PART – 1

TECHNICAL SPECIFICATION FOR HVAC SYSTEM

PROJECT DETAILS:

HVAC SYSTEM TENDER

CLIENT:

SOUTH INDIA TEXTILRE RESEARCH ASSOCIATION, Peelamedu, Coimbatore, TamilNadu.

MEP CONSULTANTS:

M/s. ENERSAVE SOLUTIONS Plot:29, Rangarajapuram 4th street, Santhospuram, Chennai – 600073, TamilNadu.

SUMMARY SHEET

Project	:	Auditorium building
Work	:	Air conditioning of auditorium.
Tender to besubmitted by	:	15.11.2023. 16:00 hours
Tender to be valid for	:	90 days
Time period for completion of work	:	2 months

TENDER DOCUMENT

Proposed Air Conditioning works for Modelling Centre.

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CODES, STANDARDS AND REGULATIONS:

- Generally, all works under this contract shall be complied with the following Indian Standards of latest version.
- The contractor shall make available copies (upon Award of Contract) of the above standards for reference of the Owner.

AIR CONDITIONING EQUIPMENT:		
IS 659	Safety Code for air conditioning	
IS 660	Safety Code for mechanical refrigeration	
IS 3615	Glossary of terms used in refrigeration & air conditioning	
IS 5111	Testing of refrigeration compressors	
IS 7896	Data for outside design conditions for air conditioning	
IS 10617	Thermostats for use in refrigeration, air conditioners etc.,	
IS 8148	Packaged air conditioners	
IS 10594	Thermostatic Expansion Valve	
SP 7	National Building Code (Group 4)	
NOISE AND VIBRATION:		
IS 2264	Preferred frequencies for acoustical measurements.	
IS 3483	Code of practice for noise reduction	
IS 3932	Sound level meter for general purpose use.	

IS 9736	Glossary of terms applicable to acoustics in buildings.	
IS 9901	Measurement of sound insulation in buildings & building element	
IS 9876	Guide to the measurement of air borne acoustical noise &	
	evaluation of its effects on man	
IS 10423	Personal sound exposure meter	
IS 11446	Measurement of air borne noise emitted by compressors units	
	intended for outdoor use.	
IS 12710	Glossary of terms used in acoustic emission testing.	
IS 4758	Methods of measurement of noise emitted by machines	
IS 14280	Mechanical vibration – balancing – shaft and fitment key convention	
IS 12065	Permissible limits of noise level for rotating electrical machines.	
PIPE AND FITTINGS:		
IS 638	Gaskets	
IS 1239	Mild steel tubes & fittings	
IS 3589	Electrically welded steel pipes	
IS 6392	Steel pipe flanges	
IS 778	Gun metal gate, globe and check valves for general purpose	
IS 5822	Code of practice laying of electrically welded steel pipes for water supply.	

IS 3624	Burden tube pressure and vacuum gauges
IS 2592	Recommendation for methods of measurement of fluid flow by means of orifice plates and nozzles

PUMPS AND VALVES:		
IS 1620	Horizontal centrifugal pumps for clear, cold, fresh water	
IS 778	Copper alloy gate, globe & check valves for water works purposes.	
IS 4854	Glossary of terms for valves and their parts.	
IS 5312	Swing check type non-return valves.	
IS 8092	Code for inspection of surface quality of steel castings for	
	valves, fittings & other piping components.	
IS 12969	Method of test for quality characteristic of valves.	
IS 13095	Butterfly valves for general purposes.	
REFRIGERANT G	AS AND OIL:	
IS 4578	Lubricating oils for refrigeration machinery	
IS 10609	Refrigerants – Number – Designation	
SHEET METAL WORKS:		
IS 277	Galvanized Steel sheet	
IS 513	Cold rolled low carbon steel sheets.	
IS 655	Metal Air ducts	
THERMAL INSULATION:		
IS 3069	Glossary of terms, symbols & units relating to thermal insulation materials	
IS 3346	Method of determination of thermal conductivity of	
	thermal insulation materials	

VENTILATION:	
IS 3103	Code of practice for Industrial Ventilation
IS 4894	Centrifugal Fans
ELECTRICAL:	
IS 325	Three phase induction motors
IS 1822	Motor starters of voltage not exceeding 1000 V
IS 996	Single phase small AC and universal motors
IS 732	Code of practice for electrical wiring and fittings for buildings
IS 2516	AC circuit breakers for voltage not exceeding 1000 volts
IS 4047	Heavy duty air break switches and composite units of air
	break switches and fuses not exceeding 1000 volts
IS 2208	HRC cartridge fuse links up to 650 volts
IS 1554-Part I	PVC insulated (heavy duty) electric cables for working
	voltage up to and including 1100 volts.
SAFETY CODES:	
IS 660	Safety code for mechanical refrigeration
IS 659	Safety code for air conditioning
IS 3016	Code of practice for fire precautions in welding and cutting operations
IS 818	Code of practice for safety and health requirements in
	electrical and gas welding and cutting operations

IS 5216	Code of safety procedures and practice in electrical
	WOIRS
IS 3696	Safety codes for scaffolds and ladders.

INTERNATIONAL STANDARDS:		
SMACNA	HVAC Systems – Duct Design	
SMACNA	HVAC Air duct leakage test manual	
SMACNA	HVAC duct construction standards – Metal & flexible	
SMACNA	Rectangular duct construction	
SMACNA	Round duct construction	
SMACNA	Energy conservation guidelines.	
SMACNA	Energy recovery equipment and systems, air to air	
SMACNA	HVAC Systems – Testing, adjusting & balancing	
ASHRAE	Handbooks	
/ ISHRAE		
ASHRAE	Gravimetric & Dust spot procedures for testing air cleaning	
	devices used in general ventilation for removing particulate	
	matter. – 52.1	
ASHRAE	Methods of testing liquid chilling packages.	
ASHRAE	Number designation & safety classification of refrigerants	
ASHRAE	Practices for measurement, testing & balancing of building,	
	heating, ventilation & air conditioning system.	
ASHRAE	Ventilation for acceptance indoor air quality- 62.1 – 2007	
ASHRAE	Commissioning of HVAC Systems.	

ASHRAE	Methods of testing liquid chilling packages as per
	ASHRAE 30 Latest Standard
ASHRAE	Thermal environmental conditions for human occupancy- 55
ASHRAE	Energy Standard for Buildings except Low-rise Residential Buildings -90.1
UL-555	Fire Dampers
ANSI	Scheme for identification of piping system
ARI	Rotary Screw Chilling Package ARI 560 Latest
АМСА	Laboratory methods for testing fans for rating as per ANSI / AMCA 210
CARRIER	System Design Manual

All works performed and equipment's and materials supplied under this contract shall comply in every respect with the Rules and Regulations of the Local Authorities including but not limited to:

-Energy Conservation Building Code – ECBC.

- Electrical supply and inspection regulation
- Fire Regulation & Machinery regulation.
- National Environmental Regulation (NER)
- National Fire Protection Association (NFPA)

AIR HANDLING UNITS

SCOPE OF WORK:

Scope of this section comprises the supply, installation, testing and commissioning of Air Handling Units of the schedule of equipment. The air handling units shall be medium static as given in the bill of quantities and complete with mixing box wherever required, 10-micron filter washable type, MERV 13 filter, 6 row deep direct expansion type cooling coil, mist arrester etc. in place and the unit shall be draw through type with the above mentioned filters in the return air path and cooling coils followed by fan and discharge outlet with aluminum damper. Filters shall be washable type.

