

## 2. INFORMATION TO BIDDERS

### 2.1. GENERAL INSTRUCTIONS

- 2.1.1. The IITKGP intends to award the work of “SUPPLY, INSTALLATION, TESTING AND COMMISSIONING OF AIR CONDITIONING WORK FOR PROPOSED LABS FOR CENTRE OF ROBOTICS AT 1<sup>ST</sup>& 3<sup>RD</sup>FLOOR, CRR BUILDING, IIT KHARAGPUR”.The work consists of comprehensive repair, renovation and modification of existing electrical systems.
- 2.1.2. Constraint: The job needs to be executed in Residential area without causing any disturbances to the Residence of campus quarters and hostel resident and also road networks.
- 2.1.3. The vendor shall work out execution sequence and methodology so as to complete the project within the envisaged time and the estimated cost, duly handling the constraint mentioned above.
- 2.1.4. Bidding documents are to be obtained electronically through websites: <https://eprocure.gov.in/eprocure/app>
- 2.1.5. <http://www1.iitkgp.ac.in/topfiles/tenders.php>.
- 2.1.6. This bid document shall be read in conjunction with GCC (General Conditions of Contract) available on <http://www1.iitkgp.ac.in/topfiles/tenders.php>.
- 2.1.7. The bidder shall visit and inspect the site and obtain all information on his own responsibility and at own cost, which may be necessary for the purpose of quoting and submitting the tender. No excuse or ignorance as to site conditions and local information shall be accepted after awarding of the contract. Access to the site will be granted by the Engineer-in-charge on all working days within working hours.
- 2.1.8. IITKGP shall not provide any space at site for labour hutments.
- 2.1.9. All clarifications about the tender shall be sought by bidder on or before 30<sup>th</sup> Aug 2019 3.30PM through e-mail to the Engineer-in-charge on [sbanerjee@adm.iitkgp.ac.in](mailto:sbanerjee@adm.iitkgp.ac.in)
- 2.1.10. Completion certificate issued by Competent Authority will only be considered as credential. If the Completion certificate issued by Competent Authority does not reflect the type of work, then Final bill / Schedule of Quantity of the qualifying works also to be attached along with the Completion certificates. Certificate from private individuals / organizations for whom such works have been executed shall not be accepted.
- 2.1.11. The bidding document (consisting of specifications, the schedule of quantities of various types of items to be executed, the set of terms and conditions of the contract and other documents / drawings, if any), Addendum/Corrigenda, Clarifications to Pre-bid queries can be downloaded from the websites: i) <https://eprocure.gov.in/eprocure/app>
- 2.1.12. <http://www1.iitkgp.ac.in/topfiles/tenders.php>; iii) <https://eprocure.gov.in/eprocure/app>. Corrigenda, if any shall be published only on these websites *at any time before the closing time of tender*. The institute shall not be responsible for any delay / difficulties / inaccessibility of downloading facility for any reason whatsoever. *The tenderers who have downloaded the tender documents from website must visit the website and ensure that such addendum(s)/corrigendum(s) (if any) is also downloaded by them. This shall be the responsibility of the prospective registered bidders to check the web site for any such corrigendum/addendum before closing time of tender and ensure that bid submitted by them are in accordance with all the corrigendum's/addendums.*
- 2.1.13. All costs, charges & expenses that may be incurred in connection with the preparation of his tender shall be borne by him and the Institute accepts no liability whatsoever therefore.
- 2.1.14. **Rates quoted by the bidders shall be inclusive of GST (Goods and Services Tax - Central, State and Interstate) and all applicable taxes. Income Tax and all other statutory deductions like labour cess etc. will be deducted from the bill as per prevailing rules.**
- 2.1.15. Exemption to IITKGP against any tax/ duty/ fee/ surcharge/ charge/ cost, if any, found applicable or sought later from IITKGP after award shall be passed on to IITKGP by the contractor without dispute.
- 2.1.16. IITKGP reserves the right to reject any or all of the bids without assigning any reason.
- 2.1.17. **Bid Validity:** Bid shall remain valid for 120 days from the date of submission.
- 2.1.18. **Firm Price: Bidder's quoted Rates/Prices for executing the activities under the Contract shall remain firm till completion of the entire work & shall not attract any escalation under any circumstances whatsoever.**
- 2.1.19. If any information furnished by the bidder is found as false / fabricated, then his bid will be rejected and treated as cancelled. Even if such manipulation is detected at any stage after signing of the contract, it would lead to termination of the contract besides forfeiture of Earnest Money Deposit and liabilities towards prosecution. In such cases the bidder will be debarred from participation in future tendering process in IITKGP for next 05 (Five) years.
- 2.1.20. **Earnest Money Deposit(EMD)** of requisite amount and that in prescribed mode or proof of payment thereof shall be enclosed with the Technical Bid explained in following section.

- 2.1.21. **Refund / Conversion of Earnest Money Deposit:** The Earnest Money received shall be refunded to the unsuccessful bidders without any interest after the opening of financial bids. The Earnest Money Deposit of successful bidder shall be retained and converted into part of Security Deposit.
- 2.1.22. **Forfeiture of Earnest Money Deposit:** Earnest Money Deposit will be forfeited in any of the following cases:
- The bidder withdraws / modifies his tender during the period of Bid Validity.
  - The bidder, in case of tie between lowest bids, refuse to submit revised offer.
  - The bidder does not accept the correction of arithmetical errors of his tender.
  - The bidder fails to deposit Performance Guarantee and information as per format given in GCC within the stipulated time period before award of the work.

