 99% efficiency at 3 micron. Filtering to conform to ASHRAE & EUROVENT standards.	
2.4.2	Filter Path	Air filter shall be provided in the return air path.	
2.5	AHU Cooling Coil		
2.5.1	Cooling coil construction	Constructed from 13mm OD, 27 SWG round seamless copper tubes, mechanically bonded to 37 SWG aluminium mild rippled fins with die-formed directional guide channels, assembled within a heavy-gauge galvanized steel framework. Fins 12 FPI, mechanically bonded to copper pipes. Coils provided with air vent and drain plugs; assembly supported on slide frames for easy withdrawal. Bends ready-made with solder rings on both ends; continuous aluminium dual sine-wave fins; tubes staggered in direction of air flow. Coils mounted on structural steel tracks, removable from either end	

S.No	Particulars	DDK's Requirement	Tenderer's Offer
		without dismantling other sections. Coil headers fully enclosed within the insulated coil casing section; inlet/outlet connections extended minimum 150mm beyond the coil casing exterior through pre-cut openings with sealing collars. Drain connections furnished for each coil, external to the unit cabinet. Drain pan constructed of stainless steel, installed inside the double-skin panel to avoid condensation, fitted with drainage coupling on both sides, three-directional slope, die-pressed without brazing joints, insulated with fire-retardant thermal insulation. Coils tested against leaks at hydraulic pressure of 10 kg/cm ² maintained for 2 hours with no observed drop.	
2.6	AHU Expansion Valve		
	Type	Direct Expansion	
	Capacity	To match refrigeration Capacity	
3	Outdoor Air Condensing Unit	The DX Air-Cooled Condensing Unit shall be self-contained, factory tested and assembled. Made of galvanised steel sheets, powder coated. Complete with Inverter type scroll compressor, condenser coil, fans, charging points and controls. External panels removable, 1.2mm zinc-coated sheet steel, powder-coated cabinet.	
3.1	Air Condensing Unit Capacity and Type	3 x 20 Ton Under ASHRAE conditions of 4.4°C suction and 40.5°C condensing temperature — at least 60478 kcal/Hr +/- 5%. Not more than three units to form the total capacity of plant.	
3.2	Air Condensing Unit Construction	Air-cooled condenser with single or multiple coils, minimum 3 rows deep. Tube thickness 0.3mm, dia not less than 0.7mm, internally grooved. Fins of aluminium, thickness 0.16mm, 13 fins per inch, mechanically expanded bonding of tubes & fins. Condenser fan direct driven, motor mounted on fan guard with double ball bearing, Class F insulation. Fan propeller type, mild steel. Low-profile weatherproof type with high efficiency direct-drive external rotor motors and axial blade fans. Constructed from heavy-duty aluminium, corrosion-resistant via anti-corrosive epoxy coating for polluted areas. Heavy-duty mounting legs and assembly hardware included. Suitable for 24-hour operation, vertical or horizontal discharge. Fully factory wired, requires 230V single phase 50Hz electrical service. Heat exchanger includes mechanically expanded cross-hatched copper tubes and louvered aluminium fins.	
3.3	Heat Rejection Capacity	Corresponding to compressor duty	
3.4	Air Condensing Unit – Type of Cooling	Condenser coils, air-cooled	
3.6	Outdoor Unit Cabinet	Weatherproof, with necessary arrangement for placing the cabinet made with MS Angle Iron framework.	
3.7	Outdoor Unit Mounting	Mounted on vibration-proof mounting at a suitable place (location decided by zonal offices in consultation with the station, minimizing refrigerant pipe length).	
3.8	Routing of Refrigerant Pipe	Refrigerant pipes from plant room to outdoor unit secured by routing through proper cable trays.	
3.9.1	Compressor Type	Inverter type Scroll compressor, Each unit with capacity at least 20,159 kcal/Hr +/- 5%.	
3.9.2	Refrigerant	Non-ODS refrigerant as per ASHRAE standards 34 Class A-1 only.	
3.9.3	Make of compressor	By standard and reputed manufacturer	
3.9.4	Compressor Type and Construction	High efficiency compliant scroll design, EER not less than 11.1 BTUH/Watt (COP not less than 3.25) at ARI rating conditions. Charged with mineral oil, designed for non-ODS refrigerant (ASHRAE 34 Class A-1 only). Internal motor protection, mounted on vibration isolators.	