3.1 Double Skin Air Handling Units:

- The outer skin shall be pre-plasticized over the galvanized 0.63 mm GI sheet. Inner sheet shall be 24G galvanized sheets 0.63 mm minimum 270 gsm. Alternatively outer sheet shall be pre coated on minimum 0.8mm thick GI sheet. Inner sheet remains the same.
- The frame work shall be extruded anodized aluminium section having internal channels for captive holding of neoprene gaskets to prevent leakage / seepage of air. Leak proof shall be made with additional aluminium profile if required. Additional PVC isolators between panels shall be provided to ensure zero metal contact of inner and outer skin.
- 3. The drain pan shall be at least 500 mm wide sufficiently extended to collect all condensate, internally mounted with sloping sides for quick drain out and fabricated out of 1.2 mm SS 304 stainless steel sheets.
- 4. The drain pan shall be fully insulated with minimum 30 mm PUF with GI cladding. The PUF insulation shall be sandwiched between 1.2 mm SS 304 stainless steel sheets facing the inner condensate side outer skin like the AHU outer skin. The drain pan shall have coil skid facility for easy installation /removal of coils. Noncorrosive SS bridges for coil placement and SS drain nipple of size 40mm shall be provided.
- 5. The fans shall be centrifugal DIDW heavy-duty backward curved / Airfoil blades / EC motor with Axial or plug fan best suited for static pressure given, outlet velocity of fan not exceeding 10 mps. The fan shall have pre-greased ball bearings sealed for life. The fan meets the external static's, which may be required for supply and return air distribution. Fan shall be AMCA certified only for noise and air distribution. Alternatively, EC fans selected with single or multiple fans meeting the air quantity requirement shall also be considered. Consultant shall select the best efficient combination of fan and motor from the above variance. Motors shall be EC / PM / IE3 or IE4 as the case may be.

- 6. Extruded profile shall be minimum 2mm thick and filled with PUF & interim tie members between panels to be of extruded aluminum double profile.
- 7. Frame beneath the fan and motor shall be of good quality material to take care of dynamic load of fan and motor.
- 8. Mist arrester shall be provided to minimize condensate water carryover to supply air duct.
- 9. All the mouth collars for supply air, return air, fresh air and exhaust air shall be of Class 2 leak extruded aluminum profile.
- 10. Cleanable, non-flammable synthetic fiber filters 45 mm thick with flaps over frames to prevent air getting without filtering shall be provided. Velocity through the filters shall not exceed 2.2 Meter per second, and pressure drop through clean filters shall not exceed 4 mm WG. The efficiency of filters shall be as under.

Clean filter	1 - 2 mm pressure drop
Dirty filter	4 - 6 mm pressure drop
Efficiency	90% down to F 7 filters

Filter construction shall be minimum with 2 layers of non-woven synthetic reinforced with aluminum mesh finished with minimum 2 layers of HDPE washable media.

- 11. The injected polyurethane material should be minimum 26+/-2 mm PUF shall be sandwiched between the two metallic skins for all thermal break units. The insulation material shall be a non-bituminous non-flammable adhesive. The insulation shall be 26 mm PUF for all the Air handling units for all comfort air conditioning. Density of PUF shall be minimum 45Kg/cum.
- 12. Cooling coils be constructed from minimum 12.7 mm OD round copper tubes of thick 0.41mm combined with mild rippled aluminum fins of minimum 0.17 mm thick and die formed directional guide channels. The fins shall be mechanically bonded to the copper pipes. There shall be minimum six rows of coils or as required to provide necessary indoor conditions. Cooling coils shall select in multiple sections and each section height shall not be more than 450 to 500mm. Interlacing of circuits shall be done to ensure dry coil operation.
- 13. Minimum 450 mm access door shall be provided for easy access to filters, coils, fans etc. Each access door shall be provided with easy release ½ turn nylon handles and GM Chrome plated locks. Hinges shall be heavy-duty die cast solid aluminum with SS pivots. A safety **"trip-switch"** shall be provided to automatically cut off the electrical supply to the fan when the access door is opened while the AHU is in operation.

- 14. Connecting duct shall be sound insulated as specified in Section "INSULATION".
- 15. AHU unit controls shall be as follows:
 - a) Control circuit energized when fan is started.
 - b) Dry bulb temperature shall be controlled by means of a modulating supply air thermostat to control the compressor operation.
 - c) Extra control contacts shall be provided in the control circuit to automatically shut off the AHU on receipt of a signal from the fire alarm system and for remote control operation.
 - d) Necessary electrical components such as VFD / starter components, safety components, isolators etc shall be part of AHU and fitted in the AHU as integral part of the unit in an IP55 enclosure. Surface mounting over the AHU body will not be accepted.
 - e) Necessary power wiring from panel to motor shall be factory wired, tested and AHU run test report capturing free air delivery, motor no load, load test reports shall part of delivery advice.

ALLOWABLE AIR LEAKAGE:-

Casing Air Leakage Rate

The air flow leaking through the casing of a Central Station Air-handling Unit per 100 square feet [10 m2]of Casing Surface Area, cfm/100 ft2 [L/s/10 m2]

Leakage Class

The rating class designation that defines the maximum expected air flow leakage, cfm/100 ft2 [L/s/10 m2], of the CSAHU casing operating within the interior pressure conditions specified for the total casing surface area Negative and positive



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Positive

Negative

Casing Air Leakage Rate:-

Table 2. Casing Air Leakage Rating Class ^{1,2}		
Class - Leakage, CL _x	Maximum Casing Air Leakage Rate, CL_r , cfm/100 ft ² (at $P_r = 1$ in H_2O)	
CL_1	1	
CL_2	2	
CL ₃	3	
CL_6	6	
CL_{12}	12	
CL ₂₄	24	
CL100	100	
Notes:		
1 Rating differential pressure for each CSAHU shall be determined according to the maximum unit		

1. Rating differential pressure for each CSAHU shall be determined according to the maximum unit operating conditions specified.

2. All values apply to positive or negative pressure conditions.

Installation:-

- The unit shall be installed as per manufacturer's recommendations. Care should be taken that no panels are damaged or scratched. In case of damage or scratch, panel shall be replaced free of all cost to the Client. No repairing is allowed at site or factory. All such damaged panels shall be returned once the new panels arrive at the site.
- The contractor shall ensure that the complete installation is totally vibration free.
- MS structural platform for the AHUs shall be provided by the Owner. However, the Contractor shall supply all foundation bolts. Base plate, cushy foot mountings, vibration eliminators, etc. and shall ensure that all the above accessories are placed securely in proper position.
- Double aluminum profile shall be provided for better leakage control.

Electrical System: The equipment shall be with factory designed electrical system fitted within the AHU. EC Motor electrical components shall be fitted in IP55 as a system(with additional Isolation panel with all Controls wired up to the panel, All Terminal Blocks and Control shall be Part of this panel), The Status and operation monitoring system shall be capable enough to view parameters such as Current MFM), Speed, Filter Condition, Motor Direction, Power Consumed and Trip Status through Communication which shall be built in BACnet /Ethernet/Modbus - as required which shall be part of EC Fan. Necessary provision for multistage Temperature Sensor to control the outdoor units, Differential Pressure Sensor shall be provided by OEM to control Speed of AHU, monitor Filter Clog Condition. In case of EC fans, It is mandatory that electrical system shall be IP55 protection and Smart AHU HMI shall be along with Run, Trip Indication Lamp shall be mounted on the AHU without any sort of protrusion visible outside, a separate access door shall be provided for ease of service, OEM shall be responsible for the EC fan Pre wired till isolation panel with multi core cable at their factory and pre tested before dispatch. SMART AHU Display shall be responsible for Start / Stop, Filter Clog Alarm, Temperature indication, Temperature Signal to outdoor units, KW Consumed, Current Consumed, air quantity Delivered and Provide complete feedback of above to Main BMS too. Electrical system shall be accordingly designed for employing EC / PM motors.