## 2.2. SUBMISSION OF TENDER

- 2.2.1. **Help for Contractors, FAQ, Information about DSC and Bidders Manual Kit containing the detailed guidelines for e-Procurement system are also available on Central Public Procurement Portal.** [<https://eprocure.gov.in/eprocure/app>]
- 2.2.2. **It is mandatory for all the bidders to have a valid Class-II/Class-III Digital Signature Certificate (in the name of person having power of attorney to sign the Bid) from any of the licensed Certifying Agency (Bidders can see the list of licensed CA's from the link [www.cca.gov.in](http://www.cca.gov.in)) to participate in e-Procurement of IIT KHARAGPUR.**
- 2.2.3. **It is mandatory for the bidders to get their firm /company registered with e-procurement portal <https://eprocure.gov.in/eprocure/app> to have user ID & password.**
- 2.2.4. **Tender documents will be available online on website <https://eprocure.gov.in/eprocure/app> which can be downloaded free of cost.**
- 2.2.5. **Bidders may download and refer the "Instructions for Online Bid Submission" from (<https://eprocure.gov.in/eprocure/app;jsessionid=A8B54EEC72D86DF9AA9D9B2DDACDAB8D.eprocgep4?page=BiddersManualKit&service=page>).**
- 2.2.6. **The tender documents shall be submitted online in the prescribed format given on the websites and technical bids received online shall be opened as per NIT or Corrigendum thereof. No other mode of submission is acceptable. Detailed credentials as per the requirement of eligibility criteria and all tender papers except Bill of Quantities are to be submitted in "Technical Bid".**
- Bill of Quantities with rates duly filled in are to be submitted in the format provided online in the name of "Financial Bid". Hence, physical submission of the documents is limited to submission of original Earnest Money Deposit in the form of Pay Order/ Demand Draft / Bank Guarantee/MSE registration certificate as per provision given in sub-clause 1.2.5 of NIT & 2.2.15 of Information to Bidders.**
- Representative of the bidder, who chooses to attend, may attend the online opening of the technical bids on the scheduled date and time of Bid opening. However, such representatives shall be allowed to attend the opening of the Technical Bids, only, if such person presents the letter of authority issued in his name by the bidder on his letter head.**
- 2.2.7. **Bidders cannot submit the tender after the due date and time of e-bid submission. Time being displayed on Central Public Procurement Portal <https://eprocure.gov.in/eprocure/app> ("Server System Clock Time") shall be final and binding on the bidder. e-Bids are required to be submitted by bidders, only as per the Indian Standard Time (IST) and not the time as per their location/country.**
- 2.2.8. **The bidders are advised to submit their e-bids well before the e-bid due date. IIT KHARAGPUR shall not be responsible for any delay in submission of e-bids for any reason including server and technical problems.**
- 2.2.9. **The Technical and Financial Bid shall be digitally signed by the Authorized Signatory of the bidder & submitted "on-line" only. The authorized signatory of the bidder must be in possession of Power of Attorney before submitting the digitally signed bid. Scanned copies of various documents can be prepared in .pdf file format.**
- 2.2.10. **Any tender received without original Earnest Money in the form as specified in clause 1.2.8 of tender documents shall not be considered and shall be summarily rejected.**
- 2.2.11. **IIT KHARAGPUR reserves the right to cancel the tenders before submission/opening of tenders, postpone the tender submission/opening date and to accept/reject any or all tenders without assigning any reasons thereof. IIT KHARAGPUR's assessment of suitability as per eligibility criteria shall be final and binding.**

2.2.12. **Tenderers may note that they are liable to be disqualified at any time during tendering process in case any of the information furnished by them is not found to be true. EMD of such tenderer shall be forfeited. The decision of IIT KHARAGPUR in this regard shall be final and binding.**

2.2.13. **The sealed EMDs shall be received at the Office of Superintendent (Electrical),1st Floor, Old Building, IIT Kharagpur, Kharagpur WB 721302, up to 15:30hrs,11<sup>th</sup>September 2019 or Corrigenda otherwise.** EMD received after the due date and time shall not be considered.*The EMDs* shall be submitted in a sealed envelope super scribed “SUPPLY, INSTALLATION, TESTING AND COMMISSIONING OF AIR CONDITIONING WORK FOR PROPOSED LABS FOR CENTRE OF ROBOTICS AT 1<sup>ST</sup>& 3<sup>RD</sup>FLOOR, CRR BUILDING, IIT KHARAGPUR”with NIT No.IITKGP/IW/RAC/CRR/3F/2019-20as NIT No., clearly super scribed as “EMD “