S.No	Particulars	DDK's Requirement	Tenderer's Offer
		Hermetically sealed scroll compressor for 3-phase operation, 380–420V, 50Hz. Mounted on the base of the packaged unit on resilient rubber grommet mounting with steel sleeve bolts and nuts.	
3.9.5	Mounting	Suitably mounted on vibration absorbers.	
3.9.6	Protection Circuits	Rated for continuous working under tropical conditions; suitable starter with overload and under-voltage protection, single-phasing preventers. Thermal protector (preferably winding-embedded) for automatic motor switch-off if winding temperature exceeds safety limits.	
3.9.7	Interlocking of Compressor with Blower & Condenser units	Provision for interlocking the compressor with blower motor and condenser cooling fan motor shall be available.	
3.10	Microprocessor-based controller with LCD display for compressor and condensing unit	Microprocessor based, large LCD backlit graphic display, controls accessible from unit front without removing panels. Accurate temperature control; selectable return/supply air control. User-friendly menu-driven interface with help screens; access protection against unauthorised changes. Normal mode display: unit number, temperature set points/actuals, time, date, operating status, dynamic mode icons.	
3.10.1	Control system features	Programmable: temperature set point, high temperature alarm, unit identification number, startup delay, cold-start delay, fan run-on timers, sensor calibration, compressor sequencing according to life served. Alarms (audible, visual, general) for high temperature, high pressure, low pressure. Protections: single-phasing preventors, reverse phasing, phase imbalance, phase failure, overload tripping (MPCB) of all components.	
3.11	First charge of Refrigerant and Oil	Included in the supply.	
3.12	Air Condensing Unit Refrigerant Circuit	Direct expansion type, one or more hermetic scroll compressors with crankcase heaters. Hot gas bypass solenoid valve on single-compressor models. Includes manual-reset high-pressure control, auto-reset low-pressure switch, externally equalized thermal expansion valve, high-sensitivity refrigerant sight glass, large-capacity filter drier, charging/access ports in each circuit. Each refrigeration circuit includes rigidly mounted isolation valves in discharge and liquid lines (air-cooled units only).	
3.13	Thermostat for shutting off the plant	Separate thermostat in the return air circuit, operational between 20°C–30°C for cutting out/bringing in the compressor. Each plant with separate set of thermostats, adjustable type, accuracy within +/- 1°C.	
3.14	Refrigerant, Electrical & Control Circuits	The air conditioning unit shall be complete with all refrigerant piping, electrical wiring and control switches necessary for control and operation of the equipment within the unit.	
4	Ducting	AHU outlet connected to the existing GI duct. Interconnecting GI duct constructed with 26G perforated aluminium sheet or with acoustic insulation of 25mm thick fibre-glass rigid board with RP tissue.	
5	Location of AHU, Air Condensing Units and Electric Switch Gear Panels	AHU must be installed in the AHU-8 room (After dismantling AHU-8). Air condensing units installed at a suitable place after inspection of the site. Electric switchgears of the new AHU to be installed near the old electric switchgear location of the old AHU, so that routing of cable in the existing trenches can be done.	
6.1	Installation of Piping	All necessary piping provided to make the AC equipment complete and ready for regular, safe operation, per manufacturer recommendation. All condensate drainage pitched in direction of flow for proper drainage. Necessary precautions to close pipe ends to prevent debris entry. Pipes cut accurately to site measurements to	