Testing:

• AHUs shall be tested for their design performance and test results shall be furnished.

REFRIGERANT PIPE.

SCOPE: -

The section comprises the general requirements for the design, workmanship, quality of materials and accessories to be used for refrigeration piping and the tests to be carried out on the same. Tender shall prepare drawing for the layout and work as per the approved drawing.

COPPER PIPING:

If specified in tender schedule copper piping shall be used for refrigeration piping, tubing up to 15mm diameter shall be bright-annealed copper tube. Over 15mm hard drawn seamless copper tubing shall be used. Fittings like bends, tees, and sockets shall be of copper or brass and shall be suitable for duty involved. Flare type compression fittings shall be allowed up to 15mm size for which annealed copper tubing is used. Tubes up to and including 15mm size may bent to form 90deg. Bends with inside radius not less than 3 tube diameters. For bigger sizes, bend fittings as mentioned above shall be used. Valves shall be of packed, back seating type, and shall be forged or cast brass construction.

JOINTS IN COPPER PIPING:

Joints between pipes or pipes and fittings shall be of the socketed or flanged type. Brazing alloy of the silver-copper-phosphorous type shall be used and joints shall made by the flow of brazing alloy by capillary action along the annular space between the two mating surfaces. Ends of mating tubes shall be square cut and cleaned properly to remove burrs and dirt or oxide. For flare type fittings, tubes shall be fully annealed at the flare before and after flaring.

REFRIGERANT CIRCUIT:

GENERAL:

The vendor shall design the piping and prepare installation drawings showing full details of piping arrangement, pipe sizes and thickness, methods of supporting pipes and connections in various components for approval of Engineer-in-charge. Work shall commence only after approval. Piping shall be able to withstand the thermal stresses and vibrations encountered during normal operations. While designing the piping particular care shall be taken in respect of the following.

HOT GAS LINE:

a) Oil entrainment by hot gas shall be achieved under all load conditions likely to be encountered during normal operation.

b) Horizontal lines shall have a grading of at least 1:250 away from the compressor and towards condenser to permit gravity draining of oil to condenser.

c) Where specified in tender schedule, oil separator of centrifugal type shall be provided with each compressor and oil shall return to the compressor crankcase or to the oil receiver if provided. The oil separator shall have steel

or copper shell and copper or copper alloy packing.

d) When one or more compressors are connected to one or more condensers, discharges piping shall be joined in 'Y' or loop connections to avoid bull heading of gas from the compressor.

e) Equalizer lines shall be provided if called for in tender schedule. These shall be horizontal and have the same size as the discharge line of the largest compressor for hot gas and oil equalizers. Gas and oil equalizers shall be provided with brass valves as described in para2.1.1.

f) Hot gas mufflers shall be installed in vertical position or in horizontal position graded away from the compressors. Mufflers shall be designed to prevent oil trapping.

LIQUID LINE:

- a) Liquid lines shall be sized to ensure that flashing of liquid refrigerant does not occur.
- b) Liquid line solenoid valves shall be provided with test switches to enable manual energizing.

c) A full flow brass liquid strainer with bronze screens and permanent magnet shall be provided in a readily accessible position with isolating valves and a valve in bypass line. Screens shall be easily removable.

d) Each liquid shall be provided with a permanently installed refrigerant drier or rechargeable type. Drier shall be installed with a valve in bypass line.

e) Liquid cum moisture indicator shall be installed on all liquid lines.

f) Wherever liquid receiver is provided, it shall be fabricated from electric welded steel and have a total capacity to hold not less than 1.25 times the volume, in liquid state, of the refrigerant in the system. Liquid level indicator shall be provided with the receiver.

g) Suction trap of adequate capacity shall be provided before each compressor or grouped compressors connected in parallel to collect all oil and refrigerant slugs.

SUCTION LINE:

a) Oil shall be entrained by the suction gas under all conditions of load likely to be encountered in normal operation.

b) Horizontal suction lines having suction trap or suction line at separator shall be pitched at least 1:250 in the direction of flow of refrigerant.

c) Piping should be so designed as to ensure that oil would not separate from gas and drain to compressor in slugs.

d) Piping shall have loops and direction changes to absorb normally encountered vibrations.

e) All suctions line shall be insulated as specified in Section IX paragraph 5.0, 'Insulation'. Insulation shall be carried out only after pressure testing is completed.

LINE ACCESSORIES:

ISOLATING VALVES:

If required isolating valves shall be provided to isolate each compressor, liquid receivers if provided, evaporators, strainers, drier and any other component requiring proper operation and maintenance.

THERMOSTATIC EXPANSION VALVES:

Each cooling coil shall be provided with its thermostatic expansion valve to ensure that specified accuracy of temperature control of the system can be achieved. No valve shall operate 35% below its rated capacity. Adjustable superheat control and external equalizer port shall be provided for each valve. Each expansion valve be easily removable for cleaning and adjusting. Expansion valve bulb shall be located immediately after the evaporator outlet on the suction line 45" above bottom of pipe. Valve should be set so that overfeeding does not occur at partial load conditions.

PIPING INSTALLATION:

The entire refrigerant piping shall be installed in a workmanship like manner, true to alignment and grade as required. Tube ends shall be kept plugged or kept always closed before installation and where practical, during construction, to prevent ingress of moisture and foreign matter. All duct and welding flux should be removed before installation. Piping supports shall be spaced not more than 2 meters apart and substantial enough to prevent bending stresses. The supports shall be rigid type, either ceiling hung/wall bracketed angle iron or vertical drop of GI pipe. Each support shall be isolated from pipe by providing anti-vibration springs or neoprene rubber liner. Valves shall be supported separately to avoid transmission of stresses to connected pipes.

TESTING:

PRESSURE TEST:

After completion of piping installation, entire piping installation shall be pressure tested with dry nitrogen at the following pressures.

a) For systems using R-407C high side pressure testing shall be not less than 28kg/cm2 and low side pressure testing not less than 11kg/cm2. Testing shall be carried out as follows.

i) System shall be charged with inert gas (nitrogen) to 1kg/cm2 gauge pressure, and all joints shall be checked for large leakages with soap solution. Leaks shall be marked, pressure released, and repairs carried out. Brazed joints that leak shall be opened and redone. These shall not be required by addition of brazing alloy to the joint.

ii) After all leaks have been repaired, system shall be retested with test pressure as narrated above and maintained for not less than 8 hours. No measurable drop in pressure should be detected after pressure readings are adjusted for temperature changes. Pressure gauges and controls may be closed during pressure testing.

EVACUATION AND CHARGING:

After pressure testing is completed, evacuation shall be carried out as follows releasing pressure.

a) A 2-stage rotary vane vacuum pump shall be connected to the refrigeration system. On no account should the compressor be used for purpose of creating vacuum.

b) Vacuum pump shall be operated to reduce the pressure to 250microns absolute and allowed to operate at this pressure for 6hrs. System shall then be isolated and allowed to stand for 6hrs.

c) Vacuum shall be broken with a mixture of dry nitrogen and a small quantity of refrigerant to be used. System shall be evacuated to 100microns and allowed to stand for 24hrs. Leak detection with halide torch or electronic leak detector shall be carried out.

d) If no leak exists correct quantity refrigerant and oil shall be charged into the system. Final leak detection should be carried out once again to ensure leak tightness.