### 2.3. EVALUATION OF BIDS AND AWARD OF WORK

- 2.3.1. The Bid of bidder will be opened on the specified date and time. Bids shall, first, be checked for payment of **Earnest Money Deposit**. Only those bids found to have duly paid/ submitted Tender Fee and Earnest Money Deposit shall be considered for evaluation.
- 2.3.2. Evaluation of **Technical Bid**: The bids received will then be assessed on the eligibility criteria mentioned at para 1.3of Notice Inviting Tender. **Bids found not meeting the eligibility criteria shall be considered non-responsive and shall be rejected summarily.**
- 2.3.3. IITKGP retains the right to revert back to individual bidders with further clarifications / queries on the Technical Bid. The bidder has to respond to the queries within the specified time mentioned in the covering letter.
- 2.3.4. On the date & time specified for opening of Financial Bid or the Revised Financial Bids as the case may be will be opened on specified date and time.
- 2.3.5. **EVALUATION OF Financial Bids**: The Financial Bid should contain the complete bid document with duly filled in Schedule of Financial Quote.Financial Bids opened as above will be checked for arithmetical errors.
- 2.3.6. **Letter of Award (Work Order)** shall be issued to the successful bidder only after receipt of the Performance Guarantee, along with Program Schedule, details of Technical Staffs to be deployed for the work and Complaint Redressal Mechanism **as per following para.**
- 2.4.8 (a) Contractor shall submit Complaint redressal arrangement with name & contact number of the contractor’s authorized representative for the purpose.
- 2.3.7. **Agreement (Contract)** consisting of complete tender document including conditions, bill of quantities, technical proposal and specialized services, drawings, if any, and acceptance thereof together with any correspondence leading thereto, shall be drawn and signed with the awardee **within10 days** of the Letter of Award.
- 2.3.8. **Date of start** of work shall be reckoned from **the 10<sup>th</sup> day** of the issue of the Work Order.
- 2.3.9. **Defect Liability Period (DLP)**: In partial modification to clause no.16 of General Conditions of Contract (GCC), the Defect Liability Period shall be **12 months** after the certificate final or otherwise of its completion of work or till the final bill has been prepared.

#### 2.3.10. TERMS OF PAYMENT:

- a. 70% towards supply of materials at site.
- b. 20% towards installation.
- c. 5% towards successful commissioning and handing over with all test reports and as-built drawings approved by IIT- Kharagpur.
- d. 5% towards retention amount till the completion of Defects Liability Period.

Period of payment will be minimum 45 days from the date of submission of bills.

### 2.4. COMPLAINT REDRESSAL MECHANISM

- 2.4.1. All maintenance complaints shall be got addressed by the contractor to the satisfaction of Engineer-in-charge within 3 days from the date of issuance of the “Job Card” from IIT Kharagpur.
- 2.4.2. Complaints requiring completion time more than 3 days shall be responded specifically by the contractor with the scheme, in consultation with Engineer-in-charge, and timeline for compliance, to the Engineer-in-charge within 3 days from the date of issuance of the “Job
- 2.4.3. Any complaint left unattended by the contractor beyond 3 days without specific reasons on record shall attract levy of penalty of Rs 50/- per complaint per day from 4th day to 7th day and Rs 100/- per complaint per day thereafter recoverable from dues to the contractor.

### 3. UNDERTAKING BY THE BIDDER

#### U N D E R T A K I N G

I / We have read and examined the Tender document including terms & conditions, specifications, bill of quantities, drawings and designs, general rules & directions, General Conditions of Contract, Special Conditions of Contract and all relevant other documents, publications and rules referred to in the Conditions of Contract and all other contents in the tender documents for the work.

I / We, hereby tender for execution of the work specified for the Indian Institute of Technology Kharagpur within the time specified and in accordance in all respects with the specifications, designs, drawings and instructions in writing.

We agree to keep the tender open for 120 days from the last date of its submission and not to make any modifications in its terms and conditions. A sum of Rs. \_\_\_\_\_ has been deposited in cash / demand draft of a scheduled bank / Pay order as earnest money. If I / we, fail to furnish the prescribed performance guarantee within prescribed period, I / we agree that the said Director, Indian Institute of Technology Kharagpur or his authorized officer shall without prejudice to any other right or remedy, be at liberty to forfeit the said earnest money absolutely. Further, if I / we fail to commence work as specified, I / we agree that the Director, Indian Institute of Technology Kharagpur shall without prejudice to any other right or remedy available in law, be at liberty to forfeit the said earnest money and the performance guarantee absolutely, otherwise the said earnest money shall be retained by him towards security deposit to execute all the works referred to in the tender documents upon the terms and conditions contained or referred to therein.

Further, I / We agree that in case of forfeiture of earnest money or both Earnest Money & Performance Guarantee as aforesaid, I / We shall be debarred for participation in the re-tendering process of the work.

I / We hereby declare that I / We shall treat the tender documents, drawings and other records connected with the work as secret / confidential documents and shall not communicate information derived there-from to any person other than a person to whom I / We am / are authorized to communicate the same or use the information in any manner prejudicial to the safety of the State.

**Seal & Signature of Contractor**

Postal Address

**Dated**

**Witness**

**Address**

**Occupation**

## ANNEXURE-I

**TECHNICAL STAFF OF CONTRACTOR**

Name of the Work: SUPPLY, INSTALLATION, TESTING AND COMMISSIONING OF AIR CONDITIONING WORK FOR PROPOSED LABS FOR CENTRE OF ROBOTICS AT 1<sup>ST</sup>& 3<sup>RD</sup>FLOOR, CRR BUILDING, IIT KHARAGPUR

DISCIPLINE	NAME	QUALIFICATION	EXPERIENCE	CONTACT NUMBER
Overall Project In-charge				
Engineer - Structure and Civil Works				
Engineer – Electrical & Mechanical Works				
In-charge - Safety, Health & Environment				
In-charge for Maintenance (DLP) period				

Seal & Signature of Contractor

1. Checklist for Documents to be uploaded on <https://eprocure.gov.in/eprocure/app>

Sl. No.	Documents	Reference
1.	Tender Documents	2.3
2.	EMD	1.2.8
3.	Company registered by Govt. Organisation like CPWD/PWD/MES/Autonomous bodies or Other PSUs	1.3.3
4.	GST Registration Certificate	1.3.3
5.	Permanent Account Number	1.3.3
6.	Completion Certificate during last 07yrs.	1.3.2
7.	Updated Electrical Contractor Licence	
8.	ANNEXURE-I	

Signature of contractor

## 4. PARTICULAR CONDITIONS

Indian Institute of Technology intends air-conditioning of the labs at Centre for Robotics at 1<sup>st</sup>&3<sup>rd</sup> floor of the CRR building.