S.No	Particulars	DDK's Requirement	Tenderer's Offer
		place without forcing.	
6.2	Piping Support	Proper supports for all piping/tubing to prevent vibration or excessive deflection. Extra supports at bends and heavy fittings (valves) to avoid undue stress. Independent supports so equipment is not stressed by piping weight.	
6.3	Piping Sleeve	Where pipes pass through walls, steel pipe sleeve 50mm larger than pipe outside diameter shall be provided. Where pipes are insulated, sleeve to be large enough for ample clearance for insulation also.	
7.1	Filter Clogging Indicators	Necessary sensors (differential pressure or other electronic) with indicators for clogged air filter, installed by OEM of packaged unit or project implementing agency.	
7.2	Condenser Clogging Indicators	Necessary sensors (differential pressure or other electronic) with indicators for clogged condenser, installed by OEM of packaged unit or project implementing agency.	
8.1	Vibration Isolation	Foundation blocks with suitable mounting arrangements and vibration isolation for the AHU & outdoor units for effective control of transmission of vibration and structure-borne noise. Instructions per Annexure-II 'Noise & Vibration Control' to be followed.	
8.2	Heat Insulation Treatment in AC Plant Room	Necessary heat insulation treatment from false ceiling up to real ceiling shall be carried out as per the sketch at Annexure-VIII. Necessary under-deck heat insulation treatment shall be carried out on the roof of the AC Plant Room over the false ceiling.	
8.3	Platform for Outdoor Condenser Unit	Supply, fabrication, cutting, welding, erection at site and painting of MS angle structural steel work for mounting the condenser units, per good manufacturing/installation practice and approved drawings. Structural steel to IS:2062 (latest version); welding electrodes to relevant IS codes; fabrication/erection per IS:800, welding per IS:816 and IS:822. Steel work painted with one coat zinc chromate primer and two coats synthetic enamel paint.	
8.4	Outdoor Piping	Refrigerant pipes from AHU to all outdoor units should be secured by routing through proper cable trays.	
9	Electric Control Panel	Supply, Installation, Testing & Commissioning of Electrical panel (wall mounted) with MCCB as incomer, power contactors for individual units, selector switch (auto/manual/off), control wiring, provision for fire interlock, ON/OFF push button, ON/OFF & trip indication lamp, power and control wiring, terminals, backup MCB, metering (1 no. multidata meter — V, A & Hz), CT's & RYB phase indication lamp, control MCB, 1 no. 230/24V transformer 12VA etc. Control/distribution panel to supply power for AHU and outdoor condensing unit operation, with monitoring of AHU status locally and remotely at the control room, with all necessary interconnecting cables. Includes end termination of cables — single compression type cable gland, sockets, crimping lugs, insulation tape, gland earthing with adequate copper clamps and bare copper wire connecting to the main bus bars.	
9.1	Construction	One cubicle-type switchboard with appropriate ratings of an incoming MCCB, bus bar and individual MCCB units for each plant, provided in the AC plant room.	
9.2	Wiring of Control Circuit of AC Plant		
9.3	Bus-bar	Three phase and neutral copper bus bar, adequately rated for the load.	
9.4	Electrical Earthing	Two nos. of earthing shall be provided as per Annexure-VII. Earth resistance of each earthing shall be less than 1 Ohm. Earth connected to electrical switchgear of AC plants with 25mm x 3mm copper strip.	

S.No	Particulars	DDK's Requirement	Tenderer's Offer
9.5	Indicators / Instruments	Switchboard provided with at least: voltmeter with selector switch for measuring voltage of all 3 phases; separate ammeter of suitable range for each plant; neon lamp/LED type phase indicator in each phase; indicators for functioning of individual plants.	
9.6	Remote Status Indication Panel	A panel with status indications of the working of the packaged unit shall be wired & installed in the control room, with Green Lamp/LED for OFF and Red for ON conditions. Tenderer shall carry out SITC of remote indication panel including cabling from AC plant room to control room.	
9.7	Electrical Wiring	Wiring in AC plant room for AC equipment carried out in concealed conduits per site condition; conduits provided and buried in walls/floor by tenderer. Alternatively cables neatly taken on cable trays above 2300mm height.	
9.8	Cables	Copper conductor PVC cables of 1100V with suitable current rating for wiring of various plants. 4 Core x 10 Sq.mm to be used for AHU motor.	
9.9	Conformity to IS Standards	Switchboard, electrical equipment and wiring shall conform to relevant IS specification.	
9.10	Lighting Arrangement above False Ceiling	Wiring for incandescent lamps — 4 nos. above false ceiling with ON/OFF switch below false ceiling, for inspection purposes.	

SECTION - III**SCHEDULE OF REQUIREMENTS FOR SITC OF 3X20 TON AIR-COOLED PACKAGED AIR-CONDITIONING PLANTS**

S.No	Description	Qty & Unit	Ref. to paras for technical specifications	Tenderer's Compliance
1	Supply, Installation, Testing, Commissioning of 20 Ton Capacity Air-cooled scroll condensing unit with eco-friendly Non-ODS refrigerant as per ASHRAE standards 34 Class A-1 only.	3 Sets	8 of Section-II	
2	Supply, Installation, Testing & Commissioning of 60 Ton Capacity / 24000 CFM horizontal floor mounted double skin Air handling unit with 50MM thick Puff Panels, 6 Row deep copper Direct expansion cooling coil with distributors, backward curved centrifugal fans of Kruger/Nicotra make driven by 3 Ph Sq. Cage induction motors, with outlet canvass and supply air dampers and Variable Frequency Drives.	1 Sets	2 & 4 of Section-II	
3	Supply, Installation, Testing & Commissioning of 3-Phase VFD Drives. Drives shall have AC Choke. Input Voltage: 3 phase 380V-480V with permitted fluctuation range - 15%~10%. VFD shall have LED digital keyboard, communication port for integration with BMS (open protocol RS-485), 5DI, 2AI, 2AO, 1DO, IP Rating IP20, built-in C3 filter, housed in IP54 enclosure with complete wiring and termination. Enclosure shall have Auto/Manual selector switch, Speed Raise/Lower provision, with push buttons for Start/Stop and indication for the same.	1 Sets	2 of Section-II	
4	Supply & laying of copper pipe: (a) 1-5/8" Copper pipe for suction line suitable for 20 Ton AC, with Nitrile rubber insulation of 19mm thick (as per actuals) (b) Copper pipe for liquid line suitable for 20 Ton AC (as per actuals)	As per actuals	3.8, 8.6, 6 of Section-II	
5	Supply & Installation of GI perforated cable tray with top cover with supports. Size: 300 x 75mm. Make: JSW / Intech / PROFAB.	As per actuals		
6	UPVC drain piping, insulated with 9mm nitrile rubber insulation.	Approx.		
7	Supply & fixing of control panel/distribution panel including remote monitoring at Control Room regarding the status of AHU, compressor etc., with all necessary interconnecting cables and power supply extended up to the present LT panel with copper cable (3 core, 25 sq.mm armoured cable, to be provided by the tenderer). Length to be decided in the pre-bid meeting.	1 Sets	9 of Section-II	
8	Providing visual remote indication at control room with necessary electrical wiring, combined for both AHUs.	1 Set		
9	Providing Heat Insulation Treatment in AHU Room.	As per size of AHU	8 of Section-II	
10.1	Providing Under Deck insulation.			
10.2	Providing Iron Angle Platform Arrangement for Outdoor Condensing Units.	1 Job		
11	Filter clogging / Condenser clogging indicators for Outdoor Condensing Units, Cooling Towers, AHU's.	—		

