TENDER

for

Supply, Installation, Testing Commissioning and maintenance of HEPA Air Purification System in GIZ Office

Tender Number: 91144955

Date: 19th Nov'2020

(Single Envelop Bid System)

Brief Tender Notification

Particulars	Description
Purpose of Tender	Supply, Installation, Testing and Commissioning of HEPA Air Purification System at GIZ office
Tender reference number	**91144955**
Date of tender announcement	**19th Nov'2020**
Site visit by interested bidders	**20th Nov'2020 until 26th Nov'2020 (10.00am – 5pm Monday to Friday).**
Last date to submit pre-bid queries by the interested bidders	**30th Nov'2020**
Last date to provide clarification to the queries. All the queries will be answered in the form of (Frequently asked question) FAQ and will be uploaded on the website www.tendernews.com	**4th December'2020**
Last Date and time for submission of bids	**16th December'2020**
Mode of Submission	Bids to be submitted in GIZ India's audit proof email ID as per the instructions given below.
Validity of Bids/ Offered Price	90 days from the last date of submission of bids i.e. The selected supplier will not be able to vary from their financial bid until the completion of the Order, if awarded by GIZ
Address for Bid Submission	The Head of Contracts and Procurement GIZ India, GDCO Office 46, Paschimi Marg, Vasant Vihar, New Delhi-110057
Location of Performance	• B5/1 Safdarjung Enclave New Delhi • B5/2 Safdarjung Enclave New Delhi

Tender Notice

GIZ Country Office (India) is soliciting the bids from interested suppliers/companies for supply, Installation, Testing and Commissioning of Air Purification System as per the terms and condition of tender documents.

Purpose of the Bid

Supply, Installation, Testing and Commissioning of HEPA Air Purification System in the existing AC system of GIZ Office

Process of tender submission

The following documents are attached with the tender applications: -

1) Terms of Reference
2) Sample covering Letter- Annexure- A
3) Sample declaration Letter- Annexure- B
4) Technical Questionnaire- Annexure- C
5) Bill of Quantity/Price format
6) General Terms & Conditions

Interested bidders are requested to carefully examine all documents and submit the entire tender proposal as instructed in above mentioned documents. Any deviation/ differentiation from the instruction will lead to disqualification of the tenderer from the bidding process.

The bid must reach to GIZ Country Office **on or before 16th December'2020** in the below mentioned email ID Only-

qn_quotation@giz.de; QN_Quotation@giz.de

favouring: Head of Contracts and Procurement, GIZ Country Office, German Development Cooperation office, 46 Paschimi Marg, Vasant Vihar, New Delhi- 110057 (India)

Please mark your email

- **Tender Ref**: **"**Supply, Installation, Testing and Commissioning of HEPA Air Purification System, SAP No- **91144955**

Bids received in any other manner, i.e.- hard copies, fax or in any other email ID will be summarily rejected.

**we also request interested bidders to frequently check the web portal for receiving any latest OR revised information pertain to the above-mentioned tender. Information may be updated such as*

extension of bid submission dates, keeping in view the ongoing COVID-19 situations and its implications nationwide.

Timelines;

a) The bidders must submit the bids/queries on the below mentioned email id's -

Description	Deadline	Email ID	Remarks
SITE VISIT	**20th Nov'20 until 26th Nov'20**	**Please contact Mr. Virender Kumar Mobile Nr. 9871281135**	**Timings 10:00am to 5:00pm Monday – Friday**
Per-bid Queries from Bidders	**30th Nov'20**	**Please send it to: sanjay.dhar@giz.de and johney.reberio@giz.de Mandatorily mark queries on both email id's**	**Please mention the subject line as – "QUERIES FOR TENDER Supply, Installation, Testing Commissioning and maintenance of HEPA Air Purification System in GIZ Office - 91144955.** *Pre-bid queries received after this deadline shall not be entertained.*
Clarifications given by GIZ	**4th Dec'20**		**The FAQ/Clarifications shall be shared with all bidders.**
Bid Submission deadline	**16th December 2020**	**Please send the proposal only on: qn_quotation@giz.de**	**Don't send the bids on any other email id apart from qn_quotation@giz.de or else the bids shall be disqualified.**

Bids sent to any other email id, apart from qn_quotation@giz.de shall be immediately disqualified.

Please refrain from making any personal / telephonic / telefax contact about this tender to any personnel of GIZ India.

We look forward to receiving your offers.

TERMS OF REFERENCE

Background:

For over 60 years, the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH has been working jointly with partners in India for sustainable economic, ecological, and social development.

The focal areas of Indo-German cooperation currently are:

- Energy;
- Environment, Climate Change and Biodiversity;
- Sustainable Urban and Industrial Development;
- Sustainable Economic Development ;

The Federal Ministry for Economic Cooperation and Development (BMZ), the Federal Ministry of the Environment, Nature Conservation and Nuclear Safety (BMU) as well as the Federal Ministry for Economic Affairs and Energy (BMWi) are the main commissioning parties of GIZ in India. Other clients include Indian public sector clients, the European Union and foundations.

The GIZ Country office in New Delhi, India is responsible for Financial, Administrative and Human Resource management functions covering the GIZ activities in India and the region. The website of GIZ is www.giz.de

Purpose of the Tender

GIZ India would like to overhaul its existing AC system to upgrade it as per the terms of reference. The interested bidders must undertake the task of supply, installation, testing, commissioning of the Air Purification System in GIZ office, B-5/1 and B-5/2. The special and technical specifications are as follows-

A. SPECIAL CONDITIONS

1. **Scope:** The scope of work to be carried out under this contract is illustrated in Specifications and BOQ. The Contractor will carry out and complete the said work under this contract in every respect in conformity with the contract documents and with the direction of and to the satisfaction of the Owner's (GIZ is referred to as Owner) site representative. The contractor will furnish all labour, materials and equipment (except those to be supplied by the owner) as listed under BOQ and specified otherwise, transportation and incidental necessary for supply, installation, testing and commissioning of the complete system as described in the Specifications and as listed in BOQ. This also includes any material, equipment, appliances and incidental work not specifically mentioned herein or noted on the drawings/documents as being furnished or installed, but which are necessary and customary to be performed under this contract.
2. **Civil Works:** All kind of civil works associated with **Mechanical** installation are part of the scope of this contract.

3. **Performance Guarantee:** The contractor will perform the work in accordance with the tender documents, drawings and other documents forming part of the contract. At the close of the work and before issue of final certificate of virtual completion, the contractor will furnish written performance guarantee against defective materials and workmanship for a period of **one year** from date of testing, commissioning and satisfactory handing over.

   The Contractor will hold himself fully responsible for reinstallation or replacement, free of cost to Owner because of defective workmanship.

4. **Specifications:** The work will be installed as per BOQ. However, any change found essential to coordinate the installation of this work with other trades will be made without any additional cost to the Owner wherever possible or an approval will be taken from Owner. The data given herein and on the Drawings is as exact as could be secured, but its complete accuracy is not guaranteed. The drawings are for the guidance of the contractor, exact locations, distances and levels will be governed by the site conditions and the Architectural & Interior layouts.

5. **Materials & Equipment:** All materials and equipment will conform to the relevant Indian Standards and will be of the approved make and design. Makes will be strictly in conformity with list of approved manufacturers as listed in list of approved makes. Contractor will be responsible for the safe custody of all materials and will insure them against theft or damage in handling or storage etc.

6. **Penalty Clause:** The client shall withhold 10% of the total basic amount of the project until such time the project achieves the stated desired Air Quality parameters.

   I. Fresh air should be 30% extra as per ASHRAE std 62.1 as per space and occupancy details.
   II. Air Quality parameters should be as per ISHRAE Class-A level.
   III. At the outlet of the system, should have minimum 95% reduction of PM2.5 levels as measured with an A Class laser measuring sensor.

7. **Completion Certificate:** On completion, a certificate will be furnished by the Contractor countersigned by the supervisor, under whose direct supervision the installation was carried out.

8. **Demonstration to Owner:** At completion, devices subject to manual operation will be operated at least two times in presence of Owner's site representative to demonstrate satisfactory operation.

B. TECHNICAL SPECIFICATIONS

I SYSTEM DESIGN DATA

1. General

The Mechanical Services described herein and on the accompanying BOQ are for GIZ, SAF1 & SAF2 Building, New Delhi.

2. Description of Works:

The extent of work is detailed on the accompanying drawings and described more fully in the remainder of this specification. The extent of work covered by this contract includes the supply, installation, testing and placing into service, commissioning, twelve (12) months defects liability and maintenance of the whole of the mechanical services. AMC will consist of 02 years whereby cost of filters/consumables to be quoted as a package price offer. AMC will start immediately after the expiry of defect liability period/warranty of one year.