AIR DISTRIBUTION SYSTEM

1.0 **GENERAL:**

The scope of work consists of supply, fabrication, installation, testing and commissioning of all sheet metal ducts and supply, installation, testing, commissioning and balancing of all grilles, registers and diffusers, in accordance with the specifications and the general arrangement as shown in the drawings.

Ductwork shall mean all ducts, casings, dampers, access doors, joints, vanes,

stiffeners, hangers and supports, etc. to be included in the item.

All ducts shall be fabricated from galvanized steel sheets of the following thickness as indicated in schedule of quantities & as per the latest industrial practice with latest edition i.e. specification of metal air duct out of class VIII sheet.

1.0 **RECTANGULAR DUCT:**

Duct Size	G. I	AI.	Type of Joint	Type of Bracing
Upto 600	24	22	GI Flange at 2.5mtr. Center	Cross Bracings

601 – 750	24	22	25x25x3mm angle iron	25x25x3mm MS
			frame with 6mm dia	angle bracing at
			nuts and bolts	1500mm from
				joints
751 - 1000	22	20	25x25x3mm angle iron	25x25x3mm MS
			frame with 6mm dia	angle bracing at
			nuts and bolts	1500mm from
				joints

1001-1500	22	20	40x40x5mm angle iron	40x40x3mm MS
			frame with 8mm dia	angle bracing at
			nuts and bolts	1500mm from
				joints
1501 - 2250	20	16	40x40x5mm angle iron	40x40x3 MS angle
			to be braced diagonally	bracing at 1200mm
			with 10mm dia nuts &	from
			bolts	joints/40x40x3mm
				MS
				angle diagonal bracing
2250 & above	18	14	50x50x6mm angle iron	50x50x3mm MS
			frame with 10mm dia	angle bracing at
			nuts and bolts at	1200mm from
			125mm center	joints

Sheet metal ducts shall be fabricated out of galvanized steel sheets conforming to BIS 655, BIS 277, BIS 737 & SMACNA where it is called for. Sheets used shall be manufactured by Hot dip process ad galvanizing shall be Class VIII – Minimum Average Coating 120gm/sq.m as per BIS 277:1992

1.0 SUPPORTING OF DUCTS:

Duct	Spacin	Size of MS	Size of rod dia
Size	g	angle (mm	(mm)
(mm)	(M)	x mm)	8
Up to	2.5	40x3	10
750	2.0	40x3	15
751 to 1500	2.0	50x3	15
1501 to 2250	2.0	50x3	
2251 & above			

- Full length threaded rod with suitably sized Anchor fasteners, nuts and washers made of GI shall
- only be used for hanging the ducts. In case of round ducts the contractor shall use 4mm thick multi
- strand GI wire with suitable hold on type clips on both ends.

1.θ FABRICATION:

All ducts shall be fabricated and installed in workman like manner, generally

conforming to IS 655. Round exposed ducts shall be die formed for achieving

perfect circle configuration.

- a) Ducts so identified on the drawings shall be acoustically lined with insulation as described in the section 'Insulation' and as indicated in schedule of quantities. Duct dimensions shall be designed to accommodate the thickness of the acoustic lining, where required and indicated in schedule of quantities.
- b) Ducts shall be straight and smooth on the inside with neatly finished joints.
 All joints shall be made airtight.
- c) All exposed ducts within conditioned spaces shall have slip joints no flanged joints. The internal ends of slip joints shall be made in the direction of airflow.

Exposed ducts, where required or as indicated in Schedule of quantities, shall be painted with two coats of enamel paint of approved color.

Ducts and accessories within ceiling spaces, visible from air-conditioned

areas shall be provided with two coats of mat black finish paint.

- d) Changes in dimensions and shape of ducts shall be gradual. Curved elbows, unless otherwise indicated, shall have a centerline radius equal to one and a half times the width of the duct. Air turns shall be installed with vanes, arranged to permit the air to make the turn without appreciable turbulence. Suitable vanes shall be provided in duct collar to have uniform/ proper air distribution.
- e) Duct shall be fabricated as per details shown on drawings. All ducts shall be rigid and shall be adequately supported and braced where required with standing seams, tees, or angles of sample size to keep the ducts true to shape and to prevent bulking, vibration and breathing.
- f) All sheet metal connections, partitions and plenums required to confine the flow of air to and through 18g GI/16-gauge aluminum thoroughly stiffened with 25mmx25mmx3mm angle iron braces and fitted with all necessary doors as required to give access to all parts of the apparatus. Access Doors shall be not less than 450mm x 450mm in size.

2.0 INSTALLATION:

All ducts shall be installed generally as per the drawings and in strict accordance with approved shop drawings to be prepared by the Contractor.

 The contractor shall provide and neatly erect all sheet metal work as may be required as per specifications and drawings. The work shall meet with the approval of Owner's site representative in all its parts and details.

- Necessary allowance and provision should be made by the contractor towards beam, pipe or any other obstruction in the building, irrespective of the same is shown on the drawings or not. Where necessary to avoid beams or other structural work, plumbing or other pipes, and /or conduits, the ducts shall be transformed, divided or curved to one side, provided the required area being maintained as per the design requirements.
- If duct cannot be run as shown on the drawings, the contractor shall install the duct between the required points by any path available, in accordance with other services and as per approval of Owners site representatives.
- iv) All ductworks shall be independently supported from building structure. All horizontal ducts shall be rigidly and securely supported, in approved manner with trapeze hangers formed of MS rods and angle iron under ducts at not greater than 2meter centers. All the vertical ductwork to be supported by structural members in every floor. Airconditioning contractor shall supply and install 50mm cube MS boxes with 10mmdia steel rod passing through box, all given two coats of red oxide paint, the MS rod tied with reinforcement bar at point of suspension shall be nearly exposed and opening subsequently filled with plastic compound after duct hangers are installed. If duct passes through such areas where space between ceiling slab to false ceiling is more than 1500mm then duct should be supported by wall mounted brackets of size 40mm x 40mm x 3mm thick MS angle frame.

 v) Ducting over furred ceiling shall be supported from the slab above or from beams, after obtaining approval of Owner's site representative. In no case shall any duct by supported from false ceiling hangers or be permitted to rest on false ceiling.

All metal work in dead or furred down spaces shall be erected in time to avoid delay of work of other contractors working in the building.

- vi) Where metal ducts or sleeves terminate in woodwork, tight joints shall be made by means of closely fitted heavy flanged collars. Where ducts pass through brick or masonry opening a wooden framework shall be provided within the opening and crossing ducts provided with heavy flanged collars on each side of wooden framework, so that duct crossing is made leak- proof.
- vii) All ducts shall be totally free from vibration under all conditions of operation. Whenever duct work is connected to fans, air handling units, fan coil units or ductable split units that may cause vibrations in the ducts shall be provided of closely woven, rubber impregnated double layer asbestos/canvas or neoprene coated fiber glass fire resistant flexible connection. The flexible connections located close to the unit, in mutually perpendicular directions. The flexible sleeve at least 10cm long securely bonded and bolted on both sides. Sleeve shall be made smooth, and the connecting ductwork rigidly held by independent supports on both ends. The flexible connection shall be suitable for pressures at the point of installation.

 viii) Airconditioning unit or any other unit shall be connected to duct work by inserting at air inlet and air outlet a double canvass sleeve.
 Each sleeve shall minimum 150mm securely bolted to duct and the connecting ductwork rigidly held in line with unit inlet or outlet.