S.No	Description	Qty & Unit	Ref. to paras for technical specifications	Tenderer's Compliance
14	Any other materials/works required to complete the SITC. Description of the item/work to be mentioned by the bidder.	1 Job		
15	Accessories: The price/charges of each item of spares shall be quoted separately along with make.	—		
15.2	Pressure Gauges for refrigerant & oil (High Pr., Low Pr. & Oil Pr. gauge).	2 Nos. each		
15.3	Dial type thermometer for suction and discharge side.	2 Nos. each		
17	Supply and Application of 25MM thick External Thermal Insulation of Supply Air ducting. Material: cross-linked polyolefin/polyethylene foam, closed-cell structure, factory-applied reinforced aluminium foil, density within 25 Kg/m ³ , thermal conductivity not exceeding 0.032 W/mK. Stuck to cleaned duct surface with factory pre-fixed cold adhesive; finished with 200 gsm glass cloth.	As per actual requirement		

SECTION - IV**SCHEDULE OF MEASUREMENTS AND CHECKS**

S.No	Item	Measurement	Unit
1	Compressor	i) Insulation of compressor motor ii) Power consumption iii) Refrigerant gas suction pressure iv) Refrigerant gas discharge temperature v) Refrigerant gas discharge pressure vi) Speed of compressor	Ohm V, A Kg/Sq.cm Deg.C Kg/Sq.cm RPM
2	Condenser	i) Insulation of condenser fan motor ii) Speed of condenser fan motor iii) Cross section area iv) Air velocity	Ohm RPM — —
3	Fan / cooling coil	i) Quantity of air flowing (reading at return intake) ii) Air temp. entering – DB & WB iii) Air temp. leaving – DB & WB iv) Static pressure developed by each fan (pitot tube to be used) v) Insulation of blower motor vi) Power consumption of blower motor vii) Speed of the blower motor viii) Speed of the blower	CFM Deg.C Deg.C mm of WG Ohm V, A RPM RPM
4	Any other item suggested by indenter/representative	—	—

CHECKS

The following checks will be made before the plants are operated for trial run:

S.No	Check	Requirement
1	General visual and mechanical checks of the installation.	
2	Verification of alignment, tightness and completeness of assembly.	
3	Pressure test with nitrogen before charging, to test the strength of joints.	A pressure of 24 Kg/sq.cm shall be applied to the high side and 7 Kg/sq.cm on the low pressure side.
4	Vacuum Test	A vacuum of 0.0014 Kg/sq.cm (0.2 Psig) shall be created and maintained for 24 hours before charging the refrigerant.
5	Working of protective devices: i) L.P. cutout ii) H.P. cutout	
6	Working of thermostat: i) Operating temp. for total shut down of compressor.	
7	Working of expansion Valve	Check for any hissing noise
8	Uniformity of temperature over the entire surface of cooling coil	
9	Undue heating of component such as switchgear, panel, motors, refrigerant pipes etc	
10	Temp. of fuses of AC plants after 4 hours of working.	

11	Overload settings of the motor	
12	Noise level with compressor and condenser working, and with compressor disconnected and system working normally	Sound pressure meter to be used ('A' scale and 'C' scale to be taken).
13	Noise level at a distance of 1 meter from the air cooled condenser	do

ANNEXURE - I**STATEMENT OF TECHNICAL SPECIFICATION AND PERFORMANCE**

The tenderer should submit the following technical data of the equipment offered along with the tender (vide clause 1.3.2 of Section I).