3. Scope of Works:

The scope of work will cover installation, testing & commissioning of the following: -

a. TFA units including (Filters, EC Fan, Cooling/Heating Coil);
b. Heat Pump type outdoor units;
c. Refrigerant piping system;
d. Air distribution system including duct work, grilles, diffuser, dampers etc;
e. Air filtration system;
f. Insulation work for piping;
g. Thermal insulation for duct work;
h. Electrical panels & cabling work;
i. Complete control system;
j. Control units on each floor of the buildings;
k. Operations for 1 year during warranty period and 2 years under AMC;

4. Basis of Design:

a. Site Location: New Delhi
b. Geographic Location: Long: 77.1º E Lat: 28.6º N
c. Altitude : 216 m from MSL

External Design Conditions:

Internal cooling design conditions should be achieved at external conditions which are not exceeded by the maximum historical weather data for New Delhi.

Outside Design Conditions:

S. No.	Condition	Dry Bulb Temp °C	Wet Bulb Temp °C /°F	Relative Humidity %

1	Summer	**48.4**	**23.9**	**20**
2	Winter	**5.0**	**4.2**	**60**
3	Monsoon	**35**	**28.4**	**73**

Fresh Air calculations:

SAF1

Floor	Area Sqft	Per Sqft	CFM per person	Occupancy	Fresh Air	% Extra	Total	Toilets Exhaust	Total F/A Required
BASEMENT	625.0	0.18	7.5	40	413	30	536	300	836
FIRST TO FOURTH	1880.0	0.06	5	60	413	30	537	300	837

SAF2

Floor	Area Sqft	Per Sqft	CFM per person	Occupancy	Fresh Air	% Extra	Total	Toilets Exhaust	Total F/A Required
BASEMENT	1780.0	0.06	5	78	497	30	646	150	796
FIRST FLOOR	2700.0	0.06	5	63	477	30	620	300	920
SECOND FLOOR	2000.0	0.06	5	45	345	30	449	300	749
THIRD FLOOR	2000.0	0.06	5	45	345	30	449	300	749
FOURTH FLOOR	1650.0	0.06	5	30	249	30	324	300	624

5. Design Parameters:

i. **Design Parameters for selection of Air Purification Units and its components will be:**

Maximum Air velocities

Maximum face velocity across pre-filter: 500 Ft/Min. (152M/Min.)

Maximum face velocity across Cooling Coil: 500 Ft/Min. (152M/Min.)

Maximum fan outlet velocity: 2000 Ft/Min. (610M/Min.)

6. System Details:

i. 1 x 2000 CFM and 1 x 3000 CFM Dx based Air Purification systems will be used for treating the Outdoor Air for SAF1 Building.

ii. 1 x 2000 CFM and 1 x 3000 CFM Dx based Air Purification systems will be used for treating the Outdoor Air for SAF2 Building.

iii. iiiCeiling Suspended type recirculation units covering 600 sq./ft area with F9, Carbon filter combo and with HEPA filter.

iv. TFA units will be of Double skin panel construction and floor mounted type and will consist EC centrifugal fans, Heating/Cooling coils, filters, controls and accessories etc. as per BOQ and schedule of equipment.

v. Speed regulators will be provided with TFA for fan speed modulation.

vi. The capacity of the VRV/VRF type outdoor units will be 12 HP and 18HP each for 2000 CFM and 3000 CFM unit respectively.

vii. Air distribution will be done by rectangular GI ducts and to be connected with existing PVC pipes for fresh air supply.

viii. The exposed ducts will be treated with protective coating as discussed in the insulation sections.

8. SEQUENCE OF OPERATION

The sequence of operation of the TFA unit will be as below:

- All the filter sections will be completely sealed before operation of the TFA.
- There will be no hindrance in the inlet passage of the TFA
- The Cooling and heating mode of the TFA will be controlled as per the weather conditions.
- The TFA will be running all the time if the building is occupied.

I. CEILING SUSPENDED TYPE RECIRCULATION UNITS Ceiling Suspended type Air Purification Units Recirculation type complete with 0.8 mm pre-printed GI sheet outside high Efficiency fan with controller and regulator for fan speed modulation, suitable for 220+/-10% volts, 50 Hz, 1 phase AC supply, with HEPA filter. The unit will be complete with circular duct for suction and discharge along with Al powder coated supply air grills for Supply and Suction wherever required otherwise flexible duct will be used to

circulate the air. Unit will be complete with power and control wiring, threaded rod, fasteners etc.

II. DX SYSTEMS

SCOPE

The scope of this section comprises the supply, erection, testing and commissioning of **Heat Pump** type VRV/VRF Dx Units conforming to these specifications and in accordance with the requirements of Drawings and Schedule of Quantities.

CONDENSING UNIT

Air cooled inverter based condensing unit will be supplied and installed generally as shown on the Drawings. The condensing units will be complete with rotary compressors of the hermetically sealed type, fans, condenser coils, motors and control system.

Inverter type air cooled condensing unit will provide the minimum cooling/Heating capacities as detailed in the Drawings or Equipment Schedule. The condensing unit will be able to provide the required cooling capacity when operating at a continuous ambient air temperature of up to 48.4°C. Units should have minimum COP of 3.8 as per ASHRAE 90.1, 2016 std.

Compressors will be driven by an electric motor designed for single phase, 50 cycle operation. Refrigerant used will be a ‘green refrigerant’ greenhouse gas (GHG) of less than 50.

The condensing unit will be fitted with condenser coils in the compressor compartment of the unit. The condenser coils will be of the coiled tube type with copper tubes of the external finned type.

The condenser fans will be fabricated from aluminium alloy coated with corrosion resistant coating and will be complete with non-corrodible blind screens. The fan motor will be of the direct drive totally enclosed fan cooled weather-proofed type.

The compressor will be mounted with the outdoor units. Each section will be constructed of thick sheet steel all welded / bolted construction, adequately reinforced with structural members and provided with sufficient access panels for proper lubrication and maintenance. Base panel will be constructed of fabricated steel structure provided with an under frame suitably braced. Removable panels in fan and coil sections will provide access to all internal parts. Panels will be internally lined with Nitrile rubber as per section “Insulation” for the thermal insulation and acoustic lining.

Split units will be factory finished with durable alkyd spray enamel. Shop coats of paint that have become marred during shipment or erection will be cleaned off with mineral spirits, then coated with enamel paint to match the finish over the adjoining shop-painted surface.

Piping

All connections of Refrigerant piping will be in high grade Copper of Refrigeration quality with Eddy Current Testing and material test Certificates. Insulation of cold lines will be carried out with closed cell nitrile rubber insulation sheets and tubes of appropriate thickness so that condensation does not occur. Pipe insulation joints to be sealed with Al tape.

Installation of Piping

All refrigerant piping for the air conditioning system will be constructed from soft seamless up to 15.9mm and hard drawn copper refrigerant pipes for above 15.9mm with copper fittings and silver- soldered joints and connections to equipment will us compression fittings. The refrigerant piping arrangements will be in accordance with good practice within the air conditioning industry, and are to include charging connections, suction line insulation and all other items normally forming part of proper refrigerant circuits.

All joints in copper piping will be sweat joints using low temperature brazing and or silver solder. Before joining any copper pipe or fittings, its interiors will be thoroughly cleaned by passing a clean cloth via wire or cable through its entire length. The piping will be continuously kept clean of dirt etc. while constructing the joints. Subsequently, it will be thoroughly blown out using nitrogen.

After the refrigerant piping installation, has been completed, the refrigerant piping system will be pressure tested using nitrogen at pressure of 580 PSIG. Pressure will be maintained in the system for 24 hours. The system will then be evacuated to minimum vacuum of 700mm hg and held for 24 hours. The air-conditioning system supplier will be design sizes and erect proper interconnections of the complete refrigerant circuit.

The thickness of copper piping will not be less than mentioned below as per Standard ASTM B 280-03:

Pipe Size in mm (OD)	Wall Thickness in mm
41.3	1.52
38.1	1.52
34.9	1.4
31.8	1.4
28.6	1.27
25.4	1.27
22.2	1.14
19.1	1.07
15.9	1.02
12.7	0.81

9.5	0.81
6.4	0.76

The high pressure & low-pressure suction line pipe dia. and the liquid line pipe dia. will be selected according to the standard OEMs installation procedure/manual.

Covered cable tray for refrigerant pipes

a. **Perforated type pre-galvanized tray:** perforated type pre-galvanized cable trays without cover of the following sizes will be used for running refrigerant pipes in the false ceiling and cable trays with cover for outdoor locations.