### 1. AIR-CONDITIONING

#### DESIGN CRITERIA

#### 1.1 OUTDOOR DESIGN CONDITIONS :

Outdoor Design Conditions for Kharagpur are based on Weather data compiled and published by ISHRAE (WeDCo) for Kolkata and past experience corresponding to 2 % annual cumulative frequency of occurrence and the outdoor design conditions have been considered as follows:

Design Conditions	DRY BULB		Mean Coincident WBT		RH
	Deg F	Deg C	Deg F	Deg C	%
SUMMER	110	43.3	83	28	33
MONSOON	94.4	34.66	82	28	60
WINTER	56	13	48	9	55

#### 1.2 INDOOR DESIGN CONDITIONS

Based on past experience, indoor design conditions for centrally air-conditioned spaces shall be as follows:

SPACE	Temperature Deg C	Relative Humidity %	Remarks
Entire area	26±1.1	60±10 % at full load condition	

**Note:** Winter Heating is not envisaged.

#### 1.3 MECHANICAL VENTILATION

Area	Air Changes Per Hour(ACH) as per NBC	Remarks
Toilets	15	

#### 1.4 BUILDING CONSTRUCTION DATA

The Building construction data for calculating the building air-conditioning load is as below.

- i. External Wall :  $U = 1.81 \text{ Watt / Sqm}^{\circ}\text{C}$   
(0.32 Btu / HrSqft<sup>o</sup>F) (230mm thick brick wall)
- ii. Roof (Exposed to sun) :  $U = 1.316 \text{ Watt / Sqm}^{\circ}\text{C}$   
(0.23 Btu / HrSqft<sup>o</sup>F)
- iii. External Glass Specifications : Glass with following details:  
 $U = 5.8 \text{ Watt / Sqm}^{\circ}\text{C}$   
(1.02 Btu / HrSqft<sup>o</sup>F)  
Solar heat gain Coefficient: 0.8

#### 1.5 OCCUPANCY AND INTERNAL HEAT GAIN

SPACE	Occupant Density	Equipment Load	Lighting Load	Fresh Air
1 <sup>st</sup> and 3 <sup>rd</sup> floor	75sft /person	125W/ Person	Average 1 W/sft	Asper ASHRAE 62.1 2004 or ACPH @1.5 , whichever higher

## 2. COOLING ESTIMATE

Estimated cooling loads are tabulated in table-2.

**TABLE -2**

### PRELIMINARY COOLING ESTIMATE FOR LABORATORY & SEATING AREA - KHARAGPUR

SL. NO	FL	PARTICULARS	AREA (sqft)	PERSON	EQUIPL OAD (kW)	COOLING CAPACITY (TR)	IDU CAP	ODU CAP
1.	1 <sup>st</sup> Fl	Room no 203	903	10	2.0	6.8	1.2 TR x 5nos Hiwall unit	<b>36 HP x 1 No</b>
2.	3 <sup>rd</sup> Fl	Room no 401B	1700	20	3.0	12.5	7.95 TR x 1no + 5 TR x 1no ductable unit	
3.	3 <sup>rd</sup> Fl	Innovation & store and Student Chamber	1131	15	2.0	8	7.95 TR x 1no ductable unit	
4.	3 <sup>rd</sup> Fl	Robotics Chamber	660	8	1.0	4.5	5 TR x 1no ductable unit	
5.	3 <sup>rd</sup> Fl	HOD	270	1	0.5	3	1.2 TR x 2nos Hiwall unit	
<b>TOTAL</b>			<b>4664</b>					

## 3. PLANT SELECTION

To meet the air-conditioning demand load of 34.8 TR for 3rd floor of CRR building (as per table-2) shall be air conditioned with energy efficient inverter scroll/twin rotary compressor in air cooled VRF units. The scroll compressor can operate efficiently on part load and there by substantial energy is saved. Multiple all inverter scroll compressor in the VRF units shall be grouped together to get the benefit of overall part load operation at of peak hours, seasonal & daily temperature variation.

- The rooms are to be air-conditioned by 1 x 36 HP (preferably in the combination of 2x18HP) air cooled all inverter type VRF outdoor unit and Hi-wall/ductable type indoor units as described in the table-2. The outdoor unit to be placed roof/ ground lvl. of the building as per the suit at site condition. The outdoor units shall be grouped together and shall modulate to get the benefit of overall part load operation at of peak hours, seasonal & daily temperature variation. The ODU units shall be top discharge type. The multiple indoor units shall be connected with the outdoor units through insulated hard drawn copper pipes. The copper pipes shall be UV protected in the outdoor area.
- The ductable unit shall supply conditioned air through insulated (insulated by 13mm thick al. foil faced nitrile rubber) GI duct. Necessary volume control damper, grille & diffuser shall be provided to meet the desired airflow. The duct support/ hanging arrangement shall be taken from ceiling.

**Additional scope need to be considered by AC vendor:**

- Opening /Closing / Making hole in existing Masonry wall/ Concrete / Glass structure to facilitate entry and exit of duct / pipe work and finishing it good.



- b. Supply & Installation of decorative pelmets if required to install the IDUs.
- c. Drain to be terminated to the nearest drain point.
- d. Any type of painting related to HVAC work if required.

All signal/control/power wiring/Earthing (from nearest existing earthing) related to HVAC system are included in HVAC scope of works including their terminations.