Sl No:	Items	
A	AIR CONDITIONER	
i	Packaged air conditioner make	
ii	Packaged air conditioner type	
iii	Guaranteed refrigerating capacity of packaged air conditioner for return air conditions of 26.7°C DB and 17.9°C WB	Kcal/Hour
iv	% De-rating of capacity with increase in ambient temp. by	
a	5°C	%
b	10°C	%
B	COMPRESSOR UNIT	
i	Refrigerating capacity under ASHRAE Kcal/Hr rating conditions & 50Hz operation of the motor	Kcal/Hour
ii	Number of compressors per packaged AC plant	
iii	Capacity	
iv	BHP required for the compressor	
v	Operating speed of the compressor	
vi	Refrigerant (name) & quantity	
C	FAN (BLOWER)	
i	Blower (fan) speed	RPM
ii	Static pressure developed	WG
iii	Make, Model & HP of blower motor	
iv	Speed of blower motor	RPM
D	COOLING COIL	
i	Coil face area	Sq.m
ii	Number of rows	
iii	Fins per cm	
iv	Make, Model & HP of fan motor	
E	AIR COOLED CONDENSER	
i	Coil face area	Sq.m
ii	Number of rows	
iii	Fins per cm	
iv	Make, Model & HP of the fan motor	
v	Speed of condenser fan	RPM
vi	Heat rejection capacity	

ANNEXURE - II**CODES, REGULATIONS, NOISE AND VIBRATION CONTROL**

The latest codes and regulations shall be followed in execution of the work; however some details are given below:

S.No	Description	IS Code
1	Safety code for air-conditioning	IS 659:1964 (reaffirmed 1991)
2	Safety code for mechanical refrigeration	IS 660:1963 (reaffirmed 1991)
3	Testing of refrigeration compressors	IS 5111:1993
4	Air-cooled heat exchangers (Amendment 1)	IS:10470:1983 (reaffirmed 1991)
5	Hermetic compressors	IS:10617 Part I, II & III:1983 (reaffirmed 1991)
6	Thermostats for use in refrigeration etc.	IS:11338:1965 (reaffirmed 1991)
7	Steel for general structural purpose	IS:2062:1992
8	Piping work up to 150mm Dia	IS 1239 Part I & II 1990/1992 & BS:3601
9	Hot Dip Zinc coated steel Tubes	IS 4736:1968
10	Gaskets	IS 638:1979 (reaffirmed 1993)
11	Mild steel Tubes & fittings	IS 1239 Part I & II
12	Colour code for the identification of pipelines	IS:2379:1963
13	Specific requirements for the direct switching of the individual motors	IS 4064 (Part II):1978
14	PVC Insulated (HD) Electric Cables for working voltage up to 1100 volts and up to 11 KV grade respectively	IS:1554 (Part I & II)
15	Starter	IS 8554 (Part I):1979
16	Inspection and testing of installation	IS 732 (Part III) 1979
17	Three phase induction motors	IS 325
18	Code of practice for electrical wiring installation	IS 732:1989
19	Code of practice for earthing	IS 3043:1966
20	Wrought aluminium & aluminium alloy sheet and strip for general engineering purposes	IS:737
21	Bourdon tube pressure and vacuum gauges	IS 3624
22	Glossary of terms used in refrigeration and air-conditioning	IS:3615
23	Specification for single phase small AC & Universal motors	IS:996
24	Circuit breaker A.C.	IS 2516:1980 (Part I & II)
25	Contactors for A.C. Voltage 1100V	IS:2959 1975
26	Low voltage switch gear and control gear Assemblies	IS 8623:1993 (Part I & II)
27	Code of practice for selection of Starters for AC induction motors	IS 3914
28	Code for selection, installation & maintenance of switch gear and control gear Part I & IV	IS 10118:1982
29	Conduits for electrical installations	IS 9537:1981 part I to IV
30	Permissible limits of noise level for rotating electrical machines	IS 12065:1987
31	Code of practice for installation and maintenance of motors	IS 3106:1966
32	Electrically welded steel pipes for water, gas and sewage	IS 3589
33	Method for testing panel type air filters and AC purposes	IS 7613:1975 (reaffirmed 1991)

34	Unbonded glass wool for thermal insulation	IS 3690:1974
35	Expanded polystyrene for thermal insulation	IS 4671:1984 (reaffirmed)
36	Centrifugal fans (1st Revision)	IS 894:1987 (reaffirmed 1991)

SAFETY CODES

The following IS codes shall be followed:

S.No	Description	IS Code
1	Safety code for air-conditioning (Revised) amendment.	IS:659:1964 (reaffirmed 1991)
2	Safety code for mechanical refrigeration	IS:660:1963 (reaffirmed 1991)
3	Safety code for scaffolds & ladders	IS:3696
4	Code of practice for fire precaution in welding & cutting operations	IS 3016
5	Code for safety procedures and practices in electrical works	IS:5216
6	Code of practice for safety and health requirements in electrical & gas welding and cutting operations	IS:3696

SPACE

All shop drawings shall be prepared by the Tenderer after examining Architectural and other drawings, site conditions and shall be based and designed on the spaces shown on them.