   - 150 x 40 x 40 x 2 mm thick

b. **Hot Dip Galvanizing Process for Mild Steel:** Hot dip galvanizing process for MS sheet will be as follows, which will be used for refrigerant pipes. Zinc to be used for galvanizing will conform to minimum Zn 98 grade as per requirement of IS:209 as up to date. Minimum weight of zinc coating for mild steel flats with thickness up to 6mm in accordance with IS:6745 as up to date will be 400 g/sqmt. The weight of coating expressed in grams per square meter will be calculated by dividing the total weight of Zinc by total area (both sides) of the coated surface. The Zinc coating will be uniform, smooth and free from imperfections as flux, ash and dross inclusions, bare patches black spots, pimples, lumpiness, runs, rust stains bulky white deposits, blisters. Mild steel flats / wires will undergo a process of degreasing pickling in acid, cold rinsing and then galvanizing.

Refrigeration Pipe workings for Compression Joints

Pipework for refrigerant systems will generally be installed in accordance with this section and will be run in copper. The copper pipe used will be of refrigeration quality. The pipework is to be fully annealed up to and including 7/8" (22mm) OD and internally degreased and cleaned. The minimum acceptable pipe wall thickness will be in accordance with Standard ASTM B 280-03. Exposed pipework to be of the half hard type. Pipework to be carefully positioned to ensure ease of movement to absorb expansion and contraction.

Pipework will be designed and installed so that any oil in the compressor discharge refrigerant which may pass through the oil separator (where fitted) is carried through the system and returned.

At any point where a large quantity of oil may accumulate an oil separator and a means of returning the oil to the compressor will be provided.

Joints on pipework will be flanged, brazed or made with soldered capillary fittings. The methods of jointing selected should be compatible with the test and working pressures of the system. If fittings are used, they will be to the same standard as the pipe and bends are to be of the long radius type.

Pipework will be reamed after cutting (using a pipe cutter) and will be free from burrs, scale and other defects and will be thoroughly cleaned before erection. At all times

during the installation of the pipework all ends will be capped except when actual jointing is taking place and all pipework will be kept sealed prior to installation.

Joints are to be thoroughly cleaned to bare metal before being brazed with cuprotectic or silver solder, where joints are between copper to another material, e.g. brass or steel only silver brazing rod will be acceptable. Flux used for silver solder joints will not contain ammonia which is harmful to copper. Low melting point tin-silver solders are unacceptable. Whilst pipes are being brazed and after brazing dry nitrogen is to be passed through the tube at a velocity sufficient to displace the air within the tube to ensure oxidization does not take place.

To ensure that no oxides have formed in the pipeline, after completion of all pipe joints (but before testing) up to three brazed joints per system may be selected at random by the Supervising Officer for removal and examination.

If oxides or burrs are found in a joint all pipework will be replaced by the Sub-Contractor at no extra cost to the contract. After examination joints cut out will be made good by the Contractor at his expense.

Pressure testing will be carried out using a small quantity of the correct refrigerant boosted with dry nitrogen. This test pressure will be left in the circuit for a MINIMUM period of 24 hours. All joints will be checked with an electronic Leak Detector with the nitrogen cylinder disconnected. Should the test pressure vary by more than 2% over 24 hours the test is unacceptable and requires to be repeated. Once successful, triple evacuation is to be carried out with the vacuum pump connected to the low and high side.

Prior to evacuation, all valves within the system must be fully opened except the compressor service valves which should remain closed.

The compressor should not be operated during the evacuation process.

Evacuation of the system must be performed with a vacuum pump capable of pulling a vacuum of 50 microns (0.5 torr) or more. This pump should be connected to the low and high side of the system with copper tubes or high vacuum hoses.

Triple evacuation procedure is to be adopted as follows:

ENSURE THAT ALL VALVES TO THE ATMOSPHERE ARE CLOSED.

a) Evacuate each system to a pressure (absolute) of 1500 microns (1.5 torr), then break the vacuum to a pressure of 14 kN/m² with the selected refrigerant for the system.
b) Repeat the above procedure.
c) Open the compressor suction and discharge valves and evacuate to a pressure (absolute) of 500 microns (0.5 torr).
d) The vacuum pump should be left running continuously for a period of 2-3 hours.

e) At a vacuum of 500 microns (0.5 torr) the vacuum pump should be switched off. Close the pump isolation valve. Observe the pressure of the system. If there is a slow and continuous rise of more than 2% then the process must be repeated as this is an indication of an air leak in the system. The presence of free water in the system will be indicated by a rise in pressure accompanied by a levelling until a constant value is maintained.

When the system has been satisfactorily evacuated, (i.e. the system maintains a vacuum of 500 microns, (0.5 torr) and the pressure rise is less than 2%), the vacuum should be broken with refrigerant vapor as soon as possible and the system pressure increased to above atmospheric to reduce any possible likelihood of moisture ingress (0.35 bar).

Each system must be charged with refrigerant from its original container through a combination filter drier.

In order to allow reasonable maintenance, shut-off valves designed for the proper flow rates of refrigerant will be fitted as follows:

Rota lock valves will be fitted to the suction port of each compressor.

1) A liquid line shut-off valve will be fitted adjacent to, and both sides of, the liquid line filter driers.

Refrigeration Pipework Support Centers

Pipe Run mm	Size of Spacing on Horizontal Run mm mm	Spacing On Size Vertical
4.76	800	1000
6.35	800	1000
9.5	1000	1200
12.7	1200	1500
15.8	1200	1800
19.05	500	1800
22.22	1800	1800
28.57	1500	1800
34.9	1500	1800
41.27	1800	2400

53.97	2000	2400
66.6	2000	2400

Prior to charging the system the pipework will be pressure tested to the satisfaction of the Supervising Officer and then evacuated and dehydrated.

Valves required for compressors, liquid receivers, etc. will be of either diaphragm or bellows type or be packed valves complete with a back seating and a seal cap.

A suitable sized liquid line filter/drier and sight glass will be fitted adjacent to the evaporator coil and prior to the solenoid/expansion valve assemblies. A solenoid valve will be fitted where pump down control is required or possibility of migration exists.

It is not permissible to mount driers adjacent to the condensing unit except where the total liquid line length is less than 3 meters.

Braided flexible vibration eliminators will be fitted to both suction and liquid lines where they connect to the condensing unit(s). The length of flexible to be suitable to ensure vibration/pulsations is not transmitted through the pipework.

Where pipes and cables pass through equipment casings, the openings will be suitably sized and lined to prevent contact, chatting and wear.

II. TFA UNITS

1. Scope:

Scope of this section covers the supply, erection, testing and commissioning of TFA units conforming to these Specifications and will comply with the requirements of the Drawings and Schedule of Quantities.

2. General:

The treated fresh units will be factory assembled packaged double skin construction, draw-thru type comprising of various sections, filter section, Cooling coil & Heating coil section and fan section, filters as shown on drawings and included in schedule of quantities

- TFA units will be Eurovent certified or fulfil air tightness L2 as per EN 1886 standard (test report of factory testing provided).

3. TFA Enclosure/Housing:

The TFA housing will be double skinned construction suitable for outdoor application with a rain hood and bird net on intake. Both inner and outer surface of panels will be fabricated out of 0.8mm galvanized iron pre-plasticised/pre painted sheet.

The thermal break profile will be achieved with the fibre-glass insulation which will be 50 mm thick panel, 48 kg/m^3 density.

The main structure will be rested on 1.5mm thick galvanized channel box section structural framework with stainless steel screws.

This cabinet construction will allow reduction in the sound level from the fan of an TFA. The cabinet construction will be maintenance friendly through easy access to all components. The panels will be able to be opened from all units' sections without compromising the unit rigidity. The TFA will be designed to low energy consumption, high thermal insulation and airtight casings. The leakage in the TFA will comply with L2 as per EN 1886 standard.

4. Access Door:

The Inspection and access panels will be hinged type. The hinges will be casted, powder coated Zinc alloy. Flushed Locks and Handles will be of glass fibre reinforced polyamide. Other panels will be screwed on to the frame with sealant and soft rubber gasket thus making the joints airtight. All screws used for panel fixing will be covered with PVC caps. Special hollow gaskets and seals will be used on inspection doors and to create separation between the airstreams to ensure negligible air leakage and mixing.

5. Filter Section:

Fully sealed filter section for easy withdrawal & renewal of filter cells. The enclosure will be sized to accommodate the filters. The gaps between filter frames and housing will have synthetic rubber packing, to eliminate any air leakage. All filter frames will be of aluminium.

Fully sealed filter section for easy withdrawal & renewal of filter cells. The enclosure will be sized to accommodate the filters. The gaps between filter frames and housing will have synthetic rubber packing, to eliminate any air leakage. All filter frames will be of aluminium.

The air filtration system will guarantee the following indoor air quality standards:

1. Fresh air should be 30% extra as per ASHRAE std 62.1 as per space and occupancy details.
2. Air Quality parameters should be as per ISHRAE Class-A level.
3. At the outlet of the system, should have minimum 95% reduction of PM2.5 levels as measured with an A Class laser measuring sensor.