SPIRAL OVAL DUCT:

Spiral oval duct is fabricated from steel strips helicoidally wound and seamed with a four-ply lock seam, which give the pipe added rigidity. Oval duct will fit in spaces where there is not enough room for round, yet it is joined using the same techniques of round duct assembly. It can be joined using slip coupling with sealer providing a tight joint. In larger size or in the case of high aspect ratios flanged joints may be used. Spiral oval duct, which is machine manufactured from round spiral lock seam duct is available in varying sizes and aspect ratios, size is not available in spiral can be fabricated from lock seam. Spiral duct with couplings and Flanges to all SMACNA 2005 3rd edition stranded. Finally spiral oval duct shall be power coated as per the client requirement.

3.0 SPLITTERS AND DAMEPRS:

All dampers shall be opposed blade type dampers of robust construction and tight fitting. They shall be made of G.S. sheet minimum 16g thick and shall have brass bushes. The design, method of handling, and control shall be suitable for the location and service required.

Dampers shall be provided with suitable links, levers and quadrants as required for their proper operation control or setting devices shall be made robust, easy to operate and accessible through suitable access doors in the ducts. Every damper shall have an indicating device clearly always showing the damper position. Handles will be provided with extended arms to account for insulation thickness. Dampers shall be placed in ducts and at every branch supply or return air duct connection, whether indicated on the drawings, for the proper volume control and balancing of the system.

10. LINEAR DIFFUSER:

Linear diffuser shall be extruded aluminum construction multi-slot type with air pattern controlled provided in each slot. Supply air diffusion shall be provided with volume damper in each slot of the supply air diffuser. Plenum shall be provided for each supply air diffuser.

The material of the grill shall be as follows:

- All grilles shall be selected in consultation with the Client/Architect/Consultant. Different spaces shall require horizontal or vertical face bars, and different width of margin frame.
- All grilles shall have a soft, continuous rubber gasket between the periphery of the registers and the surface on which it must be mounted. The effective area of the registers shall not be less than 75%.
- iii) Grilles shall be adjustable pattern as each grilles bar be pivotable to provide pattern with 0 to 100 deg. horizontal are and up to 30deg deflection up or down. Bars shall hold deflection settings under all conditions of velocity and pressure. Extruded aluminum grilles shall have fixed bars.
- iv) Bars longer than 45cm shall be reinforced by set-back vertical members of approved thickness.

The materials thickness of grilles, diffusers, damper shall be as follows:

ТҮРЕ	MS	ALUMINIUM
DIFFUSER		
A) Frame	20G	18G
B) Louvers	20G	18G
GRILLERS:		
A) Frame	20G	18G
B) Louvers	26G	24G

V.C. DAMPER:		
A) Frame	20G	18G
B) Louver	26G	24G

v) Fresh air intake and exhaust louvers:

All the louvers shall be rain protection type and shall be fabricated from extruded aluminum section. The louvers shall additionally be provided with heavy duty expanded metal (aluminum-alloy) bird screen and also 20micron filter for fresh air intake.

vi) Testing & Balancing:

After the installation of the entire air distribution system in all respects all the ducts shall be tested for leaks before painting the interiors. It is also mandatory to run the air distribution system continuously for 48hrs for driving away any dust or foreign material logged within ducts during installation before final painting is done.

THERMAL /ACOUSTIC INSULATION & LAG COATING FOR DUCT & PIPES.

General:

The Insulation of refrigerant piping, drain piping, ducting, etc., shall be carried out as per specifications given below:

2. <u>Materials:</u>

The materials to be used for insulation shall be as follows, unless some other material is specifically mentioned elsewhere.

2.1 **Duct Insulation:**

Insulation material shall be closed cell elastomeric nitrile rubber / XLPE of suggested thickness as given below based on application. Conductivity value shall be the best in the industry.

The ducts shall be insulated with the insulation sheets as follows.

Duct insulation thickness shall be as follows:

Duct in conditioned space -13 mm thick

Duct in unconditioned space (Exposed sun) - 25 mm thick

Duct with treated fresh air

3.0 Other Insulation:

- 19 mm thick

The material for acoustic treatment of ducts, rooms, roofs etc. shall be open cell nitrile rubber. The density shall be 150 kg/m3 and the material shall be in the form of rolls of uniform density. The coefficient of thermal conductivity K = 0.036 w/m k

4. Drain Piping:

Insulation of drain piping shall be carried out using 6 mm thick insulation tube of closed cell elastomeric EPDM insulation. The density of the EPDM should be 60 - 80 kg/m3 as per ASTM D 1667.

5. <u>Refrigerant Piping:</u>

The suction line and liquid line of refrigerant piping shall be insulated with 19 mm and 13mm thick closed cell elastomeric insulation as specified for refrigerant pipelines.

6.0 <u>Installation:</u>

Clean the surface with a wire brush and make it free from rust and oil. The cleaned surface shall be treated with one coat adhesive

on duct surface.

One coat of adhesive on one side of insulation sheet simultaneously.

Leave it to dry.

Stick the insulation on ducts and press for

smoothness. The joints shall be sealed with

the same adhesive.

A. Application Technique for Indoor Duct/Piping - Fire Protection Coating

Material approved – Fevicol AC DUCTKING LAGCOATING AF5590

- 1. Fevicol AC Duct king Lag coating AF5590 can be applied for the following applications.
 - a. Duct Thermal Insulation Indoor ducts.
 - b. Chilled water Piping Indoor Area
- 2. On what types of Insulation materials this can be used Nitrile Rubber, XLPE, PUF, EPS.
- **3.** Application procedure:
 - a. Stir the adhesive thoroughly before use. Add required Color as specified by the client if any.
 - **b.** Clean the substrates to be bonded so that they are free from Dust / Rust / oil etc.
 - c. Apply the coating over insulation surface uniformly by brush or spreader.
 - d. Immediately wrap 7mil glass cloth tightly with overlapping so that no gaps are left. Alternatively, Glass Cloth can be dipped in the adhesive & wrapped.
 - e. Allow to dry and apply additional Finish coat in similar fashion if required.
 - f. Allow to cure for 24 hrs. at ambient temperature.

B. Application Technique Exposed Area for – Fevicol Weather Protekt Coat

- **1.** Fevicol Weather Protekt coat can be applied for the following applications.
- a. Duct Thermal Insulation Exposed ducts.
- b. Chilled water Piping Exposed Area

2. On what types of Insulation materials this can be used – Nitrile Rubber, XLPE, PUF, EPS, Glass wool, Rockwool.

- 3. Application procedure
- a) All surface of ducts/pipes shall be clean, dry and dust free.
- b) Insulate both duct/pipeline with Insulation Materials and allow them to bond.

c) Above the insulation surface apply one-layer Fevicol-weather protekt coat and wrap 10 mill glass cloth. Allow the Fevicol Weather Protekt coat to dry up to 4 hours from 1st application.

d) Then apply second coat of Fevicol Weather Protekt coat and allow it to dry.

e) Final coat can be applied upon on work completion.

f) Specified Colour selection can be used on Fevicol Weather Protekt coat from the first coat onwards till completion.