NOISE AND VIBRATION CONTROL

The tenderer must take all necessary precautions to have a minimum noise generation and its transmission as deemed necessary. Minimum vibration as permitted by the relevant IS code shall be ensured. A few points for guidance are given below:

Double fire-retardant flexible connection shall be made from air discharge to the duct. Vibration isolation pads of suitable thickness and loading for elimination of vibration shall be provided under packaged unit, air cooled condensers etc. as per recommendations of the manufacturer.

Flexible conduits of suitable diameter and length are to be provided for making flexible electrical connection to the motors. All conduit connections where conduits are 60mm and larger shall be made of at least 1.2 times the minimum length and installed in U shape, grossly slack, to provide maximum vibration isolation. The floor supported piping shall be mounted on rubber pads with 7.5mm ribbed neoprene pads between the base plate and the support.

All suspended ceiling shall be isolated on hangers. The vibration hangers shall have stable steel spring. A neoprene neck shall be provided where the hanger rod is connected to the supporting element to prevent metal-to-metal contact. The steel spring element shall have static deflection equal to half the static deflection of the isolated equipment and shall be used to support all equipment from the vibration equipment or from the floor or ceiling of the equipment room.

All other mechanical equipment such as expansion tanks etc. shall have double deflection neoprene in compression for overload of 9mm. The top and bottom surface shall be ribbed and bolt-holes shall be supplied in the base.

In case of conduits, pipes, tubes, the annular space between construction and penetrating element shall be filled with fibrous material and both sides sealed with hardening-resistant sealant. Details given in para 3.3.2 of Section III.

All floor mounted vibration isolated equipment shall be supported on steel frames or concrete block.

The air conditioning tenderer shall take all other precautions or provide on his own if not specified above for reducing noise level to within limits or minimise vibrations in all mechanical equipment without any additional cost.

ANNEXURE - III

INSPECTION PROCEDURE FOR INITIAL INSPECTION OF PACKAGED AC PLANTS AT MANUFACTURER/TENDERER WORKS

Air Conditioning Plant Comprising Compressor & Condenser:

1. Physical verification of the unit for its make, model, type, capacity etc. shall be carried out of the equipment offered at manufacturer's/tenderer's works with reference to AT.
2. Manufacturer's test certificate shall be scrutinized to check compliance with the requirement as specified in the order.

Fan and Cooling Coil:

1. Salient features such as model, size, physical dimensions and other details of various sections, fan motor detail, fan dimension etc. shall be verified against the contract requirements.
2. Manufacturer's test certificate for the motor and air-handling unit shall be furnished and scrutinized as per contract requirements.
3. Test certificate for static and dynamic balancing of the fan/blower shall be furnished for verification.
4. Manufacturer's internal test certificate on salient features like type, material, number and gauge of fins and tubes and number of rows shall be furnished and verified with reference to contract requirements.
5. Hydraulic pressure to the extent of 24 Kg/cm² shall be applied and this pressure should be maintained for 15 minutes, and no drop should be observed indicating any leaks. Alternatively, pneumatic submerged pressure test shall be carried out for 15 minutes with compressed air or dry nitrogen at a pressure of 24 kg/cm² to ensure that there is no leakage.

Switch Gear, Control Gear and Measuring Instruments:

1. It shall be verified that control panel is of CPRI approved make.
2. Manufacturer's test certificate for MCCB shall be verified as per contract requirement.
3. Availability of measuring instruments of required accuracy for conducting different tests shall be verified.

Electric Motor:

1. It shall be verified that the electric motors are of approved make.

Notes:

- i) All the components where initial inspection at manufacturer's works is not stipulated shall be of approved make.
- ii) Accuracy of testing instruments shall be as mentioned in the inspection procedure laid down in this Section.

ANNEXURE - IV

INITIAL TEST AT SITE AFTER INSTALLATION WITH TEST READINGS

Tenderer's representative shall witness all types of routine tests. Performance tests of equipment/control installed shall be carried out at site.