- Washable pre-filter:
  - Filter class G4 / MERV 8 / 10 micron;
  - Metal frame, synthetic filter media with a metal mesh on both sides.
  - 50 mm deep;
  - Box type;
  - Maximum face velocity 2.0 m/s;
  - Pressure loss of clean, new filter 20 Pa, recommended washing pressure 50 Pa.
  - Any local or imported product.

- Coarse filter:
  - Filter class M5 / MERV 9 / 5 micron;
  - Synthetic filter media;
  - 100 mm deep;
  - Box-type, maximum filter installation by-pass leakage of 6% (EN 1886);
  - Eurovent certified;
  - Maximum face velocity 2.0 m/s;
  - Pressure loss of clean filter 25 Pa, recommended changing pressure 200 Pa.
  - Imported Eurovent Certified

- Combined carbon and chemical filter (Bryair):
  - Macro Porous Chemical filter;
  - flat and corrugated sheet of Active Desiccant;
  - Impregnated chemical (**KMnO4**).
  - 200 mm deep;
  - Honeycomb matrix;
  - Tested in accordance to the standards of ASHRAE 145.2;
  - Pressure loss of clean filter 100 Pa;
  - Maximum face velocity 2.0 m/s;
  - Bryair make with the SS 304 frame.

- Fine filter:
  - Filter class F7 / MERV 13 / 0.3-1 micron;
  - Synthetic filter media;
  - 300 mm deep;
  - Box-type, maximum filter installation by-pass leakage of 6% (EN 1886);
  - Eurovent certified;
  - Maximum face velocity 2.0 m/s;
  - Pressure loss of clean filter 25 Pa, recommended changing pressure 275 Pa.

- HEPA filter:
  - Filter class HEPA / H13;
  - Glass Fibre media; 300 mm deep;
  - ABS Header Frame 25mm, tested acc. EN 1822
  - Eurovent certified;
  - Maximum face velocity 2.0 m/s;
  - Max Pressure drop 500 Pa.

6. Centrifugal EC Plug Fan Section

The fan will be Backward Aerofoil type. Fan will be of low noise and high static efficiency design. The impeller will be designed to give excellent performance characteristic with high static pressure development without stalling. The impellers will

be manufactured from high performance composite material and balanced according to ISO1940. Fan casings will be made of galvanized sheet steel, with MEZZ flanges connection to suit galvanised steel ductwork.

- Fan will be Eurovent or AMCA certified centrifugal, backward curved EC fan;
- Pressure generation of 1200 Pa including external pressure;
- Air flow rate 1000 CFM. Automatic fan speed control based on pressure loss across all filters with remote re-set facility;
- Ziehl-Abegg or EBM papst;
- Noise level during operation should be under 60dB(A) at the grill level of the supply air from the proposed system; and it should be under 50dB(A) at the workstation level;

7. Motor

Motor enclosure will have IP54 protection. Motor winding insulation will incorporate thermal class 155 AS standard. Fan will be supplied with the speed controller to regulate the flow by changing the speed of the motor. Motor bearings will consist of maintenance free ball bearing design. Auto-reset thermal contacts will be provided as standard.

8. Dx Cooling Coil (Kit with control)

Units will have electronic expansion valves (EEV's) to control refrigerant flow rate in response to load variations in the room. The cooling coil will be made out of seamless copper tubes and have continuous aluminium fins. Anticorrosion treatment for avoiding corrosion of coils will be done. Each coil will be factory tested at 21kg/sqm air pressure under water. The coils will have 10 to 12 fins per inch. Coil tube water velocity will not exceed 2.5 m/s. The coil size will be designed at an operating air velocity of 2.5 m/s

IV. SHEET METAL DUCT

1. General:

Scope of this section comprises the supply, erection, testing & balancing of GI sheet metal duct work and air registers conforming to the drawings & specifications as given below: Note: Duct pressure testing through testing machine to be specified and done at site.

Noise level should be under 60dB(A) at grill level of supply air from the proposed system and under 50dB(A) at workstation level due to the system installed.

2. Factory Fabricated (As per SMACNA):

2.1 Material for Ducting

All the ducts will of LFQ (Lock Forming Quality) grade prime G.I. raw material furnished with accompanying Mill Test Certificates. Galvanizing will be 120gms per sq./m. (Total coating on both sides).

In addition, if deemed necessary, sample of raw material, selected at random by owner's site representative will be subject to approval and tested for thickness and zinc coating at contractor's expense.

The G.I. raw material should be used in coil-form (instead of sheets) so as to limit the longitudinal joints at the edges only, irrespective of cross-section dimensions.

2.2 Governing Standards

Unless otherwise specified here, the construction, erections, testing and performance of the ducting system will conform to the SMACNA standards and Addendum of SMACNA.

2.3 Duct connectors and Accessories

All the transverse duct connectors (Flanges\Cleats) and accessories related hardware such as support system will be zinc coated (galvanized).

2.4 Fabrication standards

All the ductwork including straight sections, tapers, elbows, branches, shoe pieces, collars, terminal boxes and other transformation pieces will be factory fabricated. Equivalency will require fabrication by utilizing the following machines and process to provide the requisite quality of ducts and speed of supply.

Coil lines to ensure location of longitudinal seams at corners\folded edges only to obtain the required duct rigidity and low leakage characteristics. No longitudinal seams permitted along any side of the ducts.

All ducts, transformation pieces and fittings will be made on CNC profile cutters for required accuracy of dimensions, location and dimensions of notches at the folding lines.

All edges will be machines treated using lock-formers and rollers for turning up edges.

Selection of G.I. and Transverse Connectors

Duct construction will be in compliance with 1" (250 Pa) w.g. static norms as per SMACNA.

All transverse connectors will be 4-bolt system.

To avoid any leakage additional sealant will be used.

The specified class of transverse connectors and duct gauge for a given duct dimensions will be 1" (250 Pa) pressure class.

Non-toxic, AC-application grade P.E. or PVC gasketing will be provided between all mating flanged joints. Gasket sizes will conform to flange manufacturer's specification.

2.5 Duct construction

The fabricated duct dimensions will be as per approved drawings and all connecting sections will be dimensionally matched to avoid any gaps.

Dimensional Tolerances: All fabricated dimensions will be within + 1.0mm of specified dimension. To obtain the required perpendicularity, permissible diagonal tolerance will be +1.0mm per meters.

Each duct pieces hall is identified by coded sticker, which will indicate specific part number, job name, drawing number, duct sizes and gauge.

Ducts will be straight and smooth on the inside. Longitudinal seams will be airtight and at corners, which will be either Pittsburgh or snap button punch as per SMACNA practice, to ensure air tightness.

Changes in dimensions and shape of ducts will be gradual (between 1:4 and 1:7) turning vanes or air splitters will be installed in all bends and duct collars designed to permit the air to make the turn without appreciable turbulence.

Plenum will be factory fabricated panel type and assembled at site.

Factory fabricated ducts will have the thickness of the sheet as follows and length of the piece not more than 1200mm and should have beading at every 300mm.

Recommended SMACNA standard at 4 feet Transverse Joint Reinforcement

Duct Static Pressure In Inches	**1”**	**2”**	**3”**	**4”**	**6”**
Duct Size (mm)					
150-250	B-26	B-26	B-26	B-26	C-26
251-300	B-26	B-26	B-26	C26	C-24
301-350	B-26	C26	C26	C26	C-24
351-400	B-26	C26	C26	D-26	D-24
401-450	C26	C26	C26	D-26	E-24
451-500	C26	C26	D-24	D-24	E-24
501-550	C26	C26	D-24	E-24	F-22
551-600	C26	D-26	E-24	E-24	F-22
601-650	C26	D-26	E-24	E-24	F-22
651-700	C26	D-26	E-24	F-22	G-22 R
701-750	C26	E-24	E-24	F-22	G-20
751-900	D-26	E-24	F22	G-22 R	H-20 R
901-1000	E-24	F-22	G-22R	H-20 R	I-18
1001-1200	E-24	G-22	H-20R	I-18	I-18
1201-1300	F-22	H20	I-18	I-18	J-18 R
1301-1500	F-22	H-20 R	I-18	I-18 R	-
1501-1800	H-22	I-18	J-18 R	-	-

1801-2100	I-20	J-18 R	-	-	-
2101-2400	I-18	J-18 R	-	-	-
2401-2700	I-18	-	-	-	-

Note: SMACNA- Sheet Metal & Air Conditioning Contractor National Association Inc. "HVAC Duct construction standard metal & flexible"- Third Edition 2005 USA.

In 1" static pressure i.e.: comfort cooling application optional "C&S and C&SS cleats joints can be used

Up to 450mm duct size use C&SS cleats. Over 750 mm duct size use TDF/TDC flanges with respective gauges as mentioned above.

Alphabets B, C, D, E, F, G, H, I and as per SMACNA 2005, transverse joint reinforcement table 1-12m

(T- 25b flanged) and TDC addendum.