### TEST READINGS

#### ITEM

#### TEST READINGS TO BE TAKEN

#### AT THE TIME OF COMMISSIONING

AIR-COOLED VRF OUTDOOR UNIT

Refrigerant pressures

Oil pressure

BHP consumed at 100%, 75% & 50% Load

Ambient Temp

MOTOR

Voltage & Amperage

INDOOR UNITS

Entering/leaving Air Temperatures DBT/WBT

Air flow rates

SUPPLY & RETURN AIR GRILLES

Air flow rates

Supply air DBT/WBT

SPACE TEMPERATUTRES

DBT/WBT/RH

## Technical specification of VRF unit

### 1.0 Scope

Scope of this section comprises of design, supply, erection, testing and commissioning of ALL Inverter Scroll Scroll/ Rotary or Twin rotary VRF type system. The VRF product must be manufactured at ISO 9001-2008 certified factory.

### 2.0 OUTDOOR UNITS: INVERTER VRF SYSEM

The Air cooled direct expansion type Full Inverter VRF outdoor unit shall be factory assembled, powder coated GI sheet metal cabinets, all hardware of **anti-rust quality**, conformal coating on PCB to protect from duct & humidity, hydrophilic blue fin material for better corrosion resistance, top discharge type with Brushless DC Motor only.

- I. The Top Discharge type VRF ODU must have bigger condenser coil face area with higher CFM fan resulting in improved efficiency, less deration due to higher ambient temperatures.
- II. The ODU to be selected to deliver actual capacity at 42 degC and it should be operational upto 50degC.
- III. The Outdoor unit must consist of Inverter Scroll/twin rotary inverter Compressor only. Tender BOQ specified VRF ODU must be having All Inverter Scroll/twin rotary compressors. There should not be any fixed compressor or Partial inverter, if found Bidder will be rejected at any stage of Project.
- IV. The VRF system must compatible with R410A green Refrigerant only. System must be pre-charged at Factory. If required additional, based on the site, then it will be charged additional at site.
- V. Condenser Heat exchanger made of copper tubes, are inner grooved for high heat transfer. The condenser fans are fitted with high efficiency BLDC motor that regulate air flow depending on demand resulting more power saving.
- VI. The VRF system must be designed to operate across a WIDE Voltage range from 320V to 460V resulting in high uptime even in such erratic power conditions.
- VII. ALL Inverter VRF must be designed with the new generation Refrigerant Cooled PCB, which helps maintain the drive within allowable temperature range. It enhances the reliability of the system when it is working under very high ambient conditions otherwise vendor has to confirm that the machine shall be operable upto 50degC ambient condition.
- VIII. VRF (Full Inverter Type) must be designed with twin large accumulator & and an efficient oil recovery management system, hence allow the system to be set up with long & flexible piping.

The equipment must be suitable for:

- a. Max. actual piping length - 180 Rmt
  - b. Max. total piping length - 1000 Rmt
  - c. Max. Level difference between ODU-IDU - 90 Rmt
  - d. Max. level difference between IDUs - 40 Rmt
- IX. Each Indoor units must be connected (with VRF Outdoor unit) by means of individual Copper Refrigerant network or Y distribution joints only. The mentioned "Y" joint or refnet joints must factory make & tested by OEM. The individual size, of refnets or "Y" joints , connecting to individual indoor units, to be calculated & supplied by OEM / Bidder only.
  - X. All Inverter VRF should have emergency back operation. In-case of double compressor ODU, it must operate or function even if there is a failure or maintenance downtime of one compressor.
  - XI. In modular VRF, where multiple units have been combined to run, as one larger unit, the system must operate even in case of failure or maintenance downtime or shutdown of one VRF ODU. It will help to ensure that cooling/heating remains LARGELY unaffected even during servicing.
  - XII. As all the Indoor units are interconnected by the communication cable, if there is any break in any communication cable, subsequent IDUs are affected and must not function. By activating the IDU emergency operation on the Next Generation All Inverter VRF, the other IDUs must function despite of such break.

### 3.0 INDOOR UNITS:

**General:**

All indoor units (Hiwall Split, Cassette) as specified under this item shall have, in general, noise levels shall be less than 45 db. For critical application noise levels below these limits may, however, be specified during design stage.

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

**Place of Installation : Kharagpur**

Constructional details	As per bid drawings and documents.
Power Supply	The power supply variation limits for 230V and 415V shall be as following. All electrical equipment shall perform satisfactorily under these conditions Voltage variation +/- 10% Frequency variation +/-5% Control wiring – 220V, 1Ph, 2 wire, 50Hz
Others	Dust filters action level 20 Microns. The noise level within the air conditioned space shall be restricted to 45 dB NC Level for Hiwall& Cassette unit & 50db for Ductable indoors. Not more than that.

#### 4.0 Installation

- 4.1 The outdoor unit shall be installed as decided by the Indian Institute of Technology- Kharagpur. The room unit shall be either ceiling or wall/ floor mounted as shown on drawings/ as per the requirement of client.
- 4.2 Refrigerant lines shall be inconspicuously and generally as shown in the drawings and as directed on site. The suction and liquid lines shall be bonded together and insulated with elastomeric tubing. The joints of insulation need to be sealed by joint tape of same material. UV protection for outdoor piping is required. All power wiring shall be drawn from the nearest socket outlet and shall include the control wiring, power wiring, on-off switch with speed controller.
- 4.3 All pipe sizing shall be done taking into account the length and rise.
- 4.4 A 12mm insulated drain pipe shall be provided as shown on the drawing and as directed on site.