On completion of installation, the tenderer shall conduct initial test. Any defects found shall be rectified immediately. The test readings during initial test run shall be recorded in the Test Readings Proforma enclosed with this Annexure.

The initial test, which has to be carried out by the tenderer, shall be (but not limited to) as follows:

- a) Pressure tests for all refrigerant circuits as given in this specification/as recommended by the manufacturer before charging the system.
- b) To check satisfactory functioning of all electrical motors, switchgear, control, pressure testing of all air handlers etc.
- c) To check alignment of motors.

Notes:

All necessary test instruments such as thermometers, pyrometer, pressure gauges, anemometer, dust-count meter, sound level (decibel) meter, personnel, and required quantity of gas, oil and lubricants etc. shall be arranged by the tenderer at his own expense. However, power for testing and commissioning of the system shall be provided free of cost by the indenter.

In addition to the initial test as explained in Section I and above, the tenderer shall also give two continuous running tests of the system during peak summer and monsoon, each of 24 hour duration, or for 3 days each of 10 hour duration when the ambient conditions are close to the design conditions. The capacity test shall be conducted in presence of a representative of the indenter and inside and outside conditions shall be recorded on an hourly basis.

Capacity of Plant:

Before capacity tests are conducted, the following aspects shall be checked:

- a) The tests shall be conducted during the peak season only. In case the outside design conditions are not available, then tests shall be conducted at design conditions closest to outside design conditions.
- b) All internal loads such as light load, occupancy or equipment load shall be close to design loads. Otherwise, artificial load shall be generated to satisfy internal design loads.
- c) Hourly readings of temperature, relative humidity, electric current, power consumption etc. shall be recorded. The capacity of the system components shall be computed as given in the Test Reading Proforma below.

Test readings shall be furnished in duplicate prior to handing over the plants.

1. Outside Design Conditions:

- a) Season :
- b) Dry bulb temp. Deg.C :
- c) Wet bulb temp. Deg.C :

2. Inside Design Conditions:

- a) Dry bulb temp. Deg.C :
- b) Wet bulb temp. Deg.C :
- c) Relative Humidity % :

3. Compressor:

- a) Suction Temp. Deg.C :
- b) Suction Pressure kg/Sq.cm :
- c) Discharge temp. Deg.C :
- d) Discharge pressure kg/Sq.cm :
- e) Oil Pressure kg/Sq.cm :
- f) Capacity of compressor motor(HP):
- g) Starting current (Amps) :
- h) Readings of voltmeter, Ammeter and power factor meter.

Power computation at various loads of	100%	75%	50%	25%
Motor current (Amps)				
Voltage (Volts)				
Starting current (Amps)				
Power Factor				

4. Condenser:

- a) Air flow rate CFM :
- b) Heat rejection capacity :

5. Fan and Coil Section:

- a) Coil face area Sq.mt. :
- b) Maximum air quantity CFM :
- c) Actual air quantity CFM :
- d) Air velocity m/hour :
- e) Entering air temp. DB/WB Deg.C :
- f) Leaving air temp. DB/WB Deg.C :
- g) Motor drive for air handlers —
- i) Rated horse power (HP) :
- ii) Rated voltage/current :
- iii) Actual voltage/current :
- iv) Starting current (Amps) :

The above data should be recorded for each individual unit.