R means reinforcement with Zeebar Stiffener / Joint Tie Rod /Mid Tie Rod.

The gauges, joints and bracing for sheet metal ductwork will further conform to the provisions as shown on the drawings.

Ducts larger than 600mm will be cross broken, duct sections up to 1200mm length may be used with bracing angles omitted

Changes in section of duct work will be affected by tapering the ducts with as long a taper as possible. All the branches will be taken off at not more than 45 DEG. Angle from the axis of the main duct unless otherwise approved by the Engineer-in-charge.

Ducts 2250 mm and larger require special field study for hanging and supporting methods.

In addition to above the following points should be also taken into account while fabrication of ducts.

- All ducts of size larger than 450mm will be cross broken.
- All ducts will be supported from the ceiling/slab by means of MS rods of 9mm diameter with MS angle of size 40mm x 40mm x 5mm at the bottom with neoprene pad in between the duct & MS angle. The ducts will be suspended from the ceiling with the help of dash fasteners. Provision for necessary ancillary materials required for hanging the ducts will be arranged by the contractor.
- The vanes will be provided wherever required and will be securely fastened to prevent noise & vibration.
- The rubber gasket will be installed between duct flanges in all connections and joints.
- All flanges and supports should be primer coated.
- The flexible joints will be fitted to the delivery side of AHU fans with Fire Retardant Double canvass. The length of flexible joints should not be less than 150 mm and not more than 300mm between faces.
- The ducting work can be modified if deemed necessary in consultation with the Engineer in Charge to suit actual site conditions in the building.

- These dampers will be provided in the ducting work for proper control and balancing of air distribution. All dampers will be louver type robust construction. These dampers will be fitted with easily accessible operating mechanism, complete with links, levers, quadrant for proper control and setting in a desired position. The position of the handle of the damper operating mechanism will be clearly visible and will indicate the position of the damper in the duct. All dampers, splitters will be fabricated out of G.S. sheet of two gauges higher than the duct piece having these fittings. Dampers will be installed in duct at all required locations. **No extra payment will be made separately since these form part of Air Circulation System.**

NOTE: In case angle iron supports are not feasible to be installed for supporting the ducts due to height constraint then the contractor will support the ducts with M.S flats of at least double the thickness of the angle iron supports.

V. INSULATION:

1. General:

Scope of this section covers the fixing of Thermal/Acoustic insulation of ducts, pipes, fittings, equipment etc conforming to these Specifications and will comply with the requirements of the Drawings.

2. Duct Thermal Insulation

Ducts are included in Schedule of Quantities will be provided with thermal insulation for complete length of duct up to the outlet.

Material will be engineered Nitrile Rubber closed cell of 20mm thickness closed cell Cross linked (class “O”) insulation with wrapping from 7-mile fibre glass cloth and two coats of starbond for UV and water protection

3. Refrigerant Pipe Insulation

The Thermal conductivity of the nitrile rubber insulation material will not exceed 0.033 W/m K at 25C degrees mean temperature and material Insulation material will be non-toxic, chemically inert, non-combustible as per BS 476: Part 4, non-ignitable as per BS 476: Part 5, and class ‘O’ as per BS 476 Part 6 &7 and also will confirm IS 8183. The thickness of insulation will be so selected as to prevent the any condensation & the insulation thickness will be selected to meet ECBC2007 & ASHRAE 90.1-2004.

The whole of the liquid and suction refrigerant lines including all fittings. Will be insulated with 19mm thick insulation for copper pipe size 19mm & above & 13mm for copper pipe size 19mm below with electrometric nitrile rubber as specified in BOQ. Insulation will be suitable for maximum operating temperature.

4. Protective coating over duct

To provide mechanical strength and protection from damage, exposed duct as indicated in BOQ will be covered with Thermal insulation protective coating with Alkali resistance glass fibre fabric of 90-180 or GSM 5-7mm minimum thickness reinforcement.

The coating’s non-volatile content must be as per guideline of ASTM 1644-01. Water permeance (perms) will be as per guideline ASTM E-96. The coating flammability, surface burning characteristics as per guideline ASTM E-84.

Ducts will be first coated with resin polymer compound and then covered with alkali resistance glass-fibre cloth. Apply two finish coat of resin polymer compound. Ensure that each coat of resin polymer compound is totally cured before the next coat is applied. The application method strictly follows as per manufacturer's TDS. Aluminium cladding will be provided on all exposed ducts.

No broken insulation anywhere will be permitted under any circumstances whatsoever. If anywhere the quality of installation is found to be inadequate as per Specifications or as per the performance requirement, the installation will have to be redone without any extra cost to the Client.

The sample of insulation material will be submitted for approval to the Consultant. Adhesive used for setting the insulation will be non-flammable, vapor proof, CPRX compound

VI. ELECTRICAL INSTALLATION

1. General:

Scope of this section comprises the supply and installation of all electrical equipment such as motors, motor control centres, starters, cables, interlocks, etc., as required.

2. Starter Panel Boards:

The total height of the panel will not be more than 500 mm unless otherwise specified and maximum height of operating handle will not be more than 500mm and minimum height not less than 300 mm from FFL. The total depth of the panel will be adequate to cater for proper cabling space.

Circuit Breakers: The ACB, MCCB, MPCB, RCCB and MCB will be used for Main panels, Sub panels & distribution boards will be as specified below:

2.1 Moulded case circuit breaker (MCCB):

The MCCB should be current limiting type with. The service short circuit breaking capacity (Ics at 415 V AC) should be as specified in BOQ. Ics and Icw of MCCB will be same. MCCB will be current limiting and comprise of quick Make – Break switching mechanism, double break contact system, arc extinguishing device and the tripping unit contained in a compact, high strength, heat resistant, flame retardant, insulating moulded case with high withstand capability against thermal and mechanical stresses. All MCCBs will be capable of defined variable overload, short circuit and earth fault adjustment with thermo magnetic / microprocessor releases. All MCCB with microprocessor-based release unit, the protection will be adjustable overload, short circuit and earth fault protection with time delay. The tripping time of MCCB will be less than 10m/sec under short circuit conditions. All the MCCB up to 250A will be provided with thermo-magnetic release and all MCCB above 250A will be provided with microprocessor release. MCCB should have ROHS compliance. MCCBs should be suitable for positive isolation. Suitable discrimination will be provided between upstream and downstream breakers in the range of 10-20 milli seconds. The manufacturer will provide both the discrimination tables and let through energy curves. The MCCB will not be restricted to Line/Load connections.

The handle position will give positive indication of 'ON', 'OFF' or 'Tripped' thus qualifying to disconnection as per the IS/IEC indicating the true position of all the contacts. In case of 4 Pole MCCB, the neutral will be defined and capable of offering protection.

The general-purpose control switch will be provided for ON/OFF, Auto/Manual. The switch will be provided with engraving plates on the front with the complete inscription. The switch will be normally a fixed control box type heavy-duty unit.

Indicating lamps will be of the panel mounting, LED type and will have execution plates marked with its function wherever necessary. The colour of the lamp cover will be red for 'ON' and green for 'OFF'.

MCCBs for motor application should be selected in line with Type-2 Co-ordination as per IEC60947-2.

Provisions of protections & Interlocking in MCCB: The MCCB will be provided with following protections.

- Microprocessor and thermal-magnetic trip units will be adjustable and it will be possible to fit lead seals to prevent unauthorized access to the settings.
- Microprocessor trip units will comply with appendix F of IEC 60947-2 standard: (measurement of rms current values, electromagnetic compatibility, etc.) Protection settings will apply to all poles of circuit breaker.
- All Microprocessor components will withstand temperatures up to 125°C

MCCB will be provided with the following interlocking devices for interlocking the door of a switch board.

- Breaker Door will be interlocked to prevent the door being opened when the breaker is in the ON position.
- Handle of breaker will be interlocked to prevent unnecessary manipulations of the breaker.
- Defeat-interlocking device to open the door even if the breaker is in ON position. - The trip command will override all other commands.

2.2 Miniature Circuit Breaker (MCB):

MCB will comply with IS-8828/ IEC898. MCB will be quick make and break type for 240/415 V, AC 50 Hz application with magnetic thermal release for over current and short circuit protection. The breaking capacity will not be less than 10 KA at 415 V, AC. MCBs will be DIN mounted. The MCB will be Current Limiting type (Class-3). MCBs will be classified (B, C, D ref IS standard) as per their Tripping Characteristic curves defined by the manufacturer. C' curve type MCB will be used for inductive and resistive load & D' curve type MCB will be used for resistive load. The MCB will have the minimum power loss (Watts) per pole defined as per the IS/IEC and the manufacturer will publish the values. MCB will ensure complete electrical isolation & downstream circuit or equipment when the MCB is switched OFF.