#### 5.0 Testing

- 5.1 The unit shall be tested for establishing the capacity and power consumption. Tests shall be carried out in accordance with IS 5141 – 1969 (revised upto date) computed results shall tally with specified capacity and power consumption figures furnished with the tender offer.
- 5.2 On completion of piping the system and the piping shall be tested using Nitrogen gas by raising the pressure to 1.5 times the working pressure and holding the test pressure for 3 hours.
- 5.3 Tests shall be carried out on
- The compressor and drive motor side
  - condenser side for heat rejection
  - Cooling coil for cooling capacity
  - Evaporator air volume
- 5.4 A test certificate from prototype factory tests will be acceptable.

## 6.0 Mode of Measurement

- 6.1 Each unit shall be measured as one item of work which shall consist of:
- Outdoor unit
  - Indoor unit
  - Refrigerant and drain piping (with insulation)
  - Electrical power control wiring, room thermostat and control panel
  - Refrigerant charge & oil
  - Erection
  - Commissioning and testing

## 7. REFRIGERENT PIPING

### 7.1 Scope.

The scope of this section covers supply, installation of refrigerant piping & drain piping with insulation as specified here & as shown in the drawings.

### 7.2 Refrigerant copper Piping

- 16/18 gauge copper tubing shall be used to make connections to equipment's wherever required.
- Flare fittings e.g. flare nuts; tees, elbows, reducers etc. shall be of brass.
- The pipes and fittings shall be connected by means of welded joints. The connections to gauges, controls etc. (if any) shall be with soft copper tubing and flare fittings.
- Refrigerant piping routing shall be decided by Engineer – in – Charge.
- The refrigerant piping installation shall be as per drawing.

### 7.3 Drain Piping.

- All condensation drainage shall be pitched in the direction of flow to ensure adequate drainage with an adequate trap seal to prevent leakage / infiltration.
- Provide pitch of 20 mm per meter for a smooth drainage of condensate.
- Condensate drain piping fixing shall be as per drawing.
- The routing of Drain Piping shall be decided by Architect/ Engineer – in – Charge.
- The material for the drain pipe is CPVC.
- Drain piping supporting shall be as per drawing.

### 7.4 Suction Line Insulation

The Suction Line shall be insulated with 19/25 mm thk. Nitrile Rubber Insulation covered with aluminium foil ( As per Specified with K Value of 0.027-0.029 K Cal/Hr.MDeg C at 0-16 Deg C)

### 7.5 Drain Piping Insulation

The drain pipes shall be insulated with 6mm thick Nitrile Rubber Insulation.

## 7.6 Mode of Measurement

- Refrigerant pipes with insulation shall be in linear measure along the center line of the pipe including accessories, supports etc and paid for per RMT.
- Condensate drain pipes with insulation shall be in linear measure along the center line of the pipe including accessories, supports etc and paid for per RMT.

## AIR DISTRIBUTION

### 1.1 Scope

The scope of this section comprises of supply, fabrication, installation and testing of all sheet metal ducts and supply, installation, testing and balancing of grilles and diffusers, in accordance with these specifications and the general arrangement shown in the drawings. The duct work will conform to IS standards/codes and relevant ASHRAE Guidelines. For this purpose it is contractors responsibility to arrange at site all necessary equipments like drilling machine, welding machine, etc. and necessary work force. The duct rates mentioned in the BOQ are inclusive of nuts, bolts, sheets, supports, gaskets etc. complete and duly installed.

### 1.2 Duct Material

The material for various application of air distribution ducting shall be as follows : -

Application	Material
1) Air Conditioning.	Cold rolled sheets continuous galvanised with a zinc coating of 120GSM as per IS: 277 – 1977.
2) Supports & Duct Flanges.	Mild Steel Structural Steel Sections.
3) Gasket.	Foamed rubber.
4) Bonding	Mastic Sealant.

### 1.3 Duct Fabrication.

The ducts shall be fabricated from galvanised steel sheets (GSS) class VIII conforming to ISI:277 – 1962 (revised) or aluminum sheets conforming to IS:737 – 1955 (for aluminum ducts, if any). The thickness of the sheets should be as follows :

#### Thickness of Sheets for Rectangular Duct Construction.

Maximum Side	Thickness of Sheets	Gauge
Upto 750 mm.	0.63 mm	24
From 751 to 1500 mm	0.80 mm	22

Maximum Size. (mm)	Minimum Thickness (mm)	Transverse Joint.	Bracing.
Upto 300	0.63 (24 SWG).	S-Drive, Pocket or bar Slips on 2.5 m centers.	None.
301 to 600	0.63 (24 SWG)	S-Drive, Pocket or bar Slips on 2.5 m centers.	None.
601 to 750		S-drive, 25 mm pocket or	25X25X3 mm

		25 mm bar slips on 2.5 m centres.	angles, 1.2 mm from joint.
751 to 1000	0.80 (22 SWG)	Drive, 25 mm pocket or 25 mm bar slips on 2.5 m centres.	25X25X3 mm angles, 1.2 mm from joint.
1001 to 1500		40X40X mm angle connections, or 40 mm pocket bar slips with 35X3 mm bar reinforcing on 2.5 m centers.	40x40X3 mm angles, 1.2 mm from joint.
1501 to 2250	1.00 (20 SWG).	40X40 mm angle connections, or 40 mm pocket or 40 mm bar slips, 1 m maximum center with 35 X 3 mm bar reinforcing.	40x40X3 mm or40X40X3 mm From joint.
2251 and above.	1.25 (18 SWG).	40X40 mm angle connections, or 40 mm pocket or 40 mm bar slips, 1 m maximum center with 35 X 3 mm bar reinforcing.	40x40X3 mm diagonal angles, or40X40X3 mm angles, 60 mm From joint.