Specification for 7 Mill Woven Glass Cloth

Product	: 7 Mill Fibre Glass Cloth
Width	: 40" +/- 1"
Length	: 100 Mtr or as mentioned on label
Appearance	: White
GSM	: 200 GSM +/- 10GSM PER SQM
THICKNESS	: 0.18MM +/- 0.03MM
WEAVE	: PLAIN
THREAD COUNT WARP	: 42 +/- THREADS/INCH
WEFT	: 28 +/-
THREADS/INCH BREAKING	i
STRENGTH WARP	: 30KG/CM
WEFT	: 23KG/CM

TEMPERATURE RESIST: 350 Deg Celsius

Specification for 10 Mill Woven Glass Cloth

Product	: 10 Mill Fibre Glass Cloth
Width	: 40"+/-1"
Length	: 100 Mtr or as mentioned on label
Appearance	: White
GSM	: 275 GSM +/- 10GSM PER SQM
THICKNESS	: 0.23MM +/- 0.03MM
WEAVE	: PLAIN
THREAD COUNTWARP	: 42 +/- THREADS/INCH
WEFT	: 28 +/-
TEMPERATURE RESIS	: 350 Deg. Celsius

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OUTDOOR UNITS

1.0	OUTDOOR UNIT FOR AIR-CONDITIONING SYSTEM.
	Scope: Scope of this section comprises of the supply, installation, testing and
	commissioning of outdoor confirming to the specifications and in accordance with
	the requirement of drawings and of the Schedule of Quantities.
1.1	<u>GENERAL CONDITIONS :</u>
1.1.1	The Ducted Spit Air-conditioning out door unit shall be self contained factory
	tested and assembled unit.
1.1.2	The construction, production, type and testing of Ducted split air conditioners shall
	conform to latest IS standards. Units shall be industrial heavy duty type.
1.1.3	Units shall be air cooled DX Type. It shall be modular, microprocessor based, and
	ceiling suspended, side discharge with access panel.
1.1.4	The outdoor units shall be made of Galvanised steel sheets and powder coated. All
	fasteners used in the outdoor units shall be of good quality.
1.1.5	The unit shall be complete with Scroll compressors, condenser coil, blowers and fans,
	drier, TEV, charging points and controls.
1.1.6	The noise level of the unit shall not exceed 60 dB(A) at 1 meter distance from the unit
	for the ODU and 50 dB(A) for the IDU. All precautions to reduce noise and vibration
	transmission to be taken care.
1.2	CONSTRUCTION :
1.2.1	The panels shall be constructed of 1.2mm zinc coated sheet steel. The cabinet
	shall powder coated.
1.2.2	The panels shall be removable and include captive ¼ turn fasteners. The cabinet shall
	be assembled with pop rivets providing ease of disassembly.
1.2.3	The unit shall have access for routine service and installation work.

<u>1.5</u>	SCROLL COMPRESSOR
1.5.1	The compressor shall be of the high efficiency complaint scroll design with C.O.P not less
	than 2.5 for 11TR and 16.5 TR machine & 2.6 for 8.5TR machine both at ARI rating
	conditions. The compressor shall be charged with mineral oil and designed for operation
	on R-407C or any other ozone friendly refrigerant. Each compressor shall have internal
	motor protection and be mounted on vibration isolators.
1.5.2	Compressor shall be hermetically sealed scroll compressor suitable for 3-phase operation
	with operating voltage between 380 – 420V and operating frequency of 50HZ. Compressor
	shall be mounted on to the base of the packaged unit on top of resilient rubber grommet
	mounting with steel sleeve bolts and nuts.
1.6	REFRIGERATION CIRCUIT
1.6.1	The refrigeration system shall be direct expansion type with one or more hermetic scroll
	compressors, complete with crankcase heaters.
1.6.2	A hot gas bypass solenoid valve shall be used on single compressor models. The system shall be include a manual reset high pressure control, auto reset low pressure switch, externally
	equalized thermal expansion valve, high sensitivity refrigerant sight glass, large capacity filter drier and charging/access ports in each circuit.
1.6.3	Each refrigeration circuit shall include rigidly mounted isolation valves in the discharge and liquid lines to aid servicing and installation (air cooled units only).
1.8	EXPANSION DEVICE
	Expansion device shall be only Electronic thermostatic expansion valve suitable for R- 407C or any other ozone friendly refrigerant with inlet and outlet connections. The expansion device shall also be suitable for a maximum operating pressure 400 psig.

1.9	AIR COOLED CONDENSER
1.9.1	Air-cooled condenser shall be with single or multiple coils of minimum 3 rows deep. The tube thickness 0.3mm and dia of not less than 0.7mm. The tube shall also be internally grooved. Fins shall be made of Aluminium of thickness 0.16mm having 13 fins per inch and the method of bonding of tubes & fins shall be mechanical expansion.
1.9.2	Air cooled condenser shall have maximum surface area to ensure a good heat transfer across the coil. The air cooled condenser fan shall be direct driven and motor mounted on fan guard and the motor shall be equipped with double ball bearing. The motor shall have class'F' insulation. Fan shall be propeller type made of mild steel. The maximum imbalance of the fan shall be 0.35gram.
1.9.3	The Air-cooled condenser shall be the low profile, weatherproof type incorporating high efficiency, direct drive, external rotor motors with axial blade fans. The condenser shall balance the heat rejection of the compressor at 40 Deg C ambient.
1.9.4	The condenser shall be constructed from heavy duty aluminum and corrosion resistant through special anti corrosive epoxy coatings for any specific polluted areas. Heavy duty mounting legs and all assembly hardware shall be included.
1.9.5	Condensers shall be suitable for 24 hours operation and be capable of providing vertical or horizontal discharge. The condenser shall be fully factory wired and require a 230 volt, single phase, 50 Hz electrical service.
1.9.6	The high performance heat exchanger shall include mechanically expanded cross- hatched copper tubes and louvered aluminum fins for maximum heat transfer.
1.9.7	Air cooled condenser coils shall be done with anti corrosive coating suitable to withstand minimum 500 hours of salt spray.
1.10	MICROPROCESSOR CONTROLLER
1.10.1	The unit shall be supplied with micro-processor based control system. The system shall have digital display of the return air temperature and the set point temperature.
1.10.2	The following safety features shall be provided and the same shall have LED indications:
	Under voltage / Over voltage trip.

	Phase Failure / Phase reversal trip.
	High Pressure trip (comp1 & comp2 for dual circuits)
	Compressor O/L trip (comp1 & comp2 for dual circuits)
	• Fan fails indication.
1.10.3	The following mode selection shall be provided:
	• Fan Mode,
	• Cool Mode.
1.10.4	The panel shall allow temperature set point adjustment.
	The microcomputer controller should offer the following user-friendly features:
	 Run time equalization: To calculate and ensures equal run time for all compressors. Auto restart after power failure: to avoid inconvenience of manual restart. Memory back up: To keep settings intact during power failures and stoppages. Built-in-time delay: To protect compressor from instant stops and starts. Single phasing and reverse phase protection: To protect compressors from damage. Fuzzy logic: To cool intelligently based on the heat load, and hence to increase Efficiency. Self-fault diagnostics: To display system trips which facilitates faster corrective action. Easy hook-up with fire alarm system: Potential free contacts to be provided for hooking on to the fire alarm system, for stopping the units in the event of a fire.
1.11	CONTROLS
1.11.1	HP/LP cutout shall be provided for compressor protection. A thermostat located in the return air path shall control cutting in/out of the compressor. A selector switch enabling the running of the fan alone with cooling shall be provided. Reset facility shall be provided. Interlocking of compressor with condenser, and air handling fan shall be provided.