The housing will have heat resistant and having high impact strength. The terminals will be protected against finger contact to IP20 Degree of protection. All SP, DP, TP, TPN and 4 Pole MCB will have a common trip bar independent to the external operating handle. In case of multiple MCB will be provided in a single location, it should be possible to remove any MCB without disturb other MCB in the vicinity.

2.3 Motor Protection Circuit Breaker (MPCB):

MPCB will be in utilization category A, conforming to IEC 947-2 and AC3 conforming to IEC 9474.MPCB will have a rated operational and insulation voltage of 690V, AC (50 Hz). MPCB will have a rated impulse withstand voltage (Uimp) of 6 kV. MPCB will be designed to be mounted vertically or horizontally without derating. MPCB will have safety features like the contacts will be isolated from other functions such as the operating mechanism, casing, releases, auxiliaries, etc, by high performance thermoplastic chambers. The operating mechanism of the MPCB must have snap action opening and closing with free tripping of the control devices. All the poles will close, open, and trip simultaneously. The MPCB will accept a padlocking device in the “isolated” position.

The MPCB will be equipped with a “PUSH TO TRIP” device on the front enabling the correct operation of the mechanism and poles opening to be checked. The auxiliary contacts will be front or side mounting, and both arrangements will be possible. The front-mounting attachments will not change the breaker surface area. Depending on its mounting direction the single pole contact block could be NO or NC. All the electrical auxiliaries and accessories will be equipped with terminal blocks and will be plug-in type. The MPCB will have a combination with the downstream contactor enabling the provision of a perfectly coordinated motor-starter. This combination will enable type 1 or type 2 co-ordination of the protective devices conforming to IEC 60947-4-1. The MPCB, depending on the type, could be equipped with a door-mounted operator which will allow the device setting. The MPCB will be provided with releases comprising a thermal element assuring overload protection and a magnetic element for short-circuit protection. To ensure safety and avoid unwanted tripping of MPCB, the magnetic trip threshold (fixed) will be factory set to an average value of 12 Ir. All the elements of the MPCB will be designated to enable operation at an ambient temperature of 60°C without derating. The thermal trips will be adjustable on the front by a rotary selector. Phase unbalance and phase loss detection will be available.

3. Isolator Switches:

Isolator switches are to be provided for equipment located outdoors or for those located in separate enclosure, other than those nos. having the Electric Panel. Isolator

switch should be of Rotary Load Break type with a weatherproof sheet steel enclosure. Its rating will be same as the outgoing device in the Electric Panel.

4. Contactor:

Contactor will be built into a high strength thermoplastic body and will be provided with an arc shield for quick arc extinguishing. Silver alloy tips will be provided to ensure a high degree of reliability and endurance under continuous operation. The magnet system will consist of laminated yoke and armature to ensure clean operation without hum or chatter.

Starters contactors will have 3 main and 2 Nos. NO / NC auxiliary contacts and will be airbrake type suitable for making and breaking contact at minimum power factor of 0.35. For design consideration of contactors the starting current of connected motor will be assumed to be six (6) times the full load current of the motor in case of direct-on-line starters and three (3 times) the full load current of the motor in case of Star Delta and Reduced Voltage Starters. The insulation for contactor coils will be of Class "E".

Coil will be tape wound vacuum impregnated and will be housed in a thermostatic bobbin, suitable for tropical conditions and will withstand voltage fluctuations. Coil will be suitable for 220/415±10% volts AC, 50 cycles AC supply.

5. Starters:

Each motor will be provided with a starter of suitable rating. Starters will be in accordance with relevant IS Codes. All Star Delta Starters will be fully automatic. Motors up to 10HP will be provided by Direct Online (DOL) starter, motors above 10 kW and up to 45 kW will be provided by star/delta starter and motors above 45 kW will be provided by soft starter.

The following capacity contactors and overload relays will be provided for different capacity motors or as per type-2 co-ordination system.

Motor Rating	Type of Starter	Contactor capacity	Overload relay

5 HP	D O L	16 amps	6-10 amps	
7.5 HP	D O L	16 amps	9-15 amps	
10 HP	D O L	25 amps	9-15 amps	
12.5HP	Automatic Star Delta	16 amps	9-15 amps	
15 HP	Automatic Star Delta	25 amps	9-15 amps	
20 HP	Automatic Star Delta	32 amps	14-23 amps	
25 HP	Automatic Star Delta	32 amps	14-23 amps	
30 HP	Automatic Star Delta	40 amps	20-33 amps	
35 HP	Automatic Star Delta	40 amps	20-33 amps	
40 HP	Automatic Star Delta	40 amps	30-50 amps	
50 HP	Soft Starter	70 amps	30-50 amps	
60 HP	Soft Starter	110 amps	30-50 amps	
75 HP	Soft Starter	110 amps	90-150 amps	
100 HP	Soft Starter	200 amps	CT operated relay	
125 HP	Soft Starter	200 amps	CT operated relay	
150 HP	Soft Starter	200 amps	CT operated relay	

Two speed motors when specified, will be provided with DOL starter irrespective of it rating.

5.1 Direct On – Line Starters:

These starters will have heavy duty air brake contractors of suitable rating. These starters will be complete with adjustable overload relays on all three phases, single phase preventing device and under voltage release. The starters should be “hand reset” type. The “No Volt Coil” of these starters will be 220 Volts + 10%-15% (Wide band type) whenever any controls on safety devices are connected in the starters circuits, otherwise standard 415 Volts coils may be used. There will be ON-OFF push button for each starter unless remote operation of the starter is required.

6. Painting:

All sheet steel work will undergo a multi tank process of degreasing, pickling in acid, cold rinsing, and phosphating, passivating and then sprayed with a high corrosion resistant primer. The primer will be baked in over. The finishing treatment will be by application of powder coated paint of approved shade and stove.

7. Cabling:

- The cabling of various equipment will be carried using PVC Insulated and armoured cables.

- The PVC armoured power cable for use on 415 volts system will be 3 or 3.5 crore with aluminium conductors and be of 660/1100 volts grade, as per IS 1554 (Part I) 1964. The cross section of the cable will be to suite the load and rating of the equipment. The cables will be of aluminium conductor, PVC insulated, strip armoured with overall PVC sheathing.

- The cables will be laid as per IS-1255/1967, Indian standard code of practice.

- The cables will be laid, as per drawings in the ducts/pipes/trays etc., along a short and convenient route between switch board and the equipment, (either in trenches, on wall or on hangers, supported from the slab). Cable routing will be checked at the site of work to avoid interference with structure, equipment etc. Where more than one cable is running close to each other, proper spacing should be provided between them.

- The radius of bends of the cable should not be less than 12 times the overall dia. of cable in order to prevent undue stress and damage at the bends, the cables should be supported with wooden cleats on M.S. supports, when laid in trenches, or wall/ceiling suspended hangers. When laid underground the cables should be covered with fine soft earth and protected with 2nd class bricks. Suitable G.I. pipe will be used wherever cables are laid under the roads etc.

- Wooden bushes will be provided at the ends of pipes through which cables are connected through.

8. Surface Wiring:

- The surface wiring will be cased in conduits which will be of 1100 volts grade and conform to IS 9587-1987 (revised to date).

- The conduits used will be of high quality & all joints will be made with sockets. The bends and elbows will have inspection covers fixed with grease free screws. The

joints will be watertight. Approved metal saddles will be used to secure the exposed conduits at a space of 1 meter or less. The connections of the conduits to switches etc. will be secured by check nuts and ebonite bushes provided at the ends of conduits.

- The M.S. conduits will be heavy duty and rigid type –ISI marked/conforming to IS specifications. The wall thickness will not be less than 2 mm. For conduits above 32 mm dia. Metallic conduits of 19 mm dia. and below will not be used. Conduit accessories (Boxes etc.) will conform to IS-5133-1968 and IS -2667-64 (amended-revised to date). Conduit pipes will be jointed, wherever necessary by means of screwed couples and screwed accessories only. In Long distance straight, run of conduits inspection type couplers at suitable intervals will be provided.

- Threads on conduit pipes will be between 13 mm to 19 mm long.

- The wiring will be carried –out at per IS 732 – 1989 (Amended and revised to date).

- Flush inspection covers will be provided in case of Concealed, recessed conduits. The staples for the conduits will not be spaced more than 0.60 meters apart. Before filling up the chase with concrete the conduits should be given a coat of rust proof paint.

- The wires will be drawn only after all the conduits have been properly fixed in position. Fish wires (steel wire: 16 SWG) will be laid in conduits for drawing of wires subsequently.

9. Control cabling/wiring:

- Control cables will be 1100 volts grade, as per IS 1554, made from copper conductor of 1.5 Sqm PVC insulted single core, strip armoured with an overall PVC sheathing.

- The cables and conduits wiring will be carried out as per details given under 2.2 and 2.3 above.