1.6 All duct shall be fabricated and installed unless otherwise stated as per IS : 655 – 1963 with amendment – 1 (1971 edition.)

Ducts shall be straight and smooth on the inside with neatly finished joints. All joints shall be made airtight. The gauges, joints and bracing for sheet metal duct work shall further conform to the provisions as shown on the drawings. The internal ends of slip joints shall be made in the direction of air flow. Ducts larger than 1000 mm shall be cross-broken. Duct sections upto 1200mm length may be used with bracing angles omitted. Tapering angle should not be more than 30°. Change in dimensions and shape of ducts shall be gradual. Curved elbows shall have a centre line radius equal to one and half of the duct. All Air turns of 45° or more shall be installed in all abrupt elbows and shall consist of curved metal blades or vanes arranged to permit the air to make the turns without appreciable turbulence. Guide vanes shall be fabricated out of 0.63 mm (24 SWG) thick G. S. sheets and equally spaced on side runner to be riveted /bolted to duct sheets. Guide vanes shall be securely fastened to prevent noise or vibration. GI splitter dampers complete with brass metal lever shall be installed at each bifurcation/trifurcation point of duct for proper flow of air quantity in each duct. Joints, seams sleeves, splitters, branches, take-offs and supports are to be as per duct details as specified.

### 1.7 Duct Installations

All ducts shall be installed as per the drawings and in strict accordance with approved for construction drawings prepared by the contractor.

During the construction the contractor shall temporarily close duct openings with sheet metal covers / polyethylene sheets to prevent debris-entering ducts and maintains them clean.

All necessary allowances and provisions shall be made by the contractor for beams, pipes or other obstructions in the buildings, whether or not the same are shown on the drawings. Where it becomes 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, the required area being maintained as approved or directed by the Architect/Consultants.

If a duct cannot be run as shown on the drawings, the contractor shall install the duct between the required points by any path available, subject to the approval of the Architect/Consultants.

All duct work shall be of high quality approved galvanised steel sheet, guaranteed not to crack or peel on bending or fabrication of ducts.

All ducts shall be rigid and shall be supported from the ceiling / slab by means of MS Rods of 8 mm (3/8") dia with MS angles at the bottom as shown in the drawing. The rods shall be anchored to RC slab using Anchor/dash fasteners. A rubber gasket of 5 mm thickness shall be provided between duct and angle to avoid metal-to-metal contact and vibration. Double nuts will be provided under angle supports.

The hanger spacing for duct supporting shall be not more than 2 meter.

Where ducts touches with wall or ceiling or beams or columns or floor, a rubber gasket of 5 mm thickness shall be provided between them.

All flanges, bracing and supports are to be mild steel and are to be essentially given a coat of red oxide primer.

Fire retarding flexible canvas / Rexene connections not less than 100 mm and not more than 200 mm are to be fitted to the delivery of all IDU's.

#### 1.8 Duct Supports.

Duct supports shall be as follows:

Duct Perimeter (mm)	Support.	Location.
Upto 1800	40 X 40 X 3 mm MS angle with 9 mm tie rod.	At Transverse Joints.
Over 1800 to 2500	40 X 40 X 6 mm MS angle with 12.5 mm tie rod.	At Transverse Joints.
Over 2500	50 X 50 X 6 mm MS angle with 15 mm tie rod.	At Transverse Joints.

#### 1.9 Volume Control Damper (VCD) & Duct damper

- The Volume Control dampers & Duct Dampers shall be lever operated and complete with locking devices, which will permit the dampers to be adjusted and locked in any position, and clearly indicating the damper position.
- The dampers shall be of splitter, butterfly or louver type. The damper blade thickness shall not be less than 1.25 mm (18 gauge).
- Manual volume opposed blade dampers shall be complete with frames and bronze bearings as per drawings. Dampers and frames shall be constructed of 1.6 mm thick galvanised steel sheets and blades shall not be more than 225 mm wide.
- For air balancing an opposed blade damper with quadrant and thumbscrew lock should be provided.
- At the junction of each branch duct with main duct VCD's must be provided. At the delivery of all IDU's VCD's must be provided.
- The dampers shall be of Extruded aluminium.
- Installation of VCD's shall be as per drawings.

#### 1.10 Fire Damper

- Dampers could be fusible link type as indicated in BOQ.
- Fire dampers shall be provided at the delivery of all IDU's.
- The dampers shall be of multiple blade type. The blades shall be constructed with minimum 1.8 mm thick aluminium sheets. The frame shall be of 1.6 mm thick. Other materials shall include return spring, locking device and temperature sensor.
- Installation of fire damper shall be as per drawings.

#### 1.11 Standard Grilles and diffusers

- The supply and return air grille/diffuser shall be fabricated from extruded aluminium sections of thickness not less than 1.5 mm. The supply air grille/diffuser shall have single / double louvers. The front horizontal louvers shall be of adjustable type. The rear vertical louvers shall be of aluminium extruded sections and adjustable type. The return air grille shall have single horizontal extruded section fixed louvers.
- The damper blades shall also be of extruded aluminium. The grille flange shall be fabricated out of aluminium-extruded section. Grilles longer than 450 mm shall have intermediate supports for the horizontal louvers.
- The ceiling type square/circular diffusers shall be of aluminium-extruded section with flush or step down face.
- All supply diffusers shall be provided with extruded aluminium dampers, with arrangement for adjustment from the bottom. (The centre portion should be spring loaded for easy removal and fitting).
- All grilles and diffuser shall be epoxy powder coated of 15 Micron in approved colour.
- Diffuser and grille shall be installed as per drawings.
- The linear grilles shall be provided with End Pieces at ends.
- Fresh air fan and fresh air intake as per BOQ.
- Measurement shall be as per neck size.