1.12	VIBRATION ISOLATION
1.12.1	The entire unit shall be placed on neoprene ribbed pads of 6mm thickness and size 150 X 150 mm.
1.12.2	CONDENSATE DRAIN PIPING: 40 mm dia hard FRLS Grade PVC Drain Pipe shall be used to remove condensate from Evaporator Unit to drain point. The joints shall be properly sealed so that there is no water leakage. U trap shall be provided at the end. Additional insulated Drain tray shall be provided below the Evaporator Unit, if required. All Drain Pipes shall be insulated, with 6 mm thick EPDM closed cell nitrile rubber.
1.13	ELECTRICAL
1.13.1	The units shall be supplied with a control panel, which shall house the complete electrical switch gear. The panel shall be housed in the outdoor unit itself. All necessary contactors, over load relays, anti-recycle timer relays etc shall be housed within this panel. Main power supply, if not specified otherwise in the BOQ or elsewhere, shall be terminated by the client in this panel and feeder cables to feed power to the indoor unit shall be carried out by the AC contractor only.
1.14	<u>TESTING</u>

LIST OF APPROVED MAKE

The Tenderer shall quote his rates on the basis of the brand/make stipulated in the item of works as described in BOQ, specifications and furnished in technical data. In case of delay in delivery of item ordered by the contractor the owner reserves the right to select any of the brands indicated from the "List of Approved Makes to full fill the delivery requirement. The contractor cannot claim anything extra if the owner changes the make but within the list of approved make.

<u>S.No.</u> <u>Items</u>	Acceptable Makes
1. DX Ductable Units /ODU	Daikin / Hitachi / Bluestar / Voltas
2. Propeller fan	System air /Kruger/Caryaire/Nadi/ Ostberg
3. Grilles / diffusers / dampers	Cosmic / Air master
4. VRF	Mitsubishi /Toshiba / Daikin
5. Refrigerant fittings	Totaline / Mandev / Mexflow/ Uniflow
6. PVC Pipes	Surya/Prakash/Finolex/Supreme
7. Copper pipe	Totaline / Mandev / Mexflow / Uniflow
9. XLPE Insulation	Paramount/Cani/Thermobreak
10. Flexible duct	Cosmic / Venus

11.	Factory fabricated ducting	WAD / Venus / Seven Star / Cosmic
12.	Lag coating material	Pidilite
13.	Air handling unit	System aire / Airprism tecch / Edgetech
14.	Open cell nitrile rubber insulation	A Flex / K Flex / Superlon / Armacell
15.	Controls	Honeywell /Siemens/Johnson control/Belimo.
16.	Vibration Isolators	Resistoflex
17.	VFD	YASKAVA / As approved
18.	Controller	Siemens/Rockwell/Vipa/ As approved
19.	Pressure sensor	HTA Instruments/Honywell / As approved
20.	Fire dampers / Gravity louvers	Cosmic / Airmaster
21.	Fire damper actuator	Belimo / Honeywell
22.	MS Pipes / GI Pipes	Tata / Jindal
23.	Pipe fittings	VS / B&M / Jainsons
24.	Flexible drop	HD / Tyco / Vaiking
25.	XLPE Insulation	AEROLAM / PARAMOUNT.

Note: For Sl.No. 1 & 4 please mention model number in your offer.



	HVAC BOQ - SITRA PROJECT								
S.No	Description	Qty	Unit	Supply Rate	Supply Amount	Labour Rate	Labour amount		
Α				INR	INR	INR	INR		
1	SITC of Double skin air handling unit with 3 set of 6 rows intrawind coil,multiple filter section with 10 micron filter and MERV 13 filter of size 610mm x 610mm x 175mm with a maximum pressure drop of 12mm, drive package,drift eliminator, vibration isolation springs, IE3 motor etc. assembled in pre plastisiced GI sheet of approved colour of 0.6mm thick on the outer side and powder coated GI sheet of 0.6mm thick on the inner side of following capacities. Cooling coi of the AHU shall be compatiable for connecting DX 11TR Outdoor unit x 3nos. No GI / MS parts to be employed on the innder side of the unit. All the sections of AHU inner side shall be powder coated. Filters should be minimum 4 ply filter medium and oven ply of aluminum net and entire filter should be assembled in aluminium frame work. Unit shall have pressure measuring ports in all the sections. Filter area should be at least 5 to 7.5% more than coil area and restricting the cooling coil face velocity not more than 500fpm. The equipment shall come with factory fabricated 28±2mm thick PUF insulated panels. The equipment shall be with factory designed electrical system fitted within the AHU. Motor electrical components shall be fitted in IP55 as a system(with additional Isolation panel with all Controls wired up to the panel, All Terminal Blocks and Control shall be Part of this panel). The equipment shall be with factory designed electrical system fitted within the AHU. EC Motor electrical components shall be fitted in IP55 as a system(with additional Isolation monitoring system shall be capable enough to view parameters such as Current MFM). Speed, Filter Condition, Motor Direction, Power Consumed and Trip Staus through Communication which shall be buitin Bacnet/Ethernet/Modbus - as requied which shall be part of EC Fan. Necessary provision for Temperature Sensor, Differential Pressure Sensor shall be IP55 protection and Smart AHU HMI shall be along with Run, Trip Indication Lamp shall be mounted on the AHU without any sort of protrusion visible outs								
а	8500cfm / 33TR @ 50mm static Floor mounted Mounted AHU (Coil 17 TR x 2 nos) each coil connecting to 2 Nos of 8.5TR ODU	Nos	1						
2	SITC of 150mm length matching the size of the outlet / duct connection Fire rated canvass connection with a zip for measuring temperature and necessary supporting arrangements	Sqm	2						
3	SITC of DX outdoor unit for above indoor capacities, including all safety controls, thermostart control, MCCB or MCB, additional refrigerant gas with necessary supporting arrangements of following capacities.								
а	8.5 TR DX ODU	Nos	4						
b	SITC of Refrigerant pipe with Insulation finished with Lag coating - Suction line	Rmt	40						
С	SITC of Refrigerant pipe with Insulation - Liquid line finished with lag coat	Rmt	40						
d	SITC of suitably sized powder coated pipe tray to accommodate all the refrigerant pipes neatly clamped on to the tray and the tray well supported on the wall. Cost shall include all items as required including tray and pipes supporting arrangements.	Rmt	20						
3	DRAIN PIPE :-								

	SITC of UPVC heavy class drain piping insulated out of 6mm thick closed cell nitrile rubber material of approved make as per					
	specification as mentioned above complete with supports, consumables, fittings, pipe sleeves, U trap & leak arresting of following					
	sizes.					
а	Dia 50 mm	Rmt	10			
b	Dia 32 mm	Rmt	QRO			
4	RECTANGULAR DUCT :					
	SITC of Rectangular Galvanized Steel Sheet Ducting made of Lock-forming quality GSS Class VIII - complying with IS-277 and having					
	120 GSM coating classification with Grinnle supports saddles and ar state or G full threaded rods and G lotted channel support					
	The series with holts, nuts, near rene representation as a secient with RTV / silicon secient eleves turning vanes timent as a second second with RTV / silicon secient eleves turning vanes timent as a second seco					
	Thanges in accordance with the approved shop drawings and specifications size and quantities as below					
а	24 G sheet	Sqmt	11		 	
b	22 G sheet	Sqmt	20			
с	SITC of factory fabricated insulated double skin plenum of size provided as per drawing including necessary cut outs made for duct	Nos	1			
	connections and supporting arrangements as required for complete installation of plenum.					
-						
5	BUC of thermal insulation on the external surface of ducts using 12mm thick CLASS O closed Coll nitrile subher, insulation shall be					
	and of the main institution of the external surface of outcis using standard the class of tobed can have a model. Installation shall be	Samt	50			
	daving one more cost of lag shall be applied as final finish.	Sqiitt	50			
	arying the more coar of Lag shall be applied as main mish.					
6	VOLUME CONTROL DAMPER					
a	STC of 186. GI Volume control damper including all fittings and necessary supporing arrangements	Samt	2.5			
b	Above damper motor actuator including control cable, electrical cable and ON/OFF switch.	Set	2			
7	FIRE DAMPER :-					
	SITC of Fire Dampers arrangement. The damper shall be made out of 16G thick galvanized sheet steel frame and blades of 18G					
	galvanized steel with air tight arrangement with manual fusible link. Fire damper shall be provided for SA ducts entering the	Sqmt	4			
	auditorium.					
8	MS STRUCTURE FRAME:					
	 ISITC of MS channel / angle iron frame work for ODU & AHU All structure shall be neatly nainted with one cost of anti-corrosive and					
	two costs of approved enamel paint. Wondor shall visit the site and accertain the requirement and nuote accordingly for this work	Job	1			
8	FRESH AIR GRILLE WITH BUG MESH:					
	SITC of linear type 30° deflection fresh air grille with bug filter including all fittings and necessary supporting arrangements of following	Nos	1			
	size. Size (750x500)					
		I		<u> </u>	 	
	Total					