10. Earthing:

All equipment connected with electric supply will also be provided with double earthing continuity conductors. The size of earthing strip will be consider based on IS: 3043. The area of earthing conductor will be as per fault calculation.

11. Cable size with Motor Rating:

MOTOR	D.O.L. STARTER	STAR DELTA STARTER

H.P.	KW	Rated Amps	CABLE SIZE AL. SQ. MM	CABLE SIZE AL. SQ. MM
0.5	0.37	1	3C X 2.5	X
0.75	0.55	1.3	3C X 2.5	X
1.0	0.75	1.9	3C X 2.5	X
1.5	1.1	2.6	3C X 2.5	X
2.0	1.5	3.7	3C X 2.5	X
3.0	2.2	4.8	3C X 2.5	X
5.0	3.7	7.8	3C X 4.0	X
7.5	5.5	11.2	3C X4.0	X
10	7.5	16	3C X6.0	X
12.5	9.3	19	X	2 X 3C X 10
15	11	20.8	X	2 X 3C X 10
20	15	28	X	2 X 3C X 16
25	18.5	34	X	2 X 3C X 16
30	22	40	X	2 X 3C X 16
35	26	46.5	X	2 X 3C X 16
40	30	53	X	2 X 3C X 16
50	37	65	X	2 X 3C X 25
60	45	78	X	2X 3C X 35

12. Cable Trays

The cable trays will be provided complete with all necessary coupler plates, elbows, tees, bends, reducers, stiffeners and other accessories and hardware. All hardware (i.e. bolts, nuts, screws. washers, etc.) will be hot dip galvanized. Cable Trays will be ladder type for all vertical runs and perforated type for horizontal runs. The detail of cable tray is given below:

Cable Trays will be MS Powder coated perforated and factory fabricated out of MS channels, angle iron, tee, bends, sections, flats and perforated sheet for different loads and number and size of cables as given below:

Perforated type cable trays of the following sizes of powder coated.

- 150 x 40 x 40 x 2mm thick

Note : Suitable length of 10mm dia GI painted rod suspenders at 1500mm intervals will be included in the item for perforated type cable tray.

Miscellaneous:

- The final connections to the equipment will be through flexible connections in case of conduit wiring and also where the equipment is likely to be moved back and forth, such as on slid rails.
- An isolator switch will be provided at any motor which is separated from the main switch panel by a wall or partition or other barrier or is more than 15 meters away from the main panel.
- Two separate and distinct earthing conductors will be connected from the equipment up to the main switch board panel.
- The branch lines from the main panel to each equipment will be separated and should not crises cross other lines.
- The entire installation will be tested as per Electricity rules and I.S.S. 732 – 1973 with amendments 1, 2 & 3 prior to the commissioning of the plant and a suitable test report furnished by a competent and authorized person. The test report will be obtained by contractor himself at his own expenses.
- All exposed switch board panels, conduits, hangers, etc., will be given 2 coats of suitable paint of approved colour, when all work has been completed

VII. TECHNICALSUBMITTALS

The successful tendered offer the award of work will furnish submittal for various equipment giving complete selection details for the approval of consultants, prior to ordering of equipment

Submittals will be submitted for the following:

- TFA units with static pressure calculation
- Filters details & test certificates
- Pipes/ insulation/factory fabricated ducts
- Centrifugal EC fans
- Outdoor unit details
- Electrical Panels

Test certificates will be submitted by the contractor for various items

VIII. TEST AT SITE

1. General:

The Contractor must perform all inspection and tests of the system as a whole and of components individually as required, under the supervision of the Architect, in accordance with the provisions of the applicable AHSRAE Standards or approved equal and furnish necessary test certificates from manufacturers.

2. Commissioning/checks of following items will be done.

i. Delivery checks of critical components and report
ii. Ductwork cleanliness review and requirements of cleaning if not clean
iii. Pressure testing of TFA units (factory test results L2- as per EN 1886)
iv. Filter by-pass leakage testing (factory test results)
v. Pre-commissioning checks and report

3. Duct Work:

- All branches and outlets will be tested for air quantity, and the total of the air quantities will be within plus five percent (5%) of fan capacity.
- Fire Dampers, Volume Dampers and Splitter Dampers will be tested for proper operation.
- Noise level during operation should be under 60dB(A) at the grill level of the supply air from the proposed system; and it should be under 50dB(A) at the workstation level

4. Electrical Equipment:

- All electrical equipment will be cleaned and adjusted on site before application of power.
- The following tests will be carried out:
- Wire and cable continuity tests.
- Insulation resistance tests, phase to phase and phase to earth, on all circuits and equipment, using a 500 volt meggar. The meggar reading will be not less than one mega ohm.
- Earth resistance between conduit system and earth must not exceed half (1/2) chm.
- Phasing out and phase rotation tests.
- Operating tests on all protective relays to prove their correct operation before energizing the main equipment.
- Operating tests on all starters, circuit breakers, etc.

5. Performance Test:

- The installation as a whole will be balanced and tested upon completion, and all relevant information, including the following will be submitted to the Architects.
- Air volume passing through each unit, duct, grilles, and apertures.
- Electrical current readings, in amperes of full and average load running, and starting, together with name plate current of each electrical motor.
- Any other readings will be taken which may subsequently be specified by the Client/Consultant.
- Drawings marked with all grill outlets with CFM.
- Indoor air quality as specified in Chapter II, Section 5 above.
- Noise level during operation should be under 60dB(A) at the grill level of the supply air from the proposed system; and it should be under 50dB(A) at the workstation level

IX. TECHNICAL DATA

Contractor should furnish technical data as mentioned below, of the equipment and accessories offered by him as per scheme given in schedule of equipment and Bill of Quantities.

S. No.	Description	Unit	Condition of Services

1. GRILLES/DIFFUSERS/DAMPERS:

- Make, Materials and Gauge
- Fire Dampers - UL Listed
- Grilles
- Louvers
- Diffusers
- Duct Dampers

3. INSULATIONS:

- Manufacturer
- Materials
- Thickness
- Thermal Conductivity

4. AHU/TFA:

- Unit No.
- Manufacturer
- Type-
- Air Quantity m^3/Hr
- Fan Outlet Velocity M/S
- No. of Fans Nos.
- Fan curve
- Dia. of Fans mm
- Fan Speed RPM
- Total Static Pressure MM WG/
- Balancing-Static and/or Dynamic
- Operating Weight Kg.
- Overall Dimension m

S.No.	Description	Unit	Condition of Services

- Dimension of Coil m
- Finned Area m^2
- No. of Rows No.
- Fins Per cm No.
- Type of Fins
- No. of Circuits Nos.
- Water Velocity in Tubes M/S
- Tube Material
- Tube Dia mm
- Thickness of Tubes mm
- Fin Material
- Water Pressure Drop m
- Motor Output HP/KW
- Type of Motor
- Type of Air Filters
- Velocity Across Filters M/S
- Filters details
- Efficiency of filters

D. RECOMMENDED MAKE OF MATERIALS

S.No.	MATERIALS	MANUFACTURER/ SUPPLIER
1	DX Units	Toshiba/Daikin/Midea/LG/Hitachi
2	TFA	DRI
3	EC Centrifugal Fan	EBM Papst/ Ziehl-Abegg/Rosenberg

4	Pre filters/Coarse filters/Fine filter	Camfil
5	Combined Chemical and carbon filter	Bryair
6	GI Sheets	Tata/Sail/Jindal
7	Factory Fabricated Ducts	Rolastar/Zeco/Eco duct/ GP Spira
8	VCD	Caryaire/Conaire/Precise/Mapro/System Air
9	Grills, Diffusers	Caryaire/ Conaire/Precise/Mapro/System Air
10	Protective Coating	Paramount
11	Nitrile Rubber	Armaflex/A-Flex/K-flex
12	MCCB	ABB ((T-Max)/L & T (DH-Series)/MDS Legrand/Schneider Electrical (Compact NS/NSX)
13	MCB	ABB/Hager (L & T)/MDS Legrand/Schneider Electrical(MG)Multi-9
14	Cables	KEI/RPG/Skytone/Universal/Havells
15	Controls	DRI
16	Hinge, handle, Locks	Southco USA, Industrilas

Minimum Eligibility Criteria for participation in tender process

- The company must have a registered office in **Delhi NCR Region** with minimum experience of **05 years** in constructions/interior/HVAC works including large scale supply and installation of HVAC high side and low side works with prior experience in Airpurification system.
- The company must possess a valid **PAN, TIN, and GST Number.** Company must have all the **regulatury and statutory licencese/approvals** in order to carry out any constuction/HVAC related works in any client site.
- The company must have a minimum client list of **10 medium/ large size companies** in the past 03 years having undertaken large scale construction/HVAC/airpurification related works. Prior experience of working with International organisation/embassies will be desirable though not mandatory.
- The company must have minimum annual turnover of **INR 05 Crore (50 million) or more** during each of the last two financial years.
- The company should be able to provide own resources or should have capacity to associate with contractor for civil or electrical works as required in the project.