6. Filters:

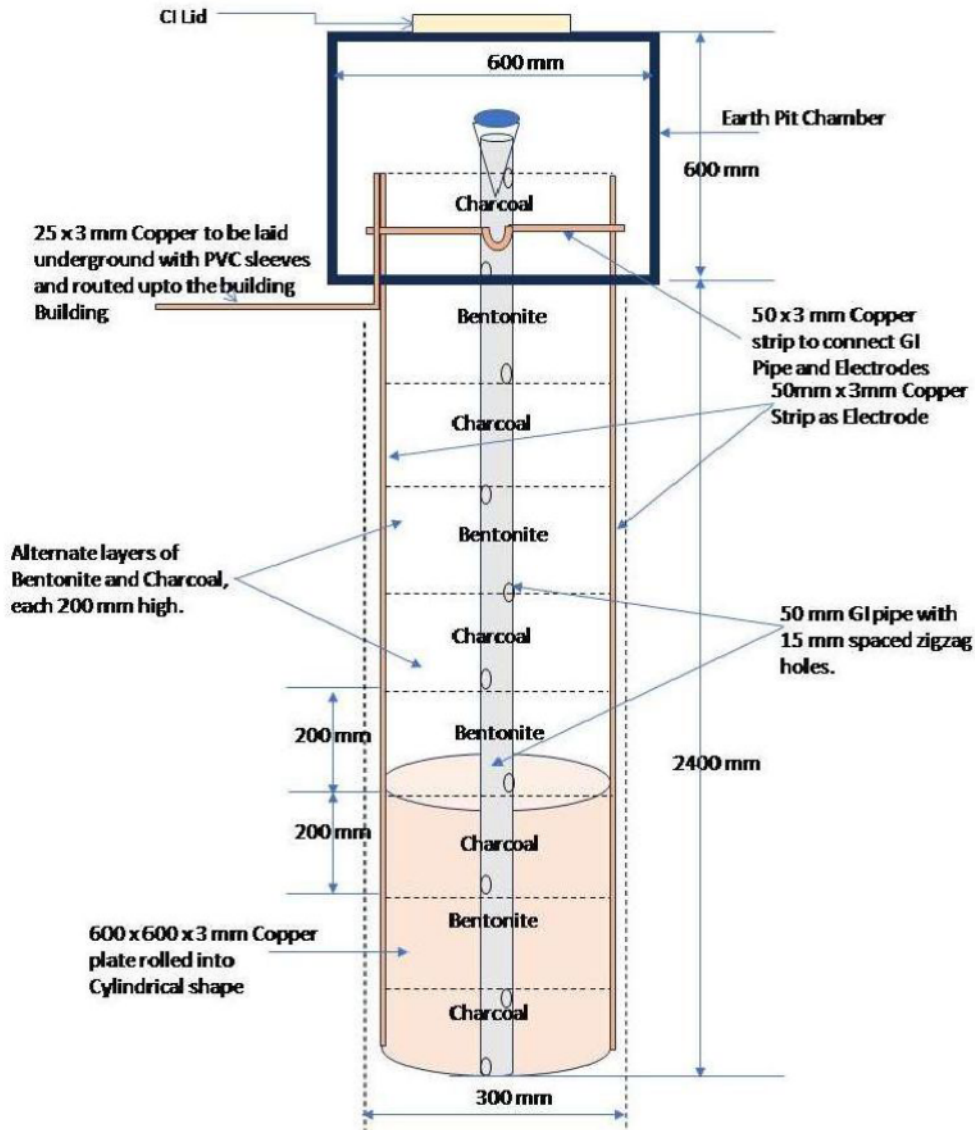
- a) Area of filters m² :
- b) Effective area m² :
- c) Velocity of air m/hr. :
- d) Quantity of air m³/hr. :

ANNEXURE - V**LIST OF APPROVED MAKES OF DIFFERENT EQUIPMENT**

S.No	Equipment	Approved Makes
1	Whole Packaged Air cooled AC plant / Condensers (with scroll compressor)	VOLTAS / BLUESTAR / CARRIER / DAIKIN / O'GEN / HITACHI
2	AHU	VOLTAS / BLUESTAR / CARRIER / DAIKIN / O'GEN / HITACHI / ZECO / EDGETECH / JCPAIR / SAGARAIR
3	Industrial Type Thermometer	EMERALD / D.S. ENGINEERS / JAPSIN
4	Glass Wool	U.P. TWIGA / KIMCO / OWENS CORNING
5	Expanded Polystyrene	METTUR BEARDSSELL / THERMOLLOYD / STYRENE
6	Fibre Glass Rigid Board	U.P. TWIGA / KIMCO / OWENS CORNING
7	Paints	ICI / ASIAN / JENSON & NICHOLSON / GOODLASS NEROLAC / SHALIMAR
8	Air-Circuit Breakers / MCCB	L&T / SIEMENS / CROMPTON / ABB / SCHNEIDER
9	MCB	LEGRAND / GE / MDS
10	Power Cable	ICC / CCI / GLOSTER / GRANDLAY / UNIVERSAL / INCAB / HAVELLS / FINOLEX / POLYCAB
11	Control Cable	GLOSTER / GRANDLAY / NATIONAL / HENLEY / BATRA / INCAB / UNIVERSAL
12	Voltmeter / Ammeter	A.E / IMP/ L&T (Digital)
13	Switches	L&T / SIEMENS / GE
14	Current Transformer	A.E / KAPPA / PRECISE
15	Contactors and Overload Relays	L&T / SIEMENS / GE / ABB / SCHNEIDER
16	Indicating Lights / Push Buttons	SIEMENS / L&T / VAISHNO
17	Selector / Toggle Switch	KAYCEE / L&T / LAKSHMI
18	Changeover Switch	ELECON / L&T
19	Time Delay Device	SIEMENS / L&T / BCH
20	Single Phase Device	L&T / MINILEC
21	Electrical Panel, Sub Panels, etc.	ASPL / MILESTONE / TRICOLITE / CPRI Approved firms

ANNEXURE-VII

Earthing Diagram



ANNEXURE VIII

23 mm Thick Heat Insulation