	HVAC BOQ - SITRA PROJECT								
S.No	Description	Qty	Unit	Supply Rate	Supply Amount	Labour Rate	Labour amount		
Α				INR	INR	INR	INR		
1	SITC of Double skin air handling unit with 2 set of 6 rows intrawind coil,multiple filter section with 10 micron filter and MERV 13 filter of size 610 x 610 x 175mm with a maximum pressure drop of 12mm, drive package,drift eliminator, vibration isolation springs, IE3 motor, backward curve airfoil fan etc. assembled in pre plastisiced GI sheet of approved colour of 0.6mm thick on the outer side and powder coated GI sheet of 0.6mm thick on the inner side of following capacities. Cooling coi of the AHU shall be compatiable for connecting DX 8.5TR Outdoor unit x 4nos. Filters should be minimum 4 ply filter medium and oven ply of aluminum net and entire filter should be assembled in aluminium frame work. Unit shall have pressure measuring ports in all the sections. Filter area should be at least 5 to 7.5% more than coil area and restricting the cooling coil face velocity not more than 500fpm. The equipment shall come with factory fabricated 28±2mm thick PUF insulated panels . The equipment shall be with factory designed electrical system fitted within the AHU. Bot or electrical components shall be fitted in IP55 as a system(with additional Isolation panel with all Controls wired up to the panel, All Terminal Blocks and Control shall be Part of this panel). The equipment shall be with factory designed electrical system fitted within the AHU. EC Motor electrical components shall be fitted in IP55 as a system(with additional Isolation panel with all Controls wired up to the panel, All Terminal Blocks and Control shall be Part of this panel). The Status and operation monitoring system shall be capable enough to view parameters such as Current MFM), Speed, Filter Condition, Motor Direction, Power Consumed and Trip Staus through Communication which shall be built mBacnet/Ethernet/Modbus - as requied which shall be part of EC Fan. Necessary provision for Temperature Sensor, Differential Pressure Sensor shall be provided by OEM to control Speed of AHU, monitor Filter Clog Condition. It is mandatory that EC fans electrica								
а	8500cfm / 33TR @ 50mm static Floor mounted Mounted AHU (Coil 17 TR x 2 nos) each coil connecting to 2 Nos of 8.5TR ODU	Nos	1						
2	SITC of 150mm length matching the size of the outlet / duct connection Fire rated canvass connection with a zip for measuring temperature and necessary supporting arrangements	Sqm	2						
3	SITC of DX water cooled outdoor unit of 8.5 TR capacity, including shell & tube water cooled condenser, water pressure switch, all safety controls, thermostart control, MCCB or MCB, additional refrigerant gas with necessary supporting arrangements of following capacities.								
а	8.5TR DX Water cooled condensing unit	Nos	4						
b	SITC of Refrigerant pipe with Insulation finished with Lag coating - Suction line	Rmt	40						
с	SITC of Refrigerant pipe with Insulation - Liquid line finished with lag coat	Rmt	40						
d	SITC of suitably sized powder coated pipe tray to accommodate all the refrigerant pipes neatly clamped on to the tray and the tray well supported on the wall. Cost shall include all items as required including tray and pipes supporting arrangements.	Rmt	20						
3	DRAIN PIPE :-								

	SITC of UPVC heavy class drain piping insulated out of 6mm thick closed cell nitrile rubber material of approved make as per					
	specification as mentioned above complete with supports, consumables, fittings, pipe sleeves. U trap & leak arresting of following					
1	sizes.					
а	Dia 50 mm	Rmt	10			
b	Dia 32 mm	Rmt	QRO			
4	RECTANGULAR DUCT :					
	SITC of Rectangular Galvanized Steel Sheet Ducting made of Lock-forming quality GSS Class VIII : complying with IS: 277 and having					
	120 GSM coating classification with Gripple supports, saddles, anchor fastner or GI full threaded rods, and GI slotted channel support					
	/hangers with bolts. nuts neoprene fire retardant gaskets and sealed with RTV / silicon sealant. elbows, turning vanes, slip on					
	flanges, in accordance with the approved shop drawings and specifications, sizes and quantities as below.					
а	24 G sheet	Sqmt	11			
b	22 G sheet	Sqmt	20			
c	SITC of factory fabricated insulated double skin plenum of size provided as per drawing including necessary cut outs made for duct	Nos	1			
L_	connections and supporting arrangements as required for complete installation of plenum.			l	ļ	
5	DUCT INSULATION WITHIN THE AHU ROOM:-					
	SIIC of thermal insulation on the external surface of ducts using 13mm thick CLASS O closed Cell nitrile rubber. Insulation shall be		50			
	carried out as detailed as per specification. Over the insulation one layer of 7 mil cloth dipped in Lag coat shall be applied and after	Sqmt	50			
	drying one more coat of Lag shall be applied as final finish.					
6					-	
2	VIC of 18G. GLVoume control damper including all fittings and percessary supporting arrangements	Samt	25			
h	Above damper motor actuator including control cable electrical cable and ON/OFS witch	Set	2.5			
~		500	-			
7	FIRE DAMPER :-					
	SITC of Fire Dampers arrangement. The damper shall be made out of 16G thick galvanized sheet steel frame and blades of 18G					
	galvanized steel with air tight arrangement with manual fusible link. Fire damper shall be provided for SA ducts entering the	Sqmt	4			
	auditorium.					
8	MS STRUCTURE FRAME:					
	SITC of MS channel / angle iron frame work for ODU & AHU. All structure shall be neatly painted with one coat of anti corrosive and	lob	1			
	two coats of approved enamel paint. Vendor shall visit the site and ascertain the requirement and quote accordingly for this work.	300	-			
9	FRESH AIR GRILLE WITH BUG MESH:				+	
	SITC of linear type 30° deflection fresh air grille with bug filter including all fittings and necessary supporting arrangements of following	Nos	1			
	size. Size (750x500)					
10	SITC of MS C class piping to connect the existing cooling tower, pump and the proposed water cooled condensing unit. Work shall					
10	include cost of pipes, pipe fittings, installation, transport, supporting and painting. Pipe and valve sizes shall be as follows:					
а	32mm dia	Rmt	24			
b	100mm dia	Rmt	24			
с	32mm dia valve	Nos	8			
d	100mm dia valve	Nos	2			

е	100mm dia strainer	Nos	1			
f	Pressure gauge	Nos	2			
g	Temperature gauge	Nos	2			
	Total					