Documents to be submitted with the financial proposals - MANDATORY

- Documents pertain to the legal status of organisation (Certificate of Incorporation/Registration/Memorandum/Partnership deed etc);
- Copy of PAN, TIN and GST Registration;
- Copy of annual statememt of income tax return – last two financial year;
- Prior work order/purchase order will be attached for at least 03 companies demonstrating the similar nature of work undertaken in the past 03 years with minimum value of INR 25 Lakhs;
- Reference of 5 established clients for reference check- Following details should be provided for each client:
    a. Name of Company:
    b. Name and Contract of person:
    c. Total tenure with the organization:
- Technical questionnaire details- As per Annexure -C;
- Quality Certifications- any ISO, Quality or any Green certification – Desirable though not mandatory;
- ***The company will also declare that no child labour engaged in their organisation directy or indirectly. (As per Annexure- A);***
- ***Self-certification to the effect that the tenderer has not been blacklisted by any company or its contract has been terminated on account of poor performance. (As per Annexure-A);***

The financial proposal/BoQ must be duly signed and stamped by the authorised signatory with a covering letter, mentioning complete details/coordinates of company. The detailed Bill of Quantity (SAF1 & SAF 2) are attached with the tender documents. The agency is requested to quote for each and every items/equipments mentioned in the respective BoQs.

The financial proposal must also mention the following;

(a) Clear date for Supply, installation, testing and commission. (timelines)
(b) Warranty/Guarantee of equipments
(c) GST must be indicated separately with GST rate
(d) Payment terms
(e) Freight/Packing/Installation charges (if any) must be mentioned separately

Submission of Bids:

- The tender documents duly completed should be submitted in email with subject line as - **Tender Ref**: **91144955** and will be sent as per instruction provided in Tender Notice.

- The bids will be complete in all respect and the bidder will submit all the relevant documents as described under this tender. If required, GIZ may solicit in writing further information from the bidder.

Price Submission

- The price quoted should be exclusive of taxes (GST) and tax rate should be clearly indicated **"Price Sheet/BOQ" – Annexure- D** and any such other levies/ taxes that may be should be clearly defined.

- If no mention is made regarding taxes in the price bid, it will be presumed that your rate is inclusive of taxes

Opening and Evaluation of Tenders

- The following Tenders will be **DISQUALIFIED:**
  - Bids/Proposals received after deadline of submission.
  - Bids/Proposals submitted by fax/hard copy or any other email ID's except specified in tender documents.
  - Incomplete Bids.
  - Bidders not meeting eligibility/commercial suitability

- The Financial bids will be evaluated only in respect of those firms, which meet the technical bid criteria mentioned above by submitting all relevant documents and declaring child labour/blacklisting declaration.

- Based on the offers presented, the different proposals will be scored for excellence and final selection will be made of the best of the offers with lowest prices and as per the quality of make/brand recommended by GIZ in List of specifications.

- Any arithmetical error by the Bidder in pricing the List of Specifications/Annexure D or in the additions or in carrying forward subtotals to the summary or to the Tender will be corrected during the evaluation of the Tenders. In such cases the Tender sum will be adjusted accordingly, and the Bidder will be informed. It will be assumed that the unit price rates entered in the List of Specifications/ Annexure D, are correct.

- GIZ does neither bind himself to accept the lowest Tender or any Tender, nor will he be responsible or pay for expenses or losses, which may be incurred by any Bidder with the preparation of his Tender.

Cancellation of Tendering Action

- The Tendering Action can be cancelled, if

  (a) No Tender has been received which corresponds to the Tender Conditions,

  (b) There have been substantial changes to the basis of the Tendering Action, or

  (c) There are other serious reasons for such a cancellation.

- The Bidders will be informed without delay of the cancellation of the Tendering Action by the GIZ or his authorized representative and of the reasons for the same.

- This tender notification does not entail any commitment on the part of GIZ, either financial or otherwise. GIZ reserves the right to accept or reject any or all proposals without incurring any obligation to inform the affected applicant/s of the grounds.

- Cost incurred towards submitting the bids will in any case not be reimbursed/paid by GIZ

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Annexure A: Covering letter

Covering Letter
(To be submitted along with the Proposal/bid on company's Letter Head)

M/s …..……..
……
……
……
……

To,

The Head of Contracts and Procurement
GIZ India, GDCO Office
46, Paschimi Marg, Vasant Vihar
New Delhi – 110 057

Subject: Offer in response to Tender No. 91144955

Dear Sir/ Madam,

I/We the undersigned hereby offer to execute the scope of work and accordingly submit our offer in full compliance with terms & conditions of the bid.

The bid is being submitted as per the instructions mentioned in the tender documents.

Name of the Contact Person	
Mobile Number	
Email Id	
Land line Number, if any	
Office address	

(Signature and stamp of Bidder)

Annexure B: Declaration by the bidder

Declaration by the bidder (to be submitted along with the bid)

I/We the undersigned (herein after referred to as manufacturer) having fully understood the nature of the work and having carefully noted design, specification, terms and conditions, etc. as mentioned in the bid document do hereby declare that,

1. All the requirements of the bid document have been understood properly and accordingly agree with all provisions of the bid document and accept all risks, responsibilities and obligations directly or indirectly connected with the performance of the bid.
2. All the relevant information with regard to proper execution of the proposed work have been understood, with respect to the proposed specifications, its intended end use, availability of required materials and labour etc.
3. Are capable of executing and completing the work as required in the bid and is financially sound to execute the scope of work as per the work execution schedule. We have sufficient experience and are competent enough to perform the contract up to the satisfaction of GIZ. We also give the assurance to execute the scope of work as per the specifications, terms and conditions on award of order.
4. We have no collusion with other bidders, any employee of GIZ or team engaged in executing the scope of work.
5. We have not been influenced by any statement or promises by any employee of GIZ or anyone from the team engaged by GIZ but only by the bid document.
6. We are familiar with all general and special laws, acts, ordinances, rules and regulations of the Municipal, District, State and Central Government that may affect the work, its performance or personnel employed therein.
7. We have never been debarred to undertake similar work by any Government undertaking/department, never been blacklisted or our companies' contract been terminated due to poor performance
8. The submitted offer will remain valid for acceptance for 90 days from the last date of submission of bid.
9. All the information and the statements submitted with the bid are true to the best of knowledge.
10. We are not engage in any kind of child labour nor any of our partner/suppliers are indulge in any child labour activities.

(Signature and stamp of Bidder)

Name:

Seal/Stamp:
Date:

Annexure C: Technical Criteria

S.No.	Description	Critical Points / Criteria to follow	Response
(A)	AIR PURIFICATION SYSTEM		
		TFA Enclosure/Housing	
		The TFA will be designed to low energy consumption, high thermal insulation and airtight casings. The leakage in the TFA will comply with L2 as per EN 1886 standard or as per its procedure	
		Access Door / Filter Access (Imported Hinges and Knobs)	
		Filter Section	
		G4 - local or Imported	
		M5 / F7 / H13 - Imported Eurovent Certified	
		Chemical Filter Impegnated with KMnO4 and tested as per ASHRAE 145.2	
		Differential Pressure Switches	
		Differential Pressure Switches for measuring the differential across filter to give alarm on 80% clog and fan trip on 100% clogging of filters; Units will pass air tightness (L2) and filter by-pass leakage (maximum filter installation by-pass leakage of 6% (EN 1886)) will be tested by the manufacturer	
		Centrifugal EC Plug Fan Section & Motor	
		Fan will be Eurovent or AMCA certified centrifugal, backward curved EC fan.	
		Dx Cooling Coil (Kit with control)	
		Units will have electronic expansion valves (EEV's) to control refrigerant flow rate in response to load variations in the room.	
		Compatibility with BMS	
S.No.	**Description**	**Critical Points / Criteria to follow**	
(B)	Outdoor Dx UNIT		
		VRV / VRF Type	
		Minimum COP of 3.8 as per ASHRAE 90.1, 2016 std.	
		Acceptance on TFAs make	
		Warranty by Original Manufacture	

S.No.	**Description**	**Critical Points / Criteria to follow**	
(C)	**RECIRCULATION UNITS**		
		Ceiling Suspended Type	
		Pre painted casing from Inner and Outer side	
		Remote to control Fan speed (wired)	
		HEPA-H13 filter tested as per EN 1822 standard	
		EC Fan	
(D)	**Insulation, Ducting, Piping, Sheet Metal Works, Electrical Installations**		
D1	(For the above (D), contractor/firm has to provide sample board for approval to consultant upon receiving of PO from Client)		
D2	Contractor / Firm to follow SMACNA Guidelines at site for ducting works		
D3	For All the above electrical items, contractor/firm should submit the Test Certificates as per tender		