#### 1.13 Testing and Balancing

After completion of the installation of the complete air distribution system all ducts shall be tested for air leaks. All dampers of supply air diffuser and supply air grille shall be balanced as per user's requirements. The entire air distribution system shall be balanced using approved anemometer.

#### 1.14 Mode of Measurement.

All sheet metal ducting complete with duct supports, turning vanes, canvas connections erected in position shall be measured externally and paid per unit. All dampers shall be excluded in the duct area.

All manual control/splitter including Fire & Volume control damper sections with operations linkages, locking quadrant, sheet steel enclosure, frame, erection, supporting etc. shall be measured on the basis of quantity as mentioned in BOQ and will be paid as per unit rate.

Fresh air louvers with bird screen, damper, frame, ducting, erection & sealing shall be measured on the basis of quantity as mentioned in BOQ and will be paid as per unit rate.

Grilles/diffuser including volume control damper, installation etc. will be measured on the basis area and paid per unit area.

### 1. ACOUSTIC & THERMAL INSULATION

#### 1.1 Scope

The scope of this section comprises of supply, fabrication, installation and testing of Acoustic Material and Thermal insulation as per specification.

#### 1.2 Duct Thermal Insulation

Thermal Insulation:

The ducts shall be insulated with 19mm thick Al foil faced nitrile rubber (Class: O). All joints shall be sealed with 50 mm wide adhesive based aluminium tape. The thermal conductivity of the material shall be not more than 0.032 **W/(m0 K)** and density not less than 33 kg/m<sup>3</sup>.

#### 1.3 Duct Acoustic Insulation

Acoustic Insulation:

- a. Acoustic insulation of duct shall be with 12 mm thick rigid board of fibre glass wool of density 48 kg/m<sup>3</sup> and covered with 32 G Perforated Aluminium sheet and fastened with sheet by screw and washer with pitch not less than 12 inch.
- b. Acoustic insulation shall be as per drawing after cleaning the internal surface of the duct to make it free from dirt and dust.

#### 1.4 Mode of Measurement.

Acoustic Insulation shall be calculated on the basis of the prime duct size and paid for per unit area.

All duct thermal insulation shall be measured on the basis of duct prime surface area with addition of insulation thickness and paid for per unit area.

### 8. ELECTRICALS

#### 8.1 Scope.

The scope of this section covers supply, installation & Testing of cables connecting Indoor Unit & Outdoor Unit as per specification.

#### 8.2 Electrical.

- The supply should be complete with appropriate earthing as per IE Rules.
- Depending on the number and capacity of units to be installed, each unit should have separate control through a main incoming switch with adequate capacity of approved makes.
- Each ODU should have separate SFU adjacent to the unit / within the unit and visible from the unit.
- Electrical cabling should be done with **armoured copper cable** of approved makes only.
- Fuse switches should be HRC cartridge type with visible indication.
- The cabling shall be done as per drawings or instruction from Engineer – in –charge.
- The cabling supporting shall be done as per drawing.



9. Bidder need to submit the following data along with the technical bid:VRF Outdoor Unit Technical Data Sheet:

Sl. No	Details of Technical Requirement	
1	Make	
2	Model	
3	Combination of Base Model (if Any)	
4	Actual Cooling Capacity at 42Deg C (HP)	
5	Total Power Consumption at 42 DegC (KW)	
6	Power Supply	
7	Overall Dimension (w x d x h in mm)	
8	net weight (kg)	
9	Type of Refrigerant	
10	Pre charged refrigerant Qty (kg)	
11	Number of Accumulator	
12	Type of Expansion Valve	
13	Type of Compressor	
14	Make & model number of individual compressor	
15	Compressor quantity	
16	Total Qty of Inverter Compressor- for individual model	
17	Input Power of Inverter Compressor motor (kw)	
18	Input Power of Fixed Compressor motor (kw)	
19	Type of Condenser coil	
20	Type of Condenser Fan	
21	Type of Condenser Fan- Motor	
22	Total Number of Fans for specified capacity ODU	
23	Power input of individual Cond Fan - Motor (kw)	

VRF Indoor Unit Technical Data sheet

SI No	Details of Technical Requirement	
1	Make	
2	Model	
3	Type of VRF Indoor	
4	Nominal Cooling Capacity (TR)	
5	Input Power (KW)	
6	Net weight (kg)	
7	Sound pressure level (db)	
8	Air Flow (CFM) in high / med / Low	
9	External Static Pressure (Pa)	

**LIST OF APPROVED VENDORS**

SI No	Item	Manufacturer
1.	Inverter type VRF Outdoor Units & Indoor Units	O-general / Hitachi/Mitshubishi (Heavy)/ Daikin/ Toshiba/ Mitshubishi (Electric)
2.	Control Cables	Finolex/ Polycab/ Havells /KEI.
3.	Power Cables	Finolex/ Polycab/ Havells /KEI.
4.	CU Pipe	Rajco/ Nippon/ Mandev
5.	Thermal insulation	Armaflex/ K-flex/ Armacell
6.	Conduit	Precesion/AKG/POLYCAB
7.	Cable tray	Legrand/OBO/MK-Honeywell
8.	Electrical Starter Panel / DB	L&T/ Schneider/ Honeywell/ EAP/ Power and Control /Rayco/System Dynamic/ TTS Systematics

**Note:** For items not covered in the above list or in case of non-availability of preferred make of any item listed above, the make / brand to be used in the work, should have prior approval from the Engineer-In-Charge.